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Jane F. Potter
G. Michael Harper
Editors

Geriatrics for Specialists

Second Edition

Springer

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Foreword to the Second Edition

In the later decades, America witnessed the increasing population of seniors and many with complex healthcare problems. This demographic reality energized organizations to help clinicians create knowledge to more effectively provide healthcare to the increasing populations of medically complex and vulnerable seniors.

This book reflects the pioneering work of the American Geriatrics Society and one of its programs, the Geriatric for Specialists Initiative. This initiative from 1994 to 2019 in partnership with the John A. Hartford Foundation provided a series of grants to develop and expand research, teaching, and advocacy to help specialty physicians provide the highest quality care for seniors. Also, collaborative grant support from the Atlantic Philanthropies helped expand the initiative from 2002 through 2014.

The initiative's central premise was geriatric concepts and principles must be a part of the expertise of all clinicians caring for adults. Specialty leaders focused on geriatrics were needed. The Initiative supported potential leaders with scholarships to help develop the science needed to improve the healthcare of seniors. Now this scholarship program continues under the auspices of the NIA/NIH: Grants for Emerging Medical/Surgical Specialists Transitioning to Aging Research (GEMSSTAR). The Geriatrics for Specialists Initiative also fostered geriatrics innovations in postgraduate education and encouraged geriatric principles inclusion in specialty curricula and board examinations.

Many of these scholars, educators, their mentors and geriatrician partners created this textbook, *Geriatrics for Specialists*, published originally in 2017. With the expanding scientific basis for providing healthcare for seniors, this second addition is timely.

Now national organizations are moving broadly to infuse geriatric principles among specialty clinicians. For example, the American College of Surgeons, in 2019, launched the Geriatric Surgical Verification Program (similar to their programs in trauma and bariatric surgery). In addition, emergency medicine, anesthesiology, ophthalmology, and cardiology exemplify the many organizations focusing on programs to generalize geriatric concepts within their disciplines.

The second edition of *Geriatrics for Specialists* is edited by leaders of the Geriatrics for Specialists Initiative and written by geriatric focused specialists and geriatricians. I was greatly honored to participate in the creation of the first edition. Now from retirement, I am proud of and confident in the committed and talented editors and the many authors they have selected for this new edition. They have enriched greatly this textbook.

Professor Emeritus, The Johns Hopkins University School of Medicine John R. Burton,
Baltimore, MD, USA

Preface to the Second Edition

Reasons for This Book

Over the last two decades, medical and surgical specialists have collaborated to bring together individual advances for geriatric populations within their specialties. This has resulted in a robust body of knowledge that now guides the standards of care for older people, the research agenda for the future, and the innovations in geriatric education among specialty trainees. This book is intended to fill the void of a single source of knowledge concerning these advances in specialty care. This second edition expands the number of specialist chapters reflecting growth in research in aging and clinical care for older people in dermatology, plastic surgery, and behavioral neurology.

Intended Audience

This book is designed to be a resource to the following major audiences:

(a) Specialty clinicians caring for seniors.
(b) Researchers with interest in the geriatric aspects of specialty fields. Chapters include description of the limits on knowledge and propose next research questions.
(c) Academicians who create and deliver content on aging within the clinical graduate and postgraduate specialty training programs.
(d) Geriatricians seeking in-depth knowledge of specialty care for older patients.
(e) Members of the interprofessional teams that are so critical to clinical care and research within geriatrics, including nursing, social work, pharmacy, physical and occupational therapies, and others.
(f) Policy makers seeking to understand the strength of evidence concerning quality care for older patients provided by specialists and their associates.

The Approach Used in Developing the Book

This book is divided into three parts: crosscutting issues, medical specialties, and surgical and related specialties.

Part I: The first part deals with the crosscutting issues and addresses concepts of critical importance to all specialist providers who conduct research for and about and who also care for older patients. These chapters are cross-referenced heavily throughout Parts II and III. This has reduced repetition within individual chapters on critical concepts such as frailty, assessment tools, delirium, dementia, pharmacology, and perioperative care, while allowing authors to describe in detail where these concepts fit specifically within that discipline and relevant related literature.

Parts II and III: The surgical (Part II) and medical (Part III) parts of the book are a series of chapters addressing the major selected surgical and medical disciplines; important related specialties (e.g., rehabilitation) are included in the surgical part.

The editors developed the table of contents reflecting the state of knowledge and then recruited specialty authors who are active in clinical care, teaching, and research in geriatrics. The editors then worked with the authors to ensure that the focus of the book was practical, timely, and clear so it could be a reliable resource in everyday practice.

Background

The editors acknowledge the work of many over two decades and in particular the inspiration of the late Drs. Dennis Jahnigen and T. Franklin Williams. Dr. Jahnigen initiated the geriatric surgical and related specialties movement in the 1990s, and Dr. Williams inspired much of the work to embed geriatric principles into the subspecialties of internal medicine. Both of these individuals were prominent geriatricians: Dr. Jahnigen was a past president of the American Geriatrics Society (AGS), and Dr. Williams was a past director of the National Institute on Aging. While Drs. Jahnigen and Williams initiated this work, the major developments that followed fell to their successors. The surgical and related specialty work was initiated within the AGS and was led by the late Dr. David Solomon and Dr. John Burton, who were joined by Dr. Andrew Lee and others, including Dr. Jane F. Potter and Dr. Michael Harper, both of whom served in leadership positions in the program. The work related to the development of geriatrics in the medical specialties was led by Drs. William Hazzard and Kevin High and became a program of the Association of Specialty Professors (ASP). The strategy behind this collaborative effort was to recruit and nurture promising young faculty and trainees in the geriatric aspects of their specialty. This investment over the last almost three decades in medical and surgical specialists is a unique national success resulting in a robust body of knowledge related to specialty care of older adults.

Critical to the success of this effort was the AGS leadership, notably Nancy Lundebjerg, whose dedication and hard work have moved the inspiration of its founders into a growing focus within the American Geriatrics Society and in American medicine. None of this work would have been possible without the encouragement and support of the John A. Hartford Foundation and its president until 2015, Corinne H. Rieder, EdD. The program director, Christopher Langston, and senior project officers (Laura Robbins, Donna Regenstrief, and Marcus Escobedo) of the John A. Hartford Foundation for the two programs (surgical and related specialties within the AGS and the medical specialties within the ASP) were full partners throughout the development and operation of these programs. Their dedication, vision, and commitment ensured success and inspired all involved in the projects. Collectively, they formed a critical force behind the work that made this book possible. Within the AGS, the effort became known as the Geriatrics for Specialists Initiative (GSI). The GSI has evolved into an active group of physician specialists, geriatricians, and health professionals from other disciplines. The GSI fosters geriatric principles in education and research broadly in medical centers and within specialty societies and governing and regulatory bodies. The sustained effort within the AGS of the GSI has evolved into the Section for Enhancing Geriatric Understanding and Expertise Among Surgical and Medical Specialists (SEGUE). The leadership of SEGUE is now entirely specialists. This book is a natural succession of the work of the GSI and SEGUE within the AGS and the geriatrics program of the ASP. The career development programs, originally sponsored by the specialty organizations, were subsumed by the National Institute on Aging with the initiation of their program in 2011: Grants for Early Medical and Surgical Specialists Transitioning to Aging Research (GEMSSTAR). Many of the chapters are written by the new cohort of geriatric specialty scholars and their mentors and trainees associated with the GSI/SEGUE program of the AGS and the geriatrics program of the ASP. I am happy to turn over the leadership reins for SEGUE to Tom Robinson, MD, and Mike Harper, MD, who will carry our organization to new heights.

Houston, TX, USA Andrew G. Lee

Acknowledgment

Dr. Andrew Lee would like to acknowledge and thank his mentor (and friend) in geriatrics, Dr. John Burton. Dr. Burton has inspired a generation of geriatricians but also geriatric specialists (including me) to listen harder, to move faster, and to see further in geriatric surgical and related medical specialty care. It is rare that one gets to thank one's personal heroes in print and so I am grateful for the opportunity now to recognize my friend, my colleague, and my role model and mentor, John Burton. Dr. Lee also would like to recognize and thank his older and wiser parents, Alberto C. Lee, MD, and Rosalind Lee, MD, for proving that "getting older isn't the same thing as getting old" and that "only young people worry about getting old." He would like to thank his perpetually patient and loving wife, Hilary A. Beaver, MD, for her years of service in her own right to the cause of geriatric ophthalmology and for not just tolerating but embracing her "old man" and his academic and personal quirks and idiosyncrasies. Dr. Lee is also grateful for the love and comfort of his two wonderful daughters, Rachael E. Lee and Virginia A. Lee whom he hopes will have learned to value the wisdom of elders and to his siblings Amy Lee Wirts, MD, and Richard Lee to whom he owes a lifetime of sibling wit, shenanigans, and life experience. Finally, Dr. Lee thanks his colleagues and peers in ophthalmology, Neil R. Miller, MD, Anthony Arnold, MD, and Paul Brazis, MD, who have shown him that the path to academic retirement means that although there will be no answers, that there will be stories and the journey does not end at Professor Emeritus.

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1 Frailty

Jeremy D. Walston

1.1 Introduction

Frailty is a condition frequently observed in older adults that is a warning sign for high risk of adverse health outcomes. Although exact definitions and screening methods vary, approximately 15% of the US population over age 65 and living in the community are considered frail, and therefore at significantly higher risk of adverse health outcomes and mortality than more resilient older adults. Clinicians from surgical and medical specialties are increasingly interested in frailty because of its potential to identify those individuals at highest risks for complications related to procedures and medical interventions. Over the past 20 years, several conceptual frameworks have been developed, and measurement tools for those frameworks have been developed. Many of these frameworks and related measures have been validated by the ability to identify a subset of older adults who are at higher risk of adverse health outcomes than other older adults. This chapter provides an overview of several frailty definitions, as well as epidemiology, etiologies, and consequences. The chapter also provides guidelines as to how best identify and manage frail older adults, and highlight how frailty research can lead to better health-care guidelines for the future.

1.2 Conceptualizing and Defining Frailty

Although many frailty measurement tools have been developed over the past 20 years, two commonly cited conceptual approaches have emerged that have greatly informed and facilitated the development of additional assessment tools (Fig. 1.1).

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Physical Frailty Physical frailty is most often conceptualized as a geriatric syndrome that characterized by loss of biologic reserve that results in increased vulnerability to a host of adverse outcomes including disability, iatrogenic complications, increased hospitalization rates, and early death [2–7]. Fried et al. proposed this framework that conceptualized frailty as phenotype that resulted from a deeply biologic process that results in a syndrome of weakness, weight loss, fatigue, and slowness [2, 8]. A 2004 American Geriatrics Society/National Institute on Aging conference on frailty in older adults gave this definition further specificity as it describes frailty as "a state of increased vulnerability to stressors due to age-related declines in physiologic reserve across neuromuscular, metabolic, and immune systems" [9].

This model was operationalized into a clinical assessment tool for ambulatory older adults and was validated in several large population cohorts as highly predictive of adverse outcomes [2]. This conceptual basis and assessment approach has been widely adapted by many investigators to develop other physical frailty screening or assessment tools, to identify biological underpinnings of frailty, and to test potential intervention strategies.

Deficit Accumulation Frailty Another major theoretical construct for frailty comes from Rockwood et al., who conceptualized frailty as an aggregate of illnesses, disability measures, cognitive, and functional declines that has been termed deficit-driven frailty [10]. According to this model, the more deficits or conditions that an individual has, the more frail the individual is. In this agnostic approach, almost any conditions or deficits are interchangeable in index tools. This conceptual basis has also been widely utilized to develop risk assessment tools that tally a broad range of comorbid illnesses, mobility and cognitive measures, and environmental factors to capture frailty. Although this concept of deficit-driven frailty has been utilized in many population studies to assess risk for mortality and other adverse health outcomes, biological and intervention studies have

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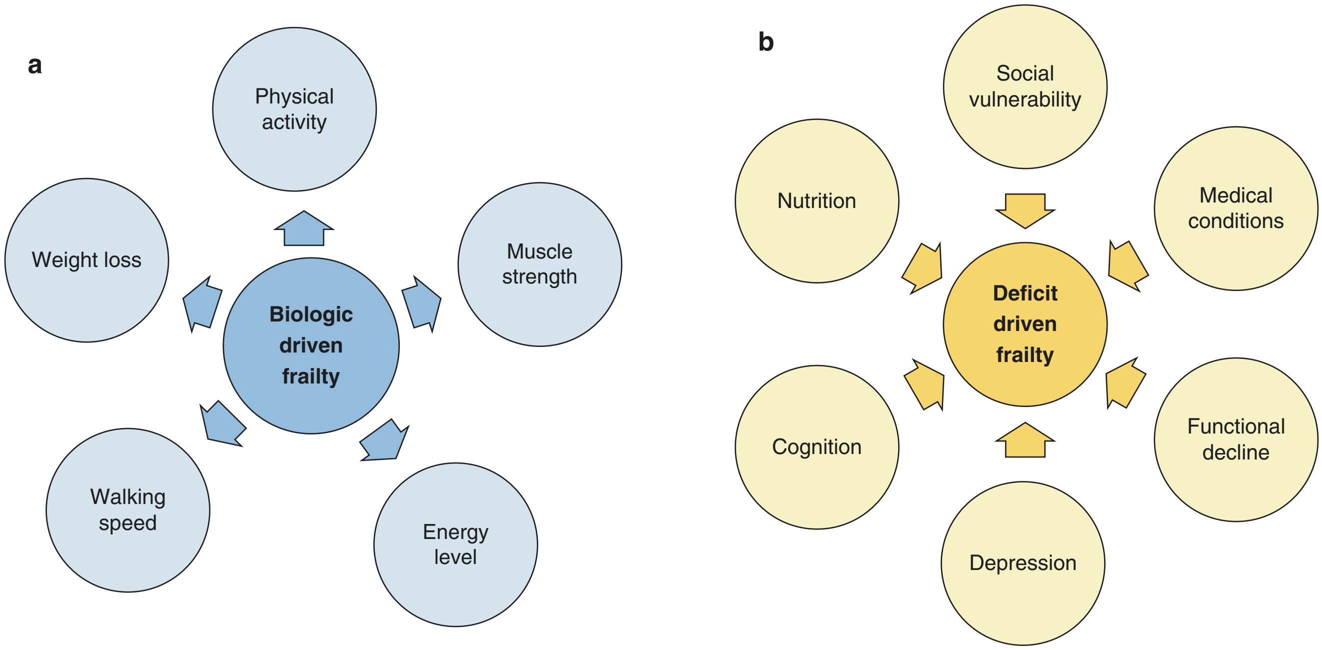

Fig. 1.1 Two conceptualizations of frailty. (**a**) Phenotypic frailty. Phenotypic frailty is conceptualized as a clinical syndrome driven by age-related biologic changes that drive physical characteristics of frailty and eventually, adverse outcomes. (**b**) Deficit accumulation frailty. The deficit model of frailty proposes that frailty is driven by the accumulation of medical, functional, and social deficits, and that a high accumulation of deficits represents accelerated aging. An important distinction between these two conceptualizations of frailty is that biologic-driven frailty causes the physical characteristics of frailty (*arrows pointed outward*). In contrast, deficit accumulation frailty is caused by accumulated abnormal clinical characteristics (*arrows pointed inward*). (Adapted from Robinson et al. [1], Copyright 2015, with permission from Elsevier)

been more difficult because of heterogeneity in posited causal pathways that underpin this measure of frailty [11].

Other Approaches
Beyond these two most commonly cited and utilized frailty measurement approaches, over 70 frailty measurement tools have been cited in the literature [12]. Many have been developed through adaptations to either the phenotypic/physical frailty approach or the deficit accumulation approach or combinations of the two. Others have been developed to have a cognitive decline focus or a pre-disability focus. This proliferation of approaches and related assessment tools and measures that include medical, social, cognitive, psychological, and educational factors have not allowed for a single definition of frailty to emerge [2, 13–16]. Despite this, many tools have been developed for specific clinical settings where risk assessment is needed. In addition, given that frailty is often highly associated with an increased risk of mild cognitive impairment and an increased rate of cognitive decline with aging [17, 18]. Conversely, the presence of cognitive impairment increases the likelihood of adverse health outcomes in older adults who meet criteria for physical frailty. Hence, it may be considered an additive risk factor to frailty in those older adults with both conditions and cognitive related questions have been added into some frailty assessments.

1.3 Frailty Prevalence, Epidemiology, and Mortality Risk

Although the prevalence of frailty varies with the tool used to define frailty and with the population studied, most population studies performed in the USA and Canada have estimated that the prevalence of frailty by whatever measure lies between 4% and 16% in men and women aged 65 and older [2, 19–23]. For example, a large review study using physical frailty measured in 15 studies that included 44,894 participants identified a prevalence of frailty of 9.9%; when psychosocial aspects were included in the definition, prevalence was 13.6% among eight studies that included 24,072 participants [24]. Prefrail individuals, most often identified with a physical frailty type tool, have a prevalence ranging from 28% to 44% [2, 22, 23].

As to the detection of a clinical transition toward frailty, most of the studies have been performed using the physical frailty phenotype. For example, in a study in the USA of nearly 6000 community-dwelling men aged 65 and older, at an average follow-up of 4.6 years, 54.4% of men who were robust at baseline remained robust, 25.3% became prefrail, and 1.6% became frail. The remaining subjects were accounted for by 5.7% mortality and the remaining 13% were lost to follow-up [23]. Of those individuals who were prefrail, over 10% went on to become frail over the next 3 years.

Demographic associations with frailty include older age [22], lower educational level [22], smoking, unmarried status, depression, and African American or Hispanic ethnicity [19, 23, 25]. A number of chronic disease states, including most especially congestive heart failure, diabetes mellitus, hypertension, and peripheral artery disease [15, 26, 27] are also significantly associated with physical frailty.

Frailty has been widely utilized as a mortality risk assessment tool. Several studies have compared the most commonly utilized screening tools and found that these indices were comparable in predicting risk of adverse health outcomes and mortality [20, 28–30]. A 2013 consensus conference also referenced tools that can be easily utilized to diagnose frailty [31]. In most studies of physical frailty, the increasing mortality in models adjusted for disease, age, and socioeconomic factors ranges from 2.24 at 3 years in the Cardiovascular Health Study to 6.03 in the Women's Health and Aging Studies I and II [2, 21]. In the longitudinal Women's Health Initiative Observational Study, mortality risk was increased over 3 years in those with baseline frailty (HR 1.71; 95% CI 1.48–1.97) [22]. In a study in men, mortality was twice as high for frail, compared with robust, men (HR 2.05; 95% CI 1.55–2.72) [23]. Mortality prediction was demonstrated to be similar across 8 scales of frailty developed within previously collected data in the Survey of Healthy, Aging and Retirement in Europe (SHARE), with death rates three to five times higher in cases classified as frail compared with those not classified as frail in all tools studied [32]. This collective evidence suggests that those who are frail have a two- to sixfold risk of mortality in the subsequent 3 years compared to their robust counterparts.

In addition to mortality, frailty status is predictive of a host of adverse health outcomes. After adjustment for comorbidities, frailty predicted hip fractures (HR 1.74 (1.37–2.22)) and disability (HR 5.44 (4.54–6.52)) over 3 years in the participants of the Women's Health Initiative [22]. Frailty also predicted adverse outcomes related to renal transplantation, general surgery interventions, and trauma [33, 34].

In surgical populations, frailty predicts adverse outcomes as well. Using a frailty phenotype tool to ascertain frailty, this group measured frailty in a preoperative assessment and found that the frail individuals were at increased risk of postoperative complications (OR 2.54; 95% (I 1.12–5.77)), increased length of stay (incidence ratio 1.69; 95% (I 1.28–2.23)), and a markedly increased risk of discharge to an institutional care setting such as rehabilitation or nursing home (OR 20.48; 95% (I 5.54–75.68)) [33].

1.4 Pathophysiology

Multiple epidemiological studies have helped to reveal that dysregulated immune responses characterized by chronic inflammatory pathway activation, endocrine, and hormonal measures that influence skeletal muscle, as well as altered stress response and energy response systems are strongly related to physical frailty. The underlying basis of this multisystemic dysregulation is unclear, but is hypothesized to be driven by age-related cellular and molecular changes, genetics, body composition changes, and specific disease states (Fig. 1.2) [9, 35]. Sarcopenia, or age-related loss of skeletal muscle and muscle strength, is a key component of physical frailty. Decline in skeletal muscle function and mass is driven in part by age-related hormonal changes [36–39] and increases in inflammatory pathway activation [40].

There is strong evidence linking chronic inflammatory pathway activation to frailty. Serum levels of the proinflammatory cytokine IL-6 and C-reactive protein (CRP), as well as white blood cell and monocyte counts, are elevated in community-dwelling frail older adults [36, 41–43]. IL-6 acts as a transcription factor and signal transducer that adversely impacts skeletal muscle, appetite, adaptive immune system function, and cognition [44] and contributes to anemia [45, 46]. Immune system activation may trigger the clotting cascade, with a demonstrated association between frailty and clotting markers (factor VIII, fibrinogen, and D-dimer) [42]. Further, there is evidence linking a senescent immune system to chronic CMV infection and frailty [47]. Frail older adults are also less likely to mount an adequate immune response to influenza vaccination, suggesting a biological driver of frailty [48].

Multiple age-related hormonal changes have been associated with frailty. Decreased growth hormone and insulin-like growth factor-1 levels in later life (IGF-1) [36, 49, 50] are associated with lower strength and decreased mobility in a cohort of community-dwelling older women [51]. Decreased levels of the adrenal androgen dehydroepiandrosterone sulfate (DHEA-S) [36] are also lower in frail older adults. DHEA-S plays an important role in maintaining muscle mass and indirectly prevents the activation of inflammatory pathways that also are a component of frailty [52]. Chronically increased cortisol levels [53], especially in the afternoon, are common in frailty and likely impact skeletal muscle and immune system function. Evidence is mixed that lower levels of the reproductive hormones estrogen and testosterone contribute to frailty [54–57]. However, there is stronger evidence that links decreased 25(OH) vitamin D [41] levels to frailty [58, 59].

Finally, there is increasing evidence linking dysregulation in stress response systems to frailty beyond the inflammatory and cortisol component detailed above. For example,

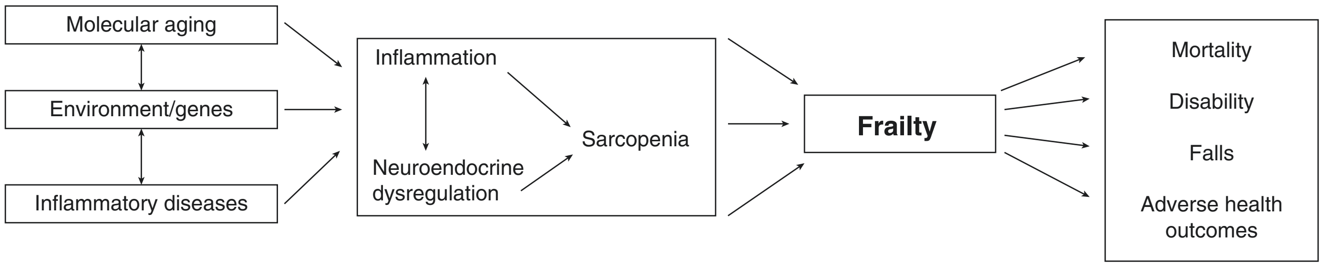

Fig. 1.2 Potential biological etiologies that drive physical frailty and the vulnerability to adverse health outcomes

dysregulation of the autonomic nervous system [60] and age-related changes in the renin–angiotensin system and in mitochondria likely impact sarcopenia and inflammation, important components of frailty [61]. This dysregulation in stress response systems may be especially relevant to patients undergoing stress surgical procedures, and likely contributes to markedly increased risk of adverse outcomes in frail patients.

1.5 Clinical Assessment of Frailty

Clinical practitioners are increasingly interested in frailty, its definitions, and most importantly how it can be utilized to reduce risk of adverse outcomes and to improve the health care of older adults. Although no gold standard has emerged to measure frailty or on how best to use information on frailty once it is obtained, many research and clinical practice groups are moving toward incorporation of frailty measurements into clinical practice. Indeed, the identification of frailty in any clinical practice settings may be helpful in highlighting the need for additional assessment and the need for individualized treatment plans that reduce risk. As part of a movement to incorporate frailty measures into clinical practice, a consensus group of delegates from international and US societies related to geriatrics and gerontology recommended that all persons over age 70, those adults with multiple chronic disease states or weight loss exceeding 5% over a year should be screened for frailty. No one tool was recommended for frailty screen, although several currently available tools described below were highlighted for potential use [31].

1.6 Choosing a Specific Frailty Tool

At present, few recognized guidelines exist on how to best choose a frailty assessment tool [12]. This is in part because most frailty assessment tools have not been extensively validated or utilized across populations, and few comparison studies have been done that show clear benefit of using one tool over the other. In addition, different tools may or may not be good matches to the intended use. For example, a brief screening tool may be appropriate for risk stratification and decision-making related to whether or not to pursue a treatment option. However, a more formal frailty assessment tool that includes physical measurements such as walking speed or grip strength might be required to better define potentially helpful preoperative interventions.

Given the wide array of tools and the wide variety of populations in which the tools may need to be implemented, the choice of which assessment tool to use should be tailored to a clinical situation and clinical need. Choosing a tool that has been previously used in a variety of populations and that has demonstrated predictive validity in several settings should also influence the choice of tools. Considerations of available time in a busy clinical practice may also drive the decision process.

Although not yet available, the development of discipline-specific frailty assessment tools, along with specific clinical guidelines of how best to manage frail older adults after they are identified is of crucial importance as older and more frail individuals are considered for medical and surgical interventions. A recent NIA conference on frailty in clinical practice has helped to formalize recommendations in a variety of clinical settings. The following list of frailty measurement tools, used mostly in the past for risk assessment in population studies, and rationale for their use was recently reviewed by Robinson et al. [62]. Additional tools and rationale for their use mentioned in this section are also available at https://frailtyscience.org/frailty-assessment-instruments.

1.6.1 Single-Item Surrogate Frailty Assessments (2–3 min)

Because quick and efficient frailty ascertainment is often necessary in a busy clinical setting, single item measurement tools have been proposed to stand in for a more formal frailty measurement to ascertain higher levels of vulnerability to adverse outcomes related to procedures. Although it is not a full physical or deficit accumulation frailty measurement, gait speed measured over a 4 m distance is recognized as a highly reliable single measurement tool that predicts adverse outcomes [63, 64]. The inability to rise from a chair, walk 10 ft, turn around, and return to sitting in the chair in ≥15 s, (timed up and go test), is closely related to both postoperative complications and 1-year mortality [62]. Some of these single measures are components of both the frailty index and frailty phenotype approaches, and although they can be easy to use and predictive of adverse outcomes, they lack sensitivity and specificity of the full frailty assessment tools.

1.6.2 Frail Scale and Study of Osteoporotic Fractures (SOF) Frailty Tools for Quick Assessment (<5 min)

The Frail Scale screening tool for frailty is loosely based on the physical frailty phenotype construct with an additional comorbidity question [65–67]. The Geriatric Advisory Panel of the International Academy of Nutrition and Aging advocates this approach for develop frailty as a case-finding tool [63]. It requires asking five questions and scoring a one for each yes (Table 1.1). Those who are frail score 3, 4, and 5; those who are robust score 0 [66]. The assessment is easy to perform and score, requires no extra measuring device, and has been found to identify those at most risk for adverse outcomes in populations.

Another easy to use screening tool for quick risk assessment is the SOF frailty tool [28]. Frailty is determined when individuals have two of the following three components.

- Weight loss of 5% in the last year
- Inability to rise from a chair five times without the use of arms, or
- A "no" response to the question "Do you feel full of energy?"

Both of these tools can be readily deployed in a clinical setting as a way to find high risk patients who may need further assessment.

1.6.3 Physical or Phenotypic Frailty (10 min)

Phenotypic or physical frailty is widely used by frailty researchers and has been utilized to measure frailty in many clinical and research settings. As described above in the conceptual basis of frailty, it was designed around the concept of an aggregate loss of function across physiological systems, which is in turn manifested by specific signs and symptoms in frail older adults [2, 8]. This was then operationalized into a clinical exam described below. The tool has been widely validated to predict risk for adverse health outcomes as well as most frailty assessment tools in many different research and clinical settings. It has been especially prominent in the study of the biological basis of frailty, and in the development of interventions focused on the specific components of frailty [68, 69]. This frailty assessment tool was 1 of 2 strategies recognized by the American College of Surgeons/American Geriatric Society's optimal preoperative assessment of the older adult [70]. Although the tool requires a questionnaire, a hand-held dynamometer, and a stopwatch in order to assess for frailty, it takes less than 10 min to perform by a trained clinician/technician. The recent development of comprehensive instructions and a web-based calculator for this tool has made it easier to use and has further reduced the time that it takes to get a frailty score. Access to needed measurement equipment, training guides, and the web-based calculator is available at http://hopkinsfrailtyassessment.org (December 23, 2015).

This clinical phenotype has five components that can be assessed using readily available measurement equipment and a web-based frailty calculator as described below. The score is determined on a 0–5 scale with 0 being not frail; 1–2prefrail; and 3–5 frail. The severity of the risk is linear.

The major measurement domains include:

1. *Shrinking* (greater than 5% loss of body weight in the last year).
2. *Weakness* (grip strength of the dominant hand in the lowest 20% of the age and body mass index (BMI)).
3. *Poor endurance* (self-reported exhaustion).
4. *Slowness* (lower 25% of population average measures 4-m walking time).
5. *Low activity* (assessed by activity questions that identify weekly energy expenditure of less than 383/270 Kcals for males and females, respectively).

Table 1.1 Frail scale questions[a]

Fatigue	Are you fatigued?
Resistance	Can you climb 1 flight of stairs?
Ambulation	Can you walk 1 block?
Illnesses	Greater than 5
Loss of weight	Greater than 5%

[a]Each question is assigned one point if affirmative. Frailty is diagnosed with three or more points

1.6.4 Deficit Accumulation or Frailty Index

The most widely recognized deficit accumulation method to measure frailty was developed from the Canadian Health and Aging Study [71].

Between 21 and 70 deficits or comorbidities have been published and recommended for use in this assessment [71, 72]. Although considerable time may be needed to gather information on individual patients and set up an algorithm in a medical record, a frailty index score can be quickly and automatically generated once the electronic record is in place. The frailty index score is calculated as the number of characteristics that are abnormal (or "deficits") divided by the total number of characteristics measured. Scoring has mostly been done by summing the total deficits and comparing to a published cut-off score, or by calculating a ratio between deficits and total number of characteristics. This tool can be accessed in a series of references [72–74] or through the link biomedgerontology.oxfordjournals.org/content/62/7/722.long (December 23, 2015).

1.6.5 Frailty Index Adaptations

Recent adaptations of index-type tools for risk assessment in a variety of clinical settings have been developed. These uses include risk assessment in older trauma patients and in HIV-infected individuals [75, 76]. Given that no physical measurements are necessary to calculate an index score, hospitalized and nonambulatory patients can be assessed using historical data gathered from medical records and perhaps family members. This makes these tools especially valuable for prognostication, and risk assessment for outcomes. Strength of these types of tools includes the fact that each is more specificity related to the condition than other more general tools, which in turn may allow for improved risk assessment and eventually guideline development. However, screening for frailty after acute illness or injury does not facilitate prehabilitation or other risk reduction techniques that may predate hospitalization.

1.6.6 Additional Tools

There are many additional published measures of frailty but to date are not as well studied or as broadly validated [77]. A recent review article identifies dozens and articulates their specific uses over the past decade [12]. Some of these validated tools with specific purposes (clinical risk assessment, intervention prevention) may be identified in select situations. The Edmonson Frail Scale is an index-style tool that includes 15 items related to the health and well-being of an older adult. The Clinical Frail Scale is derived from clinical observation and health provider estimation of frailty status. The Gerontopole Frailty Screening tool is used for a relatively quick assessment device that helps to guide the need for more formal frailty assessment [71, 78, 79].

Chapter 8—Office Tools for Geriatric Assessment contains information on many commonly used instruments.

1.7 Management of Frail Older Adults

Once a frail or prefrail patient is identified, there are to date no succinct guidelines on how to best manage them. However, tenets of the practice of Geriatric Medicine, which include comprehensive geriatric assessment, risk mitigation, advanced planning, and delirium prevention should be put in place for all patients who are diagnosed with frailty by commonly utilized tools [80, 81]. Building on these recommendations, and on signs and symptoms consistent with frailty, focus on improvement in excessive fatigue, maintenance of physical activities like stair climbing, and the ability to leave the home and walk at least one block can help to improve signs and symptoms and quality of life.

When considering the diagnosis of frailty, it is crucial to develop a differential diagnosis list and rule out underlying medical or psychological issues that may be driving signs and symptoms of frailty. There are many conditions to be considered in older patients with signs and symptoms of frailty that may in fact be driving the frailty phenotype (Table 1.2).

In addition to the usual tenets of disease focused physical examination, a frailty focused assessment may include an assessment of the patient's ability to rise from a stable, heavy chair five times without the use of arms, and the ability to walk across the room.

1.7.1 Laboratory Testing

When evaluating a frail patient for the first time, laboratory testing should be undertaken in order to rule out treatable conditions that mimic frailty as described above. A sug-

Table 1.2 Diseases with symptoms consistent with frailty phenotype that must be ruled out when evaluating a frail patient

Depression	
Cognitive decline	
Malignancy	Lymphoma, multiple myeloma, occult solid tumors
Rheumatologic disease	Polymyalgia rheumatica, vasculitis, rheumatoid arthritis
Endocrinologic disease	Thyroid abnormalities, diabetes mellitus
Cardiovascular disease	Hypertension, heart failure, coronary artery disease, peripheral vascular disease
Renal disease	Renal insufficiency
Hematologic disease	Myelodysplasia, iron deficiency, and pernicious anemia
Nutritional deficits	Vitamin D and other vitamin deficiencies
Neurologic disease	Parkinson disease, vascular dementia, serial lacunar infarcts

gested initial screen, based on the differential diagnosis, might include a complete blood count, basic metabolic panel, and other hormonal and metabolic tests, including albumin, vitamin B12, vitamin D, and TSH. This will help to rule out anemia, vitamin D, or B12.

1.7.2 Establishing Goals of Care

Once a frail older adult is identified, goal setting with patients and their families is crucial in providing care, establishing individual priorities, weighing risks and benefits of interventions, and making decisions regarding aggressiveness of care. As the older adult progresses along the frailty spectrum and develops more severe disease and/or disability, it becomes increasingly important to tailor medical care and interventions to the needs of these most vulnerable patients. Potential interventions (see below) that might be beneficial along the continuum of frailty are exercise, nutritional supplementation, comprehensive geriatric assessment, prehabilitation, and reduction treatments.

For robust older patients, the medical practitioner should treat known chronic diseases, manage intermittent acute illness and events, and assure age-appropriate screening measures and preventive care [82]. In the moderately-to-severely frail patient, a less aggressive approach is often indicated as aggressive screening or intervention for non-life-threatening conditions may put the frail patient at higher risk of iatrogenic complications. Procedures or hospitalizations may bring about unnecessary burden and decreased quality of life to a patient who already has a high risk of morbidity and mortality [83]. Hence careful conversation and very clear articulation of potential risk is in order for frail patients and their families.

1.8 Interventions

While it is believed that interventions to maximize functional status for older adults in general, such as exercise, can reasonably be applied to patients with frailty, data on specific exercise interventions designed to improve outcomes in patients with frailty are limited. In one trial conducted in community-dwelling frail and prefrail individuals, interventions aimed at cognitive skills (weekly training for 12 weeks followed by fortnightly "booster" sessions for 12 weeks), physical exercise (supervised group exercises 2 days per week for 12 weeks), and nutrition (supplemental iron, calcium, vitamins, and calories), individual or combination interventions improved frailty scores at 3 and 6 months, but did not impact patient-meaningful secondary outcomes (hospitalizations, falls, or performance of activities of daily living (ADL)) [68]. Another study showed that frail older adults may benefit from interventions targeting specific components of their physical frailty exam. Finally, frail older adults may benefit from an additional comprehensive geriatric assessment where social, psychological, cognitive, functional, and medical issues are identified and proactively addressed [69, 80].

1.8.1 Prehabilitation

In surgical settings, prehabilitation is being developed in order to reduce adverse outcome risk for all patients. Frail patients may benefit the most given their high risk status. Exercise is believed to be the most effective intervention in older adults to improve quality of life and functionality. The demonstrated benefits of exercise in older adults include increased mobility, enhanced performance of ADL, improved gait, decreased falls, improved bone mineral density, and increased general well-being. Studies suggest that even the frailest oldest adults are likely to benefit from physical activity at almost any level that can be safely tolerated. For example, a program of resistance training in octogenarian nursing home residents doubled muscle strength, and increased lower extremity muscle size and gait velocity [84] as well as increased mobility and spontaneous physical activity. In another study of resistance training, benefit was reported for exercise activity on as few as 2 days per week [85]. Even simple interventions can be helpful. For example, walking as little as a mile in a 1-week period was associated with a slower progression of functional limitations over a follow-up period of 6 months [86].

While functionally limited or frail individuals may never be able to meet minimum recommended activity levels, even modest activity and muscle strengthening can impact the progression of functional limitations. For these individuals a recommendation of walking for 5 min twice a day as a starting point is reasonable. The identification of a set of key activities the patient feels capable of doing helps incorporate self-efficacy into the physical activity recommendation and makes it more likely to succeed [87].

1.8.2 Nutritional Supplementation

For patients with weight loss as a component of frailty, attention should be focused on medication side effects, depression, difficulties with chewing and swallowing, dependency on others for eating, and the use of unnecessary dietary restrictions (low salt/low fat). In treatment of weight loss, oral nutritional supplements between meals (low-volume, high-caloric drinks or puddings) may be helpful in adding protein and calories. A meta-analysis of studies of nutritional supplements showed that providing nutritional supplements to older undernourished adults yielded small gains in weight (2.2%) [88]. Vitamin D supplementation for those with low serum vitamin D levels is effective for fall prevention, improving balance, and preserving muscle strength [89] and may play a role in preventing or treating frailty. In one report, lower serum levels of 25-hydroxyvitamin D (<20.0 ng/mL) were associated with a higher prevalence of frailty at baseline in a group of 1600 men over age 65, but did not predict greater risk for developing frailty at 4.6 years [90]. Given that vitamin D appears to play an important role in both muscle and nervous tissue maintenance with aging, assessment and supplementation are often indicated. In a recent intervention study that combined protein and vitamin D supplementation, those taking leucine-enriched whey protein plus vitamin D had significant improvement in physical frailty-related measurements [91].

1.8.3 Medication Review

Periodic evaluation of a patient's drug regimen is especially important for patients who are prefrail or frail. Such a review may indicate the need for eliminating certain prescription drugs that may be contributing to symptoms of frailty. Changes may include discontinuing a therapy prescribed for an indication that no longer exists, discontinuing therapy with side effects that may be contributing to frailty symptoms, substituting a therapy with a potentially safer agent, changing drug dosage, or adding a new medication. In reviewing medications, it is important to focus on the established goals of care with the patient and caregivers. Chapter 5—Medication Management, provides details on the subject.

1.9 Summary

Frailty is an increasingly recognized clinical state of vulnerability with inherent increased risk for adverse health outcomes, including functional decline and mortality. Although there is no gold standard for diagnosing frailty, there are many tools that are validated and can be used for screening depending on the purpose. The physical frailty and deficit accumulative frailty tools predominate in the literature. An international consensus group has recommended that all persons over age 70 and adults with chronic disease or weight loss exceeding 5% over a year be screened for frailty with a more formal frailty assessment. Other validated screening tools that have been developed and may be more efficient to implement into busy clinical practices are also readily available.

Once frailty is diagnosed, goal setting with patients and their families is crucial in providing high quality and safe health care for the frail individual. The establishment of individual priorities, weighing risks, and benefits of interventions and making decisions regarding aggressiveness of care are important. Exercise and activity interventions have been shown to have a positive impact on even the frailest older adults. To date, no biological or pharmaceutical interventions are recommended for frailty per se, although biologically targeted interventions such as senolytics may play a role in the future [92].

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2 Delirium

Thomas N. Robinson

2.1 Introduction

Delirium is a common medical condition that healthcare providers will encounter while caring for older adults, especially in the hospitalized patient. On a general medical service, rates of delirium range from 10 to 40% [1–3]. Further, up to a quarter of hospitalized patients over age 65 will present with delirium [4]. An additional 30% of hospitalized patients in this age group will develop delirium acutely during their hospitalization [5]. Familiarity with the clinical syndrome of delirium, identification of which patients are at risk, and knowledge on how to prevent, diagnose, and treat delirium are critical to healthcare professional's ability to provide high quality care for hospitalized older adults.

Delirium is critical to prevent and, should it occur, to recognize early because of its close association with increased morbidity and mortality in the hospitalized patient. Patients who experience delirium have long-term loss of cognitive function, higher complication rates, increased hospital length of stay, and higher mortality. Delirium has recently been recognized as a complex phenotype in older patients that shifts the prevalence focus from chronologic age and medical comorbidities to the functional impact of comorbidities especially frailty (discussed fully in a separate chapter) and disability. While the frail older adult is at higher risk for delirium in the hospitalized setting, any hospitalized patient can develop delirium.

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2.2 Delirium Definition

Delirium is defined as a disturbance in attention and awareness, with a change in cognition that occurs over a short period of time (hours to days) and fluctuates during the course of the day. Differentiating preexisting dementia from delirium is critically important. Clinically, delirium presents with inattention, disordered thinking, and loss of orientation, with a component of both agitation and hyperactivity, or, especially in the elderly, with depressed affect and hypoactivity. Patients can appear confused, have hallucinations, be somnolent, or present with all of these symptoms during the course of delirium. Unlike dementia, delirium waxes and wanes over the course of the day, so patients may have normal behavior during one assessment, and be agitated or somnolent the next. Thus, a high level of clinical suspicion is necessary in order to recognize and diagnose a patient with delirium. The hypoactive delirium subtype is widely recognized as the most under-diagnosed presentation of delirium.

2.3 Delirium Risk Factors

The risk of developing delirium following surgery is best described as a relationship between a physiologic stressor, predisposing patient risk factors, and iatrogenic conditions (see Fig. 2.1) [6]. A multitude of risk factors have been identified that increase the chances of the development of delirium; this multiplicity includes both intrinsic patient factors and external precipitating factors during a hospital stay. Risk factors for delirium are multifactorial, and there is a dose-response to the number of risk factors and the odds of developing delirium [7]. Dementia is the most closely associated intrinsic patient vulnerability that increases the risk of delirium [8, 9]. The greater the severity of dementia, the greater the risk of developing delirium [10]. Patients with underlying medical conditions associated with frailty such as poor mobility, fatigue, a high level of comorbid medical conditions [11], and malnutrition [12] also place patients at risk

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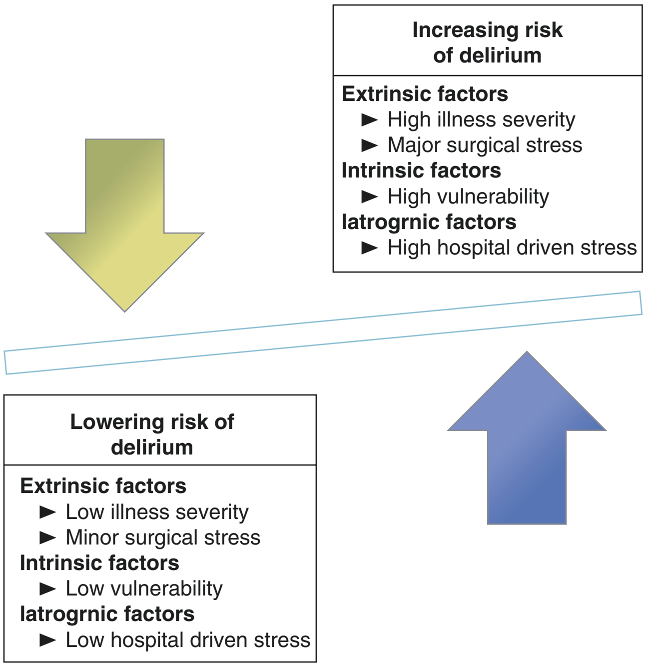

Fig. 2.1 Multifactorial model of delirium. The risk of a delirium is a combination of extrinsic factors to the patient (e.g., severity of medical illness, stress of surgical intervention), intrinsic factors to the patient (e.g., cognitive impairment, advanced age), and iatrogenic factors (e.g., sleep disruption, pain control)

for the development of delirium [13]. Frail patients can have rates of delirium of up to 60% [4]. Other intrinsic risk factors include increased age and sensory impairment (visual or hearing) [7].

Routine hospital care introduces external iatrogenic risk factors, including polypharmacy (discussed fully in a separate chapter), disruption of sleep–wake cycles, infection, psychoactive medication prescription (specifically benzodiazepines and anti-cholinergic drugs), physical restraints, use of bladder catheters, and iatrogenic adverse events have all been identified as risk factors for delirium [14]. See Table 2.1 for a summary of delirium risk factors.

Various specialty-specific rates of delirium have been reported that further identify groups of hospitalized patients who are more at risk for the development of delirium. Patients who present to the emergency department or are in the intensive care unit (ICU), oncology patients, and patients for multiple surgical specialties (e.g., vascular or orthopedic surgery) can have higher rates of delirium than the average hospitalized adult. Ten percent of patients present to the emergency department with delirium, although this number may under-represent the true incidence [13, 15]. Orthopedic injuries and operations also carry high risk, with 40% of patients developing delirium after bilateral knee replacement [16] and up to 60% following hip fracture [17]. Patients undergoing coronary artery bypass grafting have rates of postoperative delirium of 33–50% [18, 19].

Table 2.1 Risk factors for delirium

Advancing age
Impaired cognition (e.g., dementia)
Severe illness or comorbidity burden
Functional dependence
Infection or sepsis
Hearing or vision impairment
Sleep disturbance
Depression
Poor nutrition
Anemia
Alcohol use
Hypoxia or hypercarbia
Dehydration
Electrolyte abnormalities
Inappropriate medication prescription >Five new medications Benzodiazepines Anticholinergics Antihistamines Antipsychotics

Intensive care unit (ICU) patients, both medical and surgical, are at extremely high risk of delirium. The prevalence of delirium has been reported to be as high as 80% [20]. There is, however, dramatic variability in the incidence of delirium in the ICU. Recently, because of the recognition of the risk of delirium, many ICUs have specific pathways for delirium prevention, which can significantly reduce the occurrence of delirium [21, 22]. ICU care is associated with disruption of sleep–wake cycling, high severity of illness, and use of many drugs that are associated with increased risk of delirium, so it is unsurprising these patients are more vulnerable to developing delirium.

2.4 Presentation of Delirium

Delirium is exceptionally heterogeneous in its presentation. The fact that the course of delirium waxes and wanes makes the diagnosis of delirium clinically challenging has led to a wide variety of diagnostic tools which can be used to diagnose delirium (see "Diagnostic Tools" section below and Chap. 8, Screening Tools for Geriatric Assessment by Specialists).

While there are several ways to define subtypes of delirium, one of the most commonly used strata is by motor activity, known as hyperactive, hypoactive, and mixed subtypes of delirium (see Fig. 2.2) [23]. The primary distinction between these motor subtypes is the presence of agitation versus lethargy in the patient's clinical presentation. Patients with evidence of both hyperactive and hypoactive delirium are described as having mixed delirium.

There are several checklists (see section below) that identify psychomotor symptoms that are associated with

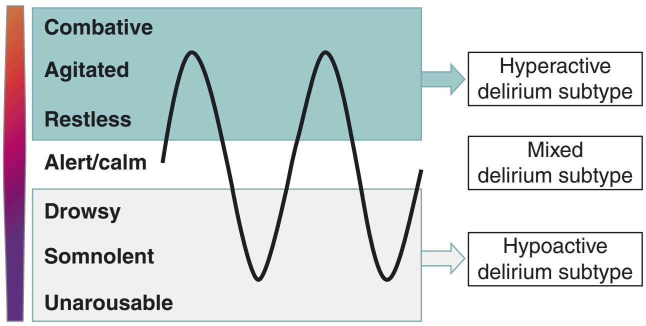

Fig. 2.2 The motor subtypes of delirium. The motor subtypes of delirium include hyperactive (pure overactive state represented in *blue*), hypoactive (pure underactive state represented in *gray*), and mixed (fluctuation between over- and underactive represented by *black line*)

delirium, and when present in combination, increase the specificity of these symptoms to delirium [24]. Hyperactivity in delirium may be associated with increased involuntary movements, restlessness, wandering, increased speed, amount, or volume of speech, inability to sleep, distractibility, combativeness, hallucinations, or tangential thoughts (among others). Hypoactive delirium may present as apathy, decreased activity, decreased speed, amount, or volume of speech, somnolence, or decreased alertness. A mixed subtype presentation occurs when patient symptoms fluctuate between these two categories of agitation and lethargy.

Hypoactive delirium may be under-represented in the epidemiology of delirium because it is difficult to diagnose [25, 26]. A high level of clinical vigilance and suspicion of the diagnosis of delirium is especially necessary to diagnose hypoactive delirium. Hypoactive symptoms may be easy to attribute to other patient health conditions without a high clinical suspicion to monitor for delirium. Further, some studies have demonstrated that postoperative patients with hypoactive delirium have worse prognosis when monitoring 6-month mortality rate [27], although other studies have demonstrated improved outcomes for patients with hypoactive delirium [28].

2.5 Diagnostic Tools for Delirium

There are many diagnostic tools to identify delirium. They can be specifically designed for the ICU patient or other clinical settings, and may focus on certain diagnostic criteria, such as motor subtype. Below are brief descriptions of some commonly used diagnostic tools and comments about specific indications or limitations.

The confusion assessment method (CAM) is the most widely recognized tool to assess delirium and can be completed in less than 5 min [29]. It uses four criteria: (1) acute onset of symptoms with fluctuating course, (2) inattention, (3) disorganized thinking, and (4) altered level of consciousness. The first two criteria must be present with either the third or the fourth criteria. It has high inter-rater reliability with high accuracy compared to psychiatrist assessment for delirium.

The Delirium Rating Scale-Revised-98 (DRS-R98) is a 16-item scale, of which 13 items score for severity of symptoms. It has high inter-rater reliability, sensitivity, and specificity, including use in patients who have concomitant neurologic disease, such as dementia [30]. It is designed for use by any healthcare professional.

The cognitive test for delirium (CTD) is a diagnostic test specifically designed to assess critically ill hospitalized patients, including patients unable to communicate, such as those who are intubated and sedated [31]. It particularly emphasizes nonverbal domains, specifically visual and auditory symptoms. It is also able to reliably distinguish the difference between delirium and other psychiatric disorders.

The Delirium Motor Subtype Scale (DMSS) is used specifically to identify features of hyperactive and hypoactive delirium [24]. It is an 11-point scale any healthcare provider can use to assess patient behaviors, and includes seven hypoactive features and four hyperactive features. Two symptoms must be present in order to classify delirium in a specific subtype.

The CAM for the Intensive Care Unit (CAM-ICU) was developed from the CAM assessment to better diagnose patients who are mechanically ventilated [32]. It uses nonverbal assessments to identify the same criteria of acute onset of symptoms with the fluctuating course, inattention, and disorganized thinking or altered level of consciousness. It has high levels of sensitivity and specificity for delirium in ventilated patients, although the traditional CAM is more effective in patients able to fully participate in the assessment [20].

The intensive care delirium screening checklist is another test for patients in the ICU setting. It is a brief checklist of eight items based on Diagnostic and Statistical Manual (DSM) criteria of delirium [33]. While it also has high sensitivity for delirium in the ICU, it is less specific than the CAM-ICU method. It is designed for use for all healthcare professionals.

The Memorial Delirium Assessment Scale was specifically developed to monitor the development of delirium in ill patients enrolled in clinical trials [34]. It involves a ten-item checklist which was validated in patients with AIDS and metastatic cancer. It is well suited for use in repeated assessments over time for patients being seen longitudinally in trials.

The important issue is that a clinician should be very familiar with one or two of these screening tools and use them in daily practice.

2.6 Medical Evaluation of Delirium

Given the heterogeneous presentation of the clinical syndrome of delirium in combination with the complex intrinsic and iatrogenic precipitating factors, a structured, thorough, and routine approach to evaluation of the patient with delirium is necessary. A hospitalized patient may have presented at admission with delirium or develop it during their hospital course. It is not only important to recognize the clinical syndrome, but also important to identify correctable conditions which contributed to the state of delirium. Acute onset of delirium may have developed secondary to a single provocative factor (such as symptomatic urinary tract infection [UTI], myocardial infarction [MI], multiple medications [polypharmacy], admission to ICU, and others).

The appropriate workup of delirium involves methodical evaluation of the patient to identify treatable causes as well as initiate behavioral interventions. Table 2.2 outlines a comprehensive workup for patients with acute delirium which should supplement bedside examination. While many of these tests should be considered to be routine in an acute clinical change, others should only be considered if clinically indicated.

Table 2.2 Medical evaluation of delirium

	Routinely ordered	Ordered if indicated
Laboratory tests	Complete blood count (infection, anemia) Basic metabolic panel (electrolyte disturbances, acid base status, renal function) Glucose (hypo- or hyperglycemia) Arterial blood gas (hypoxia or hypercarbia) Urine analysis (infection but asymptomatic bacteriuria is not thought to cause delirium and is very common in older patients, especially women	Troponin (myocardial infarction) Thyroid levels (hypo- or hyperthyroidism) Erythrocyte sedimentation rate (ESR) (inflammation) Viral titers or bacterial cultures (infection) Urine or blood drug screen (intoxication) Thiamine and Vitamin B12 (vitamin deficiency) HIV (infection) Sputum culture Blood culture
Imaging	Chest X-ray (infection)	Head CT (dementia, stroke) Brain MRI (dementia, stroke)
Clinical evaluation	Physical examination Medication review (BEERs list) [35] Social history (alcohol or benzo use)	Remove un-needed catheters
Ancillary tests	electrocardiogram (EKG) (myocardial infarction) Pulse oximetry (hypoxia)	electroencephalogram (EEG) (seizures, metabolic disturbance) Lumbar puncture (meningitis)

2.7 Prevention of Delirium

Although recognition and treatment of delirium once the patient develops the syndrome are essential, interventions to prevent delirium occurrence are essential for all patients at risk for delirium. Identification of individuals with multiple risk factors (e.g., frail, elderly, and multiple comorbidities) allows the clinician to target preventive interventions to the at-risk population. Interventions such as making sure the patient has full use of their sensory aids, orientation protocols, early mobilization measures, minimization of sleep disturbance, and avoidance or discontinuation of high-risk medications can all create an environment that will lower the risk of delirium for the at-risk patient [36]. Daily rounds that address these non-pharmacologic interventions utilize a multidisciplinary care team and plan that creates consistent assessment of these issues. Up to 40% of hospitalized patients may have preventable delirium [14, 28]. Both of the current clinical practice guideline statements strongly recommend the implementation of multi-component delirium prevention protocols for patients at risk for delirium [36, 37],

Educational programs concerning delirium in every medical center are essential. These programs should be considered a system-level prevention tool. Education of healthcare providers about recognition, prevention, and treatment of delirium consistently reduces episodes of and duration of delirium, regardless of the specific intervention or protocol [38–40]. Further, educational interventions are cost-effective and associated with no patient harm [41–43].

2.8 Treatment of Delirium

When a patient does develop acute delirium, management of a potential underlying reversible cause of the delirium is essential. Appropriate treatment of identifiable causes will improve the patient's clinical condition. However, risks and benefits of aggressive or interventional therapies should be considered when treating a delirious patient, and weighed in the context of their clinical condition and goals of care. See Table 2.3 for modifiable causes of delirium with a proposed intervention. Behavioral modifications have been described above in the section regarding prevention of delirium. Interventions such as encouraging the use of sensory aids, establishing day–night cycling, and the other interventions described in the previous section are effective in treating delirium in addition to their role in prevention.

Multiple pharmacologic interventions have been explored both as prophylaxis of delirium and as treatment. At this time, pharmacologic prophylaxis of delirium is not recommended. There are very few randomized, controlled trials exploring pharmacologic prophylaxis. Prophylactic use of

Table 2.3 Factors that cause delirium which can be clinically addressed

Modifiable delirium trigger	Clinical intervention
Immobility	Ambulate in hallway three times daily Early physical therapy consultation
Sensory impairments	Glasses accessible at beside Hearing aids accessible at beside
Impaired cognition	Orientation three times daily Family/friends at bedside
Medications	Avoid high risk medications/polypharmacy Daily medication review
Dehydration	Assess and manage volume status Adequate hydration
Pain	Proactively assess and manage pain Use opioid sparing multi-modal pain regimen
Nutrition	Proactively encourage nutrition May require swallowing evaluation
Sleep enhancement	Allow overnight sleep without interruption Reduce nighttime noise
Respiratory status	Assess and manage hypoxia Assess and manage hypercarbia
Infection	Recognize delirium as presentation of infection Work-up infection in delirium evaluation
Iatrogenic causes	Remove unnecessary catheters/lines Avoid dark daytime room

epidural anesthesia, donepezil, and tryptophan administration has not been associated with a significant change in incidence or duration of delirium [44–46]. Prophylactic haloperidol is associated with no difference in the incidence of delirium, but has been associated with a shorter duration of delirium and hospital length of stay in patients who were identified as being high risk for delirium [47]. Prophylactic haloperidol, however, is not recommended as this drug has its own serious side effects. Melatonin has been found to reduce delirium in both medical and surgical hospitalized patients but these data are not robust enough to recommend its routine use [48, 49].

Pharmacologic treatment of delirium should be reserved only for patients who have failed behavioral interventions and are at significant harm to themselves or others. Pharmacologic treatment typically is an antipsychotic, such as haloperidol, but this treatment should not be universal and is not without risk. There is significant heterogeneity in the study designs and interventions observed in studies on the pharmacologic treatment of delirium. Antipsychotics are associated with adverse outcomes such as an increase in mortality and motor side effects, including the neuromalignant syndrome. Nonetheless, haloperidol or other antipsychotics have been used for severe agitated delirium only when behavioral interventions have failed and there is concern for patient safety or that of others [36]. Antipsychotic use in the treatment of delirium may improve the symptoms of agitation but does nothing for underlying delirium pathophysiology. If ever prescribed, the clinician should have a plan for tapering and discontinuing antipsychotics as soon as possible and typically within a few days. Benzodiazepines are contraindicated in the treatment of the delirious patient and can actually exacerbate and prolong an acute episode of delirium [50].

2.9 Outcomes of Delirium

Delirium is closely associated with worse long-term clinical outcomes for patients. Delirium has been associated as an independent predictor of increased morbidity and mortality across multiple patient groups, including postoperative patients (gastrointestinal, cardiac, and orthopedic), ICU patients, and cancer patients.

In a broad variety of surgical patients, delirium is associated with significant increases in 30-day mortality [51, 52]. It has also been associated with increased 6-month mortality in general surgery and thoracic surgery patients [27]. ICU patients similarly have worsened 6-month survival if they suffered from delirium, independent of other conditions [20].

Delirium is also associated with increased morbidity in addition to increased mortality. Delirium is independently associated with increased ICU length of stay, hospital length of stay, and rate of discharge to an institutional facility [27, 51, 52]. These outcomes, especially the loss of independence with institutional discharge, may be of critical importance to patients and families when discussing prognosis and goals of care in the hospitalized patient with delirium.

2.10 Conclusion

Delirium is a common clinical syndrome in the hospitalized patient, with increasing rates in vulnerable populations, such as the frail, patients with multiple comorbidities, and those in the ICU. Delirium is a clinically heterogeneous condition, with psychomotor changes that can range from extreme agitation that endangers patient and provider safety, to subtle lethargy that can be difficult to clinically detect. The most effective prevention and treatment of delirium involve multifactorial and multidisciplinary behavioral modifications and medical optimization of underlying conditions. There is no consensus about uniformly effective pharmacologic prophylaxis or treatment. Delirium is a high risk condition, which is associated with increased morbidity and mortality, and is a critical syndrome for all healthcare providers to recognize.

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3 Preoperative Evaluation

Mark R. Katlic, Susan E. Wozniak, and Jo Ann Coleman

3.1 Introduction

The COVID pandemic notwithstanding, the greatest force affecting health care in our lifetime is the aging of the population. The growth in population is especially evident in the growth of numbers of the "oldest old," that is, those over 85 years. It is rare for a surgeon not to encounter the "oldest old" as part of his or her practice spectrum. This is paralleled by an increase in conditions commonly found in older patients (e.g., atherosclerosis, diabetes, hypertension, degenerative joint disease, age-related macular degeneration and cataracts, and cancer).

Some health-care facilities have shown impressive outcomes for surgery in the geriatric population, outcomes similar to those in the general population. Remarkably, these similar outcomes have even beenseen in complex surgical procedures such as aortic arch replacement [1], pancreaticoduodenectomy [2], gastrectomy [3], hepatectomy [4], and esophagectomy [5, 6]. But even more importantly, there is overwhelming evidence that quality of life can be maintained or improved following surgery [7–10].

However, despite the encouraging nature of these results, age remains an independent risk factor for postoperative morbidity [11, 12] and mortality [13]. Finlayson [14] found increased operative mortality in 70 and 80 year olds undergoing high-risk cancer operations. This result is emulated in a study of 30,900 colorectal resections in the National Surgery Quality Improvement Program (NSQIP) database [15]. Postoperative complications are sometimes higher and postoperative length of stay is often longer than that in younger patients [16, 17]. These results remind us there is continued room for quality improvement, a large part of which entails preoperative care uniquely fitted to the needs of geriatric surgical patients.

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Perioperative evaluation entails multiple components for a detailed comprehensive preoperative evaluation, permits more informed decision-making in recommending a certain surgery, encourages modification of a procedure to an individual patient's needs, and provides critical information regarding a patient's preoperative baseline to the team caring for a patient postoperatively. Thus, it is important to view the patient as an individual, with decisions based on functional rather than chronologic age alone.

Much literature has been published regarding "best" preoperative care for the older patient. Unfortunately no single, perfect, comprehensive validated assessment has been found. The Holy Grail of Geriatric Surgery [18] would be a simple, reliable test to assess perioperative risk in a geriatric patient. As the number of surgeries performed on older adults increases, a greater understanding of the unique needs of individual older surgical candidates will develop. Further, this allows expansion and improvement of well-vetted best practice guidelines to optimize preoperative geriatric care.

3.2 The ACS/AGS Best Practice Guidelines

Recognizing the unique needs of the aging surgical populace, the American College of Surgeons National Surgical Quality Improvement Program (ACS NSQIP) and the American Geriatrics Society (AGS) partnered to construct best practices guidelines focused on perioperative care of the geriatric surgical patient. A 21-member, multidisciplinary included the ACS Geriatric Surgery Task Force, 14 medical centers, and experts from multiple surgical subspecialties such as urology, colorectal surgery, endocrine surgery, advanced laparoscopic surgery, surgical oncology, anesthesiology, and geriatric medicine.

A focused, structured literature review (using PubMed) identified clinical trials, practice guidelines, systemic reviews, and meta-analyses published over the last decade. The expert panel reviewed the publications based on strength of evidence, relevance to geriatric patients, endorsement by

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professional associations, and most recent publications. With the initial search yielding 25,978 citations, a total of 5879 abstracts were screened and ultimately 309 publications chosen as appropriate for the study purposes. The final guidelines summarize evidence-based recommendations for improving preoperative assessment of geriatric patients [19].

Understanding the highlights of a comprehensive perioperative geriatric assessment is essential in providing quality care to the older surgical patient.

3.3 Assessing Cognitive Ability and Capacity to Understand

It is important that a patient understand the risks, benefits, and alternatives to surgery before any procedure. A physician must confirm that a patient is able to delineate in their own words basic understanding of a proposed surgical intervention. Legally based criteria to demonstrate decision-making capacity include: (1) the patient can clearly indicate his or her treatment choice; (2) the patient understands the relevant information communicated by the physician; (3) the patient acknowledges his or her medical condition, treatment options, and the likely outcomes; and (4) the patient can engage in a rational discussion about the treatment options [20].

Screening for mild cognitive impairment preoperatively in a patient without known cognitive impairment may identify patients at risk for postoperative complications. For a patient without a known history of mental decline, it is recommended to obtain a detailed history and perform a cognitive assessment, such as the Mini-Cog [21]. If cognitive impairment is suspected, referral to a geriatrician or primary care provider should be considered for further work up. It is critical to document a patient's preoperative cognitive exam as it is often difficult to assess postoperative cognitive impairment without an accurate preoperative baseline.

As Americans are living longer, the proportion showing signs of cognitive impairment and dementia has dramatically increased, especially in those over age 60 [22]. Preexisting cognitive impairment is not only associated with postoperative delirium [23, 24], but also perioperative mortality risk [25], longer hospital stays, and functional decline [26].

3.4 Screening for Depression

Depression in the elderly is not uncommon with major depression found in approximately 1–3% with 8–16% showing clinically significant depressive symptoms [27]. Patients with depression have been shown to have a greater level of pain and, in turn, require more postoperative analgesia [28]. Risk factors for depression among geriatric patients include bereavement, female sex, disability, sleep disturbance, and a history of depression. Poor health, living alone, and cognitive impairment have been associated with a higher likelihood of depression [29].

A simple screening test for depression is the Patient Health Questionnaire-225 [30]. Asking: (1) "In the last year, have you ever felt sad, blue, depressed or down for most of the time for at least 2 weeks?" (2) "In the last year, have you ever had a time, lasting at least 2 weeks, when you didn't care or enjoy the things you usually you usually do?" If "yes" is answered to either question, then further evaluation is recommended. It is important to note that the PHQ-2 has not been validated in unique circumstances such as patients with severe medical illnesses and impaired communications skills or frail elderly patients.

See chapters on Psychiatry and Tools of Assessment for additional information on screening for depression.

3.5 Screening for Postoperative Delirium Risk Factors

Delirium may be the most common postoperative complication in the older surgical population. The incidence of postoperative delirium cited in literature ranges widely, studies citing from 5.1% to 52.2% [31]. The two strongest predisposing factors for delirium are preexisting cognitive impairment and dementia [32]. Further risk factors that should be considered preoperatively include substance abuse, depression, impaired hearing or vision, polypharmacy, and poor overall functional status.

Postoperative delirium is associated with many complications including greater mortality, decreased functional recovery, longer hospital stay, and higher chance of posthospitalization institutionalization [23, 25, 26, 31, 33, 34]. Some studies conclude, however, that up to 40% of postoperative delirium in older, hospitalized adults is preventable [35, 36]. Hence, it is critical to understand a patient's risk factors for delirium and institute evidence-based interventions [37].

See chapter on Delirium for in depth discussion of delirium.

3.6 Screening for Alcohol or Substance Abuse

Alcohol abuse is fairly common in the elderly population. Blazer et al. found 15.4% of community-dwelling individuals aged >65 years to show signs of alcohol abuse [38].

Preoperative alcohol abuse and dependence are associated with increased rates of postoperative complications such as wound infection, pneumonia, and sepsis [39, 40].

All patients should be screened for alcohol and substance abuse and if a patient answers "yes" to any of the CAGE questions [41], perioperative prophylaxis for withdrawal syndromes should be considered. In non-emergent surgeries, one should highly consider sending motivated patients to substance abuse specialists [42]. Patients with alcohol use disorder may benefit from receiving perioperative vitamin B12, folic acid, thiamine and other vitamin supplemention [19].

3.7 Cardiac and Pulmonary Evaluation

Adverse cardiac outcomes have a higher probability of occurring in older patients [43]. In noncardiac surgery patients Lee et al. found a 2% risk of perioperative cardiac complications [44]. For patients with or at risk of cardiac disease, Devereaux et al. found a 3.9% risk for cardiac complications [45] a rate almost double for high-risk cardiac patients. It is important to risk stratify patients to identify those with an increased chance of cardiac complications to provide appropriate perioperative management by anesthesia and surgeons as well to clearly delineate operative risk to the patient and their family.

The American College of Cardiology and the American Heart Association (ACC/AHA) recommend completing a perioperative cardiac risk assessment on everyone using the ACC/AHA algorithm for noncardiac surgery to help establish perioperative cardiac risk in noncardiac surgery patients (complete version are available at ACC/AHA websites).

Postoperative pulmonary complications are not uncommon and affect postoperative morbidity and mortality in the older patient [46]. In noncardiac surgery patients, postoperative pulmonary complications average 6.8% increasing to 15% in those over age 70 [47]. The *ACS NSQIP Best Practices Guidelines: Prevention of Postoperative Pulmonary Complications* delineates postoperative pulmonary complication risk factors as patient-related and surgery-related factors. Of note, obesity, well-controlled asthma, and diabetes were not considered risk factors.

Strategies to prevent postoperative pulmonary complications include perioperative pulmonary function testing in patients with uncontrolled COPD and asthma, smoking cessation, and perioperative incentive spirometer instruction and usage [48]. In select patients, chest radiography and pulmonary function tests may also be helpful [48, 49]. Chapters on Pulmonary and Critical Care Medicine provide details of assessing the pulmonary status.

3.8 Functional Status, Mobility, and Fall Risk

Consideration of functional status, mobility, and fall risk in a geriatric patient are critical. Functional dependence was the strongest predictor of postoperative 6-month mortality in a prospective review of older patients who underwent major surgery [50]. Impaired mobility in elderly surgical patients has also been associated with increased postoperative delirium [31, 51].

Patients should have their functional status evaluated by assessing their capability to carry out activities of daily living (ADL). A simple screening test includes four questions: (1) "Can you get out of bed or chair by yourself?" (2) "Can you dress and bathe yourself?" (3) "Can you make your own meals?," and (4. "Can you do your own shopping (e.g., for food or at the mall)?" [49]. If a patient answers "no" to any of these questions then further evaluation should be contemplated. An assessment of formal ADLs and instrumental ADLs can also be performed [52]. It is important to document any identified functional limitations and referral to occupational and/or physical therapy [53]. Particular attention should be paid to possible deficits in hearing, vision, or swallowing as these can impact postoperative recovery. Hearing deficits can affect postoperative delirium, falls, and communication. Gait and mobility can easily be tested using the Timed Up and Go Test (TUGT) [54]. Patients having a difficult time rising from a chair or necessitating more than 15 s to finish the test are at a greater risk of falling. Communication with all members of the team caring for the patient is critical along with instituting preventive measures whenever any of these deficits are identified. See chapter on Tools of Assessment for a discussion of tools available to assess functional status.

3.9 Frailty

Frailty is a condition characterized by decreased physiologic reserve and vulnerability to stressors, leaving patients with a higher likelihood of experiencing unfortunate outcomes such as a decrease in mobility. In the worst case scenario, it may be coupled with frequent hospitalizations, need for higher level of care, and often untimely death. Fried and colleagues developed a five-point phenotypic scale for assessing frailty [55]. This was validated by Makary and associates specifically in older surgical patients. Makary et al. demonstrated frailty to independently predict increased postoperative adverse events and an increased chance of discharge to an assisted living facility [56]. We are still learning about how to optimally assess frailty and its clinical impact. The chapter on Frailty provides a thorough discussion of this condition.

3.10 Nutrition Assessment

Rates of malnutrition in elderly communities are surprisingly high. Estimates rate malnutrition for elderly in the community at 5.8%, nursing homes at 13.8%, hospitals at 38.7%, and rehabilitation at 50.5% [57]. Poor nutrition is associated with infectious complications such as surgical site infections, wound dehiscence, and anastomotic leaks [58].

A nutritional status screen should include documentation of height and weight and calculation of body mass index. A patient should be asked about any unintentional weight loss in the last year. Obtaining a baseline serum albumin and prealbumin level may also be considered.

Nutritional risk should be considered if a patient has a serum albumin <3.0 g/dL (without hepatic or renal involvement), BMI <18.5 kg/m2b, or any inadvertent weight loss of 10% to 15% over the past 6 months [59]. Referral to a dietician should be considered for individuals identified at risk for poor nutrition to develop a plan for "preoperative nutritional support." If this is not feasible it may be helpful to prescribe nutritional supplements when preparing for surgery. The European Society for Clinical Nutrition and Metabolism (ESPEN) summarizes recommendations regarding nutritional support [59, 60].

The chapter on Tools of Assessment provides more details on assessing nutrition status.

3.11 Medication Assessment

Elderly patients are at a high risk for incurring side effects from drugs. Older patients are sensitive to psychoactive effects of medications, especially those often used in the perioperative time period. Narcotics and benzodiazepines may be the cause of postoperative delirium. Chronic kidney disease and impaired renal function are also common in the older population. Ensuring renal dosing of medications is essential to prevent adverse drug side effects. Medication doses should be adjusted for renal function based on glomerular filtration rate (GFR) and not on serum creatinine alone.

Polypharmacy is common in the geriatric population as they have a greater burden of illnesses and disease. Polypharmacy is not only associated with adverse drug reactions but also greater risk of cognitive impairment and mortality [61]. When possible, nonessential medications should be discontinued preoperatively and the addition of new medications should be kept to a minimum [62].

It is essential for medication lists to be reviewed, reconciled, and documented including nonprescription pharmaceuticals such as vitamins, topical agents, herbal supplements, or nonsteroidal anti-inflammatory agents [62]. This review can identify medications that should be discontinued or dose-altered prior to surgery. The American Geriatric Society (AGS) Updated Beers Criteria for Potentially Inappropriate Medication Use in Older Adults provides peer reviewed guidelines regarding medications that should be avoided in the older population.

Conversely, it is necessary to continue those medications that are shown to reduce perioperative adverse events such as heart attack and stroke. Following the most current ACC/AHA guidelines for perioperative beta blockers and statins is also essential [63–65].

The chapter on Medication Management provides a detailed discussion of this subject.

3.12 Patient and Family Counseling

Over the last decade many more people, including the elderly, are completing advance directives. Without advance directives, physicians rely on health-care proxies to make end-of-life decisions for patients. Unfortunately, many never discuss their preferences with their next of kin. Studies also show family members, surrogates, and physicians often fail to accurately predict patients' treatment preferences [66, 67].

It is strongly recommended that as part of preoperative planning a surgeon review if the patient has an advanced directive such as a living will or a durable power of attorney for health care. It is also imperative that a surgeon clearly communicate treatment goals, the expected postoperative course, and any potential complications in words that a patient understands. Incorporating the appropriate health, language, and educational literacy (along with any written or audiovisual aids for explanation) is paramount in helping the patient and their family/social support system understand the risk and benefits of the proposed surgery. Having the patient along with his family at the same discussions can often be helpful as it allows everyone to hear the same information [68].

Taking the time to understand a patient's family/caregiver and support network can also be beneficial when considering the patient's discharge disposition. Referral to a social worker or case manager should be made if there is concern for inadequate family or social support.

3.13 Preoperative Testing and Imaging

Preoperative screening tests indicated in the geriatric surgical population include hemoglobin, albumin, and renal function tests [19]. Hemoglobin assessment is important in suspected or known cases of anemia and in surgeries anticipating a large amount of blood loss [69]. Renal function tests are necessary to assess for clearance of any medications (anesthetics, antibiotics, etc.) and as a baseline in patients taking medications that affect renal function such as angiotensin-converting enzyme inhibitors or NSAIDS [70, 71]. Measurement of serum albumin is particularly helpful in patients with multiple chronic conditions, like liver disease and those with malnutrition.

In specific geriatric surgical patients other preoperative laboratory tests that are helpful include white blood cell count, electrolytes, and coagulation tests. White blood cell count is helpful in cases of suspected infection or patients at high risk for leukopenia secondary to illness or drugs. Electrolyte studies (e.g., Na, K, Cl, CO_2) are important not only in patients with renal insufficiency but also in patients taking diuretics, ACE inhibitors, and digoxin. Coagulation studies (e.g., PT/INR/PTT) are needed in patients with history of bleeding disorders or anticoagulants.

Preoperative diagnostic tests should be based on each patient's clinical history and physical exam, type of surgery and comorbidities. Chest x-rays are important in patients >70 years of age with acute or chronic cardiopulmonary disease (e.g., asthma, COPD, and smoking). Electrocardiograms may be indicated in patients with a cardiac history (e.g., previous myocardial infarct, ischemic heart disease, heart failure, and cardiac arrhythmias), renal insufficiency, respiratory disease, or diabetes. In patients scheduled for lung resection or a clinical history of obstructive lung disease, pulmonary function tests can help quantify pulmonary function [47, 72]. Noninvasive stress testing is indicated in patients with increased risk factors who are undergoing intermediate risk or vascular surgeries [73].

3.14 The Complete Meal: Best Practices

The Sinai Center for Geriatric Surgery in Baltimore, MD incorporated all of the ACS NSQIP/AGS Best Practices and have added several others: Charlson Comorbidity Index Score, Adult Fall Risk Assessment, Eastern Cooperative Oncology Group (ECOG) Performance Status, living situation, number stairs a person can climb, hearing screen, oral/dental screen, tobacco use, pinch grip assessment, Core Healthy Days measures, Zarit Caregiver Burden Interview, and a pre-assessment and post-assessment eyeball score. This evaluation, performed by an experienced nurse practitioner on patients aged ≥75 years prior to any elective surgery, requires 20–30 min beyond a routine history and physical examination. It is performed in the preoperative assessment area. All information is entered into a database within our Cerner® electronic health record, accessible to all who care for the patient.

Problems identified preoperatively lead to more compulsive perioperative care. Alerts are placed in the chart for decreased hearing, fall risk, and potential for postoperative delirium. Patients who fail the mini-Cog are targeted for measures to prevent postoperative delirium. The Care Management Department is notified if a patient's caregiver is found to feel severely burdened preoperatively, as that patient may present a discharge disposition problem and is less likely to return directly home. Surgeons are called if their patient is frail—procedures are rarely cancelled but operations may be modified—or if the patient does not demonstrate understanding of the planned procedure.

The financial commitment for this comprehensive program includes the salary and benefits of the nurse practitioner (who also contributes to the academic and educational mission of the Center), a hand grip strength dynamometer (Jamar®, Sammons Preston Rolyan, Bolingbrook, IL), a screening audiometer (Audioscope®, Welch Allyn, Skaneateles Falls, NY), a pinch gauge dynamometer (Jamar®, Sammons Preston Rolyan, Bolingbrook, IL), information technology support to build the electronic database, and printed material to educate referring physicians. Patients potentially could be billed for a low-level evaluation in order to offset some of the expense.

3.15 The Ala Carte Menu: More Practical Considerations

Options exist in a number of areas: the person who performs the evaluation, the location of the evaluation, a more limited dataset of tests, the location of the data, and prospective versus retrospective study [74].

3.15.1 Who Performs the Evaluation?

The Clinical Coordinator of the Center for Geriatric Surgery at Sinai Hospital of Baltimore is a veteran of the Department of Surgery, with a Doctorate of Nursing Practice. However, she has taught others to do our complete evaluation, including residents and other nurse practitioners in the preoperative testing area. The total assessment could readily be performed by a nurse, resident, medical student, physician assistant, or the patient's surgeon.

3.15.2 Location of the Evaluation

The preoperative assessment area is ideal for the geriatric evaluation: many patients are there already for laboratory testing or a routine history and physical examination. However, any clinic or surgeon's office is suitable. The hand grip dynamometer, pinch gauge dynamometer, and screening audiometer are portable (and potentially expendable, see below). The timed-up-and-go, gait speed, mini-Cog, and other tests can be completed anywhere. A hospital or

Department of Surgery might decide to pilot the program in one specialty, one division, or one large surgery group.

3.15.3 Dataset for Screening

Screening that assesses general domains of frailty, cognition, and function/performance status give important details beyond a basic history and physical exam (Table 3.1). The ACS/NSQIP AGS Best Practices guidelines recommend a five-point test of frailty popularized by Friedand proven valuable in a surgical population [55, 56]. Others, however, have employed simple gait speed or the timed-up-and-go test [54]. A basic screen of cognition is the mini-Cog, which involves a three-item recall and clock-drawing; this simple test has been correlated with risk of worse postoperative results [21, 75]. ADL, Instrumental Activities of Daily Living (IADL), and performance status (e.g., Eastern Cooperative Oncology Group score) involve simple questions and assessment. Medication reconciliation and falls risk assessment have become routine in many institutions.

Table 3.1 Comprehensive versus limited dataset for screening

Comprehensive	Limited (one from each domain)
CAGE screen for alcohol abuse	*Cognition:*
Cardiac and pulmonary risk factors	Mini-Cog
Frailty, 5-point phenotype assessment	MMSE
ADL	*Frailty:*
IADL	Stair climbing
TUG	Gait speed
Nutrition screen	TUG
Hearing screen	*Function:*
Medication review	ECOG
Charlson comorbidity index score	ADL
Advanced directive counseling	IADL
Fall risk assessment	
Performance status, ECOG	
Stair-climbing question	
Living situation	
Quality of life/health rating	
Estimated creatinine clearance/GFR	
Postoperative delirium risk factors	
Caregiver burden interview	
Provider "Gestalt" assessment	
Oral/dental screen	
Pincher strength assessment	

Abbreviations: *ADL* activities of daily living, *CAGE* cut-down, annoyed, guilty, eye-opener, *ECOG* Eastern Cooperative Oncology Group Performance Scale, *GFR* glomerular filtration rate, *IADL* instrumental activities of daily living, *MMSE* Mini Mental Status Examination, *TUG* timed up-and-go test

3.15.4 Location of the Data

An electronic health record is optimal for the location of testing results, as it is accessible by all throughout the patient's perioperative course. If the database is constructed with discrete fields, it may be queried subsequently for research or quality improvement purposes. A paper form which follows the patient is also possible, as is a simple addendum to the dictated history and physical examination.

Allowing access to the geriatric preoperative assessment allows not only the surgical management team but also physical therapy, occupational therapy, nursing and social workers to understand more clearly the patient's baseline. Physical and occupational therapy are able to better gauge a patients preoperative activity status as physician admission notes often do not contain important information regarding details covered in a geriatric preoperative assessment. Social workers can often anticipate in advance what additional services may need to be obtained for the patient prior to discharge.

3.16 The Sinai Abbreviated Geriatric Evaluation

Many different geriatric and frailty evaluations exist. A review in 2016 identified 21 different frailty tools alone [76]. Some assessments use preexisting data from the medical record, some test the patient directly, and some use both sources of data. Although good for research purposes, these instruments are impractical for day-to-day use, as they are either too complicated or there is too much to remember or special equipment is required.

The Sinai Abbreviated Geriatric Evaluation (SAGE) (Table 3.2) was constructed to be practical. It can be performed by anyone in almost any setting, requires no special equipment, and takes only minutes to perform. It has been shown to be predictive of outcomes in older adult surgical patients. For example, for every one point decrease in a patient's SAGE score, that patient has a 1.5 odds ratio for a complication and a 2.0 odds ratio for postoperative delirium. SAGE has also been validated against other preoperative risk screening tools such as Fried's five-point frailty phenotype, the Charlson Comorbidity Index, and the American Society of Anesthesiologists Physical Status Class [77].

SAGE has been built into different electronic medical record systems and is in use in hospitals and clinics of various sizes. It has the advantage of actually testing the patient rather than relying on a list of comorbidities or laboratory findings. It is one alternative to more complex assessments.

Table 3.2 The Sinai Abbreviated Geriatric Evaluation (SAGE): A quick and easy screening tool for geriatric patients

Component	Domain	Description	Modified scoring[a]
Modified Mini-Cog™	Cognition	Three-minute screening tool for cognitive impairment in older adults	Recall 0 word, any clock: 0 point Recall 1–2 words, abnormal clock: 0 point Recall 1–2 words, normal clock: 1 point Recall 3 words, any clock: 1 point
Gait speed	Frailty	Patient timed walking 15 ft at normal speed (average of three trials)	Normal pace (average ≤ 7 s): 1 point Abnormal pace (average > 7 s): 0 point
Activities of daily living	Function	Four questions: "Can you get out of bed or chair yourself?" "Can you dress and bathe yourself?" "Can you make your own meals?" "Can you do your own shopping?"	Any "No" answer: 0 point Four "Yes" answers: 1 point

For the Mini-Cog™, patients were asked to remember "sunrise, banana, chair," then handed a paper with a blank circle in order to place all numbers on the clock and the hands at "10 min until 2 o'clock," then asked to repeat the three words. Patients were then guided, for the *gait speed*, to a point in the hallway 15 ft from the examiner and asked to walk to her, being timed with a stopwatch. Patients were asked the four activities of daily living (*ADL*) questions. Scores from 0 to 3 were recorded as indicated in the table

[a]The SAGE score is the sum of the scores of the three components and ranges from 0 (highest risk) to 3 (lowest risk)

3.17 ACS Geriatric Surgery Verification (GSV) Program

The Geriatric Surgery Verification (GSV) Program, a quality program of the ACS funded by a grant from the John A. Hartford Foundation, released/published standards in July 2019 along with the verification program [78]. This program reflects the design of the current ACS quality programs to promote safe and quality surgical care. The ACS *Optimal Resources for Geriatric Surgery 2019 Standards* can be found at www.facs.org/geriatrics.

For a hospital to be recognized as a center of excellence in the care of the older surgical patient the established GSV standards must be met. The standards relate to any patient 75 years and older having any elective surgery that requires an inpatient stay. Standards are modified for the nonelective older surgical patient. It is the hope by implementing these evidence-based, rigorous standards, hospitals will create patient-centered programs to enhance care for older adult surgical patients.

A number of standards relate to the preoperative assessment of the older surgical patient, including shared decision-making and assessment of geriatric-specific vulnerabilities. For example, Standard 5—Patient Care: Expectations and Protocols requires goals of care discussions and geriatric screens to identify potential areas of vulnerability (Table 3.3). The goals of care discussion should include overall health goals, treatment goals specific to the current condition, and anticipated impact of surgery and nonsurgical treatments on symptoms, function, burden of care, living situation, and survival [79–81]. Optimally, some of these should be bracketed by quotes in the patient's own words, similar to a chief complaint in a history and physical document. There is no specific set of screening tools set forth by the ACS but the use of validated instruments is recommended.

Table 3.3 Geriatric vulnerability screens, Geriatric Surgery Verification Program (GSV)

Age ≥ 85 years
Impaired cognition
Delirium risk
Impaired functional status
Impaired mobility
Malnutrition
Difficulty swallowing
Need for palliative care assessment

If a positive geriatric vulnerability screen is identified in any category, the patient will be designated as "high risk" and requires a documented management plan directed at positive findings from the screens. The plans must be guided by established protocols or an evaluation by other healthcare providers commensurate with individual patient needs [82].

In elective settings, management plans for positive screens must be implemented preoperatively. In nonelective settings, management plans for positive screens must be addressed within the 48-h postoperative window or as soon as clinically appropriate.

In the elective setting, any patient identified as high risk based on the geriatric vulnerability screens must be evaluated with interdisciplinary input after the implementation of focused management plans and before surgery to reassess the indications, risks, and benefits of the proposed operation [83, 84].

It is hoped that be performing these geriatric vulnerability screens preoperatively, a more holistic assessment of the older surgical patient will provide information not gathered from a routine medical history and physical examination. This information helps to better inform the surgical team as well as gives an opportunity for the older patient to understand their risks and benefits of surgery or the possible need for prehabilitation in a particular area [85].

3.18 Conclusion

The population is aging and the conditions that require surgery increase with increasing age. We therefore will be encountering more older adults who require surgery. The older preoperative patient benefits from an assessment that includes more than a routine physical examination and electrocardiogram.Such an assessment includes domains likely to affect the elderly: cognition, functionality, frailty, polypharmacy, nutrition, and social support. This fosters decisions based on functional age rather than chronologic age and on each patient as a unique individual.

One such assessment is that promulgated by the ACS NSQIP/AGS Best Practices Guideline. If this comprehensive evaluation is considered impractical for an institution or surgeon's office, a limited dataset of tests will still be valuable. Any opportunity to improve results in the growing population of older surgical patients should not be missed.

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4 Psychiatric Disorders in Older Adults

Kelly L. Dunn and Robert Roca

4.1 Introduction

The older patient with neuropsychiatric syndromes poses special challenges to specialists asked to provide consultation services or ongoing treatment. These syndromes complicate obtaining a clear and accurate history, may make it more difficult to perform a physical examination, contribute to noncompliance with treatment recommendations, and may directly compromise treatment outcomes. Many of these illnesses are chronic and have remitting and relapsing courses throughout the life span. Others tend to emerge as patients grow older (e.g., Alzheimer's disease) and may complicate pre-existing psychiatric illnesses. In this chapter, the presentation and treatment of five common syndromes (depression, anxiety, delirium, dementia, and psychosis) are discussed. Also, an approach to determining whether a patient has the capacity to make medical decisions—a question that arises frequently in the care of the mentally ill elderly—is presented.

4.2 Depressive Syndromes

4.2.1 Vignette

An 82-year-old widow was brought to her endocrinologist, the only physician she sees regularly, by her daughter because of a change in behavior. Mrs. S's husband of 52 years had recently died at home after a 10-year battle with prostate cancer. Since his death, she had been withdrawn, stopped attending weekly religious services, and abandoned her daily walking routine. She seemed less attentive to household chores and was frequently found "just sitting around" when her daughter stopped by for a visit. She wasn't eating adequately and had lost about 20 pounds. Prior to her decline, the patient had been in good health and took only levothyroxine and aspirin regularly. On examination, the patient was thin, neatly dressed, and subdued. She was slow in her movements and responses. She answered questions softly and simply and frequently returned to the subject of her husband's death. In response to questions about weight loss, she stated that she had no appetite, found it difficult to prepare meals for just herself, and was experiencing early satiety and some difficulties swallowing. She revealed a belief that she had developed cancer and that this was the source of her decline. She insisted on being referred to a gastroenterologist. The physician agreed to make the referral but also expressed concern to the patient and her daughter that she seemed to be struggling with a significant depressive disorder as well as grief related to the loss of her husband. While waiting for an appointment with the gastroenterologist, she agreed to start an antidepressant, mirtazapine 15 mg at bedtime. After 2 weeks, the mirtazapine was increased to 30 mg. By the time she was evaluated by the endocrinologists, many of her symptoms had begun to resolve and she had regained 10 pounds. No further workup was suggested. She did begin to attend a grief support group offered by Hospice and returned to her other routine activities.

Depressive syndromes in the elderly are heterogeneous and can be difficult to identify and treat. According to the DSM-5, a major depressive episode is diagnosed when either lack of interest or pleasure or depressed mood is present along with four or more of the following symptoms: insomnia or hypersomnia, psychomotor agitation or retardation, fatigue or loss of energy, significant weight loss, diminished ability to concentrate or make decisions, recurrent thoughts of death or suicidal ideation, and feelings of worthlessness or excessive or inappropriate guilt. These symptoms must be present for at least 2 weeks [1]. It is common for older patients to express their distress using somatic terms such as "sick" or "blah" rather than psychological terms such as

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"depressed." Compared to younger patients, older patients are more likely to have psychomotor agitation or retardation [2] and to present with depression complicated by delusions [3]. When present delusions tend to be nihilistic, somatic, or revolve around themes of persecution or betrayal.

Because the older patient may be referred to another specialist for the evaluation of a related somatic complaint or difficulty, it is important to be alert to the possibility of an underlying mood disorder. Formal screening with a standardized instrument such as the Patient Health Questionnaire (PHQ-9) [4] or the Geriatric Depression Scale (GDS) [5] may be helpful. It is also vital to supplement the history provided by the patient with information from family members or care providers. Chapter 8—Tools for Geriatric Assessment also provides information on simple screening instruments.

When depression symptoms are present in elderly patients, it is important to proceed with a thoughtful medical evaluation, even if there is a high index of suspicion of a mood disorder. Standard laboratory assessments should include a thyroid panel, a basic chemistry panel, and CBC with differential. Because symptoms of vitamin deficiency can mimic or co-occur with depression, levels of vitamin B12, vitamin D, and folate should be measured. Finally, an EKG should be obtained to rule out any contributing arrhythmia and to identify conduction system abnormalities that might affect drug selection.

Treatment of depression in the elderly should be multifaceted and comprehensive. Antidepressant medications are often indicated. The "start low, go slow" principle applies in initial dosing decisions, but older adults often require dosages comparable to those needed by younger patients. Antidepressant medications include selective serotonin reuptake inhibitors, serotonin-norepinephrine reuptake inhibitors, tricyclic compounds, monoamine oxidase inhibitors, and other agents (e.g., bupropion and trazodone); these agents differ in side effects but none has been shown to be superior to any other. Patients may require a mood stabilizer (e.g., lithium and valproate) if there has been a diagnosis of bipolar disorder or an antipsychotic (e.g., olanzapine, quetiapine, and aripiprazole) if delusions or hallucinations are present. In general, these medications should not be discontinued abruptly as this may precipitate withdrawal symptoms or the re-emergence of the symptoms for which the medications were being prescribed. A psychiatrist should be consulted if the clinician is unfamiliar with the use of psychoactive drugs, especially, because of their side effect profile, when prescribing monoamine oxidase inhibitors, mood stabilizers, and antipsychotics.

Psychotherapy is nearly always of benefit for patients willing to engage in it. In some instances, it may be the only acceptable treatment option available for patients who are unwilling to take or unable to tolerate medications. There are many kinds of psychotherapy (e.g., family therapy, cognitive behavioral therapy (CBT), individual and group dynamic therapy), and there is growing knowledge documenting the effectiveness of different kinds of psychotherapy for different conditions.

Faith-based interventions may be effective for religious patients [6]. Finally, electroconvulsive therapy (ECT) and transcranial magnetic stimulation may be appropriate treatment options, but are not always available and in any case require consultation with a mental health specialist. ECT is a very effective treatment for refractory depressive conditions.

The differential diagnosis of depression includes a number of psychiatric disorders. Depression tends to be a recurrent, relapsing, and remitting condition. Some individuals never achieve complete remission of symptoms and struggle with chronic depression; formerly called "dysthymia," this is termed "persistent depressive disorder" in DSM-5. Individuals with a history of cyclic mood swings marked by depression, irritability, and/or mania may have bipolar disorder; distinguishing recurrent major depression from bipolar depression is important because treatment is different. Finally, grief reactions are common in older adults in response to losses that grow more common with aging, for example, bereavement, loss of independence, loss of roles and productivity, loss of health. These reactions frequently include such symptoms as sadness, anxiety, social withdrawal, difficulty making decisions, sleep disturbance, and loss of appetite. While the presence of such symptoms for a period of time after loss can be normal, the persistence of these symptoms, particularly if associated with suicidal ideation or irrational self-reproach, may signal an emerging major depressive disorder for which specific treatment will be necessary.

Major depression may accompany any medical disorder and may complicate the clinical presentation as well as treatment of the medical disorder. Cardiovascular disease [7], endocrinopathies [8], neurologic disorders (e.g., Parkinson's disease [9]), cerebrovascular disease [10], and the degenerative major neurocognitive disorders (e.g., Alzheimer's disease) are commonly accompanied by depressive syndromes. In some instances, a depressive syndrome may herald a new-onset neurologic disorder [11]. Regardless of the comorbidity, a depressive syndrome should always be identified and treated and should never be dismissed as simply symptomatic of the underlying systemic process.

4.3 Anxiety Disorders

4.3.1 Vignette

A 78-year-old widow was brought to her cardiologist by her son because of complaints of chest pain and shortness of *breath. She had been a resident of a local assisted living facility for the past 4 years. The assisted living facility staff was concerned about her increasingly frequent calls for assistance because of chest pain and shortness of breath, and her son indicated that he was receiving the same kinds of calls several times per day. She had been sent to a local hospital emergency department three times in the last 30 days, and the workups had revealed no acute cardiac or pulmonary findings. She had a long history of tobacco use and continued to smoke one pack of cigarettes daily. She had previously been diagnosed with congestive heart failure and COPD. Twelve months ago the patient developed atrial fibrillation and suffered an embolic stroke. She was subsequently hospitalized and then transferred to a rehabilitation facility. A review of her records indicated that she had been prescribed diazepam 5 mg twice daily for many years and that this was not prescribed during her hospitalization or subsequently. On examination, she was neatly dressed and had a slow and tentative gait with a walker. She was irritable, argumentative, and somatically focused. Her respirations were 22/min and she had an irregular pulse of 100/min. She abruptly terminated the examination, insisting that she needed to urinate. The cardiologist decreased the dose of her diuretic and rescheduled it to morning administration. Concern was expressed about a possible life-long anxiety disorder that should be treated, but preferably not with a benzodiazepine, given her advanced age and unsteady gait. The patient agreed to a trial of citalopram 5 mg daily. After 1 month, the dose was increased to 10 mg daily. After 3 months, the patient was much less irritable and demanding, the frequency of her calls to the staff for assistance had dropped to three times a week, and she had no further trips to the emergency department. Her use of tobacco persisted, but dropped to four cigarettes a day, primarily because she was now engaged in structured activities at the assisted living facility.*

Anxiety disorders are common among elderly patients, both as primary and as co-morbid conditions. As with depressive disorders, older patients may have difficulty identifying their symptoms as anxiety and may instead use somatic or nonspecific terms. Anxiety disorders tend to be chronic conditions, waxing and waning in severity in response to life circumstances and stressors. They may not be diagnosed until late life as new stresses and losses ensue.

Anxiety disorders should be suspected when a patient presents with difficult to diagnosis and treat symptoms. DSM-5 distinguishes several specific types of anxiety disorders. Generalized anxiety disorder is characterized by excessive worry, often accompanied by tension, irritability, sleep disruption, vague gastrointestinal symptoms, fatigue, and impaired concentration. It is frequently the somatic symptoms—not complaints of anxiety—that precipitate the visit to the doctor or other health professional. Consequently, patients with generalized anxiety disorder are frequently prescribed muscle relaxants, benzodiazepines, or other hypnotics, all of which may be poorly tolerated, increasing the risk of falls, confusion, and sedation. It is common for patients with anxiety disorders to have been prescribed benzodiazepines for decades without interruption until some medical crisis results in their discontinuation, precipitating an increase in anxiety symptoms as well as symptoms of benzodiazepine withdrawal. A careful history with corroboration by family may be needed to uncover the cause of worsening anxiety symptoms in scenarios such as this.

Other anxiety disorders are less common, and most begin earlier in life. Panic disorder typically is less severe—and panic attacks less frequent—as people age, but older patients may present with episodes of severe anxiety accompanied by multiple somatic complaints, including autonomic, cardiac, pulmonary, and gastrointestinal symptoms. A senior with obsessive-compulsive disorder (OCD) may present to the physician because of physical symptoms associated with specific compulsions (e.g., dermatitis due to excessive hand washing). OCD usually becomes manifest in young adulthood but may have its onset in late life, sometimes secondary to a primary neurological disorder (e.g., basal ganglia lesion) [12]. Hoarding tends to be grouped with OCD, although persons who hoard differ from those with typical OCD in that they are not distressed by their behaviors; it is usually families or neighbors who are concerned and intervene. New-onset hoarding behavior late in life may signal the onset of a progressive dementing syndrome [13]. Posttraumatic stress disorder (PTSD) is a chronic condition precipitated by one or several identifiable traumatic events. While it generally begins earlier in life and tends to grow less intense with age, PTSD may produce psychosocial disability that persists into late life. Also PTSD may develop in a senior after a profoundly traumatic event such as a severe physical trauma, including major surgery, or criminal violation such as a robbery. Specific phobias (e.g., fear of heights, animals, closed-in spaces, etc.) generally begin earlier in life and may persist into late life. One particular fear—fear of falling—tends to begin in late life [14]. It typically presents after medical events, such as a stroke or a series of falls. It may cause patients to become functionally homebound and interfere with their ability to comply with advice from their physician to pursue physical therapy, exercise, or undergo recommended evaluation.

In considering the diagnosis of an anxiety disorder in an elderly patient, it is vital to ask about prior anxiety symptoms to establish whether there is, in fact, a long-standing anxiety disorder. Anxiety symptoms truly appearing for the first time in late life should prompt a thorough medical evaluation given the possibility that a primary medical condition may be a contributing factor. New-onset anxiety with shortness of breath or chest pain may be due to pulmonary emboli or coronary artery disease. New-onset anxiety with insomnia, weight loss, and diarrhea may be secondary to thyroid disease. Acute onset of obsessive thinking or compulsive behavior may be symptomatic of acute basal ganglia disease or a new-onset progressive neurologic disease.

Treatment should be multifaceted and comprehensive. Psychotherapy, particularly cognitive behavioral therapy, is effective in older adults [15]. Simple cognitive interventions (e.g., reassuring a patient with panic attacks that the panic symptoms will remit on their own after a few minutes) can be very powerful. Pharmacotherapy is often initiated, although the use of medications to treat anxiety disorders in the elderly has not been studied extensively. Benzodiazepines are frequently prescribed, and in fact, many patients have taken them for many years without apparent harm. However, benzodiazepines have serious side effects, including cognitive impairment and falls, and should be used infrequently and then with the help of a mental health professional, if possible. Selective serotonin reuptake inhibitor (SSRI) are the first-line pharmacological intervention, although they are not immediately effective and are not without risk. It is best to begin with small doses and increase the dosage slowly to minimize the risk of an early paradoxical exacerbation of anxiety symptoms.

Anxiety disorders often co-exist with other psychiatric disorders. Nearly one-half of older patients with a major depressive disorder have a concurrent anxiety disorder [16–18]. One-quarter of those patients with anxiety disorders also have a co-morbid major depressive disorder [16]. This phenomenon has clinical implications as patients with co-morbid depression and anxiety are more impaired, have a higher risk of suicide [19], take longer to get better [20, 21], and have higher rates of relapse [22]. It is also important to note the relationship between anxiety and dementia. Late onset anxiety may herald the onset of a major neurocognitive disorder, particularly among persons who are aware of their declining cognitive function [23].

4.4 Delirium

4.4.1 Vignette

A 72-year-old businessman suffered a myocardial infarction while at work and underwent an uneventful emergency 4-vessel bypass procedure. Seventy-two hours postoperatively, he suddenly became confused, agitated, and uncooperative. He removed his IV access. Nursing staff placed wrist restraints to prevent him from removing his urinary catheter. He refused all oral medications, including prn haloperidol. Laboratory studies were ordered and were normal except for a thyroid stimulating hormone (TSH) of 10 ulU/ml, hematocrit level of 30%, a white blood cell count of 12,000 K/cumm, and a urinalysis with 3+ bacteria, moderate leukocyte esterase and some red blood cells. There was no history of a preexisting cognitive disorder according to the medical records. His wife confirmed this, insisting that he had no symptoms of memory impairment prior to surgery and successfully managed his own marketing company. Although he denied regular alcohol use upon hospital admission, his wife acknowledged that he enjoyed his daily "cocktails" and consumed as many as four mixed drinks each evening. A presumptive diagnosis of alcohol withdrawal delirium was made. Treatment with lorazepam was ordered, and the agitation, restlessness, and combativeness began to respond almost immediately. Over the next few days, lorazepam was tapered and discontinued uneventfully. He was able to participate in physical therapy, and his cognition returned to baseline. The TSH remained elevated at 10 ulU/ml so thyroid replacement therapy was initiated. He was discharged home to his family, with referrals to AA and a strong recommendation that he refrain from drinking alcohol in any quantity.

Delirium is a very important syndrome that every clinician caring for older patients must master. It is discussed briefly here for convenience and is also discussed at length in the Delirium chapter. Delirium is a syndrome characterized by the sudden onset of disturbances in attention, awareness, and cognition usually caused by an acute medical condition, substance intoxication or withdrawal, exposure to toxins, some medications including over the counter agents or topical ophthalmologic agents or combinations of these factors. Psychotic symptoms (e.g., hallucinations, delusions, misperception of actual stimuli) and psychomotor abnormalities (e.g., agitation/hyperactivity or slowing/hypoactivity) are common. Disruptions of the sleep–wake cycle and emotional disturbances (e.g., apathy, emotional labiality, irritability, rumination, fear, and euphoria) may also occur.

Risk factors for delirium include advanced age (>75 years of age), baseline cognitive impairment, prior history of delirium, vision and hearing impairment, history of cerebrovascular disease, severe co-morbid illness, and substance abuse [24]. The rate of identification of delirium is only 30% [24]. Having a high index of suspicion is necessary in high risk populations, particularly the elderly, in whom delirium is often of the easily overlooked hypoactive type [24]. Delirium is a clinical diagnosis based on history and examination. Given the difficulty in detecting delirium, the incidence in various care settings is underestimated. Delirium is present in at least 8–17% of older patients presenting to hospital emergency departments and 40% of nursing home residents transferred to an emergency department for evaluation [25]. Studies have documented prevalence rates of 18–35% in general medical settings, 25% on geriatric inpatient units, 50% in intensive care units (ICUs), and up to 50% in the surgical, cardiac, and orthopedic care settings [25].

The complications of delirium are significant and potentially life-threatening. Delirium in the ICU is associated with an extended length of stay, the extended use of mechanical ventilation, and a two to fourfold increase in mortality [25]. The risk of death in the first 6 months following a diagnosis of delirium in the emergency room increases by 70% [25, 26]. Patients who develop delirium on a general medical floor or a geriatric unit have a 1.5 fold [25] increased risk of death in the year following the index hospitalization. Delirium present at the time of admission to a postacute care setting is associated with a fivefold increase in mortality at 6 months [27]. Postoperative delirium and delirium in the ICU are also associated with persistent cognitive impairment 12 months after hospital discharge [25, 28].

It is common for the older patient to present with delirium as the only sign of an undiagnosed underlying medical or acute surgical condition. This is particularly true for patients who are unable to give a reliable history or articulate specific complaints, such as persons with a pre-existing cognitive disorder. If caregivers report an acute mental status change, delirium should be presumed until proven otherwise. The medical workup of acute mental status changes should begin with a thorough medical history and physical examination. Basic blood work (e.g., complete blood count, comprehensive chemistry panel), urinalysis, and an electrocardiogram should be obtained. In addition, thyroid function tests, vitamin B12 and vitamin D levels, ammonia level, and screens for alcohol and drugs of abuse should be considered. Without a history of falls or a change in the neurologic exam, neuroimaging is not recommended as part of the routine diagnostic workup; neuroimaging produces new findings in fewer than 2% of patients with previously diagnosed dementia or another determined medical cause of the delirium [29], and neuroimaging findings alter treatment interventions in fewer than 10% of patients [30]. An electroencephalogram typically demonstrates generalizing slowing in delirium but could have diagnostic findings suggestive of seizure activity [31, 32], including nonconvulsive status epilepticus, and thus may be of value when nonconvulsive seizure activity is a diagnostic consideration.

The etiology of delirium is typically multifactorial, and the standard treatment approach is to begin with identifying the underlying cause(s). Infections (symptomatic urinary tract infection [caution here is needed as asymptomatic bacteria is very common among seniors, especially women, and not a cause of delirium], pneumonia, or sepsis) commonly present as or with an associated delirium. Metabolic abnormalities such as alterations in sodium, calcium, and magnesium can produce acute mental status changes. Respiratory conditions resulting in alterations in oxygenation can affect cognition acutely. Thyroid disease can also produce acute cognitive changes. Medications are estimated to be implicated in 40% of cases of delirium [33, 34], presumably through disruption of cholinergic neurotransmission resulting from the anticholinergic effects of many drugs. The Beers Criteria [35] identifies medications most frequently associated with delirium. (See also the Chap. 5.) Also not to be overlooked is the possibility of intoxication and/or withdrawal from such substances as alcohol, narcotic analgesics, and benzodiazepines.

Treatment of acute delirium is multifaceted. In addition to treating the underlying medical cause(s) (including painful conditions) and removing any exacerbating medications, nonpharmacologic interventions are essential and include strategies of re-orientation, limiting overstimulation, and ameliorating sensory deficits by providing eyeglasses and hearing aids. The presence of reassuring family and staff is essential. Although commonly used, psychotropic medications such as antipsychotics should only be considered after nonpharmacologic interventions have been implemented. Finally, the use of physical restraints should be avoided as they intensify delirium. Most importantly, several controlled studies have demonstrated that the proactive intervention by the treatment team can both decrease the incidence of delirium [36–40] and improve the rate of recognition of delirium when it occurs [41–43]. These interdisciplinary and environmental strategies are discussed in Chap. 2.

4.5 Dementia

4.5.1 Vignette

A 75-year-old married man was hospitalized emergently following a fall at home resulting in a fracture of the right femur. He and his wife agreed to surgical repair, which proceeded without complication. Thirty-six hours postoperatively, the orthopedic surgeon received phone calls from hospital nursing staff reporting that the patient was very lethargic. Laboratory studies were ordered and were unremarkable except for slightly decreased hemoglobin and hematocrit levels. He was receiving only acetaminophen for pain control. When examined by the surgeon, he was awake but confused, restless, agitated, and reaching for objects that were not present. A small dose of oral haloperidol was administered, and a neurology consultation was ordered. The neurologist found the patient awake and alert, but oriented only to his name and the name of hospital. He had mild cogwheel rigidity of the upper extremities but no tremor or psychomotor slowing. The patient denied distress and had no recollection of confusion or hallucinations. In speaking with his wife, the neurologist obtained a history of subtle but progressive memory loss over the past 3 years. Over that time he had begun awakening his wife at night, reporting nightmares as well as anxiety about "seeing people" who were not present; he eventually would accept redirection and reassurance and return to sleep. His wife also recounted a history of kicking and punching behaviors during sleep that had recently *become so violent that she frequently slept in the guest room for her own safety. The neurologist made a diagnosis of acute delirium but also suspected an underlying dementia syndrome due to Lewy Body disease. He discontinued haloperidol and replaced it with quetiapine 12.5 mg QHS. The patient continued to have occasional episodes of increased confusion and brief visual hallucinations, but the episodes of profound lethargy ceased. He was able to participate in physical therapy and was discharged home. Over the course of the next year, he experienced the recurrence of distressing visual hallucinations each time quetiapine was discontinued, so the decision was made to continue quetiapine at a low dose. Over the next several years, he showed progressive short-term memory loss and increasingly prominent Parkinsonian signs (shuffling gait, resting tremor, cogwheel rigidity). Lewy Body disease was confirmed at autopsy 6 years after his initial hospitalization.*

Dementia is a clinical syndrome caused by a diverse array of diseases and marked by declining cognitive ability of sufficient severity to produce significant functional impairment. The most common underlying pathologic entities are Alzheimer's disease (AD), Lewy Body disease (LBD), cerebrovascular disease, and frontotemporal lobar degeneration, but a wide range of other diseases may be implicated. Because this syndrome is present in as many as 30% of persons over age 85, its prevalence is growing rapidly as the population ages [1].

In the most recent version of the Diagnostic Manual of Mental Disorders (DSM-5) [1], the term dementia has been supplanted by the term "Major Neurocognitive Disorder (MND)." For most purposes, these terms can be regarded as synonymous, although there are subtle differences; for example, MND can be diagnosed in a person with significant impairment in only one cognitive domain, whereas the term dementia has been reserved for persons with impairments in several domains. One of the main purposes of this change was to facilitate the distinction between MND and "Mild Neurocognitive Disorder," a long-recognized condition in which the impairments in cognitive functioning are measurably less severe than in MND and do not preclude independent functioning.

The cardinal sign of dementia is the development of functionally significant impairment in the ability to think, reason, and remember. Impairments in learning and short-term memory are prominent in dementia syndromes due to AD and LBD, but in conditions such as frontotemporal lobar degeneration, the most conspicuous early signs may be changes in personality and social behavior (e.g., use of profanity; inappropriate sexual behavior). Other affected cognitive domains include executive functioning (e.g., planning, prioritizing), complex attention (e.g., attending to more than one task at a time), language (e.g., ability to find words), social cognition (e.g., ability to recognize emotional cues in social situations), and perceptual-motor functioning (e.g., difficulty with way-finding). In addition to cognitive impairment, most persons with dementia manifest behavioral and psychological signs and symptoms over the course of their illness, and it is often these clinical features of dementia that are most distressing to patients and to their caregivers. These include delusions, hallucinations, depression, apathy, and various kinds of agitation and aggression. While dementia symptoms often develop gradually and progress slowly, particularly in AD and LBD, they may also present or worsen suddenly as a result of an acute medical (e.g., pneumonia) or neurological (e.g., stroke) event or an adverse drug effect (e.g., dopaminergic agents for Parkinson disease; anticholinergic agents for urinary incontinence). In such cases, patients usually also have a superimposed delirium (see below).

Patients and their families often present to physicians with concerns about forgetfulness. In many cases, cognitive impairment is readily apparent and there is unequivocal evidence of functional disability. In such instances, the first task is to determine whether the observed syndrome is dementia alone, delirium alone, or delirium superimposed upon dementia (as in this vignette). While delirium and dementia share many clinical features in common, the core deficits in uncomplicated delirium are disturbances in attention and awareness evidenced by drowsiness (e.g., the delirium associated with renal failure) or by hypervigilance and distractibility (e.g., delirium associated with alcohol withdrawal). It develops suddenly as a result of an acute medical event or adverse drug effect, and it resolves gradually but variably in response to treatment of the underlying condition. In uncomplicated cases, recovery is complete. In the presence of delirium, it is impossible to make a new determination that a dementia syndrome is also present; this must await the resolution of the delirium-defining disturbance in attention. As a practical matter, delirium and dementia frequently co-exist, particularly in persons with acute medical illnesses, since dementing illnesses make patients more vulnerable to delirium in the presence of potentially deliriogenic conditions such as in this vignette; thus, a delirious episode may be the occasion on which an underlying dementia is first suspected.

Once is it clear that a dementia syndrome is present, the next task—if not previously done—is to identify the likely etiology. The most common causes are AD, LBD, and cerebrovascular disease, either alone or in combination with AD and LBD. AD or LBD is usually present in cases with gradual onset, slow progression, and prominent initial memory impairment. Genetic testing (e.g., subtyping APO-E gene) and brain amyloid scanning may help identify persons with AD but currently are not recommended for routine use. There is no specific laboratory test for LBD, although visual hallucinations and Parkinsonian motor symptoms are clinical features strongly suggestive of LBD. Cerebrovascular disease in the form of major stroke or microvascular changes is readily apparent on brain imaging. Hematology and blood chemistry studies are indicated to screen for evidence of other contributory general medical conditions (e.g., renal failure, thyroid disease, B-12 deficiency). Patients with dementia, without delirium, whose cognitive impairment is documented to have occurred over a year or so typically do not benefit from an evaluation looking for a reversible cause of their condition. Many persons presenting with complaints of memory loss do not have a major neurocognitive disorder. Some of these patients meet the criteria for a condition termed "mild neurocognitive disorder" (mild NCD) [1]. This is characterized by subjective complaints about cognition (e.g., need to make lists; difficulty multi-tasking) accompanied by objective evidence of subpar performance (i.e., between 1 and 2 SD below the mean or between the 16th and 3rd percentiles with respect to age- and education-adjusted norms) in the absence of actual functional impairment. It may be difficult in routine practice to distinguish mild NCD from worry about age-related changes in subjective performance exacerbated by depression or anxiety disorders, and it may be advisable to refer these patients for assessment by a neurologist, psychiatrist, geriatrician, or neuropsychologist for formal neuropsychological testing.

The treatment of dementia syndrome depends on the underlying cause. Unfortunately, *there are no disease-altering treatments for the most common causes of dementia*. The only FDA-approved drug treatments for AD are drugs that slow the enzymatic degradation of the neurotransmitter acetylcholine (e.g., cholinesterase inhibitors such as donepezil) and memantine, a drug that is believed to mitigate glutamate-mediated cellular excitotoxicity. None of these is believed to treat the underlying pathophysiology or to halt disease progression, although they may temporarily reduce impairment and ameliorate caregiver burden. The use of these drugs, therefore, should occur only after a thoughtful discussion with the patient and family considering these issues and the drug side effects. If used, they should be continued if, and only if, improvement in 1–3 months is seen and side effects are tolerable. There are no FDA-approved drug treatments for the behavioral and psychiatric complications of dementia. There is a general consensus that the preferred first-line approach to these problems involves attention to medical (e.g., pain), environmental (e.g., excessive noise or crowding), and interpersonal (e.g., impatient caregivers) triggers to emotional and behavioral dyscontrol, but frequently these measures are not completely effective [44]. Antipsychotic medications (e.g., haloperidol) have often been used "off-label" to treat psychosis, agitation, and aggression in persons with dementia. In the last few years, their use has diminished significantly as a result of studies showing increases in morbidity and mortality and only modest, short-term benefit associated with their use. Such results, especially the associated increase in mortality, have resulted in a "black box warning" on the package insert. However, they continue to be required for the acute management of aggressive emergencies and for the longer term treatment of psychosis, agitation, and aggression unresponsive to environmental and behavioral interventions [44]. Many other drugs have been studied, and some (e.g., citalopram [45]) have shown promise, but none has been FDA-approved for this indication.

4.6 Psychosis

4.6.1 Vignette

An 88-year-old widowed woman saw a dermatologist because of a rash. She had a long history of cognitive decline and had been a resident of a skilled nursing facility for 5 years following a series of falls resulting in rib and pelvic fractures. She was no longer ambulatory. Over the last few months, she had developed nonhealing lesions on her left hand, forearm, cheek, and shoulder. She also had a flat erythematous contiguous rash on her cheeks and forehead. Treatment with oral antihistamines (a group of drugs to be avoided in older patients—see Chap. 5—Medication Management for details) and multiple topical preparations had been unsuccessful. On exam, she was neatly dressed and seated comfortably in her wheelchair. She was confused but calm and cooperative. She denied pruritus and pain. She was insistent that "bugs" were all over her, burrowing into her skin. She was frustrated that the "stuff in the tube in the bathroom" was not helping and that her only recourse was to pull and scratch at the bugs until she extracted them. According to the family, she had always been a loner and considered eccentric but had never before verbalized these kinds of beliefs. The dermatologist discontinued all of the oral antihistamines and topical treatments, with no change in her condition. Concerned about the delusional quality of the patient's complaints, he prescribed risperidone 0.25 mg twice daily. Within 1 month, her belief that "bugs" were burrowing into her skin had resolved. Within 2 months, there was a 50% reduction in lesions, and the remaining lesions were all healing. After 3 months, there were very few lesions remaining, and the patient denied having any concerns about her skin. The nursing home staff commented that her "picking" behavior had ceased. In addition, they mentioned having recently discovered that she was smearing toothpaste on her face. They removed the toothpaste from her room, and the rash on her cheeks and forehead resolved promptly.

The term "psychosis" is not a diagnosis but a generic term used to describe a complex of mental symptoms including false perceptions (hallucinations) in any sensory modality (i.e., auditory, visual, tactile, olfactory, or gustatory), fixed false idiosyncratic beliefs (delusions) with a variety of themes (e.g., persecutory, grandiose, religious, nihilistic, irrationally self-blaming), and gross disturbances in motor behavior (catatonia) or in the organization of speech (formal thought disorder). These may be of sufficient severity to render the patient "out of touch with reality." The presence of these symptoms, particularly if severe and sudden in onset, calls for an immediate diagnostic assessment and often for emergency treatment.

The differential diagnosis is broad and includes some of the disorders already discussed in this chapter. Of course psychosis is the defining feature of schizophrenia. Schizophrenia occurs in about 1% of the population and generally emerges in early adulthood but may also have its onset in late life. Principal symptoms are delusions (often persecutory) and auditory hallucinations, although olfactory, visual, and tactile hallucinations may be prominent in late-onset cases. Formal thought disorder and catatonia may also occur. Isolated delusions, often persecutory or somatic, are the defining features of the so-called delusional disorders. In addition, delusions and hallucinations can complicate both severe depression (e.g., delusions of guilt; hallucinations urging suicide) and mania (e.g., grandiose delusions; hallucinations involving hearing the voice of God). Psychosis, particularly as manifested by visual hallucinations, may be the most conspicuous initial sign of a delirium complicating an acute medical condition, such as sepsis or alcohol withdrawal, requiring urgent diagnostic and therapeutic intervention. Psychosis may also be a prominent and very distressing feature of dementing illnesses such as AD and LBD.

Because the management of psychosis depends on the underlying cause(s), it is essential to perform an appropriate diagnostic evaluation. In a patient with new-onset symptoms, the psychosis should be presumed to be a sign of delirium, and a thorough evaluation should be undertaken urgently looking for acute medical and neurological conditions as well as for evidence of drug toxicity or withdrawal. While the treatment of the underlying condition(s) is the most important therapeutic intervention, it may be necessary to use antipsychotic medications to manage acute psychotic symptoms on a short-term basis. An exception might be delirium due to alcohol withdrawal in which case benzodiazepines (one of the very few indications for these drugs in the elderly) would serve both to treat the underlying condition and to manage the acute behavioral and psychological symptoms. Psychosis complicating primary mood disorders generally responds to effective pharmacologic treatment of the primary mood disorder (e.g., antidepressant medications) supplemented by antipsychotic medications, although oftentimes electroconvulsive therapy is necessary and is in general the most rapidly effective treatment in these cases. Antipsychotic medications are usually necessary at some point—if not chronically—in the treatment of schizophrenia and related psychotic conditions (e.g., schizoaffective disorder) and are generally as effective in older adults as in younger patients. Psychotic symptoms complicating dementia syndromes may require antipsychotic medications periodically and in some cases chronically but more often—particularly when not resulting in distress or dangerous behavior—respond to tactful redirection and distraction by caregivers.

4.7 Determining Decisional Capacity (Competency)

In general, medical services cannot be provided to patients without their informed consent. For a health professional to accept consent as meaningful, one must believe that the patient is "competent" or has decisional capacity. It is not unusual for physicians to question the competence of their patients to provide or withhold consent for treatment, particularly when they are elderly, gravely ill, or facing a particularly complex treatment decision. Determinations of capacity are issue-specific (e.g., hip surgery) and require careful consideration and communication with the patient and other informants.

Patients are capable of informed consent if they have the ability to (1) express a choice, (2) understand and state in their own words what they have been told; (3) appreciate the consequences of the choice, and (4) manipulate the information rationally to arrive at a decision in line with values and preferences (ability to reason) [46].

From a clinical standpoint, determining whether these conditions are met requires pursuit of two lines of inquiry: (1) Does the patient have a potentially competency-compromising condition; and (2) if so, is there evidence that the symptoms are interfering with decision making in this particular situation [47].

4.7.1 Vignette

An 85-year-old woman was admitted to the hospital because of a hip fracture and refused surgical treatment. At the time of evaluation, she reported having fallen 3 days before admission and had elected to stay at home rather than go to the hospital because she did not want treatment of any kind. She ultimately agreed to be taken to the hospital only because of unbearable pain. Once admitted she accepted pain relief measures but declined the offer of surgery even when informed of the risks associated with prolonged bed rest. She explained that she had had a long, good life but was now unhappy at home with her indifferent, alcoholic son and was ready to die. She appeared to understand her condition and the treatment options, clearly expressed a choice to forgo *surgery, and appeared to understand the risks associated with her choice.*

She had no appetite, slept fitfully, and had no interest in activities that had formerly brought her pleasure. Her mental status examination revealed depressed mood, sad affect, and hopelessness, but no formal thought disorder, delusions, hallucinations, or cognitive impairment. She was not contemplating self-harm but was accepting of possibly dying soon. She met formal criteria for major depressive disorder, a condition that can make patients irrationally pessimistic about their prospects and thus compromise decision-making capacity. In this case, the clinical team was concerned that depression-related hopelessness might be responsible for her negative appraisal of the desirability of treatment; therefore, the clinical team elected to treat her for depression and reassess her openness to surgical repair if her mood improved. In response to psychosocial interventions as well as pharmacotherapy with a low-dose stimulating antidepressant, her mood and affect improved markedly over the next few days (indeed, the response often occurs in just a short time). She began eating and socializing, and her sleep normalized. She continued to deny suicidality but also continued to refuse surgery and to express a readiness to die. At this point—given the resolution of the depressive syndrome—there was no evidence of a clinical condition that might be compromising her decision-making capacity, so the team regarded her as having the capacity to refuse surgery. She was discharged with a plan for home-based nursing care focused on pain management.

4.7.2 Vignette

A 75-year-old woman was admitted to the hospital because of hip fracture and refused surgical repair. Upon evaluation, she claimed to understand that the surgeons believed that surgery was essential but she was not convinced because she had known others who had recovered uneventfully from hip fractures without surgery. She also explained that she did not want surgery because radio-transmitting equipment had been implanted in her abdomen many years before during a prior procedure and she had been monitored by the surgeons since that time; she did not want to be vulnerable to such treatment again. Her mental status examination showed persecutory delusions and auditory hallucinations but no evidence of depression, mania, or significant impairment in memory, language, or other basic cognitive functions. Based on past history and her current mental status findings, she was determined to have schizophrenia.

She appeared to understand the nature of her condition and clearly expressed a choice. However, she did not appear to fully appreciate the risks associated with her choice, and the choice was clearly influenced heavily by her delusions regarding the implantation of radio-transmitting equipment. Thus she had a capacity-compromising condition and her choice appeared to be a symptom of that condition. She clearly was not competent to refuse surgery. The clinical team sought a surrogate decision-maker who could make a decision on her behalf, taking into account her values and historical preferences.

As these cases illustrate, there are two principal considerations in judgments about decisional capacity or competence. The first is a diagnostic question, that is, is there a potentially capacity-compromising condition present? If there is not—as was the case in Case I after treatment—then there is no clinical reason to question capacity. If such a condition is present, then the question is the relevance of the diagnosis, that is, can it be shown that the symptoms of the condition are compromising the patient's ability to choose rationally? If not, then there is no clinical reason to question capacity. If there is—as was the case in Case II—then the patient can clearly be said to lack capacity, and a substitute decision-maker must be sought.

If a clinician is uncertain about a patient's capacity, he or she must consider the potential consequences of any decision. In general, the more grave the consequences, in a "sliding scale" fashion, the more certain the clinician must be that capacity is present to accept the patient's choice [46]. It is always wise to seek consultation and engage a surrogate decision-maker in situations requiring the determination of capacity.

4.8 Conclusion

The neuropsychiatric syndromes described in this chapter occur commonly among elderly patients and must be taken into account by all health-care professionals when obtaining a history, performing a physical examination, ordering studies, arriving at a diagnosis, and suggesting treatment. These syndromes may mimic other medical conditions and may co-occur with *any* medical or surgical condition, complicating profoundly evaluation and treatment. Fortunately, all of these syndromes can be treated and managed, if not cured. The first and most important step is recognizing their presence. Once a syndrome is detected, the specialist may proceed down the path of differential diagnosis using familiar tools (e.g., history, exam, and laboratory studies) and develop a diagnosis-specific plan of care. The implementation of the plan of care will often call for—and depend on—the active involvement of family and other caregivers. At any point in this process of care, it may be helpful to obtain psychiatric consultation, particularly if there are complex differential diagnostic questions, if treatment would involve the use of unfamiliar medications, or if there is disagreement about a patient's decisional capacity. However, all practitioners can develop the skills necessary to recognize and treat neuropsychiatric syndromes that may compromise the care of their elderly patients. These treatments must always be discussed with and agreed upon by the patient and caregivers. Specialty expertise should be solicited whenever the clinician is not fully experienced or comfortable with the situation or treatment.

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5 Medication Management

Nicole J. Brandt and Hedva Barenholtz Levy

5.1 Background

Individuals aged 65 and over account for 15.6% of the US population. By 2040, this proportion will grow to 21.6%. The 85 and older age group is the fastest growing segment, which is expected to more than double in size from 6.5 to 14.4 million by 2040 [1]. This also is the subgroup at highest risk of adverse medication outcomes. Sixty-nine percent of patients aged 65 and older have at least two chronic conditions; 17% have 6 or more [2]. Nearly 40% of older adults experience disabilities that limit self-care, mobility, or household activities. These reported disabilities increase with each decade of life and include difficulty with hearing, vision, cognition, and ambulation, all of which ultimately impact safe medication management [3].

Despite comprising roughly 15% of the US population, older adults account for 30% of drug expenditures [4]. Eighty-eight percent of older adults are prescribed at least one medication, and roughly, 40% are prescribed five or more. Thirty-eight percent of older adults also use over-the-counter (OTC) medications and 64% take dietary supplements, further increasing the risk of adverse medication outcomes [5]. Other factors that contribute to medication complexity in older patients include age-related physiologic losses that impact drug disposition and safety, the lack of representation in clinical trials [6], and involvement of multiple physicians prescribing medications for a given patient [7]. Ultimately, suboptimal use of medications is estimated to cost the US $528.4 billion annually and result in 275,689 deaths [8]. Among older adults specifically, indirect costs associated with nonoptimized medication use have been estimated to exceed $7 billion each year [9]. With the aged population in the USA growing at a rate faster than ever before, the need to ensure safe medication management is increasingly urgent. This chapter will discuss selected age-related physiological functions and syndromes that complicate pharmacotherapy in older patients, along with strategies to optimize medication management.

5.2 Factors Impacting Drug Response in Older Adults

5.2.1 Physiologic Alterations

Frailty has been defined as a "physiological syndrome characterized by decreased reserve and diminished resistance to stressors, resulting from cumulative decline across multiple physiological systems, causing vulnerability to adverse outcomes and high risk of death" [10]. Conceptualizing frailty through the four main underlying processes—changes in body composition, energy imbalance, homeostatic dysregulation, and neurodegeneration—recognizes that the processes that underlie frailty start early in life and progress rapidly later in life but with a high degree of heterogeneity among individuals. Perhaps, even more important, this approach provides common criteria by which aging, disease, and environmental pressure contribute to the "aging phenotype" and, in turn, to frailty [11]. The syndrome of frailty is discussed in depth in Chapter 1.

This section will highlight selected organ system changes that result in alterations in pharmacokinetic and pharmacodynamic responses in older adults. Pharmacokinetic (i.e., absorption, distribution, metabolism, elimination) processes affect disposition of a medication and determine the concentration at the site(s) of action. Pharmacodynamic processes involve the interaction between a medication and the receptors and the effector organ, which results in the pharmacological response of a medication [12].

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5.2.2 Nervous System

Due to age-related changes in neurotransmitters such as acetylcholine as well as increase in comorbidities such as Alzheimer's disease, there needs to be a heightened awareness to the concept of central nervous system (CNS) drug burden which has been associated with falls [13]. There are numerous medications with anticholinergic properties (Table 5.1). These agents commonly cause delirium, urinary retention, constipation, dry mouth, and blurry vision that can impact quality of life (QOL) as well as functional capabilities of older adults. Cumulative anticholinergic burden is associated with decreases in cognitive and physical function [14]. Thus, it is important for clinicians to minimize the cumulative anticholinergic burden in older adults.

Some central nervous system (CNS)-active biogenic amines decline with age, notably norepinephrine and dopamine. The clinician must be vigilant when prescribing medications that are associated with inducing Parkinson symptoms. Examples of common offenders include but are not limited to typical antipsychotic agents (e.g., chlorpromazine, promazine, haloperidol, pimozide, fluphenazine) and antiemetic agents (e.g., prochlorperazine, metoclopramide). Drug-induced Parkinson (DIP) is generally reversible once the medication is stopped; however, symptoms can persist for 4–18 months following drug discontinuation [17]. If DIP develops, management should focus on discontinuing the medication and switching to a less offensive agent.

5.2.3 Cardiovascular System

One age-related change in the heart is a decline of the ability to respond to stress with an increasing heart rate and coronary blood flow. In part this is because of the decreased response to catecholamines (e.g., epinephrine), which is related to the diminished number or decreased sensitivity of beta-receptors in older adults [18]. As a result, it is imperative to be aware of medications that reduce cardiac output, such as calcium channel blockers or cause sodium retention, such as glucocorticoids or nonsteroidal anti-inflammatory drugs (NSAIDs), as these could stress the myocardium and lead to heart failure exacerbation.

5.2.4 Gastrointestinal (GI) Tract

Reduced gastric acid secretion and gastric emptying, reduced splanchnic blood flow, and absorptive capacity of the small intestine are probably due to the effects of disease states and have not been confirmed in healthy subjects. Furthermore, pharmacokinetic studies on the effect of aging on drug absorption have provided conflicting results. There has been evidence that the absorption of vitamin B_{12}, iron, and calcium is reduced through active transport mechanisms [19]. Yet, generally drug absorption is not impacted by aging.

5.2.5 Hepatic System

The liver is involved in the catabolism and elimination of many medications. Age-related changes impacting hepatic function include [19]

- Decrease in liver mass as well as blood flow to the liver. As a result, the bioavailability of drugs undergoing extensive first-pass metabolism such as propranolol and labetalol can be significantly increased.
- Decline in metabolic reactions such as:
  - Hydroxylation (e.g., phenytoin)
  - Dealkylation (e.g., diazepam)
  - Sulfide oxidation (e.g., chlorpromazine)
  - Hydrolysis (e.g., aspirin) can also impact the bioavailability as well as toxicities of these examples by prolonging the medications' elimination half-life.

Other types of metabolic reactions, namely, Phase II oxidative process, are not impacted by aging [20]. Thus, prescribing a benzodiazepine in an older adult is not typically recommended, but if prescribed, one should use lorazepam or oxazepam due to the metabolic process.

Despite interindividual variability in age-related changes in hepatic metabolism among older adults, clinicians must be vigilant that age-related hepatic functional decline could result in greater concentrations of drugs and increased risk for adverse drug events (ADEs). Furthermore, it is important to note that other factors influence hepatic metabolism such as gender (e.g., women eliminate zolpidem slower than men), hepatic congestion from heart failure (e.g., reduced metabolism of warfarin leads to increases in INR), and smoking (e.g., increased clearance of drugs such as theophylline and olanzapine because of induced enzyme activity).

5.2.6 Renal System

Age-related changes in renal function must be considered carefully, as failure to adjust medication dosing for renal impairment commonly leads to preventable ADEs. The following age-related changes commonly occur in the kidney, but to a variable extent between patients:

- Decrease in renal mass because of number and size of intact nephrons and reduced blood flow
- Decrease in glomerular filtration rate as well as tubular secretion and reabsorption

Table 5.1 Medications with strong anticholinergic activity and alternative approaches [15, 16]

Therapeutic class	High anticholinergic activity medications	Potential alternative approaches
Antihistamines	Brompheniramine Carbinoxamine Chlorpheniramine Clemastine Cyproheptadine Dexchlorpheniramine Dimenhydrinate Diphenhydramine (oral) Doxylamine Hydroxyzine Meclizine Pyrilamine Triprolidine	Intranasal normal saline or antihistamine (e.g. azelastine) Second-generation antihistamine (e.g., loratadine) Intranasal steroid (e.g., beclomethasone, fluticasone)
Antidepressants	Amitriptyline Amoxapine Clomipramine Desipramine Doxepin (>6 mg) Imipramine Nortriptyline Paroxetine Protriptyline Trimipramine	For depression: selective serotonin reuptake inhibitors (SSRI) (except paroxetine); selective norepinephrine reuptake inhibitor (SNRI), bupropion For neuropathic pain: SNRI, gabapentin, capsaicin topical, pregabalin, lidocaine patch
Antimuscarinics (urinary incontinence)	Darifenacin Fesoterodine Flavoxate Oxybutynin Solifenacin Tolterodine Trospium	Beta-3 Adrenergic Agonists (e.g. mirabegron, vibegron)
Antiparkinson agents	Benztropine Trihexyphenidyl	Carbidopa/Levodopa
Antipsychotics	Chlorpromazine Clozapine Loxapine Olanzapine Perphenazine Thioridazine Trifluoperazine	Second-generation antipsychotics except olanzapine if clinically warranted and benefit > risks especially in dementia patients
Antispasmodics	Atropine (excludes ophthalmic) Belladonna alkaloids Clidinium-chlordiazepoxide Dicyclomine Homatropine (excludes ophthalmic) Hyoscyamine Methscopolamine Propantheline Scopolamine (excludes ophthalmic)	Loperamide Rifaximin
Skeletal muscle relaxants	Cyclobenzaprine Orphenadrine	For acute mild or moderate pain: acetaminophen, nonacetylated salicylate (e.g., salsalate), propionic acid derivatives (e.g., ibuprofen, naproxen)—yet consider comorbidities and duration of use
Antiarrhythmic	Disopyramide	Atrial fibrillation: For rate control: nondihydropyridine calcium channel blocker (e.g., diltiazem), beta-blocker For rhythm control: dofetilide, flecainide, propafenone
Antiemetic	Prochlorperazine Promethazine	Ondansetron

Adapted from American Geriatrics Society Beers Criteria® Update Expert Panel et al. [16] and Hanlon et al. [15].

The creatinine clearance is generally used as an index of renal function to make dose adjustments when using drugs primarily or significantly eliminated by the kidney. The Cockcroft and Gault equation utilizes serum creatinine measurement, age, and weight to derive an estimate of kidney function. Despite limitations, this estimate is used widely by drug manufacturers *and* within drug handbooks to dose adjust commonly used medications such as antibiotics and anticoagulants [21]. The clinical significance of appropriate dose adjustments for renal function is noted with the novel oral anticoagulant agents (e.g., dabigatran, rivaroxaban). Increased risk of bleeding is seen for these agents when they are not dosed appropriately. Chapter 27 (Nephrology) provides a detailed discussion of the assessment of renal function and managing patients with various degrees of renal failure.

5.2.7 Body Composition

Body composition changes with aging and can potentially influence the distribution of certain drugs. In turn, drug disposition could be altered enough to be clinically significant. Some of these changes include:

- Decrease in total body water influencing the serum and tissue concentration of medications such as digoxin
- Decrease in lean body mass leading to, e.g., a need for lower doses of levothyroxine
- Decrease in serum albumin, which binds medication such as phenytoin, valproic acid, and warfarin
- Increase in total body fat, which leads to an increased volume of distribution of fat-soluble medications such as sedative-hypnotics and other central nervous system (CNS)-active medications

The magnitude of these changes is heterogeneous among older adults and is not predictable. Clinicians, therefore, must be hypervigilant for drug side effects or drug–drug interactions in supervising the care of all older adults. An additional change that is important for practitioners to be aware of is the impact of stress on the aged nervous system. Change in mental status is often a warning sign of a more insidious disease. Often an acute infection, electrolyte abnormality, or an addition or dose change of a medication is the underlying etiology.

In summary, age-related physiological changes place older adults at a variable but marked increased risk for an ADE. Clinicians must thoughtfully choose the correct dosage of the correct drug for the condition, while recognizing the heterogeneity associated with the aging population. The prescribing dictum of starting medications at a low dose and then titrating up slowly while monitoring closely and regularly for adverse effects is paramount.

5.3 Polypharmacy

The term polypharmacy refers to the use of multiple medications. Most commonly, a numerical threshold of five or more medications is used [22, 23]. However, there is no universal definition, and a numerical threshold can vary by practice setting or research protocol [24, 25]. However defined, polypharmacy is widespread, with 42% of older adults taking 5 or more prescription medications and nearly one-fifth taking 10 or more [26]. The concomitant use of nonprescription medications also must be considered. Polypharmacy can be beneficial or harmful depending on the specific patient situation, thus the importance of individualizing drug therapy [27]. In efforts to differentiate between appropriate and inappropriate or harmful polypharmacy, terms like “polymedicine” have been introduced to convey the former and “medication overload” the latter [26, 28].

Regardless of terminology, implications of polypharmacy are significant, especially among older adults who are more susceptible to adverse health outcomes [26, 29, 30]. In community-dwelling older adults, polypharmacy is associated with increased falls, adverse drug events, hospitalizations, and mortality [25, 26, 29]. Polypharmacy also has been associated with reduced physical and cognitive function, as well as delirium in hospitalized elders [26, 29]. Polypharmacy co-occurring with frailty or prefrailty has been documented in 50%–75% of older adults [30]. Finally, polypharmacy negatively impacts medication adherence, increases health-care costs, and increases the risk of geriatric syndromes, such as falls, cognitive impairment, malnutrition, and urinary incontinence [24]. As a result of the negative implications associated with inappropriate polypharmacy (medication overload) in older patients, it is important to carefully weigh risks and benefits with each added medication in this vulnerable population [26, 27].

5.4 Adverse Drug Events

ADEs are a major source of morbidity in older adults, accounting for 35% of all emergency department (ED) visits. Furthermore, older adults with ADEs are hospitalized at more than twice the rate of younger patients [31]. The term “adverse drug event” is broad and refers to any type of harm that results from medication use. Adverse drug reactions (ADRs) are a major type of ADEs, and the two terms often are used interchangeably. ADEs also encompass dosages that are too high or too low, improper drug selection, and poor medication adherence. A significant amount of ADEs among older adults are considered preventable, with estimates ranging from 28% in ambulatory patients to 60% in hospitalized patients [32]. In one study of older adults immediately following hospital discharge, nearly one in five experienced an

ADE, and of these, 35% were considered preventable [33]. Among ambulatory older adults, each ADE adds approximately $1300 in the cost of an individual's care [34].

The most common types of ADRs in older patients involve cognitive impairment, orthostatic hypotension, falls, and GI or intracranial bleeding [35]. Of note, ADRs in older adults can present differently in older compared to younger patients and thus make them harder to identify as drug-induced, e.g., dizziness, falls, confusion, or sedation might incorrectly be attributed to "normal aging" rather than the patient's medications [36]. Drugs that are most commonly involved in ADR-related hospitalizations and/or ED visits are cardiovascular agents, including diuretics; opioids and NSAIDs [33]; CNS drugs/psychotropics [36, 37]; anticoagulants/antiplatelet agents [33, 36, 38]; and insulin and oral hypoglycemic agents [31, 38].

Medication nonadherence is another type of ADE that is a significant concern in older adults. Poor or nonadherence is associated with increased health-care costs in the USA, including $100–$300 billion in hospital admissions per year across all ages [39]. Prevalence of nonadherence specifically in older adults is estimated at 26–59% [40] and contributes to 10% of hospitalizations [41]. Medication adherence is a complex topic, with numerous potential contributing factors. Commonly cited reasons for nonadherence by older adults include not believing the drug is needed, forgetfulness, confusion about when or how to take the medication, adverse effects, and cost.

Widespread clinical and economic burdens of ADEs and the fact that many are preventable underscores the importance of strategies to prevent ADEs as part of good medication management principles in geriatric care. Preventable ADEs largely are attributed to errors in monitoring or prescribing drug therapy and to poor medication adherence [42, 43]. Indeed, ongoing monitoring of patients throughout the course of drug therapy, not just upon drug initiation, is considered a key strategy in preventing ADEs [43]. As mentioned earlier, drug therapy should be initiated at low doses and titrated slowly to allow for ADR monitoring between dose increases. Clinicians should consider that any new symptom or a decline in cognitive or physical function could be an ADR in an older adult [35].

5.5 Tactics to Optimize Medication Management

There are many clinical tools and resources to combat polypharmacy and improve medication management. This section highlights some of the more valuable tactics, namely, pharmacist care, pharmacogenomics (PGx), clinical resources to optimize prescribing, and strategies to support deprescribing.

5.5.1 Pharmacist Care

As different practice models emerge for pharmacist involvement on interprofessional health-care teams, it is imperative that pharmacists provide a consistent process of care, regardless of the type of clinical activity or practice setting. To this end, the Pharmacist Patient Care Process has been developed across the pharmacy profession to guide pharmacists regarding the structure and consistency of the patient care they provide [44]. Interprofessional teams that include pharmacists have been shown to have an overall positive impact on the care of older adults [45–47]. Pharmacists providing direct patient care are associated with improved detection of medication-related problems [48] and improved diabetes and blood pressure control [49, 50]. A meta-analysis examining interventions to reduce ADRs in older adults found that pharmacist-led interventions reduced ADRs by 35% compared to 21% with non-pharmacist-led interventions [51]. Pharmacist involvement in medication management is associated with reduced ADRs, hospitalizations, and ED visits, as well as cost savings from discontinuing or switching to less costly drug therapy [52, 53]. These findings support expanding the role of pharmacists in direct patient care services to improve the care of older adults with multiple, chronic comorbidities.

An evolving opportunity for pharmacists to provide medication management is through Medicare Part D [54]. Part D plans are required to offer eligible beneficiaries a benefit called Medication Therapy Management (MTM). MTM services were established by the Medicare Modernization Act of 2003 and further revised in 2010 under the Affordable Care Act. A core piece of the MTM benefit is the comprehensive medication review (CMR). Eligible beneficiaries must meet three general conditions: presence of multiple chronic conditions (MCC), multiple medication use, and minimum annual drug expenditure set annually by the Center for Medicare and Medicaid Services (CMS). Each Part D sponsor subsequently sets its own specific criteria to define eligibility for beneficiaries enrolled in that particular plan. MTM services are provided free of charge to eligible patients. As stated by CMS, MTM services can be provided by a pharmacist or other qualified provider. The MTM program was developed to minimize ADEs and poor adherence among beneficiaries who have Medicare Part D coverage.

5.5.2 Pharmacogenomics (PGx)

Pharmacogenomics (PGx) is the study of how genes affect a person's response to medications [55]. This tactic can facilitate personalized medication management, which can reduce the risk of ADRs and ineffective therapy. The US Food and Drug Administration (FDA) provides PGx information in drug labeling for at least 283 drugs [56]. The National Institutes of Health (NIH)-funded Clinical Pharmacogenetics Implementation Consortium (CPIC) has developed peer-reviewed, evidence-based guidelines that help health-care professionals understand, interpret, and apply PGx test results in clinical decisions [57, 58]. Additionally, pharmacists, as members of the interprofessional team, are uniquely positioned to utilize these resources to facilitate the implementation of PGx data to improve patient care and medication safety [59].

5.5.3 American Geriatrics Society (AGS) Beers Criteria and Screening Tool of Older Person's Prescriptions (STOPP)/ Screening Tool to Alert to Right Treatment (START) Criteria

The initial Beers Criteria was published in 1991. It was a consensus panel's attempt to catalog potentially inappropriate medications (PIMs) for nursing home residents. It was updated in 1997 to address older adults across all settings of care. The updated criteria were then adopted by the Health Care Finance Administration (now CMS) and incorporated in the evaluation of nursing homes as part of the required survey process. A 2003 update occurred prior to the initiation of Medicare Part D. At that time, selected criteria were adopted into various quality-prescribing metrics for Medicare Part D plans. Beginning in 2012, regular updates of the Beers Criteria were initiated under the direction of the American Geriatrics Society (AGS). Updated versions were published in 2012, 2015, and 2019 [16]. Beginning in 2015, the AGS Beers Criteria have been expanded to include PIM use that addresses drug–drug interactions and drugs that require renal dose adjustments.

The criteria are intended for use in all ambulatory, acute, and long-term settings of care, with the exception for hospice and palliative care settings, and for the US population aged 65 years and older. The intentions of the criteria are multifold: (1) improve medication selection, (2) educate clinicians and patients, (3) reduce ADEs, and (4) serve as a tool to evaluate quality of care, cost, and patterns of drug use in older adults. The latest version of the 2019 Beers Criteria is available on the American Geriatrics Society website and an updated version will be available in 2022.

The Screening Tool of Older Person's Prescriptions (STOPP) and the Screening Tool to Alert to Right Treatment (START) are commonly referred to as the STOPP/START criteria. These companion tools were originally developed in Ireland in 2008 to identify potentially inappropriate prescribing in adults over the age of 65 across most clinical settings, including frail elderly. Version 2 of STOPP/START was published in 2015 and reflects consensus across 13 European nations [60]. STOPP/START is organized by physiological system or drug class plus sections on anticholinergic burden and fall-risk drugs. Both AGS Beers and STOPP are considered explicit criteria; however, STOPP contains three implicit criteria that address drug use without an evidence-based clinical indication, duration of drug use, and duplicate drug class prescription [60]. START is unique because it is the only explicit criteria tool that solely addresses potential prescribing omissions (PPOs), i.e., clinical scenarios in which drug therapy might be helpful in older adults but is not prescribed.

Interventions utilizing STOPP/START have been evaluated in hospital and nursing home settings. Results showed improved outcomes for medication appropriateness and reductions in polypharmacy, falls, ADRs, and drug costs [61]. A software-guided tool generating recommendations based on STOPP/START evaluated the impact on hospital-induced ADRs in older adults. No significant differences were found between the intervention and control groups [62] in part due to the low prescriber uptake of recommendations. [63]. These findings suggest the importance of integrating technology based tools in day-to-day clinical workflow supported by interprofessional collaboration.

Overall, PIMs identified by AGS Beers and STOPP/START are significantly associated with increased risk of adverse health outcomes (ADRs or ADEs) and hospitalizations [64–66]. As tools to optimize medication management in older adults, these two sets of criteria, along with US-FORTA described below, serve an important role to alert prescribers to PIMs so that alternative medications can be selected or clinicians can monitor with heightened attention to safety and effectiveness. Experts recommend minimizing the use of PIMs in older adults through routine review of older adults' medications at every clinical encounter.

5.5.4 US Fit fOR The Aged (FORTA)

The original FORTA was created in Europe in 2008. It was adapted for the USA in 2020 and thus is the newest tool to guide prescribing for older adults [67]. A unique feature of US-FORTA compared to AGS Beers and STOPP/START is that it incorporates both positive and negative labeling into one tool. Each drug or drug class is given a rating A through D to indicate whether it is considered appropriate and beneficial for long-term use to manage a clinical indication (A or B rating) or if it is potentially inappropriate, i.e., harms outweigh clinical benefit (C or D rating), as summarized below:

- A: drugs are indispensable; they have clear-cut benefits that exceed harms.
- B: drugs are beneficial, but to a limited extent, or they are associated with safety concerns.
- C: drugs are of questionable efficacy or safety in older adults.
- D: drugs should be avoided in older patients; omit first and identify alternative agents.

US-FORTA focuses only on chronic drug therapy. In addition, this tool is organized by diagnosis (clinical indication), which is a potential advantage for clinical specialists. It includes 27 clinical indications, ranging from atrial fibrillation to 4 subsets of behavioral and psychological symptoms of dementia, to oncological diseases [67]. Because the tool is diagnosis dependent, medications can have different ratings throughout the tool, e.g., statins have an A rating when indicated following myocardial infarction, but a D rating for dementia. FORTA has been validated in a randomized controlled trial that found improvement in over- and under-treatment (based on C–D and A–B ratings, respectively), improved physical function as measured by activities of daily living, reduced falls and ADRs, and improved clinical endpoints such as renal failure [68].

5.5.5 AGS Guiding Principles for the Care of Older Adults with Multimorbidity

Clinicians caring for older adults with MCC can find guidance in prescribing using the AGS Managing Multi-Morbidity Guiding Principles [69]. This document was created by a panel of experts under the auspices of the American Geriatrics Society. The goal of this effort was to develop an evidence base to support clinicians when making clinical decisions. Recommended MCC Actions steps include (1) identify and communicate patients' health priorities and health trajectory; (2) stop, start, or continue care based on health priorities, potential benefit versus harm and burden, and health trajectory; and (3) align decisions and care among patients, caregivers, and other clinicians with patients' health priorities and health trajectory [70]. The tips and scripts for carrying out these actions are included in the full MCC Action Framework available in the supplement (www.GeriatricsCareOnline.org). Part of this approach includes deprescribing, a result of following these "Guiding Principles," to ultimately address treatment and caregiver burden. To further support the engagement of patients and caregivers in this process, tools and collaborations have emerged. An example of this is the Patient Priorities Care, a resource developed by clinicians, patients, caregivers, health system leaders, and payers that helps focus all decision-making and health care on what matters most to patients (available at: https://patientprioritiescare.org).

5.5.6 Deprescribing

Deprescribing is "the systematic process of identifying and discontinuing drugs when existing or potential harms outweigh benefits within the context of an individual patient's care goals, current level of functioning, life expectancy, values, and preferences" [71]. This assessment of drug therapy needs to be frequently redone as patient health, goals, and values change. "You never step into the same river twice" is a useful expression of this concept. Like a river, a patient's health situation, goals, and the patient's assessment of benefit and burden from an intervention are not stagnant and will evolve with time.

Patients and their goals (i.e., prolong life, prevent morbidity, slow disease progression, or comfort care) must be repeatedly assessed. The results of these reassessments allow the clinician to identify proper patient-centered goals and then compatible therapeutic interventions for primary and secondary prevention, control of chronic diseases, treatment of acute disease, and symptom management. This process is the foundation for deprescribing [72].

An example of the application of these concepts is seen in the context of cardiovascular disease. Clinical trials and clinical guidelines encourage the initiation of long-term medication therapy for primary or secondary prevention of cardiovascular disease, as with statins. However, these guidelines rarely define the timing, safety, or risks of discontinuing the agents [73]. A recent trial illustrated safely reducing antihypertensives in older adults—the OPTIMISE trial [74]. As a result of this, the number of medications used by an older adult with cardiovascular or other chronic illnesses accumulates, leading to multiple medications and an increase in ADEs. Not surprisingly, in the last year of life, the number of medicines prescribed increases by 50% but this may not be consistent with a patient's goals. This increase in medication use coupled with the effects of advanced disease at the end of life increases the risk of ADEs [75].

Accordingly, a focused effort by the clinician is imperative to identify the goals of care and deprescribe medications whenever possible. Clinicians in the setting of advanced life-limiting illness should always do this to reduce ADEs and potentially enhance quality of life (QOL) and sometimes survival [75, 76]. However, the choice of which medicines to discontinue, as well as estimating the time to benefit and safety, is not well studied. Therefore, thoughtful clinical judgment with sensitive patient and family communication is mandatory [76, 77]. Unfortunately, this approach is not commonly used: one study reported

Table 5.2 Tactics and tools to improve medication management

Tactics	Tools	Additional information
Comprehensive and targeted medication reviews	Medicare Part D Medication Therapy Management Program Annual Wellness Visits	https://go.cms.gov/3g0Eoi2 https://go.cms.gov/2E3x480
Pharmacogenomic evaluation	Clinical Pharmacogenetics Implementation Consortium (CPIC)	https://bit.ly/349E0LE
Identifying high-risk and potentially inappropriate medications	AGS Beers	https://bit.ly/2E9eWJL
	STOPP/START	https://bit.ly/3kMFnGb
	US-FORTA	https://bit.ly/2FiRgDp
Assessing treatment burden and what matters to patients	AGS managing multimorbidity	https://bit.ly/2E9eWJL
Deprescribing	US Deprescribing Research Network (USDeN)	https://bit.ly/344tghU

that only one-third of older adults had a conversation with their health-care providers about priorities in health-care decision-making [78].

A common example of this situation is statin therapy in older adults for primary and secondary prevention of cardiovascular disease. Although there is compelling evidence to prescribe statins for secondary prevention for people who are expected to live for many years, no evidence exists to guide decisions to discontinue statin therapy in patients with limited life expectancy. A randomized trial evaluated the safety and clinical impact of statin discontinuation in the palliative care setting. This issue was addressed in nearly 400 patients with an estimated life expectancy of less than 1 year and who were all taking statin for primary or secondary prevention for at least 3 months (69% used >5 years). Remarkably, days until death after stopping statin were 229 with discontinuation versus 190 with continuation. In addition to improving survival and reducing ADEs, studies of deprescribing in appropriate situations have financial benefit: $603 million in US health-care expenditures with statins alone [79].

The awareness and research to deprescribing have been increasing over the last several years. Currently, the USA launched a Deprescribing Research Network which promotes medication management and safety in older adults. This resource as well as other tactics discussed above are available in Table 5.2.

5.6 Summary

Medication management is central to clinicians of every discipline. Physiologic changes in older adults coupled with greater medication use and comorbidities impact drug disposition and drug reactions in older adults. Careful attention is needed to optimize prescribing for older adults by reducing polypharmacy and utilizing various medication tools and tactics. Ideally including pharmacists as part of the interprofessional team will help decrease ADEs, improve attention to what matters to older adults, as well as reduce medication related problems and health-care costs.

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Palliative Care and End-of-Life Issues

6

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6.1 Introduction

Palliative care is an important dimension in the care of older adults, who account for a disproportionate percent of health-care use, with more than half of all older adults having three or more chronic diseases [1]. The person-centered focus of palliative care is especially relevant because multimorbidity is associated with many negative consequences for older adults, including higher rates of adverse events from treatments, decreased quality of life (QOL), increased risk of disability, institutionalization and death, and greater health-care expenditures [1]. Heterogeneity within the older population is multifactorial and extends beyond variability in physical capabilities. Life experience, cultural and ethnic background, and religious or spiritual identification lead to individual differences in values and goals for health care. These values are likely to be especially meaningful when serious illness is present. In order to provide optimal, person-centered care, clinicians must communicate thoughtfully and compassionately with patients and families to develop goals and plans for care that are practical and reflect each patient's personal preferences [1].

6.2 The General Principles of Palliative Care

Three case examples of older adults of the same age and diagnoses but with differing health circumstances and preferences exemplify this point and will be referred to throughout the text:

(1) Anna is a frail 85-year-old, with chronic obstructive pulmonary disease (COPD) from years of smoking, chronic kidney disease (CKD), peripheral-vascular disease (PVD), and atrial fibrillation. She ambulates with a rolling walker containing her oxygen canister. She recently moved in with her daughter after her last exacerbation of COPD when she became more forgetful and fearful of being by herself. Her need for 2 L of oxygen at all times makes it challenging to leave the apartment. Over the last 4 months, she was hospitalized three times: twice for respiratory ailments and once for *Clostridium difficile* colitis following a rehabilitation stay. She now presents to the emergency department (ED) with a dusky, cold, and painful right foot.

(2) Bob is a robust 85-year-old with COPD from years of smoking, CKD, PVD, and atrial fibrillation. He plays golf twice a week and lives independently with his wife in a senior living community. He volunteers at his church every Sunday to teach in the second-grade class. He now presents to the ED with painless jaundice.

(3) Claire is an 85-year-old nursing home resident with advanced dementia, COPD from years of smoking, CKD, PVD, and atrial fibrillation. Dependent on others for help with all activities of daily living (ADLs), Claire often wanders aimlessly around the nursing facility looking for a lost kitten. She now presents to the ED with a hip fracture following a fall.

These cases illustrate three common scenarios of serious illness for older adults. Each person has nearly the same past medical history. However, there is enormous heterogeneity in their multimorbidity, with varied implications for cognitive function, prognosis, and decision-making. What questions should be asked by the emergency medicine physician, the hospitalist, the surgeon, the anesthesiologist, the cardiologist, or pulmonologist? Who would ask about each patient's advance directives? Which provider(s) would ponder the patient's prognosis at the outset of this new serious condition? How should the patient's pre-existing life expec-

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tancy be balanced with the prognosis resultant from the new problem? Would questions differ based on the patient's decision-making capacity or level of frailty? Do the answers to these questions alter the treatments offered? Given the heterogeneity of these patients, yet with a similar pattern of chronic disease burden, what advice would you provide to each? If none of the physicians already involved with these patients are comfortable addressing all of these questions, a consultation with a palliative care provider would be helpful to develop the relevant information, options for treatment, risks, and benefits and to assist the patient and family in defining goals and plans for care. Even with palliative care consultation, effective communication among providers, patients, and families is critical to achieving optimal care. Good communication reduces physical and emotional distress, increases treatment adherence, and improves patient satisfaction [2]. One model for implementing a patient-centered care approach for older adults with multimorbidity has been advanced by the American Geriatrics Society (AGS). Items of value to the patient are integrated into outcomes [1, 3]. Models of shared decision are especially useful for older patients with multimorbidity [1, 4]. For older patients with multimorbidity and a new serious problem as described above, short-, medium-, and long-term goals may now only be achievable over a few weeks or months.

6.2.1 Trajectories of Decline

Four prototypic health-care trajectories for serious illness have been described in the literature: [5, 6] (1) sudden death; (2) death following a disease of progressive, linear decline (e.g., noncurable cancer); (3) death following an illness with intermittent, acute exacerbations, or a "saw-toothed" functional decline (e.g., congestive heart failure or COPD); and (4) death from gradual progressive functional decline (e.g., neuromuscular disease or dementia). Expert consensus recommends palliative care should be integrated early in the disease trajectory not just for those with diagnoses of cancer [7, 8], but for those with Parkinson's disease and related disorders [9] and other comorbidities, such as congestive heart failure [10].

These patterns of decline are shown in Fig. 6.1. In these trajectories, the patient typically has been living in a state of variable, but limited, functional reserve often with dependence in activities of daily living (ADLs) for months or years prior to death. These situations, especially with a new illness or injury superimposed, require complex judgments by clinicians of the risks and benefits of medical interventions and their implications on prognosis: both for maintenance and return of function and on longevity.

6.3 The Specialty of Palliative Care Medicine and Its Interface with Other Programs and Specialties

The World Health Organization (WHO) defines palliative care as health care that "Improves the quality of life of patients and their families facing the problems associated with life-threatening illness, through the prevention and relief of suffering." "It affirms life, and regards dying as a normal process; it intends neither to hasten nor postpone death" [11]. Palliative care focuses not only on the patient, but also on his or her supporters, as all are profoundly impacted: physically, emotionally, socially, and spiritually. While the terms "palliative care" and "palliative medicine" are often used interchangeably, the broader term "palliative care" is preferred when referring to the multidisciplinary services including interdisciplinary teams and programs aimed at maintaining hope, preserving dignity and autonomy, and improving quality of life (QOL) for patients and families. "Palliative medicine" is a phrase reserved for the portion of a team who are the medical providers only [12]. Palliative support is appropriate at any stage of illness—from diagnosis onward—and can be combined with treatments aimed at disease modification or cure. Team assistance and recommendations differ depending on the stage of illness and the preferences of the patient [13]. For example, soon after learning of a new serious diagnosis, a patient's goals may be focused on prolongation of life, preservation of function with disease cure as able. At this early stage, the palliative team may focus on building rapport with the patient and family while assisting with the practical burdens of being sick [14]. As a serious illness evolves, and treatment options diminish or become more burdensome, patient's goals often evolve, frequently shifting away from attempts at disease modification or cure and toward full comfort and palliation. During the evolution away from curative or disease-modifying treatment, the options for palliative treatments increase. Patients and families may focus on other goals such as being able to return or remain home, improving physical comfort, alleviating spiritual distress, and other means of maximizing quality of life. Over time, the role of the palliative team will also change, likely assisting with increased symptom management and end-of-life (EOL) issues. The palliative team may provide continuity of care and can assist in creating seamless transitions to home or other settings for post-acute care. Hospice services at home, or in an inpatient setting, may be a vital option to help the patient leave the hospital or prevent hospital or emergency department admission.

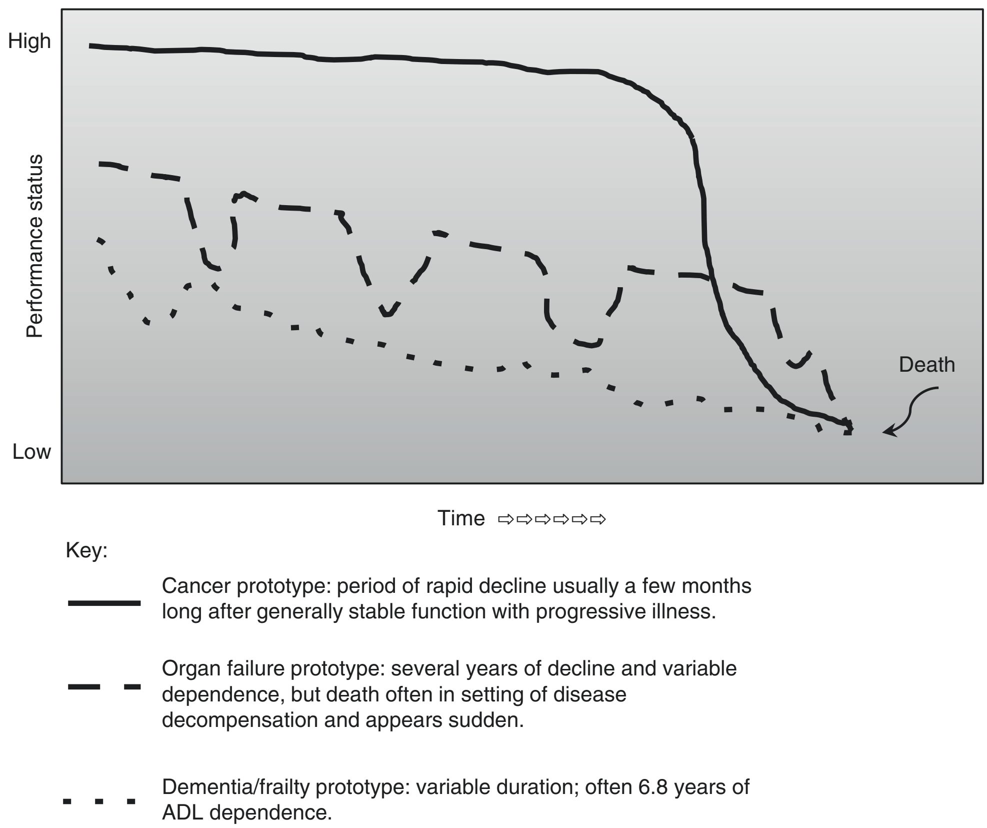

Fig. 6.1 Serious illness trajectories [5, 6]

6.4 Hospice Versus Palliative Care

While palliative care includes hospice care, it is not limited to this. Hospice services are limited to those whose life expectancy is estimated to be less than 6 months and focuses on end-of-life (EOL) care. Palliative care providers care for patients at any point in the trajectory of a serious disease, regardless of prognosis [15] (Table 6.1).

In the USA, hospice is an integrated bundle of services that is covered by medical insurance. Hospice provides services, durable medical equipment, and medications related to the terminal prognosis, and not to other comorbidities. The care is provided by an interdisciplinary team. The Medicare Hospice Benefit requires each hospice to provide nurse case management services, access to physician services, chaplaincy, social work, and volunteer support. Bereavement counseling for 13 months after a patient's death is also offered. To enroll a patient in hospice, two physicians must certify they believe the patient has a life expectancy of 6 months or less. Patients are reassessed for hospice service eligibility at regular intervals, and services may extend beyond 6 months if a patient's condition is continuing to decline. However, if the patient's condition stabilizes, regulations dictate consideration of discharging the patient from hospice care. Patients can revoke the hospice benefit at any time, such as if they are hospitalized. A reevaluation for eligibility is required before enrolling in hospice again.

Hospice services are provided in the location the patient defines as "home" and, for example, may be engaged in a patient or family member's private home, a nursing home, group home, assisted living facility, detention center, jail or other communal living environment, and even homeless shelters. The Medicare Hospice Benefit is commonly used to fund services and is the prototype for most other insurers, including the Veterans' Affairs Medical System, which is known to have robust EOL care services, as well as progressive palliative and supportive care programs.

6.5 Palliative Medicine Versus Geriatric Medicine

Palliative medicine and geriatric medicine share many common features. Both rely on interdisciplinary teams to provide care. Geriatric medicine emphasizes the importance of comprehensive assessment to optimize a patient's function. Palliative medicine focuses primarily on optimizing quality of life through alleviation of adverse symptoms, helping patients and families identify goals of care, and supporting effective emotional coping for patients and families [16]. Both specialties encompass the care of older

Table 6.1 Hospice versus palliative care

	Palliative care	Hospice
Primary goal	Assist patient to achieve goals Improve quality of life Alleviate suffering	Improve quality of life Relieve suffering
Recipients	Anyone with a serious illness	Patients whose physicians certify a life limiting illness and a prognosis of 6 months (or less) if illness runs usual course Patients who elect their "hospice benefit" (e.g., insurance)
Providers	Interdisciplinary team may include MD, APN, SW, chaplain, and other staff	Interdisciplinary team must include MD, RN, SW, chaplain, volunteer, and a bereavement specialist
Time frame	Can be initiated at any time from diagnosis onward Indefinite access	Life expectancy of less than 6 months Services typically continue through death but may be discontinued if patient's condition improves and life expectancy exceeds 6 months, or if patient elects to resume disease-modifying treatments
Special benefits	May continue to receive treatments aimed at cure or disease modification	Provides and pays for medications, durable medical equipment related to the hospice diagnosis Volunteers provide some additional services
Location	Mostly hospitals, oncology practices, nursing homes, and group practices	Mostly at home Widely available
Challenges	Not widely available in the community setting	Typically, hospice benefit does not cover disease-modifying therapies such as chemotherapy, IV antibiotics, transfusions, etc. New models of "concurrent care" (e.g., hospice and some chemotherapy) in some areas, especially if commercial insurance underwrites treatment Most hospices require caregiver in the home Personal care aide hours very limited
Payment	Professional fees are reimbursed by medical insurance, e.g., MD/NP fees covered by Medicare Part B Support from other programs (e.g., hospital, oncology practice) No payment mechanism from Medicare for non-medical providers, e.g., chaplain, personal care aides	Medicare Hospice Benefit or as defined by commercial payers

adults near the end of life and overlap in the care of frail elders. Both palliative and geriatric medicine teams have expertise in evaluating a patient's expected course, communication with patients and families to decide goals of care, develop advance care plans, and providing care throughout the course of the illness. Palliative providers have additional training and expertise in determining life expectancy, symptom control at end of life, and management of special populations of patients, such as those in the intensive care unit (ICU), patients with oncologic emergencies, nearing death with heart failure, human immunodeficiency virus (HIV), amyotrophic lateral sclerosis (ALS) and other degenerative neurological diseases, COPD, and chronic incapacitation from trauma. Geriatricians more typically have expertise caring for patients needing palliative care in nursing home, assisted living and home care venues, and management of the multimorbid patient. Both geriatric and palliative medicine specialists identify patient goals of care and address the comprehensive elements of function and well-being.

6.6 Evidence Base for Palliative Care

The Center to Advance Palliative Care (CAPC) (www.capc.org) has developed a platform for sharing expertise, tools, and resources in order to promote the integration of palliative care into every clinical setting serving those with serious illness. Other sources of guidelines and position statements have been developed by the American Academy of Hospice and Palliative Medicine (AAHPM), the National Coalition for Hospice and Palliative Care (NCHPC), the American Society of Clinical Oncology (ASCO), and the Choosing Wisely campaigns. When palliative care is integrated into the care of patients in the ICU, research shows increased family satisfaction and comprehension; decreased family anxiety, depression, and posttraumatic stress disorder; decreased conflict over goals of care; decreased time from recognition of poor prognosis to comfort-focused goals; increased symptom assessment; increased patient comfort; decreased use of nonbeneficial treatments, and decreased ICU and hospital length of stay [17, 18].

In the ED, there is evidence that proactive palliative care has generally positively impacted length of stay in the hospital, direct hospice referrals patient and family satisfaction, and intensive care utilization [19]. While the sites of care for palliative medicine consultation have historically been centered in the hospital setting, palliative services are moving to other places of need including outpatient clinics, assisted living environments, and nursing homes. Various models for outpatient palliative care services have been implemented. In one randomized trial, early palliative care for patients with nonsmall-cell lung cancer in the outpatient setting resulted in improvements in both quality of life and mood. Participants also had less aggressive medical care at the end of life and longer survival [7].

The Institute of Medicine (IOM) report "Dying in America" described the state of end-of-life care in the USA [20]. This 2014 report concluded that improved medical and social supports to both patients and family could enhance quality of life while reducing costs. However, additional research suggested that many studies do not include adequate numbers of seniors [21]. "Geriatric Palliative Care" has been proposed as an "intersection subspecialty" for seniors. The cases presented early in the chapter exemplify this point and highlight the unique complexity present in each patient. Anna requires chronic management of COPD and other comorbidities. Her acute problem is likely to worsen her other conditions and lead to more debility. Also, she is at high risk for a delirium, which if not prevented will worsen markedly her prognosis [22, 23]. Geriatric palliative care also must carefully address the needs of caregivers who are typically daughters or a senior partner often already overwhelmed with the care of supporting their children, grandchildren, or meeting their own care needs. Such situations often preclude home hospice [24–26]. Palliative care planning, therefore, must consider all involved with helping the patient if an effective plan is to be developed [21].

6.7 Skilled Home Health Versus Home Hospice

Home health agencies offer many of the same services as home hospice: nurse case management, durable medical equipment, medication management, and social work assessment. Both skilled home health and hospice are provided by most insurers. The primary goal of hospice services is to improve quality of life through the end of life and this service continues through death (unless the patient is discharged from hospice). The goal of skilled home health services, however, is to resolve a medical or surgical problem (e.g., a wound) or functional loss from an illness or injury (e.g., therapy after a stroke). Services are short term and stop once the patient maximally improves. Hospice agencies provide 24-h telephone access to assist caregivers in managing urgent issues with the goal of caring for the patient effectively at home and avoiding hospital care. On the other hand, most skilled home health agencies do not have a 24-h on-call program and urgent needs must be provided by the primary care provider or emergency medical services.

6.8 Generalist Versus Specialty Palliative Care

Basic palliative medicine attitudes and knowledge are appropriate for all clinicians caring for patients with serious illness [27, 28]. Such training and expertise in so-called primary palliative care has been endorsed by the 2014 IOM report [20, 27, 29]. These proposed generalist palliative skills needed by all clinicians include the following:

- Ability to elicit patient-centered goals of care
- Ability to develop and convey prognostic information and treatment options
- Assessment of pain and other physiologic and psychological symptoms
- Assessment of spiritual or social/practical burdens of illness
- Coordination of care for a safe transition to the next level of services

Educational resources to help clinicians gain palliative skills are increasingly available and offered through many continuing medical education programs and hospital grand rounds. Consider review of the following:

- Vital Talk resources focused on communication skills available at http://vitaltalk.org
- Information from the Serious Illness Care Program available at: https://ariadnelabs.org/areas-of-work/serious-illness-care/
- Center to Advance Palliative (CAPC) has both free resources on Palliative Care as well as specialized programs for program development available for enrolled institutions and members available at: capc.org

A study of over 1000 patients over age 80 years with serious illness showed the unique issues in this population compared to younger adults and children [30]. These older patients had a higher prevalence dementia, reduced prevalence of cancer, fewer recommendations for symptom management, and more questions concerning decision-making capacity, more issues related to withholding/withdrawing life-sustaining treatments and consults took more time to complete. These differences were substantiated in a slightly younger group, which showed that 70% of patients older than 60 years lacked decision-making capacity at the time health-care decisions were made [31]. In a third study, prior advance care planning conversations have been shown to reduce the emotional distress of surrogate decision makers of ICU patients [32]. These three studies point out the complexity of palliative care for seniors and the importance of advance care planning.

For patients with serious illness, generalist palliative care should be provided at the same time as attempts at disease-modifying treatments. Palliative care specialists may work alongside the patient's primary clinician to provide an extra layer of support. Due to the relative paucity of palliative medicine specialists, efforts are underway to expand access to palliative specialty care through telehealth consultation and education. One such model is Project ECHO (Extension for Community Healthcare Outcomes) which has been successful for delivering geriatric care and education to rural providers [33] and has been adapted to palliative care [34].

6.9 Communication and Shared Decision-Making

Even today, many clinicians have received limited training in communication, estimating life expectancy, or breaking bad news [4, 35, 36]. As a result, many clinicians feel unprepared to help patients needing palliative and end-of-life care [4]. Patients with serious illnesses and their families or other caregivers desire and need clear and honest information [37, 38] from clinicians in order to wisely plan all aspects of their future: who will provide care, where will it be provided, what are the goals of care, what will become of their finances, what about their employment, and how do they think about dying. A stepwise approach of a compassionate explanation of the development of their current situation and the current options is best in hosting a family meeting and/or breaking bad news. Doing this thoughtfully and openly, with a wise sense of the course of the illness and with sensitivity and empathy, decreases stress, confusion, false hopes, and anger for all. Such a conversation allows for the development of a satisfactory and shared decision that will help address all aspects of care including venue transitions and potential self-pay concerns [4, 37, 39]. The burdens of difficult decision-making on patient and family—as in circumstances with life and death consequences—may be lightened when informed clinicians make recommendations based on their understanding of the goals of the patient [40].

A review of communication strategies with patients who have serious illness provides best practices and advocates for shared decision-making using the patient-centered care model [37]. These strategies mirror the AGS [1] decision-making paradigm: (1) assess the patient's and family's understanding of the disease state and prognosis; (2) ascertain patient preference about information sharing and decision-making; (3) involve family as guided by the patient; (4) discuss patient priorities, fears and thoughts about quality of life and function; (5) explore tradeoffs in quality of life, as patients often have goals more important than longevity; and (6) convey as accurate prognostic information as possible.

One approach to breaking bad news and negotiating a patient-centered care plan uses the mnemonic SPIKES, for setting up the encounter, asking the patient their perception of the medical situation, requesting an invitation to share prognostic information, providing knowledge, empathizing with emotion, and summarizing and strategizing for next steps [4]. An example of how this approach could be employed to assist in a conversation with Bob, a patient story early in the chapter, is shown in Table 6.2.

Contrary to the belief of some clinicians, patients are not harmed by discussions of end-of-life issues or goals of care planning [37]. Rather, patients and families wish to control the amount and timing of information they receive, especially when it relates to the prognosis of an illness(s) [38]. Commonly, patients and families need for information diverges as an illness progresses: family members typically want more detailed information and patients less. The COVID-19 pandemic has triggered new ways of clinicians, patients, and families communicating about goals of care [41].

The wise clinician must acknowledge and respond to patient and family emotions [42]. Unaddressed emotions can interfere with the ability to process and retain information and may impair decision-making ability. Promptly responding to emotion—either verbally or nonverbally—legitimizes the feelings expressed and conveys openness on behalf of the clinician to discuss concerns fully and as they arise in the future [37, 42]. Finally, sensory and cognitive impairments are common in older adults and may affect their ability to understand information presented verbally or visually (Table 6.3) [43, 44].

6.10 Symptom Relief in Serious Illness and EOL

Palliative assessment and treatment must incorporate considerations of the distinct pattern and severity of a patient's comorbidities. Persons with dementia have unique needs in palliation. Cognitive impairment decreases a patient's ability to articulate complaints of distressing symptoms and to understand the disease process and develop and voice goals of care. Therefore, recognizing nonverbal cues is especially important to effective management. In situations of cognitive impairment, behavioral interventions (e.g., a compassionate and appropriate touch) are helpful. In the hospital, seniors are affected greatly by their environment. Noise, lighting, multiple visitors or providers at once, and irritating interven-

Table 6.2 The SPIKES model employed in Bob's case[a]

		Context	Words to consider
S	Setup	Find a private space, if in double room, draw curtain Ensure patient comfort Ensure uninterrupted time Turn off pager, phone Ensure presence of significant others Family/friends Medical team	Use nonverbal actions which show commitment to the patient and value to the dialogue: Sit down Ensure patient's physical comfort Attentive, open posture
P	Perception	Assess patient/family's understanding of what is happening Note vocabulary used by patient Shared decision-making on meeting agenda	"What is your understanding thus far about your jaundice, and what did you hope to learn today?" "To make sure we are starting in same place, can you tell me what you understand about your yellow eyes, and what I can help you understand?"
I	Invitation	Obtain patient's invitation to discuss details of illness; "ask" Key with cross-cultural dialogues Key with prognostic information	"Are you the type of person who likes to know all the details about what is going on, or would you prefer I speak with your son?" "How much information would you like to know about the future? About your diagnosis?" "Would discussing prognosis be helpful to you?"
K	Knowledge	Give a warning shot Provide information info in small chunks and check for understanding Avoid technical words and mirror patient's word choice If patient says "growth" you say "growth"	"I have your test results, and I have some bad news…" For example: "It appears as if we are unable to provide surgery due to the position of the cancer." "What questions do you have? Is there anything I can help clarify?"
E	Empathize	Empathize and explore the emotions expressed by the patient Acknowledge emotion Normalize feelings Explore Use "I wish" statements	"I know these are not the results we wanted." "Tell me what the hardest part of this is for you?" "I am upset! Why did that surgeon examine my dad! I thought that meant he was going to have surgery!"
S	Summarize and strategize	Summarize what has been said Clear plan for next steps and follow-up	"Are there any last items I can help clarify?" "Let's meet again at noon tomorrow to continue this discussion, after the medical oncologist has visited." "I want to make sure I have clearly explained your dad's situation. Can you give me your understanding of what is ahead?"

[a]Adapted from Baile [4]

tions (e.g., IVs, oxygen, or catheters) can worsen agitation and discomfort, and these must be routinely assessed and modified. Seniors with chronic conditions and/or frailty often experience severe and distressing symptoms, such as limited activity, fatigue, and physical discomfort or pain, which must be addressed [45, 46]. Because of comorbidities and age-related physiological loses, drug management is complex in older patients needing palliative care. Chapter 5 provides an in-depth consideration of these issues. Of special consideration in palliative care, two cardinal points should be made: use oral medications whenever possible, and when significant pain is present, avoid long-acting opioids, until the appropriate drug and formulation using short-acting agents have been established.

6.10.1 Symptom Assessment

A structured review of patients' goals and their current distressing symptoms needing attention is key to successful treatment. Such a review will need to be repeated frequently. For example, symptom management for a patient with only hours or days to live is likely to focus solely on comfort measures without concern of over sedation. When life expectancy is measured in weeks to months, concern for adverse effects of medications typically remains prominent. While cognitive impairment can make symptom assessment and management more challenging, nursing home residents with mild-to-moderate cognitive impairment have been shown to have self-reports of pain as valid as those without cognitive

Table 6.3 Communication challenges and strategies with older adults

Potential challenges	Strategies
Low vision	Ask and assess if low vision is present Adjust communication materials to avoid visual prompts Use "teach back" technique to assure understanding
Hearing loss	Ask and assess if able to hear adequately Establish optimal environment to promote communication, e.g., quiet well-lit room, seated directly in front of patient, minimize distractions Provide "pocket talker" or similar hearing augmentation tools Use "teach back" technique
Low health literacy	Reduce complexity of communication Avoid jargon and technical terms Try to use their words when possible Reduce the density of communication, no more than three concepts per encounter Use "teach back" technique
Memory impairment	Assess cognitive function by history-taking, chart review, or cognitive screen Identify family or health-care proxies to participate
Reduced concentration	Optimize environmental factors to promote concentration Assess ability to concentrate and receive information Identify family or health-care proxies to participate
Cultural influences	Recognize language and cultural barriers to communication Ask about communication preferences Ask about individual values and cultural backgrounds and seek to understand and integrate into care Use "teach back" technique for patient and family/health-care proxies
Role expectations	Ask what and to whom information should be disclosed Ask about preferences for decision-making strategies

impairment [47]. Tools for symptom assessment include the easy to use Edmonton Symptom Assessment Scale [48]. This measures ten levels of distress for ten common symptoms including pain, fatigue, nausea, anorexia, dyspnea, and several affective features.

Patients with cognitive impairment have difficulty recalling previous symptoms making their comparison of interventions difficult. In this situation, the clinician must rely on changes in function, behavior, or mood, as these may mirror improvement or deterioration of symptoms [49]. Several validated instruments are available to use in patients who are unable to communicate because of aphasia or intubation [50–52].

6.10.2 Approach to Management (Table 6.4)

With the goals of care established and assessment of symptoms complete, a comprehensive approach to symptom relief should be pursued. First, medications that do not further the patient's goals should be discontinued, such as multivitamins and other agents for prophylaxis. Medications traditionally avoided in the older adult could now be considered if consistent with the goals of care. The mantra of "Start Low, Go Slow" guides prescribing. A second step is to optimize the "environment of care," a term that refers to practices related to the patient's experience. The goal is to promote quality of life, such as liberalizing diet. If not at home, efforts should be made at opening visiting hours, reducing or eliminating vital signs, and allowing family, pets, and children to visit and even to sleep over.

6.10.2.1 Persistent Somatic Pain

Many older adults suffer from chronic non-malignant pain associated with musculoskeletal and other disorders. In some seniors, pain sensation may diminish, inherently reflecting age-associated physiological deterioration in the nociceptive pathways, typically occurring after age 80 [53]. However, patients with cancer seem not to benefit from nervous system aging and are likely to experience significant pain from their cancers [54] and as a consequence of treatment [55].

Expert groups recommend beginning pharmacologic therapy with nonopioids such as acetaminophen at or less than 3 g/day (or lower in the presence of liver disease or alcohol excess) and with caution (see below) nonsteroidal anti-inflammatory drugs (NSAIDs), then adding opioids of the necessary strength for worsening moderate pain, and stronger opioid plus nonopioid plus adjuvant therapy for more severe pain [51].

NSAIDs are particularly risky in older adults. Chronic NSAID use is associated with an increased risk of peptic ulcer disease, acute renal failure, fluid retention, stroke, and myocardial infarction. In addition, NSAIDs interfere with a number of commonly used medications such as warfarin and corticosteroids. Older adults are at higher risk for adverse effects due to age-related loss of physiologic reserve, polypharmacy, and multimorbidities. It is advised to avoid chronic NSAID use if possible. Even the so-called safer NSAID celecoxib in higher doses has a greater incidence of gastrointestinal and cardiovascular adverse events. While naproxen, a longer acting NSAID, may have less cardiovascular toxicity than other NSAIDs, this and other long-acting NSAID preparations (e.g., piroxicam and oxaprozin) are best avoided, if possible [56]. Opioids are recommended for moderate-to-severe cancer pain but are generally underpre-

Table 6.4 Palliative treatments for symptoms

Symptom	Special features	Treatments	Special considerations
Somatic pain	Opioids first line for cancer pain	Morphine oral/IV/SQ Oxycodone oral Hydromorphone oral/IV/SQ Fentanyl transdermal/IV	Always start bowel medications at the same time as opioids to prevent constipation Start with half the opioid dose recommended for younger adults Fentanyl and oxycodone are safer than morphine in those with renal impairment
Neuropathic pain	Adjuvants or co-analgesics helpful in addition to opioids	Gabapentin may cause dizziness Pregabalin 25–50 bid in debilitated patients Tricyclic antidepressants (TCA) Carbamazepine Selective serotonin reuptake inhibitors (SSRI) Mixed reuptake inhibitors (SNRI) Topical lidocaine patches Ketamine IV/PO (limited data in older adult) Methadone	Start with gabapentin 100 mg at bedtime. Increase weekly, as tolerated If stopping gabapentin or pregabalin, taper over a week to avoid seizures Gabapentin and pregabalin both require renal adjustment Methadone is dangerous due to unpredictable metabolism and interaction with many other medications. May prolong QTc. For use by experienced prescribers only
Dyspnea	If bronchospasm present, give bronchodilators If volume overloaded, give furosemide 40 mg PO/IV one dose If oxygen sats <90, give oxygen 2 L/min Low-dose opioids relieve dyspnea	Albuterol 2 inhalations every 4 h prn or 3 ml nebulizations every 2 h prn Morphine 5 mg PO every 2 h prn or 2 mg SQ/IV every hour prn	Monitor respirations Consider non-pharamcologic options including fans, relaxation, CPAP, BiPAP, physical comfort measures
Anxiety	Investigate causes	Nonpharmacologic treatments first (empathic listening, psychotherapy, integrative therapies such as music, relaxation mindfulness, Reiki, massage) SSRI may take weeks for full effect Gabapentin or trazadone Short-acting benzodiazepine, e.g., lorazepam Long-acting benzodiazepine if chronic (e.g., clonazepam)	
Delirium	Common in older adults, especially those with low vision and hearing and cognitive impairment. Seek underlying cause. Anticholinergic medications likely to precipitate or worsen (e.g., diphenhydramine)	Haloperidol 0.5 mg PO/IV/SQ every 4 h as needed. Increase by 1 mg every hour until desired effect. Maximum daily dose 20 mg	Consider QTc monitoring at higher doses
Constipation	Fecal impaction more common in older adults. Can lead to urinary retention	Senna Docusate Add milk of magnesia concentrate if supported by renal function 10 mg PO daily or bisacodyl 10 mg PO/PR every day Methylnaltrexone SQ every other day until BM	Start prophylactic Senna daily or twice daily with start of opioid treatment Rectal exam to rule out fecal impaction Consider KUB to rule out obstruction
Fatigue	Most common EOL symptom across all disease states	Methylphenidate 2.5 in morning and at noon. Avoid taking near evening hours	Evidence for effective treatment is lacking
Nausea/ vomiting	Common in advanced cancer. Symptoms derive from disease or its treatment. Multiple neurotransmitters may be targeted simultaneously for symptom relief	See separate table	

(continued)

Table 6.4 (continued)

Symptom	Special features	Treatments	Special considerations
Anorexia	Almost universal in seriously ill persons May be more distressing to family than patient Evaluate and treat reversible causes, such as constipation, nausea, or oral thrush	Lift dietary restrictions and encourage patients to eat whatever is most appealing Avoid enteral feedings in patients with advanced dementia. Instead offer oral assisted feeding and "comfort feeding" by hand Enteral feedings might be considered in patients with proximal GI obstruction and high level of function, or patients with ALS, or patients receiving chemotherapy or radiation involving proximal GI tract	Megestrol acetate may improve appetite, weight, and quality of life in some patients but has not been shown to prolong life or improve tolerance of cancer therapies Corticosteroids may increase appetite, weight, and quality of life in some patients but has not been shown to prolong life or improve other outcomes
Depression	Commonly under-recognized and under-treated in older adults and those near the end of life Mistaken belief that depression is normal in older adults and seriously ill persons	Standard treatments (SSRIs) are effective but take 2–6 weeks before therapeutic Psychostimulants are generally safe and can be given concurrently with standard antidepressants, e.g., methylphenidate 2.5 mg PO q a.m. and lunch time Electroconvulsive therapy (ECT) is safe and may be used when a rapid response is needed. Presence of space-occupying CNS lesions precludes ECT Cognitive behavioral therapy and active listening are helpful	
Bladder spasms	Obtain urinalysis and culture/sensitivity. Treat UTI if believed to be present (asymptomatic bacteria is common) If Foley present, can it be removed?	Oxybutinin 5 mg PO TID for 48 h. Maximum daily dose is 20 mg Tolterodine 1–2 mg PO BID Scopolamine patch every 72 h Phenazopyridine 200 mg PO TID × 48 h	Anticholinergic therapy may worsen delirium

scribed in older patients with cancer pain [57, 58]. Key to effective pain relief is dosing the medicine at regular intervals, decided by its duration of relief of the patient's pain. Morphine sulfate is the standard in the treatment of pain at end of life, but oxycodone may be preferred for those with severely compromised renal or hepatic function (see Table 6.5). The FDA had made recommendations that clinicians prescribing opioids must discuss naloxone availability and consider coprescribing naloxone for patients who take benzodiazepines or other central nervous system depressants, have a history of prior opioid overdose, or have household members at risk for accidental ingestion. For reference, FDA safety communication on discussing naloxone with all patients prescribed opioid pain relievers is available at: https://www.fda.gov/media/140360/download (accessed on July 30, 2020).

6.10.2.2 Neuropathic Pain

Neuropathic pain is caused by damage to the somatosensory nervous system. Seniors are at increased risk because many diseases that cause neuropathic pain increase in incidence with age, including diabetes mellitus (painful diabetic neuropathy), herpes zoster (postherpetic neuralgia), low back pain (lumbar spinal stenosis), cancers, limb amputation, and stroke. Treatment options are influenced by heterogeneity, multimorbidity, changes in pharmacodynamics and pharmacokinetics, polypharmacy, and limited evidence base for treatment decisions in older adults. Older adults are underrepresented in clinical trials and this reduces the generalizability of results to older populations [59]. Gabapentin and pregabalin are anticonvulsants that may be effective for neuropathic pain. Tricyclic antidepressants also may help but are less desirable in older adults because of their anticholinergic effects. Topical lidocaine in patch or gel may be useful for some. Please see Table 6.5 for additional agents which may be helpful.

6.10.2.3 Dyspnea and Cough

Dyspnea is multifactorial in etiology and results from the interplay of pathophysiologic stimuli from hypoxemia, bronchospasm, airway obstruction, pneumonia, and anxiety. Self-reported dyspnea occurs in more than 75% with advanced heart failure [60] and is a more reliable measure than the respiratory rate, presence of pulmonary congestion, hypercarbia, or hypoxemia. Managing a patient with dyspnea should be a blend of disease-targeted treatments and symptom relief interventions. Opioids are especially effective in the treatment of dyspnea. They act both centrally to reduce the perception of dyspnea and peripherally on lung opioid receptors that influence respiratory drive and through capil-

Table 6.5 Commonly used opioids

Name	Preparations	Dosing	Precautions
Morphine	Versatile as available in oral or parenteral formulations. May be used IV, SQ, IM, PO, although IM avoided in comfort-focused care Short-acting oral form also called "Morphine Immediate Release" Morphine elixir *concentrate* 20 mg/ml may be used with patients no longer taking oral sustenance. Place in buccal fold Morphine, sustained release (MS Contin©). Typically used every 12 h but may be used every 8 h with increasing uptitration	Start with 2.5–5 mg PO every 4 h PRN, or 1–2 mg IV every 3 h PRN based on renal function and opioid naïve status	Start with low-dose short-acting form PRN Titrate up as needed after 1–2 doses No ceiling Avoid in renal failure Prevent constipation Use opioid conversion chart to guide change of one opioid or form of opioid to another
Oxycodone	Oral preparations only Oxycodone: short-acting opioid (approximately 3–4 h) Oxycodone sustained release (Oxycontin©): longer acting (approximately 12 h)	Start with 2.5–5 mg PO every 4 h PRN	Start with low-dose short acting Avoid using fixed combinations (e.g., acetaminophen 325 mg-oxycodone 5 mg) when escalating doses Prevent constipation Use opioid conversion chart to change from one opioid to another
Hydromorphone (Dilaudid)	Available for oral, IV, SQ delivery More potent than morphine: 1 mg IV hydromorphone ~ 6.5 mg IV morphine	Oral elixir option may be ideal for some older adults	A preferred opioid in renal failure Start with low dose and titrate up as needed Prevent constipation Use opioid conversion chart to guide change of one opioid to another
Fentanyl	Available for IV, SQ, or transdermal application Parenteral forms have short half-life	Fentanyl transdermal patch doses 12, 25, 50, 75, and 100 mcg/h Change q 72 h Use opioid conversion chart to calculate dose if switching from short-acting opioids	Not removed by dialysis, therefore a preferred option for patients undergoing hemodialysis No analgesia from patch for 8–14 h Do not start patch on opioid naïve patient with cancer pain Use opioid conversion chart to guide change from one opioid to another Prevent constipation

IV Intravenous, *SQ* subcutaneous, *IM* intramuscular, *PO* oral

lary vasodilation. Opioids are considered safe in the treatment of dyspnea, and remote concerns about them causing respiratory depression and CO_2 retention with appropriate prescribing are unfounded [61]. Oxygen is an important treatment, especially for those who are hypoxemic. One large randomized and double-blind study of palliative oxygen versus canister room air for non-hypoxemic patients suggested that patients may benefit from moving air alone. Simple maneuvers such as a handheld fan directed at the face may also provide benefit. Nonpharmacologic interventions such as acupuncture and pulmonary rehabilitation have potential benefit but have not yet been carefully studied [61]. Some patients experience cough and dyspnea as two discrete symptoms. Guidelines for cough management in patients with lung cancer have been developed by The American College of Chest Physicians (ACCP) [62]. Additionally, noninvasive ventilation may be an appropriate component of palliative care for short-term prolongation of life and relief of dyspnea [63].

6.10.2.4 Anxiety

Anxiety is common in association with medical illnesses and depression. Medical illnesses (e.g., COPD) and the medications used to treat them may cause symptoms that mimic or exacerbate underlying primary anxiety disorders. Standard treatments for generalized anxiety disorders in late life include cognitive behavioral therapy and medications such as selective serotonin reuptake inhibitors (SSRIs) and selective serotonin and norepinephrine reuptake inhibitors (SNRIs). Benzodiazepines are usually avoided in older adults because of the risk of falls, cognitive impairment, depression, and the potential for abuse [64]. However, in the last days and weeks of life, as a patient's goals of care evolve, they may be appropriate for symptom relief.

6.10.2.5 Delirium

Delirium is common near the end of life and may be a manifestation of a modifiable clinical condition, especially a reaction to a drug, an infection, urinary retention, obstipation, or pain. Accordingly, an underlying etiology should always be sought to guide appropriate management. Patients with cognitive impairment are at an especially high risk for delirium, but delirium is a prominent feature of the end stage of many neurologic, oncologic, and organ failure conditions and it is not always reversible. Agitation, hallucinations, and confusion from delirium cause distress to both patients and families and these symptoms should be treated. Patients and families will need education and reassurance about the course of delirium and that it may last for weeks or months. Behavioral treatments such as avoidance of overstimulation, reassurance, reorientation, treasured photos, or other items are helpful. The presence of trusted caregivers or pets typically helps greatly. Nonpharmacologic approaches such as favorite music may be particularly effective in all but especially in those with dementia. Haloperidol remains the neuroleptic of choice. Anticholinergics (such as diphenhydramine) and benzodiazepines often exacerbate delirium and their use should be avoided except at the very end of life, once full comfort becomes the goal of care [65]. Chapter 2 provides an in-depth review of delirium in all situations.

6.10.2.6 Constipation

Constipation is the most common distressing symptom in seriously ill persons. It is the only persistent adverse effect of chronic opioid use. There are no data to support one laxative over another. Most experienced clinicians begin with a bowel stimulant (e.g., Senna) and escalate doses as needed. Osmotic agents (e.g., polyethylene glycol) may be added if needed, and being mindful of the volume per dose to be consumed. Suppositories, enemas, or manual disimpaction may be required. Methylnaltrexone is an opioid receptor antagonist given subcutaneously and may be used in cases of refractory, opioid-related constipation. While this is the best studied, there are still limited data to support using this agent, or other opioid receptor antagonists, in seniors. Newer agents for chronic constipation, such as the small intestinal secretagogues lubiprostone and linaclotide, have limited data supporting their use at the end of life.

6.10.2.7 Fatigue

Fatigue is experienced by up to 60%–97% of end-stage renal disease (ESRD), COPD and heart failure patients and is associated with poor quality of life [45, 66]. Mechanisms likely include age-related changes in muscle strength and mass, as well as organ dysfunction and adverse medication effects. Fatigue is a subjective complaint with no ideal quantifying measure. It is a part of the important syndrome of frailty, discussed at length with guidance to its assessment in Chap. 1. There are limited data to guide treatment of this common symptom and stimulants, such as methylphenidate, are often used, with minimal evidence of support. Integrative modalities such as bright-light therapy, acupuncture, yoga, Tai Chi, and Qigong may be helpful [67, 68, 69, 70]. Finally, sleep disordered breathing, such as sleep apnea, may be an important contributor to a patient's symptom of fatigue. It is widely under-recognized and should be considered. Chapter 27 provides guidance to the evaluation and treatment of sleep disordered breathing.

6.10.2.8 Nausea and/or Vomiting

Nausea and/or vomiting occur under a variety of conditions in response to activation of one or more emetic triggers and are present in approximately 60% of patients with cancer that is considered advanced report nausea [71]. Nausea is mediated through the gastrointestinal lining, the chemoreceptor trigger zone in the medulla oblongata, the vestibular system, and the cerebral cortex. Vomiting is coordinated through the brainstem. Because of the multiple neurotransmitters involved in nausea, there are a number of treatment options (Table 6.6) and typically more than one scheduled agent is needed for control.

6.10.2.9 Anorexia

Anorexia is almost always seen near the end of life and may be distressing to family although not to the patient. Ice chips, popsicles, moist compresses, artificial saliva, and good mouth care are helpful. Lemon glycerin swabs irritate dry mucous membranes and should be avoided. While corticosteroids and megestrol acetate are associated with appetite enhancement and some weight gain, and may improve quality of life in some, they have not been associated with prolongation of life or improved treatment outcomes. With the exception of amyotrophic lateral sclerosis or proximal gastrointestinal obstruction associated with a good functional status and active treatment (e.g., patient undergoing radiation therapy for esophageal cancer), there is no evidence that enteral feedings at the end of life improve survival or quality of life and are not routinely recommended. If consistent with patient and family goals, it is recommended that dietary restrictions be liberalized and patients be encouraged to eat whatever they wish: so-called comfort feeding.

6.10.2.10 Depression

Depression is common in older adults with and without serious illness. Prevalence may be as high as 42% in palliative care settings. Mood disorders also include anxiety and anticipatory grief, commonly seen in older adults with advanced illness. These symptoms are correlated with poor quality of life and increased mortality. Anticipatory grief is defined as a feeling of loss associated with current and anticipated changes related to illness. Grief should be distinguished from depression as the treatment and course often differ. Vegetative symptoms such as insomnia, weight change, and

Table 6.6 Nausea relief

Medications	Class	Special comments
Haloperidol (Haldol)	Dopamine antagonist	Very effective. Commonly used by hospice. Avoid in patients with Parkinson's disease
Olanzapine (Zyprexa)	Dopamine antagonist	Very effective. May be more effective than haloperidol, but more costly
Prochlorperzine (Compazine)	Dopamine antagonist	May precipitate sedation, delirium, and urinary retention in older persons
Promethazine (Phenergan)	Dopamine antagonist	May precipitate sedation, delirium, and urinary retention in older persons
Perphenazine (Trilafon)	Dopamine antagonist	May precipitate sedation, delirium, and urinary retention in older persons
Diphenhydramine	Antihistamine	May precipitate sedation, delirium, and urinary retention in older persons
Meclizine	Antihistamine	May precipitate sedation, delirium, and urinary retention in older persons. Helpful with vestibular nausea
Hydroxyzine	Antihistamine	May precipitate sedation, delirium, and urinary retention in older persons
Scopalamine	Anticholinergic	Especially helpful in vestibular causes of nausea. May cause delirium and urinary retention in older adults
Ondansetron	Serotonin antagonist	Effective for chemotherapy induced nausea
Granisetron	Serotonin antagonist	Effective for chemotherapy induced nausea
Metoclopramide	Prokinetic agent	If dysmotility present. May cause dystonia in rare cases
Cimetidine, famotidine, ranitidine	H2 receptor antagonists	If dyspepsia and/or gastritis present
Omeprazole, lansoprazole	Proton-pump inhibitors	If dyspepsia and/or gastritis present. If gastritis present
Lorazepam	Benzodiazepam	Helpful for anticipatory nausea, or nausea worsened by smell, sight, sound, or emotion
Hypnosis, biofeedback	Non-pharmacologic	Helpful for anticipatory nausea
Reiki (a Japanese alternative medicine approach), ceiling fan, small meals	Non-pharmacologic	Useful for all types of nausea

anorexia are not reliable markers of depression and may stem from the underlying disease. Change in mood, suicidal ideation, and anhedonia are more reliable indicators. Treatment of depression in older adults with advanced illness is similar to treatment in other adult populations and can improve both depressive symptoms and mortality [72]. However, patients with advanced dementia are less likely to benefit from treatment with antidepressants. Cognitive behavioral therapy may offer substantial benefit. If prognosis is long enough, SSRIs are the pharmacologic treatment of choice. When life expectancy is short, psychostimulants such as methylphenidate are generally safe in older adults and may be effective. Electroconvulsive therapy may also be considered when a rapid response is needed (and CNS lesions are absent). Chapter 4 provides an in-depth discussion of depression in seniors.

6.10.2.11 Loud Respirations

Loud respirations (tracheal congestion or the "death rattle") often occur near the very end of life, as patients fail to maintain their swallow reflex. This phenomena occurs because the patient is unable to clear secretions from the oropharynx, typically in the last few hours or days of life, and reflects the oscillation of secretions during inspiration and expiration. Although there is no evidence this is distressing to patients near the end of life, families and caregivers themselves often find the noisy respirations alarming. Optimal management includes preparing and educating the family about this occurrence. Sometimes gentle oral suction with a soft catheter helps, but deep suction is generally discouraged, as stimulation of the mucosa can trigger greater production of secretions. If pharmacological intervention is needed, anticholinergic medications can dry the secretions (Table 6.7).

6.11 Determining the Prognosis

Prognosis is a variable of enormous importance in palliative care and it must be assessed and thoughtfully communicated to the patient and caregivers [73]. Using age alone to estimate life expectancy without considering the clinical situation and disease burden leads to over treatment of frail and fragile patients or under treatment of highly active functional patients [74]. While "prognosis" is often assumed to refer to "remaining life expectancy," a prognosis can also forecast

Table 6.7 Management of active dying

Signs and symptoms	Management
Neurologic changes: Decreasing level of consciousness Increasing drowsiness Absence of eyelash reflexes	Prepare families on what to expect Assume continued "awareness" of patient and encourage family members to talk to patient Promote familiar and comfortable environment of care (e.g., loved ones, pets, music) Encourage family to show affection with touch
Terminal delirium Confusion Restlessness or agitation Day/night reversal Visions/hallucinations	Education and support for family and caregivers Consider treatment of underlying causes if death not imminent Trial of opioids as first line (assess for worsening agitation, myoclonic jerks) Benzodiazepines Haloperidol (avoid in Parkinson's disease)
Respiratory changes: Diminished breathing Shallow breathing Periods of apnea or Cheyne–Stokes respirations Use of accessory muscles Appearance of breathlessness	Educate and support family Opioids or benzodiazepines in low doses for breathlessness
Circulatory changes create: Cool, clammy skin Increased perspiration Mottled extremities Decreased urinary output Decreasing blood pressure Increasing heart rate	Educate and support family Encourage gentle bathing Blankets will not warm patient's periphery
Gastrointestinal changes: Ileus as peristalsis ceases Loss of sphincter control Incontinence of urine and/or stool	Prepare and educate family Maintain cleansing and skin care Typically can manage with absorbent pads Consider urinary catheter or rectal tube if cleansing care is distressing to patient, increasing caregiver burden, or threatening skin breakdown
Loss of ability to swallow "Death rattle" Reflects accumulation of saliva or oropharyngeal secretions May sound like gargling	Educate and support family; often alarming, despite patient's comfort Discontinue all unnecessary IV fluids; consider IV diuretic if BP favorable Reposition patient to help clear secretions, e.g., turning side to side, lowering head of bed briefly, or raising head Avoid suctioning Reduce production of saliva and secretions with scopolamine or glycopyrrolate Glycopyrrolate 1 mg PO/IV/SC BID/TID prn (glycopyrrolate does not cross the blood–brain barrier, thus lower the risk for delirium with use) Scopolamine transdermal 1.5 mg q 3 days; takes 12 h for full effect Hyoscyamine 0.125–0.25 mg PO/SL q 4 h prn Atropine ophthalmic drops may be used orally or sublingually, 1–2 gtt TID

other outcomes, e.g., referring to the earlier cases, the likelihood that Anna will need an amputation, or Bob's ability to tolerate chemotherapy. Estimating mortality can be performed reliably for a population but poorly for an individual. Prognosis is a point estimate and will evolve in any patient over time as new issues and data emerge. Life tables are one means of deriving broad estimates of survival but do not necessarily apply to individual patients. Mortality estimates can also be derived by applying disease-specific prognostic indices, such as the BODE Index for COPD [75] or the MELD score [76] for advanced liver disease. However, the applicability of a single disease-specific prognostic index to an individual with multiple severe illnesses is unknown.

One systematic review [73] identified 16 validated, nondisease-specific prognostic tools in adults over age 60 and assessed each for quality and utility as an index for mortality. The review evaluated indices for older adults who reside in the community, nursing facilities, and eight tools which were validated for use in hospitalized patients: five for patients in the emergency department or at hospital admission, and three at hospital discharge. In sum, the most common predictors of mortality were functional status and comorbidities [73]. None of the studies reported a *C*-statistic greater than 0.90: showing a lack of precision in mortality forecasting. Typically, mortality indices do not include positive factors such as social support or family history, which could be pertinent in families with exceptional longevity [77, 78].

Not all patients with a serious illness want to be informed of a clinician's predicted prognosis. It is important, therefore, to ascertain if the patient wishes to receive such information [38]. In the majority of patients, prognostic estimates are desired and the clinician must then use his or her judgment in presenting as accurate an estimate as possible, while acknowledging significant uncertainty. For example, consider saying to Bob: "Patients with your condition often live several months, and by that I mean three to six, but this estimate could be more or less."

6.12 Ethical and Legal Considerations

One of the key steps in health-care decision-making is determining if the patient has decision-making capacity. Determination of decision-making capacity is decision- or issue-specific, e.g., focused on a specific question, such as the capacity for Claire to consent to surgery, or for Anna to participate in discharge planning decisions. The need to consider a patient's decision-making capacity is especially challenging in patients with delirium or progressive cognitive decline.

If a patient is found to lack decision-making capacity, the patient's surrogate decision maker should be asked to provide informed consent about goals of care, including for diagnostic procedures, treatments, or placement. In the absence of a previously designated proxy, each state has specific legal statutes detailing the order of surrogacy for patients unable to speak on their own behalf. It is suggested that surrogates make decisions using the ethical principle of "substituted judgment," or in effect, speaking on behalf of the patient: "What would the patient say if he were here with us and speaking for himself?" [79]. If a living will or other advanced directive document exists—including informal communications, such as social media postings or e-mail writings—the health-care team and the surrogate can use these to guide the understanding of the patient's wishes. Ideally, a proxy has an in-depth understanding of the values by which the person leads their life and will be equipped to make choices using substituted judgment. Alternatively, if it is unclear what the patient would choose, or if the surrogate does not know the patient well, a "best interests standard" can be used to inform decision-making. This standard is used when the patient's values are unknown, and the care team and surrogate choose what a "reasonable person" or "what most people choose in this situation" [80]. States vary in what is used for the legal term for a health-care proxy, but two common terms are Durable Power of Attorney (DPOA) and Health Care Power of Attorney (HCPA).

A growing body of literature exists that surrogates decision makers may develop posttraumatic stress disorder following the extreme emotional duress of serving as a health-care proxy [32, 81]. Clinicians can lessen this burden if they facilitate conversations with surrogates using phrases such as "What would your Mother say if she were able to talk to us now?" rather than "Do you want us to resuscitate your Mother?"

A common and difficult decision for a proxy is to consider not using a medical intervention (e.g., do-not-resuscitate, or do-not-intubate), or, especially, to discontinue medical treatments that are not helpful or becoming burdensome, such as cessation of dialysis, artificial nutrition, or ventilator support. Families may equate the withdrawal of non-beneficial medical treatments as equal to euthanasia or a deliberate action undertaken to end life. However, this is not the case, and the courts have found it ethical and legal for patients or their surrogates to elect to withhold or withdraw medical treatments that are burdensome or have become ineffective [15]. Decisions to avoid burden or suffering also apply to less dramatic choices such as hospital transfer, imaging, or phlebotomy as these all may feel assaultive, especially in cognitively compromised individuals [82].

The Alzheimer's Association advocates that patients with dementia document their end-of-life preferences early in the course of their disease, while they have capacity, and can fully and freely participate in the advance directive process. They further state those with dementia "has the legal right to limit, refuse or stop medical treatments" [83].

Further consider our case of Claire, whose situation was described at the beginning of the chapter. She developed a sudden change in consciousness with tachypnea and tachycardia on postoperative Day 3. Chest X-ray findings were consistent with aspiration pneumonitis. Her son was urgently telephoned to re-address the goals of care and whether Claire would want to be treated with endotracheal intubation. When the benefits and burdens of mechanical ventilation are described, the clinician must present the immediate and long-term impact of the procedure. Informed consent must include this full spectrum of information, as well as a full range of treatment options including those that provide comfort and dignity focused care. The "*Best-Case, Worst-Case*" communication technique is one method to ensure a full, informed consent to the pros and cons of a treatment's short and longer term potential outcomes—as well as the pros and cons of palliation—is shared with a patient and family [84]. It is important to inform all that the goal of palliative care is to provide dignity and comfort, and it is not euthanasia. The cause of death is the underlying disease, and not the medications used to provide comfort (Table 6.8). Chapter 4 also provides information on determining capacity.

Table 6.8 Key distinctions in major EOL ethical concerns[a]

	Withhold life-sustaining technology	Withdraw life-sustaining technology	Palliative care and use of opioid analgesics	Physician-assisted suicide	Euthanasia
Intent of treatment	Avoid unwanted treatments	Discontinue unwanted or ineffective treatments	Relieve suffering	Terminate life	Terminate life
Cause of death	Underlying disease	Underlying disease	Underlying disease	Intervention prescribed by physician and administered by patient	Intervention administered by physician

[a]Adapted from Swetz and Kamal [15]

6.13 Culture

Culture and ethnicity are often significant determinants of a senior's perspective on serious illness and health-care decision-making. Cultural background includes religion and spiritual beliefs, ethnicity, educational background, and identification with any particular community, such as those with veterans status or who identify as LGBTQ+. Cultural heritage also influences communication with health-care providers. Clinicians should recognize the influence of personal cultural context on communications and goals of care. Older adults as a group often display minimal assertiveness with providers and are more reluctant to express their opinions when they disagree with recommended treatments [85, 86]. Older adults are often accompanied by family members or others whose presence may affect their own autonomy [87].

Culture may affect a person's values of and preferences for care. For example, African Americans select hospice care at a lower rate than Caucasians, especially for non-cancer diagnoses [88, 89]. African Americans are more likely than other groups to discontinue hospice services in order to seek life-prolonging treatments [90]. In addition, older African Americans from the southeastern USA are more likely than older Caucasians from the same region to hold spiritual beliefs that conflict with choosing palliative goals, distrust the health-care system, experience discomfort when discussing death, and want more aggressive medical care at the end of life [91]. These elements influence decisions near the end of life [91].

Cultural background inevitably shapes patient and family expectations regarding the roles to be played by the patient, family, provider, and other members of the community. While US culture values autonomy and truth-telling with respect to health care, some subcultures are wary of truth-telling with respect to their elderly loved ones with serious illness. Traditional Navajo beliefs, for example, hold that talking about potential negative outcomes causes them to occur [92]. Some cultures outside the USA value withholding information from the patient and allowing the family or provider to make health-care decisions [93]. The clinician must identify these variable cultural beliefs and acknowledge them, if patient appropriate care is to be provided.

6.14 Health Literacy

Older adults have the lowest health literacy rates, increasing the risk of misunderstanding issues concerning medical decision-making, and experience higher rates of poor health outcomes [94]. Health literacy is a concern for all patient–provider communications, but especially when language barriers and cultural differences are present. In some cultures, family decision-making is valued over individual decision-making [95, 96]. Bias or insensitivity to cultural differences leads to negative interactions of patients with health-care providers and the health-care system in general. Clinicians must avoid making assumptions about decision-making style and ask patients and families directly about their preferences for communication [95].

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Hospital Medicine

7

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7.1 Demographics

The marked rise in the number of older adults is reflected in US hospital data. Although adults aged 65 and older currently represent approximately 13% of the US population, they account for a disproportionate amount of healthcare utilization and 40% of hospitalizations. By 2030, adults aged 65 and older will represent nearly 20% of the population. Adults aged 85 years and older constitute the most rapidly growing segment, and although they currently only account for approximately 2% of the population, by 2030 their numbers will increase by 20% [1]. Those 80 and over as a group are the heaviest users of healthcare and hospitalizations. The most common reasons for admission to the hospital for older adults include heart failure, cardiac arrhythmias, acute coronary syndromes (ACS), and pneumonia. Although these diagnoses are similar to those of a younger adult population, older patients have a longer average length of stay (5.5 days versus 5.0 days for adults who are 45–64 years old) [2]. For adults over age 80, the most common causes of hospitalization are heart failure, pneumonia, urinary tract infection (UTI), septicemia, stroke, and hip fracture [3]. Patients over 80 have been found to receive fewer invasive procedures and less costly care than a younger cohort. This difference has not been shown to be due to the patient's preferences regarding life-sustaining care or their severity of illness [4]. They are also more likely to be transferred to long-term care: approximately 40% of patients over the age of 85 are transferred to a skilled nursing facility (SNF) [3].

- Older adults account for nearly 40% of all hospital admissions and nearly 50% of all costs related to hospitalization [3]. They also suffer more adverse events in the hospital, including delirium, hospital-acquired infections, and adverse drug reactions.

7.2 The Vulnerable Older Adult

Aging results in significant, progressive reduction in physiologic reserves across multiple organ systems. Despite this, older adults sustain themselves in "homeostenosis"—a delicate state invisible to the clinician's eye. These physiological losses make an older adult vulnerable to any significant perturbation or stress. Older adults have muted physiologic responses to acute stressors, such as an infection, an adverse medication effect, dehydration, or surgery. These stressors expose the elders' underlying vulnerability due to their lack of compensatory reserve.

- Aging-related physiologic vulnerability combined with the increased prevalence of chronic disease with aging is manifested as unexpected clinical failure of the heart, lungs, kidney, brain, or other organ systems that were not the primary reason for admission to the hospital [5] (Table 7.1).

7.3 Marked Heterogeneity Among Older Adults

Descriptions of age-related physiologic declines and comorbidities give the impression that the older population is clinically homogenous, but this is not true. Older adults experience

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Table 7.1 Physiologic changes of aging

Organ/system	Age-related physiologic change	Consequences of aging, not disease
General	↑ Body fat	Altered drug distribution
	↓ Total body water	
Endocrine	Impaired glucose homeostasis	↑ glucose during stress
	↑ ADH, ↓ renin, and ↓ aldosterone	Disrupted volume homeostasis
Respiratory	↓ Lung elasticity and ↑ chest wall stiffness	Increased effort, atelectasis when bed or chair bound
	Decreased recoil	↓ Exercise tolerance
	Decreased DL_{CO}	
	Decreased cough reflex	Micro-aspiration
		Ventilation/perfusion mismatch
	Increased A-a gradient	Decreased resting $P0_2$
Hematologic/immune system	↓ T-cell function	↓ Response to pathogens
	↑ Autoantibodies	
Musculoskeletal	↓ Lean body mass, muscle	↓ Strength
	↓ Bone density	Osteopenia
Cardiovascular	↑ LVH, arterial stiffness	Impaired orthostatic responses; HFpEF (e.g., diastolic dysfunction)
	↓ B-adrenergic responsiveness	↓ baroreceptor sensitivity
		↓ cardiac output and HR response to stress
		Hypotensive response to ↑ HR or dehydration
Renal	↓ GFR	Impaired drug excretion
	↓ urine concentration/dilution	Delayed response to salt/fluid restriction or overload

Adapted with permission from Fedarko et al. [58], and Kasper et al. [59], adapted with permission of McGraw Hill Education

physiologic aging at very different rates, and even in the same person, different organ systems age at varying rates; and as a result, older adults are more different from one another than are younger patients. Older adults also suffer from age-related chronic conditions, such as heart disease, diabetes, and geriatric syndromes such as dementia, frailty, and incontinence, in unpredictable ways. More than 50% of older adults have more than three chronic conditions, called multi-morbidity [6]. As a result, there is marked clinical heterogeneity, and the overriding lesson is that age itself does not predict a person's state of health or wellness, which may range from resilient to frail.

- An individualized geriatric assessment is a major step in the management of the older hospitalized adult. It provides the essential framework to deliver personalized, high-quality and safe care for this high-risk and diverse group of patients.

7.4 Assessment of the Hospitalized Older Adult: Key Themes and Common Pitfalls

Although the hospital is often lifesaving, for an older adult, it also presents serious challenges with potentially devastating consequences. Approximately one-third of patients older than age 70 develop a potentially preventable hospitalization-associated disability despite successful treatment of the acute illness. This often results in impairment of activities of daily living (ADLs) and an inability to continue to live independently [7, 8]. A systematic approach is required to identify and manage these challenges, which include cognitive and functional decline, adverse effects from medications [9], and other components. Several risk-prediction scoring tools are available to identify hospitalized older adults at risk for new-onset disability, adverse medication effects, and other hospital-associated complications. These tools can assist in targeting the high-risk patients and inform clinical care [10]. Identification of frailty provides very important prognostic information regarding morbidity and mortality [11–13].

7.4.1 Geriatric Assessment in the Hospital

Geriatric assessment (GA) has evolved to meet diverse clinical needs in a variety of settings. Core GA components involve the identification of medical, physical, functional, social, and psychological issues that then link to a coordinated team-based plan of care. The GA in the hospital focuses on a senior's unique presentation of acute illness and plans for the prevention of common adverse events during hospitalization. A recent review reported that hospitalized patients who received GA with a subsequent individualized care plan compared to those without GA were more likely to be alive and in their own homes after a year (and not be institutionalized) and more likely to have maintained their baseline cognitive function [14].

- A geriatric assessment on admission to hospital identifies the patient's baseline status, targets common geriatric problems and hazards that would otherwise have been unsuspected or disregarded, expands upon usual medical assessment to reduce hospital-associated risks and improve outcomes, and initiates planning for transition of care (Table 7.2).

The following is a list of recommended steps, recognizing that there is significant overlap and that the order and timing of each may be modified based on the patient's acuity and clinical scenario.

7.4.1.1 Step 1: Assess Capacity for Medical Decision-Making

The patient must have the capacity for medical decision-making in order to fully engage in a discussion about goals, values, and preferences. Since approximately one fourth of hospitalized elders lack decision-making capacity, all hospitalists must be skilled in assessing decision-making capacity and must routinely determine this capacity in older patients—not just when prompted by a patient's unusual behavior or denial of a recommended treatment [15]. There are four main components to assessing decision-making capacity (Table 7.3). Importantly, a patient with dementia may still maintain decisional capacity. The assessment of a patient's medical decisional capacity involves his or her ability to understand the consequences of a decision.

Table 7.2 Routine assessment for hospitalized older adults

History and physical	Geriatric area	Specific geriatric assessment	Why assess?
Care preferences	Advance care planning	Review DMPOAHC and/or Living Will (if available)	Guides care
		Assess the capability of medical decision-making	
		Assess goals of care, values, and preferences	
Past history	Healthcare utilization	Review ED or hospital admission within 30 days	Targets risk and informs transitions
	Vaccination	Review pneumococcal and influenza immunization status	Hospital is a good site for updating vaccinations
Functional status	Functional status	Assess ADLs, IADLs	Targets risk and informs transitions
		Ask: Have you recently had a decline in your functioning?	
		Ask: Do you have help at home? What do they help you with? (e.g., shopping, meals, taking a bath or shower, transportation, managing finances)	
Medication review	Over-and-under treatment	Review each medication for indication, dose, and adverse effects	Mitigates adverse medication effects and errors
	Adverse effects	Review high-risk medications (e.g., psychotropics, anticholinergics)	Informs transitions
		Ask: Are there any medications that have been recently started?	
	Adherence	Ask: About how many doses do you miss a week?	
		Ask: What do you do to make sure you get your mediations? (e.g., caregiver help, pill boxes)	
Social history	Social support	Ask: Where do you live? (e.g., home, assisted living, nursing home)	informs transitions
		Ask: Who lives with you?	Assists with prevention strategies (ETOH withdrawal)
		Ask: Are you a caregiver for someone else?	Informs transition; may need to report
	Alcohol use	Ask: How many drinks (alcohol) do you have a week?	
		Administer: CAGE	
	Elder mistreatment	Ask: Do you feel safe at home?	

(continued)

Table 7.2 (continued)

History and physical	Geriatric area	Specific geriatric assessment	Why assess?
Review of systems	Cognition	Ask: Have you had problems with your memory or confusion?	Informs hospital course and transition (do not make diagnosis of dementia in hospital setting)
	Mood	Ask: (PHQ-2): Over the past month, have you often had little interest or pleasure in doing things? Have you been bothered by feeling down, depressed, or hopeless?	
	Incontinence	Ask: Do you have trouble holding your urine? Do you wear a pad?	
	Falls	Ask: Have you fallen in the past 6 months?	
	Nutrition	Ask: Have you lost weight in the past 6 months? How much?	
	Vision/hearing	Ask: Do you have problems seeing or hearing?	
	Skin	Ask: Do you have any skin sores or ulcers?	
	Pain	Ask: Are you having pain?	
Physical assessment	General/VS	Assess temperature	Informs hospital course and transition
		Check orthostatic BP and heart rate	
		Calculate BMI	
		Perform daily skin exam	
		Assess frailty status	
		Assess for delirium	
	Cognition	Perform Mini-Cog (3-item crecall and clock draw) or other cognitive screen	
	Gait	Observe patient getting up and walking	
Labs	Renal function	Estimate CrCl (Cockcroft–Gault formula)	Mitigates errors in dosing

Modified with permission from: Pierluissi and Sotelo [60]

Table 7.3 Four elements of a decision-making capacity assessment

1. Communicating a choice
2. Understanding the question asked
3. Appreciating the situation
4. Demonstrating reasoning

Capacity is determined in relation to a specific question or situation and must be reassessed as the clinical picture changes [16]. Several tools are available to help structure the assessment including the Aid to Capacity Evaluation Tool [17]. Specialty consultants, including psychiatrists, may be brought in when there is evidence for depression or psychosis complicating the discussion. Chapters 4 and 6 also provide information on determining decision-making capacity.

- Assessing a patient's medical decision-making capacity is within the hospitalist's scope of practice.

7.4.1.2 Step 2: Establish Goals, Values, and Preferences

Establishing the patient's goals, values, and preferences is a very early step in GA. Specific treatment decisions follow this understanding, and it should drive the hospital management plan. Determine if the patient has any advance care planning in place (e.g., durable medical power of attorney for healthcare, living will) and follow the patient's desired wishes as best as possible. A helpful framework in discussion with patients with multi-morbidity includes attention to treatment-related risks, burdens, and benefits, including their anticipated life expectancy, functional impairments, and quality of life [6, 18].

To develop a plan of care in alignment with patient/family goals, preferences, and values, engage in a discussion following these guidelines. Before beginning the discussion, be as prepared as you can be with the facts of the case and share this information with the patient and family to ensure understanding. Ask open-ended questions and be prepared to listen and respond to the patient's questions and concerns (Table 7.4). Specific issues to discuss (in addition to resuscitation orders and code status) may include (as appropriate) ICU care, dialysis, nutritional support, future hospitalizations, and the role of comfort measures. Confirm understanding of the patient's wishes at the end of discussion.

With a structured approach and practice, the discussion can be completed within a short time. The benefit to patient,

Table 7.4 Ask open-ended conversation starters

"What matters most to you?"
"What would you like to see happen?"
"What would you like to avoid?"
"What fears or worries do you have about your illness or medical care?"
"What are you hoping for now?"
"What is important to you?"

family, consultants, and all involved hospital personnel is invaluable in focusing on the goals of care. In many cases, managing patient and family expectations is a key part of the initial and follow-up discussions.

At times, these expectations may be overly optimistic, failing to appreciate an extremely poor prognosis. Other times, the expectations may be based on age-related stereotypes that unreasonably deny the opportunity for an elder to recover from their acute illness. For example, a family may misunderstand the clinical picture of delirium and acute onset of urinary incontinence (two common adverse effects in the hospital setting) and come to the conclusion that their loved one suffers from dementia and chronic urinary incontinence. They may then believe that they can no longer care for the patient at home. These inappropriate diagnoses, if unchallenged by the hospital team, impact further care. The family may decide that a transfer to a more supervised setting is in their loved one's best interests, and the family's lowered expectations for recovery often solidify cognitive and functional losses.

- Directly discuss the patient's goals, values, and preferences. Develop and implement a care plan based on achieving these goals, as best as possible. Strongly consider consulting the palliative care team (discussed in depth in Chap. 6) or the ethics committee if patient and/or family expectations appear to be unrealistic or if there is conflict.

7.4.1.3 Step 3: Conduct an Effective and Efficient History and Physical

The traditional history and physical exam includes past medical history, medication review, social history, review of systems, and physical exam. Within these domains, several assessments should be systematically incorporated to elicit important geriatric issues (Table 7.5). Utilize the hospital team (e.g., nurses, social workers, pharmacists, dietitians, and therapists) to broaden and deepen the assessment in a time-efficient manner (Table 7.2).

- Incorporate key geriatric domains into the standard history and physical (rather than an "add-on"). With practice, this will allow for more focused and efficient care in the fast-paced hospital setting.

Table 7.5 The history and physical of a geriatric patient includes additional elements

Medication reconciliation
Strategies used by patient and/or caregiver to ensure medication adherence
Consider whether medications (or lack thereof) could be contributing to the patient's acute illness
Social history
Does the patient require help from others to meet ADLs and IADLs?
Does the patient feel safe at home?
Review of systems
Vision and/or hearing changes
Weight loss in the prior 6 months
Physical exam
Orthostatic blood pressure
Gait assessment

7.4.1.4 Step 4: Avoid Misdiagnosis: Know About Unique Presentations of Common Conditions

It is essential to maintain a high degree of skepticism and carefully reevaluate the initial diagnosis of older patients admitted through the emergency department. Signs and symptoms due to adverse medication effects are often incorrectly ascribed to a medical or psychiatric problem. Up to 30% of hospitalizations in the older population involve an adverse medication effect [19]. Although chest pain is the most common presenting symptom of acute coronary syndrome (ACS) in all ages, elderly patients often present with nontypical symptoms, including dyspnea, delirium, Gastroesophageal Reflux Disease (GERD), or fatigue [20]. In addition, ACS can be precipitated by other stresses, such as infection or dehydration, further delaying clinical recognition when the symptoms are nonclassical. Older adults often have severe infection without fever, leukocytosis, or other typical signs and symptoms. Even in the setting of pneumonia or sepsis, fever is absent in 30–50% of elderly patients [21]. Clinically, these infections present as nonspecific symptoms of functional decline (abrupt change in self-care ability), a new geriatric syndrome (falls or delirium)—or exacerbation of an underlying chronic condition. There is often a recognized pattern to this common "atypical" presentation of acute illness, whereby the elder's symptoms are reflective of the system with the least physiologic reserve (termed the "weakest-link principle") [22].

In addition, the presence of clinically significant chronic kidney disease is often missed (and medications incorrectly dosed) because of pseudo-normalization of the serum creatinine in older adults with low muscle mass and diminished renal function. To avoid this, renal function must be assessed by estimated glomerular filtration rate or creatinine clearance, rather than the Modification of Diet in Renal Disease equation (MDRD) that often appears in lab reports. Dementia or the new onset of acute confusion (delirium) interferes with obtaining a history and assessing symptoms. See Chap. 2 for a discussion of diagnosis and prevention of delirium. Lastly, the negative impact of ageism, combined with the absence of a reliable history, results in the inaccurate assumption of a terminal illness or advanced dementia in a malnourished, confused elderly patient who is suffering from an acute illness.

A common conundrum for hospitalists is the excessive information from imaging and laboratory assessments that frequently results. Older adults have many comorbidities and incidental findings. Therefore, often there are data that are irrelevant to the patient's acute problem. Reviewing these data carefully and deciding what is important or irrelevant requires judgment and thoughtful communication with the patient and family. It is important in developing a wise care plan and avoiding iatrogenic complications. If something is deemed irrelevant to the acute hospitalization, it may instead require follow-up in the outpatient setting, which must then be coordinated ideally with a plan in place prior to discharge.

- The interplay of normal age-related physiological change, comorbidities, and geriatric syndromes results in heterogeneous, clinical presentations of common conditions. Overall, it is essential to maintain a high index of suspicion for misdiagnosis or underdiagnosis in the older adult.

7.4.1.5 Step 5: Continuous Transition Planning: Begin on Admission

Care transitions (often termed "handoffs," "discharges," or "transfers") can be complicated and costly for older adults with complex needs, and planning for a safe and effective transition of care should begin at the time of admission. Care transitions occur between providers, levels of care (e.g., from intensive care unit to the floor), or across healthcare settings (e.g., from hospital to a skilled nursing facility, or hospital to home) and require several, well-orchestrated steps that address patient and family/caregiver, physician/healthcare provider, and health system factors [23]. While making every attempt to respect the patient's autonomy and privacy, an important first step involves including caregivers and family members in the process.

Elements of transition include care coordination, discharge planning, and disease management, and hospitalists are responsible for the patient's care from admission until the transition of care is complete. Hospitalists are encouraged by the National Transition of Care Coalition to adopt the concept of "transfer with continuous management" [24]. Unless a team-based, structured approach is utilized, key elements can get lost in the transition, resulting in highly fragmented and poor quality care. The transition plan should include a complete and clear medication list (reconciled with preadmission medication list), assessment of cognitive and functional level, lists of diagnoses, pending tests and appointments (and attention to logistical needs), abnormal findings that need outpatient follow-up, assessment of caregiver needs and resources, and advance care directives. It should also include specific education regarding self-management, warning symptoms or signs ("red flags") of their disease condition and who to call and what to do when these arise, instructions as to what to expect (including other clinical disciplines that may be involved in care, such as nursing or physical therapy), and how to navigate the next site of care (Table 7.6). At the time of any transition, a brief phone call between the current and receiving provider is very helpful.

Suboptimal care transitions are hazardous to older adults, and it impact safety, costs, functional outcomes, morbidity, and mortality. Current high hospital readmission rates in part are a sobering reflection of our failures in transitional care, and a focus of national scrutiny. Nearly 20% of Medicare beneficiaries are readmitted within 30 days, and 30% are readmitted within 90 days [25]. Risks for poor transitions in older adults include: living alone, limited self-care abilities, poor health literacy, low income, prior hospitalization, five or more comorbidities, polypharmacy, functional impairments and limited resources or caregiver support, or transition to home with home-care services (because of the challenges involved in coordinating care at home for patients with complex needs). Specific diagnoses, including depression, heart disease, diabetes, and cancer, also predict poor transitions [26].

Many problems occur if the hospitalists are not familiar with the capabilities of various settings, which include home with family support, home with home-healthcare, custodial care (e.g., assisted living), skilled nursing facilities (SNFs), acute rehabilitation hospital, long-term acute care (LTAC), and hospice care (home support or inpatient). Unless the hospitalist is familiar with various resources at each care setting, such as the availability of on-site medical care, specific medications, imaging, or lab tests at SNF, the discharge plan may be unrealistic and unsustainable. It would be wise for hospitalists to briefly visit the most common community institutions used in his or her discharges to gain firsthand knowledge of their unique resources and limitations. Table 7.7 provides a synopsis of post-acute care services and institutions. For a planned discharge to home, access to ongoing medical care, cognitive or functional capabilities of the patient, availability of a caregiver, financial resources to pay for care, and the availability of community resources are especially important to consider. Ultimately, the choice of the discharge site of care should be the best match between the patient's needs and the resources and services available at the location.

There are many well-recognized barriers to achieving a safe transition, and the process is further challenged in the

Table 7.6 Improving care transitions for older adults

Discharge/ transition barriers	Recommended approaches
Physician to provider communication	Collaborate with Primary Care Providers (PCP) in discharge and follow-up planning Promptly and accurately transfer information to the provider at the next level of care Utilize a standardized template to ensure comprehensive communication Communicate specifically about diagnoses, advance care plans, medications, allergies, adverse events, follow-up needs/pending tests and studies, red flags, and possible next steps
Medication management	Partner with clinical pharmacists to manage medication information and reconciliation, including over-the-counter products, and work to eliminate high-risk medications for older adults (Chap. 5, Medication Management for Beers list) Reconcile medications at all care transitions, and communicate list to PCP, including allergies and adverse medication events, and medications discontinued and added Educate patients about changes to their medications and develop a plan to ensure medication adherence for complex regimens
Patient and family factors	Involve patient and family members early in the process of hospitalization Work with interprofessional transfer/discharge teams to assess needs, and ensure available resources to optimize patient's medical condition, functioning and safety, and to support the caregiver Ensure that the patient and caregiver understand and agree with the goals and purpose of the transfer, and what to expect at the next level of care Assess the health literacy of patient and family, and provide access to patient care navigators to help negotiate the health system Schedule and prepare for specific follow-up appointments prior to discharge Utilize home health and/or hospice services when indicated, and consider home visits for high-risk or frail elderly patients. Use established community networks and ensure coordination
Physician–patient communication	Provide discharge counselling regarding diagnoses, medication changes, self-care instructions, appointments for follow-up, red flag symptoms, what to do if problems arise, and plans for durable medical equipment (if home) Reaffirm patient's goals of care, values, and preferences, and confirm advance care plans Provide simply written materials with illustrations to reinforce verbal instructions and promote patient self-management Utilize teach-back techniques to assess the gaps in patient and family's understanding Give opportunity to ask questions and spend time answering them Encourage use of personal health record to manage information

Adapted with permission from Kripalani et al. [61]

often-chaotic acute care environment. The recent trend of institution-based physicians providing care in one specific setting (i.e., hospitalists, SNFists), the lack of knowledge about other sites of care, and the lack of communication between these providers are the primary factors in failure of transitions of care. Adding to the insult are various electronic health record systems that lack interoperability, leading to poor handoffs. Different care settings have their own formulary restrictions and different medication reconciliation requirements. New roles have emerged, such as patient care navigators, transition nurses/coaches, and home visiting nurses, to facilitate safe care transitions and decrease fragmentation of the care provided [23].

In addition to preparing the patient and family for a safe and effective transition, direct communication between healthcare providers taking care of patients in acute and post-acute settings is of paramount importance [27]. The Transitions of Care Consensus policy statement released by a multi-stakeholder consensus group in coalition with the Stepping Up to the Plate alliance of the American Board of Internal Medicine (ABIM) outlined the standards of transitions of care between inpatient and outpatient setting [28]. Several models such as the Nurses Improving Care for Healthsystem Elders (NICHE) [29], Project BOOST [30], and the Care Transition Program [31] can be of great help in improving the transition process, and hospitalists are positioned to play a key role in their health system in selecting and implementing care transition policies to improve health outcomes [32, 33].

- Several tools are available to identify geriatric patients at risk during transitions, and to provide a team-based framework with protocols to address the complexities of care. Championing evidence-based hospital and health system transition programs, and utilizing tools such as the 'discharge checklist' proposed by the Society of Hospital Medicine's Hospital Quality and Patient Safety Committee [34], can prevent fragmentation of the care provided during the critical time of transition (Table 7.6).

7.4.2 Management of the Hospitalized Older Adult: Key Themes and Common Pitfalls

7.4.2.1 Step 6: Mitigate Hospitalization-Associated Disability

Despite successful treatment of the admitting diagnoses, approximately one third of older hospitalized adults develop new functional (cognitive and physical) impairments that affect their ability for self-care and limit their ability to continue to live independently. These patients are at high risk for readmission within 30 days, most often for an acute medical condition other than the initial admission diagnosis. The cause

Table 7.7 Synopsis of post-acute care settings

Post-acute care setting[a]	Services	Type of therapy available	Care requirements	Specialty services	Limitations
Long-term Acute Care (LTAC) Hospitals	Respiratory care, wound care, IV antibiotic therapy	Short-term rehabilitation	Trach and vent patients Complex wound care	Dialysis Pain management	Only for patients whose LOS is predicted to be close to 25 days
In-hospital sub-acute unit	Pulmonary, cardiac care, wound care	Intensive short-term rehabilitation	Reconditioning	Orthopedic Rehab	Not many hospitals have these units
Inpatient rehab centers	Wound care, pulmonary therapy, complex physical and neurological therapy	Intensive short-term rehabilitation	Patient is expected to be able to return to independent living after the rehab stay	Pulmonary rehabilitation Dialysis Stroke and other neurological rehabilitation	Patients should be able to participate in at least 3 h of daily rehabilitation
Skilled Nursing Facilities (SNFs)	Cardiac, pulmonary, wound care, and antibiotic administration	Orthopedic, neurological, and speech-language rehabilitation	Patients should have skilled care needs otherwise will be downgraded to long-term care facilities	Dialysis	Care provided may vary at different SNFs Patients must have a preceding hospital stay
Home health services	Wound care, IV antibiotic administration, skilled nursing and physical therapy	Physical therapy, occupational therapy, and speech therapy	Patient has to be homebound[b] No need for preceding hospital stay	Medical social work and aide services	Physician has to certify patient is homebound and is in need of services
Home hospice care	Medical and support services for terminal illness	Pain management	Patient has to be certified by a physician to have less than 6 months of life expectancy	Palliative care	Patient has the choice to elect or revoke hospice services

[a]Some variations may exist based on state regulations and services available in a particular institution

[b]Per Medicare (https://www.medicare.gov/Pubs/pdf/10969.pdf accessed on 12/8/2015), to be homebound means the following:

Leaving your home is not recommended because of your condition

Your condition keeps you from leaving home without help (such as using a wheelchair or walker, needing special transportation, or getting help from another person)

Leaving home takes a considerable and taxing effort

of this post-hospital syndrome—an acquired, transient condition of generalized risk—is believed to be due to the impact of bed rest while hospitalized and the usual processes of care that result in significant and global physiological stress, and a period of vulnerability [7]. The elderly hospitalized patient experiences substantial stress, including poor nutrition, sleep deprivation, pain, adverse medication effects, sensory deprivation, delirium, cognitive challenges, and physical deconditioning. These hospitalization-related events contribute to a cycle of decline, resulting in recurrent hospitalizations, institutionalization, morbidity, and mortality. Patients remain disabled long after even a brief, seemingly minor hospitalization. One year following discharge, fewer than 50% of older adults recovered to previous level of function [35].

- An acute medical illness resulting in hospitalization is a sentinel event for an older adult. Be aware of hospital-associated disability, and in addition to addressing the urgent needs of the patient's acute illness, look beyond the admitting diagnosis and prevent these predictable and devastating events (see Managing Common Risks and Adverse Events below) [7, 8].

7.4.2.2 Step 7: Manage Multiple Consultants

Beyond the role of calling and coordinating the efforts of several consultants and working with the interprofessional team, hospitalists must take primary responsibility for developing and implementing a plan of care that is aligned with the patient's and family's goals, values, and preferences. This includes engaging in difficult conversations, guiding the patient and family through medical and/or surgical disease management options, managing patient and family expectations, and appropriately integrating palliative symptom management and end-of-life care.

- In complex patients with multiple consultants, assume a leadership role and navigate the course of the hospitalized older adult with a keen eye on the patient's and family's goals of care, preferences, and values.

7.4.2.3 Step 8: Identify Patients in Need of Palliative Care Assessment

Many older hospitalized patients with serious, complex, and potentially life-threatening or life-limiting medical conditions benefit from an inpatient palliative care assessment. In

Table 7.8 High risk for unmet palliative care needs

Chronic conditions
Failure to thrive
Worsening physical symptoms
Disagreements regarding treatment options

most hospitals, this is accomplished through a palliative care consult. Expert consensus checklists are available to identify patients at high risk for unmet palliative care needs, both on admission and during daily rounds. Table 7.8 identifies four of the highest risk states. A "no" answer to the "surprise question" asked of yourself: "Would you be surprised if the patient died within 12 months?" is a very helpful criteria [36]. Chapter 6 provides detailed information in this area including what expertise in palliative care a hospitalist should have.

- The palliative care consultation service is designed to provide specialty-level care to help manage challenging symptoms, navigate complex family dynamics, and guide the patient and family in achieving difficult care decisions regarding potentially life-sustaining therapies.

7.4.2.4 Step 9: Manage Common Risks and Adverse Events

Acute hospitalization of older adults places them at risk for specific adverse events that result from vulnerability to "usual" processes of care—bed rest or decreased mobility, standing orders for pain, anxiety, and sleep that are not targeted to the special needs of older adults, complications from interventions intended to be therapeutic. The following is a brief review of common and/or high-risk events that predispose hospitalized elders to poor clinical outcomes, and includes recommended approaches to improve outcomes. Chapters 1, 2, 3, 4, 5, 6, 7 and 8 provide important information on these issues, especially frailty, delirium, psychiatry, medication management, palliative care, and tools for assessment (Table 7.9).

- Many of the poor outcomes from hospitalization are due to predictable risks and are therefore often preventable. The hospitalist should have strategies to prevent or mitigate these adverse events, although some decline may be unavoidable due to the impact of the acute illness or injury.

Table 7.9 Common risks and hazards of hospitalization

Malnutrition
Poor skin integrity/pressure ulcers
Polypharmacy and adverse med effects
Atypical presentation/misdiagnoses
Nosocomial infections
Depression
Delirium
Frailty
Cognitive impairment
Sensory impairments
Functional impairments
Falls and immobility
Constipation
Urinary incontinence
Volume shifts
Uncontrolled pain
Sleep disturbances
Managing multiple specialty consultants
Lack of identified goals, values, and preferences
Lack of medical decision-making capacity
Complex care transitions

Table 7.10 Methods to reduce falls in the hospital setting

Avoid medications with psychotropic and anticholinergic effects
Monitor volume status regularly at the bedside, including orthostatic blood pressure, especially for patients on diuretic or anti-hypertensive medications, and manage adverse effects
Provide ambulatory supervision for high-risk older adults (by nursing or physical therapy if needed) and appropriate adaptive equipment (e.g., walkers)
Avoid bed rest only orders and ensure that patients have time throughout the day to sit in a chair and ambulate
Encourage independent ambulation for those who are able to walk independently, directly countering some elder's and healthcare professionals' belief that bed rest is restorative
Attend to patient's toileting needs
Minimize the use of tethers (e.g., urinary catheters, cardiac telemetry, and IVs) and avoid mechanical restraints that limit movement in the bed. Promptly discontinue unnecessary tethers as they contribute to immobility and increase the rate of delirium, infections, and falls.

7.5 Common High-Risk Events and Recommendations

7.5.1 Falls and Immobility

Hospitalized older adults are at high risk of falling due to many factors: underlying comorbidities and functional impairments, the impact of acute illness, hospital-associated deconditioning due to bed rest, adverse treatment effects targeting the acute illness (e.g., diuretics for heart failure), hospital-induced symptom management (e.g., inappropriate use of anticholinergics or sedative-hypnotics), and challenges navigating unfamiliar surroundings. A history of prior falls, abnormalities in gait, balance, leg strength, ability to get up from the bed, and impaired cognition identify older adults at risk for falls. Immobility during hospitalization leads rapidly to decreased muscle mass and strength, impaired ambulation, and increased risk for falls. Falls increase adverse events, hospital costs, and lengths of stay. It is important to take measures to reduce the risk of falls, and several components have been shown to do so (Table 7.10).

7.5.2 Orthostatic Hypotension

Orthostatic hypotension (OH) is a common, serious, and often unrecognized issue estimated to occur in approximately 30% of older adults in the community and twice as common in those admitted to hospital [37]. It is defined as a drop of at least 20 mmHg in systolic pressure or a 10 mmHg drop in diastolic pressure within 3 min of standing. Aging-related changes in plasma volume, baroreflexes, and venomotor tone, exacerbated by comorbid conditions (e.g., diabetes, hypertension, and Parkinson's disease) contribute to OH. It can be symptomatic or asymptomatic, and most older adults are asymptomatic (e.g., they do not complain of lightheadedness). Since orthostatic pressures are usually not measured unless there is clinical suspicion, it is frequently missed in older adults. OH is exacerbated by bed rest, dehydration, medications, and other interventions. Hospitalized patients with OH are at increased risk for falls and injury, and it often persists after discharge, where it is associated with falls, syncope, cardiovascular complications, and all-cause mortality. It is an easily diagnosed and remediable condition and OH should be routinely assessed on admission and at intervals throughout the hospital stay. Contributing factors should be systematically addressed to reduce falls and other complications. Patients with OH should be taught behavioral modification techniques like standing and waiting a few minutes before attempting to walk in order to minimize falls.

7.5.3 Sleep Disturbances

Sleep disturbances occur in approximately 30% of hospitalized older adults and contribute to significant adverse effects, including delirium. Sleeplessness is due to multiple factors, including the illness itself (e.g., pain, dyspnea), high noise and light levels, medication effects or withdrawal, and frequent disruptions from usual processes of care (e.g., phlebotomy, vital signs, medication administration). Hospitalists should enter orders and work with nurses and others to minimize these disruptions. Despite the known risks associated with sedative-hypnotics, including falls, hip fractures, and delirium, approximately 30% of hospitalized patients receive these medications, often because it is included in routine standing orders. This is inappropriate, and sleep deprivation is best managed by including bundling care processes at night (e.g., ordering that vital signs, blood draws, and daily weights be obtained during the same hour rather than intermittently throughout the night), optimizing the sleeping environment, utilizing non-pharmacological sleep aids, such as warm drinks and soothing music, and avoiding generic order sets for sleep, anxiety, and pain.

7.5.4 Malnutrition

Nutritional deficiencies are a common occurrence in acutely ill hospitalized older adults and are associated with increased risk of complications, institutionalization, and death [37]. Approximately 35% of hospitalized adults age 70 and older suffer from moderate or severe protein-calorie malnutrition, and vitamin and electrolyte deficiencies further complicate the clinical course. A standardized approach to assessing nutritional risk is recommended, such as the brief Mini Nutritional Assessment (MNA) [37]. At-risk patients should receive a dietitian-led individualized nutritional treatment plan. In addition to considering supplements, important remedial factors include difficulty in self-feeding or chewing, need for dentures, dysphagia, anorexic side effects from medications, or a too restrictive diet. Constipation, commonly seen in hospitalized older adults due to decreased mobility, medication side effects, or illness, also contributes to poor oral intake. Easily implemented interventions include sitting the patient up to eat, relaxing dietary restrictions, and providing assistance as needed to promote oral feedings whenever possible. The decision to consider a feeding tube is complex and demands a careful discussion with the patient and family with an honest and full appraisal of the immediate and long-term burdens and benefits of this intervention. In certain circumstances, such as advanced dementia, feeding tubes have not been shown to prolong survival or improve comfort [38].

7.5.5 Nosocomial (Hospital-Acquired) Infections

Nosocomial infections are common in older adults with severe illness, comorbid conditions, functional impairment, and malnutrition. The lack of fever and the presence of atypical symptoms in many elders contribute to misdiagnosis. Common infections include pneumonia, intravascular catheter-related infections, *Clostridium difficile* associated diarrhea, and urinary tract infections (UTIs). The strongest risk factor for hospital-acquired pneumonia is mechanical ventilation. Patients with dementia and Parkinson's disease, as well as those on antipsychotics, are at higher risk. Strategies to prevent aspiration pneumonia include attention to oral hygiene and safe feeding techniques. *Clostridium difficile* associated diarrhea is a serious and often persistent nosocomial infection and causes significant morbidity and mortality. Risk factors include exposure to antibiotics, advanced age, duration of hospitalization, and use of a proton pump inhibitor (PPI). Key strategies include using antibiotics with the narrowest spectrum possible, avoiding PPIs when possible, early recognition and treatment, and implementation of contact precautions. UTIs associated with indwelling urinary catheters are the leading cause of nosocomial bacteremia and carry high morbidity and mortality. As seen with other serious infections in older adults, these patients often present only with unexplained confusion, hypotension, or acidosis. It is strongly recommended to limit catheter use, routinely monitor the need for the catheter, and remove it as soon as possible. Overall, adherence to infection control programs in the hospital can prevent and reduce the rates of nosocomial infections. Asymptomatic bacteriuria is very common and often leads to erroneously prescribing antibiotics (see discussion in Sect. 7.5.9). Chapter 24 provides in-depth information.

7.5.6 Pressure Ulcer

A hospital-acquired pressure ulcer (HAPU) is a CMS designated "never event" and as such, Medicare does not reimburse hospitals for the costs of treating an acquired Stage III or IV ulcer. The incidence of HAPU ranges from 7% to 9%, and it is associated with significant morbidity and mortality, high costs, and directly impacts transition planning [39]. Several hospital factors increase the risk of acquiring a pressure ulcer: immobility, malnutrition, incontinence, and cognitive/neurologic impairment. The Braden and Norton scales are commonly used in hospitals to assess risk and target patients for preventive interventions, including daily skin assessment, proper repositioning for bed-bound or mobility-limited patients, use of moisturizing creams, optimizing nutritional status, use of pressure-reducing products as indicated, and encourage ambulation. It is important to learn how to safely move and position a patient in bed (e.g., from lying to sitting up at 45°) without increasing pressure, shear, or friction forces on the skin, as an incorrect technique inadvertently causes pressure ulcers. The hospitalist should review daily with nursing the status of a patient's skin or do the evaluation her- or himself.

7.5.7 Volume Shifts, Impaired Response

Usual aging is the result of a complex interplay among the normal physiologic aging changes in the renal, endocrine, cardiovascular, and other systems, along with the additional impact of age-associated diseases such as hypertension, heart disease, and diabetes. The aging kidney is less able to concentrate urine or excrete free water, and is less able to mount an effective and efficient response to dehydration, salt restriction, or volume excess. The left ventricle is hypertrophied, and the vasculature is stiffer and less responsive to β-adrenergic stimulation. With increased heart rate, volume depletion, loss of atrial contraction, or other stresses, the aged heart is less able to maintain hemodynamic stability. In the hospital, the volume status of older patients is frequently challenged by interventions such as intravenous hydration, diuretics, salt/fluid restriction, and keeping patients Nothing Per Oral (NPO) for procedures. Because of an impaired ability to appropriately respond to volume shifts, older patients often become dehydrated, experience fluctuations in blood pressure and pulse, develop signs and symptoms of volume overload, or rapidly develop serum chemical abnormalities, such as hypo- or hypernatremia. It is important to monitor weight and physical signs of dehydration (increased skin turgor, dry oral mucosa (if not mouth breathing), lack of axillary moisture), and volume overload (jugular venous pressure, edema) to detect and treat these problems early.

7.5.8 Constipation

Constipation is common in older people and complicates the hospital course of many older adults if not anticipated and prevented. It is estimated that 50% of community-dwelling elders suffer from constipation and climbs to almost 70% in nursing home residents. Risk factors include diseases like Parkinson's disease, dementia, post-stroke syndromes, and endocrinopathies as well as medications such as opiates, diuretics, and antacids. The hospital environment puts elders at further risk of constipation due to bed rest and immobility, use of constipating medications, uremia, and electrolyte abnormalities (hypokalemia, hypercalcemia, hyponatremia).

Elders may show the typical symptoms and signs of constipation, but they often present instead with delirium, urinary retention, and overflow diarrhea or fecal incontinence/seepage in the setting of impaction. Prevention and treatment of constipation involve encouraging mobility, treating electrolyte disturbances, ensuring adequate hydration and dietary fiber along with regular screening to reduce constipating medications. If those cannot be discontinued, instituting a daily bowel regimen is essential. Once constipation develops, the use of stool softeners, such as docusate, has little to no benefit. Preferred agents include osmotic laxatives, such as polyethylene glycol, along with stimulants, such as bisacodyl and senna. Caution should be used when considering phosphate and magnesium containing products as these can lead to worsening kidney function and electrolyte disturbances in those with reduced GFR. If enemas are needed, tap water is safer in older adults. Using lactulose in patients with significant colonic dilation or pseudo-obstruction can lead to further gas production from sugar fermentation, causing worsening abdominal pain, bloating, and even perforation [40]. Chapter 24, Geriatric Gastroenterology, has a detailed review on managing constipation.

7.5.9 Urinary Incontinence

Acute urinary incontinence occurs in approximately 35% of hospitalized older adults [41], and is a high-risk condition for several reasons (Table 7.11). Hospitalists should communicate daily with nursing staff to recognize acute urinary incontinence and initiate an investigation for retention or diuresis. Too often acute urinary incontinence is ignored or assumed to be chronic or functional. It is important to remember that asymptomatic bacteriuria is very common among older adults and should not be treated with antibiotics, which occurs frequently. Delirium is not a result of bacteriuria without urinary tract symptoms or fever otherwise unexplained. Following the assessment, potential interventions include medication review to discontinue potentially offending medications, such as diuretics or anticholinergics, avoidance of tethers or restraints, cued or scheduled voiding, use of a bedside commode, limiting continuous intravenous fluids during the night, and encouraging mobility [42].

Table 7.11 Why is urinary incontinence a high-risk condition in older adults?

Moisture contributes to the development of sacral pressure ulcers
Indwelling urinary catheters are used to keep track of output (and to keep the area dry), leading to serious urinary tract infections
Patients may fall and suffer a serious injury while urgently attempting to reach the bathroom
Patients feel overwhelmed and isolated to have developed an age-related infirmity, especially when this problem is not often recognized or acknowledged by healthcare providers

7.6 Bring It All Together: Engineer Geriatric Issues into Daily Rounds

As has been detailed above, the elderly are at an increased risk relative to other hospitalized patients due to a greater susceptibility to delirium and functional decline. Many of these risks are modifiable if careful protocol-driven pre-

Table 7.12 Tips for daily rounds

Area of concern	Check/ask
Goals of care/ transition plan	Daily update on care transition plan Is plan still consistent with patient goals, preferences, and values?
Cognition/mood	Use delirium screen Ask orientation re: person, place, time Test for inattention (count from 1 to 10 and back from 10 to 1) 3-item recall; consider mini-cog Assess interaction and mood
Environment	Wake patient, help sit them up Ensure they have glasses, hearing aids, teeth Open blinds, turn on TV, hand them newspaper Encourage family to come visit, stay the night Encourage bringing familiar objects (e.g., a blanket) or photos of familiar faces from home
Mobility	Do not use “Bed rest” or “Out of Bed prn” orders Be specific: Sit in chair for meals; walk with assist 3 times daily Physical Therapy or Occupational Therapy evaluation as needed Consider briefly watching patient stand/walk during rounds
Tethers	Check need for all tethers every day Is telemetry still required? Is the IV needed (for medication, for fluids) continuously? Is continuous pulse oximetry required? Can a different option such as the ear be used? Is there an indwelling urinary catheter in place? Is it required? Are SCDs really needed? Any restraints? REMOVE and consider a sitter, if possible
Fluid balance	Check for adequate hydration (PE, weight, access to water, within reach?) Actively encourage patients to drink (as appropriate) Check for volume overload Check for orthostatic hypotension Trend daily weights
Nutrition	Consider nutrition consult Assess appetite
Continence (urine/ bowel)	Check for last bowel movement, screen for constipation Assess urine incontinence/retention Use cueing and bedside commode
Skin	Check skin daily, especially pressure points; check with nursing for skin status daily Use skin-safe techniques to move patient in bed for general exam (e.g., do not pull or drag across sheets; support when sitting up) Check IV sites
Sleep	Ask about sleep Use environmental/nonpharmacologic options
Medications (scheduled and prn)	Review medication list daily; check for new and prn medications; check against Beers Criteria (Chap. 5) Avoid anticholinergics, antihistamines, and benzodiazepines (but be aware of chronic use and do not stop abruptly) Assess for withdrawal symptoms (alcohol, other medications) Address adequate pain control

cautions are initiated. Table 7.12 proposes a checklist to use as an adjunct to daily rounds, in an effort to screen for and potentially prevent the common hospital-related complications specific to the geriatric population.

7.6.1 Alternatives to Hospital Care

It is important to recognize that hospitalizations and care transitions present significant challenges for older, frail patients. In response to this, it has been demonstrated that many older adults with selected medical conditions may safely be offered alternatives to hospitalization depending upon their clinical setting, available resources, and their goals and preferences. The alternatives to hospitalization may include bringing in home health services, or continuing medical care in the older adult's facility without transfer. Hospital-level care can be provided safely in the home for several conditions, including pneumonia and urinary tract infection. However, reimbursement rules in non-capitated systems have historically limited its feasibility [43]. In response to the SARS-CoV-2 pandemic, alternative care models, such as Hospital at Home, are gaining widespread support as reimbursement hurdles are being removed. The hospitalist will likely have a central role in helping to define alternatives to hospital care, an emerging field that is driven by advancements in technology, quality and safety outcomes, and reimbursement strategies [44, 45]. Care needs to be taken to ensure that highly reliable models are developed, implemented, evaluated, and sustained.

7.6.2 Bring High Value to the Hospital and Healthcare System

Hospitalists are ideally and uniquely positioned to play a major role in improving quality and safety for older hospitalized adults and in championing and supporting hospital-wide interventions [34]. Some of these interventions are targeted to prevent specific adverse events, such as hospital-wide fall prevention programs that use information technology, patient education, and plans of care to communicate patient-specific alerts to the team [46]. Other targeted interventions identify older patients at risk for adverse drug reactions [47] or employ protocols for medication appropriateness, including computerized decision support and alerts [48–50]. Hospital-based mobilization programs are an effective method to promote older adults to get out of bed and maintain function [51, 52]. The Hospital Elder Life Program targets delirium prevention and management through practical, hospital-wide interventions that address sleep, orientation, and cognition, successfully decreasing rates of delirium, thus reducing hospital length of stay and costs [53]. The use of checklists and admission order sets can improve quality of care for older adults by ensuring that evidence-based principles of geriatric care are integrated into daily care, such as orders for daily mobilization, assessing the presence of delirium, or restricting the use of high-risk medications.

Many hospitals have developed designated inpatient geriatric units to provide interprofessional care for high-risk elders through a combination of structural modifications, order sets and protocols, and dedicated and skilled geriatric staffing. Often called Acute Care of Elders (ACE) units, they have been demonstrated to improve function and reduce the discharge of patients to long-term care facilities. In place of geographic units, some hospitals utilize mobile geriatric interprofessional teams to provide consultation for high-risk older patients throughout the hospital. The results of such programs show benefit but have more variable results than ACE units [14, 54]. Hospitalists have increasingly participated in co-management models with medical subspecialty and surgical specialists, such as oncologists, orthopedists, and neurosurgeons [55, 56]. This model has demonstrated improvements in quality metrics, resource utilization, such as length of stay, and provider and patient satisfaction.

The Age-Friendly Health System initiative was developed in response to the disproportionate harm that older adults suffer when cared for by most health systems [57]. An Age-Friendly Health System reliably delivers a set of four evidence-based models and practices, known as the 4Ms framework, to all older adults: what *M*atters, *M*edication, *M*entation and *M*obility. Hospitalists can play a key role in assisting their organization achieve national recognition as an Age-Friendly Health System by advocating for and implementing these high-value elements of care for hospitalized older adults to improve quality, lower costs, and reduce harm.

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8 Screening Tools for Geriatric Assessment by Specialists

Jane F. Potter and G. Michael Harper

Specialist clinicians can and should use practical assessment tools in the evaluation of older patients. These instruments screen for geriatric syndromes that put a patient at risk for an adverse outcome from a new medication or procedure a specialist might be considering. Such underlying geriatric syndromes often are subtle and often not listed on the patient's problem list or in the referral letter (Table 8.1).

The population over the age of 80 years is characterized by increasing vulnerability. This vulnerability relates to three cardinal differences in this population compared to younger people:

1. *Multiple chronic health problems or multimorbidity.* Typically, an octo- or nonagenarian has 10–15 chronic health problems. One health problem may mask the symptoms of another, and treating one problem may adversely affect another. Multimorbidity typically leads to polypharmacy that creates a high risk of an adverse drug effects and drug–drug interactions.
2. *Loss of physiological reserve.* Longitudinal studies demonstrate loss of reserve beginning around the age of 30 years and continuing throughout the life span. Physiological losses are subtle, and deterioration occurs slowly. Progressive loss is appreciated earliest among athletes who notice they have lost their competitive edge. Competition times in running and swimming, for example, gradually get slower even with continued vigorous training and without injury. These physiological changes are variable among organs and individuals. However, by age 80 or so an individual has lost enough physiological reserve (in the kidney, lung, heart, etc.) that they are at increased risk of a significant clinical problem when they experience a perturbation, such as an operation, a diagnostic procedure, a fall, or a new medication.
3. *Heterogeneity among individuals*. With age, individuals become more different from one another. This heterogeneity makes the care of each older person unique. Clinical trials (which rarely include very old individuals) and clinical guidelines may or may not apply to a given patient over age 80 or so. This heterogeneity requires considerable judgment when advising a diagnostic test, surgical intervention, or medical treatment for such a patient. A careful clinical risk–benefit judgment must be made, and the patient needs to be a part of such discussions if com-

Table 8.1 Assessment domains and some recommended screening and assessment tools

Domain	Suggested tools
Falls risk	STEADI (Stopping Elderly Accidents Deaths and Injuries) The Timed Up and Go Test
Dementia	The *Mini-Cog*™ St. Louis University Mental Status Exam (SLUMS)
Delirium	The *Confusion Assessment Method (CAM)*
Frailty	Timed Up and Go >15 seconds or the Frail Scale
Depression	Personal Health Questionnaire 2 (*PHQ 2*)
Physical self-maintenance	The Katz Index of Activities of Daily Living (ADLs) The Lawton Instrumental Activities of Daily Living (IADLs)
Malnutrition	the Mini Nutritional Assessment (MNA®)
Social support	"In case of illness or emergency, who is available to assist you." Advanced care planning: living will, powers of attorney for health and finance, advance directives.
Potential for urinary retention	The *International Prostrate Symptom Score (I-PSS)*
Polypharmacy	Beers criteria STOPP/START

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plications and unexpected outcomes are to be minimized and patient understanding and satisfaction are to be maximized. While this heterogeneity is frustrating to some clinicians, it is remarkably rewarding to others as it demands maximum clinical knowledge, strong communication skills, and knowing each patient and their goals.

For a specialist who is guiding an older person, screening for subtle problems is important and tools are of value. Many of these tools are discussed in detail in other chapters. Here we discuss practical and common assessment tools that were well studied and disseminated. This chapter provides easy access for a clinician seeing a patient when time is limited. These assessment tools are most often done by various members of an interprofessional team (a group of clinicians of different professions working together regularly and collaboratively). In the office setting, these assessment tools are often performed by a nurse working in close partnership with a physician, nurse practitioner, or physician assistant.

8.1 Fall Risk

Falls are common, and after age 80 rarely have a single cause. Identifying people at risk of falls allows those individuals to be monitored more closely during times when falls are even more likely such as when starting new medications, after procedures, or during hospitalization. Falls risk screening is done by asking three key questions. Questions that are recommended come from a CDC tool called STEADI (Stopping Elderly Accidents Deaths and Injuries) [1], which was derived from the Falls Guideline of the American and British Geriatrics Societies [2].

1. Do you feel unsteady when standing or walking?
2. Do you worry about falling?
3. Have you fallen in the last year?
   (a) If yes, how many times?
   (b) If yes, were you injured?

When the patient answers "no" to all three questions, they are at low risk of falls. If the answer is "yes" to any of the questions, they are at some risk and a performance-based test is recommended. Knowing that a patient is at risk helps to avoid falls by alerting all to the increased fall risk and to developing preventive strategies.

The Timed Up and Go Test (TUG) is the most popular performance-based test and recommended by STEADI as a next step in evaluation for those who screen positive on the questions. The TUG can be done in a few seconds and provides a sense of a patient's mobility and risk of falling [3, 4].

To perform the TUG, the clinician gives the following instructions to the patient and informs the patient he or she is being timed. The patient is instructed to:

1. Rise quickly from the chair without using their arms
2. Walk 10 feet using a cane or walker if they normally do so
3. Turn around
4. Walk back to the chair and sit down.

The patient is given a precise "Start" command while an observer measures the time in seconds from the "Go" command until the patient sits back down. Fall risk is related to the elapsed time: 10 s or less—low risk for falls; 11–19—moderate; 20–29—high risk; and 30 or greater is impaired mobility with a very high risk of falling. Ideally, patients at significant risk would have an additional evaluation by a primary care provider and often have consultation with a physical therapist.

If the fall risk is significant and the benefit of a new therapeutic or diagnostic intervention is considered to outweigh the risk, preventive strategies such as guidance to the patient and family and adding "fall risk" to the problem list within the EMR.

8.2 Dementia

Cognitive impairment of any level is a significant risk factor for complications from any clinical intervention [5], such as hospitalization, a diagnostic or therapeutic procedure, or medication. Such impairment may effect up to 30–40% of seniors over the age of 80. Further, cognitive impairment is not always obvious to even a trained clinician, and for specialists, it may not be in the referral note of a patient especially when this problem is mild or moderate. Accordingly, it is in the best interest of the patient if the specialist or his or her staff screens an older patient for cognitive impairment. The *Mini-Cog*™ [6] is the simplest and most popular such assessment tool:

1. Instruct the patient to listen carefully and remember three unrelated but simple words and then repeat those words. Pen, watch, and tie are examples.
2. Instruct the patient to draw the numbers of the face of a clock after handing the individual a paper with only a blank circle representing the outline of the clock.
3. Instruct the patient to draw the hands of a clock to represent a specific time such as 9:15 or 1:25. The patient may take as much time as needed to complete this task.
4. Then instruct the patient to repeat the three words given before the clock drawing distraction.

Scoring is simple: one point is given for each correctly recalled word after completing the clock drawing and two points for a clock with correctly spaced numbers and placed hands.

Zero words recalled is a positive screen for dementia; one-two words with an abnormal clock drawing is a positive screen; one-two with a normal clock drawing is a negative screen; a score of three is a negative screen.

A clock drawing is normal only if the numbers are placed in appropriate sequence and the hands are displayed properly. A positive screen for dementia should alert the specialist to the risk associated with underlying cognitive impairment.

The Mini-Cog test is copyrighted and cannot be modified. It is freely available to universities, health professionals, hospitals, and clinics at minicog.com and can be used without permission. Other cognitive assessment tools are available, but the Mini-Cog [7] is the simplest and most popular.

There are other more sensitive screening tools to detect and monitor cognitive impairment over time. One that is gaining popularity is the St. Louis University mental status exam (SLUMS) [8], it has test characteristics superior to the Mini-Mental State exam (which is copyrighted and has fees) and is freely available complete with training materials that are important to insure proper administration and interpretation at https://www.slu.edu/medicine/internal-medicine/geriatric-medicine/aging-successfully/assessment-tools/mental-status-exam.php. SLUMS is a 30-point test, composed of 11 questions that take about 7–10 min to complete. Another cognitive screening test is the Montreal Cognitive Assessment (MOCA). This test, like the SLUMS, is valuable in early detection of mild cognitive impairment and dementia. Information on the required annual training/retraining (with fees) to have permission to use this test is at www.mocatest.org. Both SLUMS and MOCA are adjusted for education level and have versions in various languages.

8.3 Delirium

Delirium in older is easily missed by even experienced clinicians because older people often have the hypoactive type (as opposed to the hyperactive, type more common in younger individuals). Recognizing delirium is critical, as it is a sign of serious illness. Delirium in all forms is a risk factor for rapid mental deterioration, prolonged hospitalization, complications, and death. Risk factors for delirium are advanced age, multiple co-morbidities, dementia, depression, sensory impairment, and functional impairment. Precipitating factors for delirium include illness, hospitalization, under and over treatment of pain and many medications including those available over the counter.

The gold standard for the diagnosis of delirium is examination by a psychiatrist or other expert in delirium. To make the evaluation of delirium accessible to all clinicians a simplified assessment tool was created and validated [9, 10]. The *Confusion Assessment Method (CAM)* is now widely used to detect delirium [11].

The CAM uses the same criteria in the Diagnostic and Statistical Manual for Mental Disorders (acute onset of cognitive change, fluctuation, inattention, disorganized thinking, altered level of consciousness, disorientation, memory impairment, perceptual disturbances, psychomotor agitation or retardation, and altered sleep–wake cycle). The Short-form Confusion Assessment Method (CAM) is based on evaluating the patient for a change in cognition and has four questions:

1. Acute onset of cognitive change over hours to days and a fluctuating course (with a more lucid interval during a 24 h period)
2. Inattention
3. Disorganized thinking
4. Altered level of consciousness

The diagnosis of delirium requires the presence of 1, 2 and either 3 or 4. In order to rate the CAM a brief cognitive test like the Mini-Cog Test must be done.

There is a cultural bias that older people are often sleepy which is why hypoactive delirium is often missed. Also, the impaired cognition of delirium is often mistaken for dementia in a clinical setting. It is imperative to establish the onset of the cognitive change by asking other observers such as family members if and how cognition has changed from baseline. Dementia cannot be diagnosed in a patient with an altered level of consciousness and does not fluctuate over hours, or days. Dementia is a risk factor for delirium, so the two can co-exist.

Inattention can be assessed by observing that the patient is not tuned into the conversation or is not fully aware of the surroundings. A patient with delirium will often drift off in midsentence or just stare at something other than the clinician. A quick test of attention is to have patients say the months of the year forward then backward. Disorganized thinking is detected by illogical or disconnected responses to questions. Responses are often irrelevant, rambling, or incoherent or the patient may have hallucinations or delusions.

Consciousness can be assessed by evaluating the mental status for hypo or hyperactivity (agitation). A common clinical trap is to assume that the patient is sleepy or just waking up when, in fact, this is hypoactive delirium. Some experience and training are suggested. The CAM training material and the various versions of the CAM are available at https://help.agscocare.org; registration is required, and materials are free to nonprofits and educational institutions.

A guideline for both prevention and management of postoperative delirium is available at https://geriatricscareonline.org/toc/american-geriatrics-society-clinical-practice-guideline-for-postoperative-delirium-in-older-adults/CL018. It was developed by an expert panel from the American College of Surgeons and the American Geriatrics Society (AGS) with support from the John A. Hartford Foundation. The guideline can be downloaded for no charge to AGS members and for a small fee for non-members. A more detailed discussion of delirium can be found in the Delirium chapter (see Chap. 2).

8.4 Frailty

Frailty is a clinical phenotype that is a marker for increased vulnerability to adverse health outcomes and increased mortality after surgical or medical interventions. The diagnosis of "frailty" has mostly been utilized in research settings to identify those at increased risk of adverse outcomes and for biological studies. For example, in a study of over 1000 older adults receiving general surgery, those who were frail were up to 20 times more likely to need care in a post-acute facility as compared to those who were robust or not frail [12]. Subspecialists are increasingly interested in the identification of the frail subset of older adults in order to help predict and potentially prevent adverse outcomes related to procedures and treatments. Dozens of frailty assessment methods have evolved over the past several years that may be useful to clinicians as they attempt to determine which older adults may be at most risk for adverse outcomes. Most of the tools perform well at identifying vulnerable older adults. A consensus conference on frailty suggested that those over age 70 should be screened for physical frailty, in part because physical frailty can be potentially treated or prevented with specific modalities, and the adverse outcomes associated with frailty ameliorated [13]. Use of any of these tools by clinicians has been delayed because of confusion about which tool to choose, and because of lack of research on how to manage a patient differently once frailty status is determined.

In general, there have been two approaches to the identification of frailty, which in turn has driven the development of multiple frailty assessment tools. The physical frailty or phenotype approach suggests that frailty emerges from an age-related biological process that results in weakness, fatigue, and low levels of activity. The frailty index approach suggests that frailty is driven by an accumulation of illnesses as well as cognitive and social decline that can be ultimately additive. Few guidelines exist on how to best choose a tool for the purpose at hand. Most tools have not been extensively validated or utilized across populations, and few comparison studies have been done that show a clear benefit of using one tool over the other. In addition, different tools may or may not be good matches for the intended use. For example, a brief screening tool may be appropriate for risk stratification while a more formal frailty assessment could be required to define preoperative interventions meant to modify surgical outcomes.

8.4.1 Frailty Measures

Given the wide array of tools and the wide variety of populations in which the tools may need to be implemented, the choice of which to use can be tailored to a clinical situation and clinical need. In addition, choosing tools that have been previously used in a variety of populations and that have demonstrated predictive validity in several settings should also influence the choice of tools. Time to complete a frailty assessment also matters in a clinical setting. The development of discipline-specific clinical guidelines of how best to manage frail older adults in a variety of clinical settings is needed to more appropriately apply frailty tools.

8.4.1.1 Single-Item Surrogate Frailty Assessments (2–3 min)

For feasibility, single-item measurement tools have been proposed to stand in for a more formal frailty measurement. Gait speed measured over a 4 m distance is recognized as a highly reliable single measurement tool that predicts adverse outcomes [14, 15]. A timed up-and-go score (the time it takes to rise from a chair, walk 10 feet, turn around, and return to sitting in the chair) ≥15 s is closely related to both postoperative complications and 1-year mortality [16]. Some of these single measures are components of both the frailty index and frailty phenotype approaches, and although they can be easy to use and predictive of certain outcomes, they can lack sensitivity and specificity of the full frailty assessment tools.

8.4.1.2 Frail Scale (<5 min)

The Frail Scale was developed as a quick screening tool [17]. The Geriatric Advisory Panel of the International Academy of Nutrition and Aging developed this approach to define frailty as a case-finding tool [14]. This brief tool simply requires asking five questions and scoring a 1 for each yes. Those who are frail score 3, 4, and 5, and those who are robust score 0 [18].

*F*atigue (Are you fatigued?)
*R*esistance (Can you climb a flight of stairs?)
*A*mbulation (Can you walk one block?)
*I*llnesses (greater than 5)
*L*oss of weight (greater than 5%)

8.4.1.3 Physical or Phenotypic Frailty (10 min)

Phenotypic or physical frailty is the most widely used measurement tool used by frailty researchers, and especially those interested in learning about the biology that may underlie frailty. This frailty evaluation was 1 of 2 strategies recognized by the American College of Surgeons/American Geriatric Society's optimal preoperative assessment of the older adult [19]. The tool requires a questionnaire, a handheld dynamometer, and a stopwatch for implication. The recent development of a web-based calculator has further accelerated the ease of use of this tool. Access to needed measurement equipment, training guides, and web-based calculator is available at https://jhpeppercenter.jhmi.edu/a1b1/login.aspx. This clinical phenotype has five components that can be assessed using readily available measurement equipment and a web-based frailty calculator as described below. The score is determined on a 0–5 scale with 0 being not frail; 1–2 pre-frail; and 3–5 frail. The severity of the risk is linear.

The major measurement domains include:

1. Shrinking (greater than 5% loss of body weight in the last year)
2. Weakness (grip strength of the dominant hand in the lowest 20% of the age and body mass index (BMI))
3. Poor endurance (self-reported exhaustion)
4. Slowness (lower 25th percentile of population average for 4 m walking time)
5. Low activity (assessed by activity questions that identify weekly energy expenditure of less than 383/270 kcal for males and females, respectively)

Although this tool is commonly utilized in research settings, it takes more effort than other methods and requires specialized equipment (i.e., dynamometer and a stopwatch) to measure it. Hence, it may not be a practical method for a busy clinician to assess frailty.

8.4.1.4 Deficit Accumulation Index

The most widely recognized deficit accumulation method to measure frailty was developed from the Canadian Health and Aging Study [20]. Between 21 and 70 deficits are suggested to be measured. Although considerable time may be needed to gather information in the initial developmental stages of individualized frailty indices, data may be quickly accessible if they are already available in the electronic medical record. The frailty index score is calculated as the number of characteristics that are abnormal (or "deficits") divided by the total number of characteristics measured. Scoring has mostly been done by summing the total deficits and comparing to a published cut-off score, or by calculating a ratio between deficits and total number of characteristics. This tool can be accessed in a series of references [21–23]. Adaptations of this tool for risk assessment in a variety of clinical settings including trauma surgery outcomes have demonstrated the tool's predictive ability for adverse outcomes [24]. However, beyond risk assessment, the wide variety of unrelated variables included in the tool and its conceptual basis as a tool with cumulative unrelated deficits make it less useful for designing targeted interventions or biological studies in vulnerable frail patients.

8.4.1.5 Additional Tools

There are many additional published measures of frailty but to date are not as well studied or as broadly validated [25]. One of these was popularized by the Journal of the American College of Cardiology. They have created an online frailty calculator for patients with cardiac disease such as aortic stenosis: http://tools.cardiosource.org/Tools/ccpFrailty.html. This tool derives a frailty score based on a patient's BMI, gait speed, calf circumference, Activities of Daily Living (ADL), and cognitive assessments, and the answers to several questions about function and activities. This tool is now being studied for use in other conditions and as a general indicator of recovery after surgery. The authors of this chapter are grateful to Dr. Jeremy Walston (Chap. 1—Frailty) for his comprehensive review of this topic.

8.5 Depression

Depression is a common problem in older people seeking medical care and one that is often under-recognized. Clinically significant depression is important to recognize, as it can be associated with poor outcomes in the treatment of associated illnesses and in recovery from major interventions such as a surgical procedure.

The simplest screen is the Personal Health Questionnaire 2 (*PHQ 2)* [26, 27]. Ask the patient if, in the last 2 weeks, how often they have:

1. Felt down, depressed, or hopeless and
2. Little interest or pleasure in doing things

Score each item 0 = not at all, 1 = several days, 2 = more than half the days, 3 = nearly every day.

A score ≥ 3 indicates a high likelihood of depressive disorder and should be followed up. For the nonpsychiatric specialists, the most appropriate action would be to raise the question of depression with the primary care provider who can address the need for additional testing such as a PHQ-9 and interview on symptoms and causes.

8.6 Physical Self-Maintenance

A chronic loss of any physical independence by an older person is a harbinger for adverse outcomes after acute injury, illness, or surgical procedure. Physical independence can be measured by several tools.

The Katz Index of Activities of Daily Living (ADLs) [28] is the best known, most studied, and simplest to use. This ADL index has been simplified since originally introduced and assesses an individual's ability to perform six functions:

1. Bathing
2. Dressing
3. Toileting
4. Transferring
5. Continence
6. Feeding

These ADLs are activities necessary for daily living and are typically readily performed by a 7-year-old. Each is scored on a 1 or 0 basis for each of the 6 items: a score of 1 if the patient is fully independent and a score of 0 if partially dependent (needing some help) or totally dependent. A score of 6 indicates fully independent function and a low risk for complications or poor outcome. The lower the ADL score, the worse the prognosis for the patient and the greater the likelihood of complications from a clinical intervention. Patients with the lowest scores have higher mortality rate and greater risk for long-term care placement. Identified impairments are also important for the specialist to consider in planning a diagnostic or therapeutic intervention as the strategies to achieve the desired outcome may need to be modified from those used in a patient with normal ADLs.

A parallel tool, the Lawton Instrumental Activities of Daily Living (IADLs), measures more complex skills required to live in the community [29]. The IADL scale measures eight functions also on a 1–0 scale, and the lower the score the less independent the patient. This scale measures the following activities:

1. The use of a telephone
2. Shopping
3. Food preparation
4. Housekeeping
5. Laundry
6. Transportation
7. Responsibility for medications and
8. Finances

Both the Katz ADL (https://consultgeri.org/try-this/general-assessment/issue-2.pdf) and Lawton IADL (https://consultgeri.org/try-this/general-assessment/issue-23.pdf) are downloadable from the Hartford Institute for Geriatric Nursing at the New York University College of Nursing (the Hartford Institute for Geriatric Nursing website, see above).

8.7 Nutritional Assessment and Screening for Malnutrition

Malnutrition is associated with poor outcomes, e.g., longer length of hospital stay, infections, pressure injury, and mortality. The European Society for Enteral and Parenteral Nutrition (ESPEN) defines malnutrition in an older person as "the presence of either a striking unintended loss of body mass (>5% in 6 months or >10% beyond 6 months) or a markedly reduced body mass (i.e. BMI <20 kg/m^2) or muscle mass." In its clinical practice guideline on "Clinical Nutrition and Hydration in Geriatrics" [30], ESPEN recommends:

1. Screening of all older adults, regardless of body weight or obesity, for malnutrition using a validated instrument.
2. A positive malnutrition screening shall be followed by systematic assessment, individualized intervention, monitoring, and corresponding adjustment of interventions.

That practice guideline recommends the Mini Nutritional Assessment (MNA®) as the instrument best studied in older people [31, 32]. The MNA is available online at https://www.mna-elderly.com in forms for self-administration and for incorporation in the EMR. In addition to standard parameters (BMI, weight loss, etc.), it includes two common contributors to malnutrition, i.e., immobility and neuropsychological problems.

8.8 Social Assessment

While a complete social assessment is not feasible in an office practice, any clinician caring for older patients should be aware of the factors involved in social assessment and when assistance from a social worker will be important to achieving the desired outcomes. Key elements of social assessment include [33]:

1. Patient characteristics: culture, ethnicity, education, economic situation
2. Family care system: identifying the primary and other caregivers and their level of burden
3. Environment: home safety, formal services
4. Advanced care planning: living will, powers of attorney for health and finance, advance directives

A single question often used to explore an older individuals access to family care is: "In case of illness or emergency, who is available to assist you." When an individual is identified, that information needs to be in the patient's health record as should the items listed in item 4 above. When the patient answers that there is no one identified to provide care, a full social assessment is needed.

8.9 Potential for Urinary Retention in Men

Urinary retention is a common problem among older men. This problem is often precipitated by a new medication, hospitalization, or surgical procedure. The specialists planning one of these interventions should be aware of an increased risk for urinary retention. The *International Prostrate Symptom Score (I-PSS)* can be administered by the patient to identify increased risk of urinary retention. The answers to the I-PSS are weighted on a 0–5 scale. The seven questions asked concern the frequency of the following symptoms noticed in the last month:

1. Incomplete emptying
2. Frequency
3. Intermittency (how often have you stopped and started again during urination)
4. Urgency
5. Weak stream
6. Straining
7. Nocturia

The sum of scores on the seven questions is the final score. The higher the score (35 is the highest), the greater the severity of prostatic hypertrophy and therefore the more concern for the urinary retention with an intervention. The I-PPS has an eighth question concerning the quality of life due to urinary symptoms that helps to guide a clinician on how the patient might feel about treatment. The I-PPS can be downloaded from the following website: http://www.urospec.com/uro/Forms/ipss.pdf.

8.10 Polypharmacy and Medication Safety

There are over 138 definitions of polypharmacy in the literature, those definitions are often based on the absolute number of medications being taken by a single individual. It is common for people with multimorbidity to take several medications. As the number of the medication taken by an individual increases so do the odds of a drug interaction or a drug adverse effects. The use of more drugs than necessary is called "inappropriate" polypharmacy. Simply following clinical practice guidelines in older patients with multimorbidity can result in combinations of medications that are not appropriate [34]. The same number of medications in a different individual may be maintaining health and quality of life, the so-called appropriate polypharmacy.

Newly approved drugs are a special hazard when prescribed to seniors. Studies of new drugs almost never include individuals over age 80. So prescribing such a drug is like entering the older patient into an uncontrolled clinical trial in an individual at increased risk of adverse events. Except in urgent situations and without an alternative, most geriatricians wait at least 2 years after a new drug has been released before prescribing it outside of a clinical trial. Often by that time, a more accurate drug profile is emerging. The vulnerability to drugs is not just to those taken systemically but occurs with topical agents, especially those administered in the conjunctiva. The wise clinician will make a thoughtful risk–benefit judgment and include the patient and primary care provider in the decisions about initiating drugs.

Prescribing medications safely for older adults is complex and has led to the development of tools to assist clinicians in selecting new medications and also in reviewing the appropriateness of a given individual's medication regimen. Two such tools are the Beers Criteria and STOPP/START; these are reviewed in detail in Chapter 5 (Medication Management). The Beers Criteria [35] provide tables of potentially inappropriate medications (PIMs) presented in the following categories:

1. PIMs that are best avoided in older adults in most circumstances
2. PIMS to avoid under specific situations, such as drug-diseases and drug-syndrome interactions
3. PIMs to be used with caution in older adults
4. Drug combinations to avoid due to drug-drug interactions
5. Drugs to be avoided or have dose reductions based on various levels of renal function

The Beers Criteria have been widely disseminated and have been used, arguably sometimes perhaps too aggressively, [36] by insurance companies to deny payment for a drug. In response, the AGS generated a letter to insurers about payment for drugs on the Beers list [37]. That letter reemphasizes that the Beers Criteria should never be used as the sole criteria for formulary decisions but rather to inform clinical decision-making, research, training, and policy. The Beers Criteria are available from the AGS at geriatricscareonline.org where pocket cards can be downloaded for free to AGS members and for $5.00 for non-members. Chapter 5—Medication Management develops the issue of appropriate prescribing more fully.

8.11 Tools Available from the National Institutes of Health

The NIH created a valuable resource for tools in assessing issues related to neurosciences. The NIH Toolkit covers the domains of cognitive, sensory, motor, and emotional functions. While it is designed as a resource for research and covers all ages, many of the tools are applicable to clinical practice. Tools have been carefully vetted and are applicable up to age 85. The tools are available online and are free at www.NIHtoolbox.org.

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9 Cardiothoracic Surgery

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Cardiovascular disease (CVD) remains the leading cause of death and disability in the USA. Cardiovascular disease (CVD) is age-related with both the incidence and prevalence of cardiovascular disease increasing dramatically with increasing age. It is believed that the annual costs in 2015 in the USA for CVD and stroke will exceed $320 billion [1]. Further, the total number of inpatient cardiovascular operations and procedures increased 28% from 2001 to 2010. Given the strong association between age and cardiovascular disease, the increasing population over age 65 is primarily responsible for this rise in cardiovascular surgery demand. The purpose of this chapter is to outline the considerations clinicians face when operating or intervening on the elderly patient with a specific focus on the management of the two most common problems: coronary artery disease (CAD) and aortic stenosis (AS).

The assessment of the geriatric patient who requires cardiovascular surgery is critical to providing optimal care. Frailty describes a biological syndrome whereby a patient is more vulnerable to stressors—i.e., acute or chronic changes in health status [2]. For the purpose of this chapter, frailty will mostly focus on an acute change in health that results from an intervention—either surgical or other catheter-based procedure. With newer technological options being offered for patients, many new therapies can be offered to elderly patients. The overarching question is whether these newer procedures will provide more benefit than burden or, indeed, be futile.

Frailty and its assessment are discussed in depth in Chap. 1—Frailty. Several pertinent aspects of frailty related to cardiothoracic surgery are presented here for convenience and emphasis. The underlying mechanisms that promote frailty are multiple (Fig. 9.1). Inflammation [3], insulin resistance [4], and decreased levels of testosterone [5] are all thought to play a role in promoting frailty. The production of inflammatory cytokines in response to cardiac surgery is more pronounced in elderly patients [6]. This pathophysiological state results in catabolism of muscle, weakness, and malnutrition. In essence, there is little reserve present in the state of frailty and as such, major operations and procedures can exacerbate the frail phenotype.

9.1 Assessment of Frailty

There are several methods for assessing a patient to discover if frailty is present preoperatively. It is no longer acceptable to simply look at the patient and make this judgment, as was a method in the past. Rather, a protocol-driven assessment is mandatory to identify the frail patient. If frailty is present, the patient is at a much increased risk for a poor outcome after a major perturbation such as surgery. At the University of Colorado Multidisciplinary Heart Valve Clinic consisting of surgeons, cardiologists, and others, three tools used for the preoperative assessment to identify frailty seem effective: the 5-m walk test, grip strength as assessed by a dynamometer, and the Fried scale. The 5-m walk test is simple to conduct. One only needs a well-lighted hallway with 1-m length marked off to conduct this test. This test is perhaps the easiest to utilize and understand. Afilalo [7] and colleagues established that slow gait speed, defined as >6 s to walk 5 m, was an incremental risk factor for increased mortality and morbidity following cardiac surgery. These authors combined the robust risk-adjusted models of predicted mortality from the Society of Thoracic Surgeons (STS) Adult Cardiac Surgery Database and the 5-m walk test in 131 patients. Importantly, the combination of a high predicted STS risk with slow gait speed predicts a nearly 50% chance of mortality or major morbidity (e.g., stroke, renal failure, prolonged ventilation, deep sternal wound infection, or need for reoperation) (Fig. 9.2). Finally, this study showed that slow gait speed will increase the STS predicted risk two- to threefold. This finding is of great value in directing contemporary

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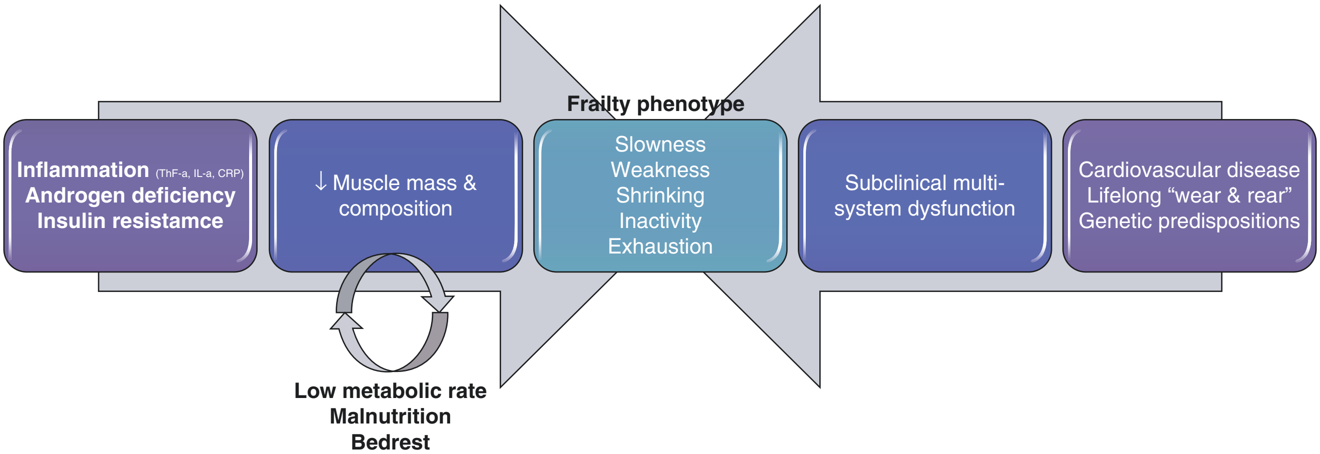
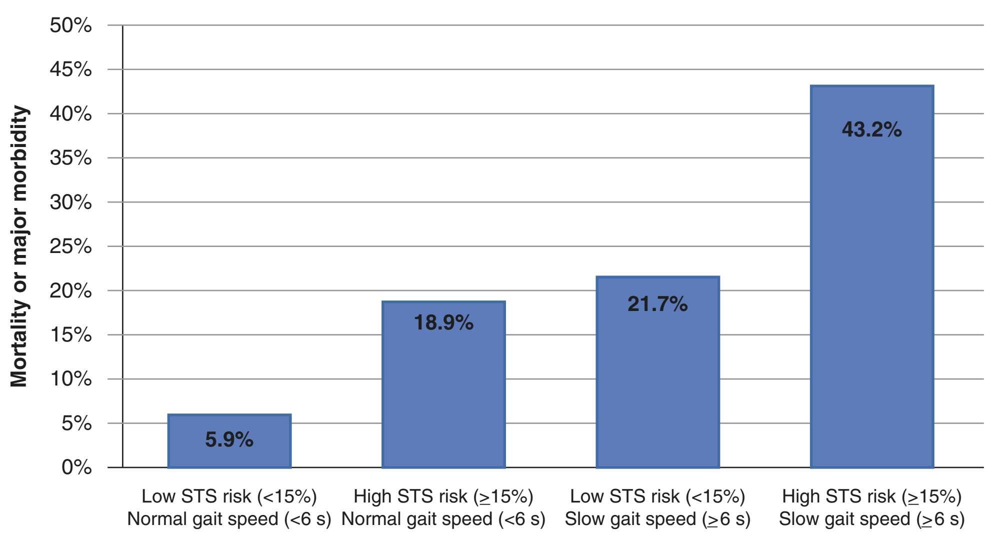


Fig. 9.1 (*Left*) The age-associated activation of inflammatory cells and decline in androgen hormones upset the balance between catabolic and anabolic stimuli, respectively, leading to a decline in muscle mass and composition known as sarcopenia . This detrimental response is aggravated in patients with insulin resistance and metabolic syndrome. The addition of bed rest and malnutrition initiates a vicious cycle of further decline in muscle mass, limiting the necessary mobilization of amino acids in times of stress. (*Right*) The accumulation of subclinical impairments in multiple organ systems resulting from cardiovascular disease, lifelong "wear and tear," and/or genetic predisposition lead to decreased homeostatic reserve and resiliency to stressors. Other pathophysiological pathways have been proposed. Biological pathways may manifest clinically as slow walking speed, weakness, weight loss, physical inactivity, and exhaustion—termed the phenotype of frailty. *CRP* C-reactive protein, *IL* Interleukin, *TNF* tumor necrosis factor (Reproduced with permission from Afilalo et al. [27])

Fig. 9.2 The dual risk factors of slow gait speed (>6 s to walk 5 m) and high Society of Thoracic Surgeons (STS) score (>15% predicted mortality or major morbidity) identified patients at the highest risk. Among those with the dual risk factors, 43.2% experienced a major morbidity or mortality compared with only 5.9% of those without either risk factor (Reproduced with permission from Afilalo et al. [7])



therapy for certain patients at increased risk for a poor outcome from open surgery. For example, frail elderly females (assessed by gait speed) with prior coronary artery bypass surgery and reduced left ventricular ejection fraction with severe aortic stenosis will be very high-risk patients for open, surgical Aortic Valve Replacement (AVR) and therefore should be considered for Transcatheter Aortic Valve Replacement (TAVR). Gait sped is now collected in the latest version of the STS Database and in the Transcatheter Valve Therapy (TVT) registry.

Frailty has a direct and strong association with excess mortality, morbidity, functional decline, and other adverse events following cardiac surgery. In two reviews of studies that objectively measured frailty in over 4700 patients collectively, frailty was strongly associated with excess mortality, morbidity, and functional decline [8, 9]. Not surprisingly, frailty was more pronounced in the older patients undergoing TAVR compared to younger patients undergoing coronary artery bypass or open AVR. Many studies point out the importance of identifying frailty preoperatively in patients proposed for open cardiac surgery for aortic valve replacement or TAVR. Its presence predicts inferior outcomes in these interventions. The association of frailty with functional outcomes remains an active area of further investigation.

9.2 Coronary Artery Disease/Coronary Artery Bypass Grafting

The combination of the explosion of the population aged >70 and the strong association of the development of atherosclerotic coronary artery disease with advanced age has fueled a demographic shift in the surgical management of coronary artery disease. Indeed, while the total volume of coronary artery bypass procedures has decreased from 2001 to 2010, the number of elderly patients referred for bypass surgery has increased. In fact, the percentage of octogenarians who receive coronary artery bypass grafting (CABG) has increased from 7% to 11% [10]. Remarkably, the mortality risk for elderly patients undergoing CABG has decreased while the predicted risk for surgery has been gradually increasing. The reasons for this achievement are unknown; however, postulated explanations include increasing use of the left internal mammary in elderly patients, more use of off-pump CABG, and greater collective experience with CABG.

Percutaneous coronary intervention (PCI) and CABG have emerged as complementary rather than competing interventions for the management of multivessel coronary artery disease. The vast majority of randomized controlled trials, which have compared PCI to CABG included very few patients >75 years of age. Small, non-randomized trials before the advent of drug eluting stents (DES) favored CABG over medical therapy [11] and CABG over PCI [12]. The quality of this body of evidence, however, is insufficient to support a firm recommendation that CABG can be demonstrated to be superior to PCI or medical therapy in elderly patients. However, age alone should not preclude the consideration of CABG in the elderly cohort. A large Canadian registry, the APPROACH database, analyzed outcomes from over 21,000 patients who underwent coronary angiography for ischemic heart disease. Nearly 1000 of this patient cohort were >80 years of age. Four-year risk-adjusted survival was highest for CABG at 77.4%, followed by 71.6% for PCI, and 60.3% for medical therapy [13]. While a selection bias for patients who received intervention is unavoidable in this retrospective analysis, it suggests that the benefits of surgical revascularization extend to elderly patients.

Equally compelling as an outcome is functional status or quality of life (QOL) for elders who elect to undergo invasive procedures. The literature that addresses QOL following CABG suggests benefits for elderly patients undergoing CABG. A retrospective analysis reported favorable 1- and 2-year outcomes in octogenarians who underwent CABG [14]. Over 80% of survivors were living in their own home, 74% rated their health as good or excellent, and 82% would undergo operation again. While frailty predicts poor outcomes, future research in this area should be directed toward answering important questions: Are there long-term consequences from an episode of delirium following CABG? Is longer-term quality of life—5–10 years—maintained in these patients?

What remains a central tenet in the evaluation of the elderly patient with ischemic heart disease being considered for an intervention is the evaluation and management by a dedicated team. This team should at a minimum consist of a cardiologist, surgeon, nurses, and potentially other allied specialties. With the patient as a focus, such a team is more likely to suggest wiser, thoughtful patient-specific recommendations. Increasingly interdisciplinary teams consisting of a highly cohesive group of clinicians of different training backgrounds are especially effective in evaluating and caring for vulnerable seniors being treated with an invasive cardiac procedure.

9.3 Aortic Stenosis/Surgical Aortic Valve Replacement and Transcatheter Aortic Valve Replacement

The management of aortic stenosis in elderly patients has undergone a tremendous paradigm shift during the past 5 years. This transformation in care is the result of the introduction of transcatheter aortic valve replacement (TAVR). In the USA, there are at present three commercially available devices—the balloon-expandable Sapien 3 the self-expanding Corevalve Evolut-R, and the self-expanding Lotus valve. These TAVR devices were originally approved by the Food and Drug Administration (FDA) for the treatment of aortic stenosis in high-risk or inoperable patients and recently for treatment of failing aortic bioprosthetic valves—so-called valve in valve (ViV) indication. Within 5 years, the Sapien Valve and the Evolut valve are now approved by the FDA for high, intermediate, and low-risk patients for aortic valve replacement. Stated differently, TAVR has now supplanted surgical aortic valve replacement (SAVR) for the vast majority of patients undergoing aortic valve replacement. Patients who still are considered for surgery include patients with anatomic reasons where TAVR is not preferred – for example, some patients with a bicuspid aortic valve and annular geometry which might predict a suboptimal outcome with a TAVR valve. Similarly, patients with multivessel coronary artery disease and aortic stenosis might be better treated with SAVR with concomitant coronary artery bypass grafting. Lastly, patients with aortopathy and an ascending aortic aneurysm >4.5 cm who are low and intermediate risk should also be considered for SAVR with an ascending aortic replacement.

The evidence supporting TAVR is derived from several studies. The PARTNER trial [15] is a landmark study which evaluated medical therapy, surgical AVR, and TAVR with a balloon-expandable valve and will be detailed here for clarity and guidance. This trial randomized 1057 patients in two arms. One arm examined patients deemed inoperable and compared TAVR to medical therapy (natural history of AS). The second arm randomized high-risk patients to TAVR or surgical AVR. The study included patients with severe, symptomatic aortic stenosis who were deemed inoperable ($n = 358$) or high risk for surgical AVR ($n = 699$). The inoperable 358 patients were randomized between TAVR and medical therapy for aortic stenosis. The 699 high-risk patients were randomized between TAVR and surgical AVR. Both arms met their predefined endpoints. In the inoperable arm, the TAVR patients had superior outcomes to medically treated patients—an absolute mortality difference favoring TAVR of 20% at 1 year. Of note, the number of patients needed to treat (NNT) to achieve this outcome was remarkably low: 4. In the high-risk cohort, TAVR was found non-inferior to surgical AVR for mortality [16].

A similar positive experience was observed in a multi-center randomized trial comparing a self-expanding TAVR—the Medtronic CoreValve—to Surgical AVR [17]. The mean age of patients in this study was 83. Many of these patients had significant comorbidities that predicted an operative mortality of at least 8%. The latest randomized clinical trials comparing TAVR to SAVR were completed in low surgical risk patients. One trial with the balloon expandable valve demonstrated non-inferiority of TAVR to SAVR [18]. The self-expanding valve demonstrated the superiority of TAVR over SAVR [19].

One of the most important developments from the introduction of TAVR has been the development and maintenance of the Transcatheter Valve Therapy (TVT) Registry. The TVT Registry was developed in collaboration with the American College of Cardiology (ACC) and the Society of Thoracic Surgeons (STS). The ACC measures outcomes after cardiac catheterization in the National Cardiovascular Data Registry (NCDR), and the STS measures the results from over 95% of the cardiac surgery programs in the USA. The partnership of these two professional societies along with the FDA and the Centers for Medicare Medicaid Services (CMS) is a national and international respected collaboration. Increasingly, the preoperative assessment strategies mentioned in this chapter are captured in this database and will be of great help in defining the benefit and burdens of these interventions for aortic valve disease in seniors.

Further, insights from the PARTNER trial can help to delineate subsets of elderly patients with aortic stenosis who may not receive benefit from intervention [20]. The validity of the STS risk model was confirmed, as operative mortality, defined as in hospital or within 30 days was 10.5 %. Recalling that the STS risk model predicted an operative mortality of 15% as a criterion for entry into the study. This small difference in observed versus expected (or predicted) mortality is likely the result of the inclusion of higher-volume and better performing AVR sites in the PARTNER trial. Important risk factors for short-term and intermediate-term mortality emerged from this analysis as well. A serum albumin of <3.0 g/dl was a factor that predicted early death. This risk factor can be viewed as reflective of a variety of factors—both catabolic situations such as advanced heart failure and factors such as weight loss and cachexia—which are traditional markers reflecting high peri-operative mortality. Two risk factors emerged that predicted mid-term death (median follow-up of 2.8 years). These factors were a BMI <22 kg/m^2 and a history of cancer—any cancer. While by definition these patients were all deemed "high risk," only 8% of patients undergoing AVR had worse 1-year survival than patients deemed inoperable.

Most believe TAVR is less invasive and therefore a less stressful intervention for elderly high-risk patients. However, the impact of frailty upon patients undergoing TAVR is largely unknown. A single-center experience involving 159 patients with frailty as determined by an index combining the variables of gait speed, grip strength, serum albumin, and activities of daily living was associated with a longer hospital length of stay; but, surprisingly, frailty was not associated with increased peri-procedural complications [21]. Frailty, as might be predicted, was independently and strongly associated with increased 1-year mortality [21].

Therapeutic outcomes with much more relevance to elderly patients are emerging with TAVR. For example, functional outcomes after both SAVR and TAVR are now highlighted with several recent reports. One-year functional outcomes were assessed for patients undergoing both SAVR and TAVR. Both preoperative frailty and complications, including the development of delirium were predictors of poor functional outcome at 1 year [22].

Further validation of frailty assessment is critical for patients undergoing either SAVR or TAVR. The question of which frailty tests that one should administer is important, as there are many different tools and measures of frailty. Afilalo and colleagues sought to determine the incremental predictive value of 7 different frailty measures in the FRAILTY – AVR study. This prospective, multi-center study assessed frailty in patients undergoing either SAVR or TAVR. Key findings from the FRAILTY-AVR study were that frailty is a risk factor for both death and disability following AVR. Further, a 4-item scale of lower-extremity weakness, cognitive impairment, anemia, and hypoalbuminemia outperformed all other frailty scores [23].

The pace of the use and evolution of TAVR for aortic stenosis is staggering. For example, within 3 years of commercial introduction, the vascular sheaths utilized to introduce the valves have gone from 24 French to 14 French in diameter, a development that has changed the delivery of the valve from a transapical (TA) approach in about 30% of patients now to over 95% delivered transfemorally (TF). Similarly, a 5% rate of major vascular complications such as stroke related to these large sheaths has dropped to 1%. Also, the latest generation valves, the Sapien 3 and the Evolut-R, have allowed the rate of moderate or severe perivalvular insufficiency to fall from 15% to now less than 2%. The Partner 3 intermediate risk trial (S3i) enrolled patients at intermediate risk (STS predicted risk of mortality of 4–8%) for surgical AVR and treated them with a Sapien 3. The peri-procedural mortality dropped from 5% to about 1%, and major complications were few [24]. There is great relevance of these data for elderly patients as the vast majority of patients over 80 years meet criteria for intermediate risk.

Now clinicians and patients appropriately are asking about the durability of TAVR. Currently, follow-up data suggest these valves remain durable for at least 5 years [25, 26], but a septuagenarian may live on average another 7–15 years. The ongoing TVT registry will accumulate these data, and the subsequent analyses will help clinicians select patients for this intervention. The ultimate goal is to select patients for TAVR who are *declining from* aortic stenosis and not patients who are *declining with* aortic stenosis.

9.4 Conclusion

The rapid growth of the elderly population continues to challenge cardiothoracic surgeons to achieve high-quality outcomes that consider a patient's quality of life and functional ability. It is imperative that surgeons, cardiologists, geriatricians, and other medical professionals collaborate in multi- and interdisciplinary teams to optimally evaluate frailty and other risk factors and then manage accordingly seniors with symptomatic CAD and AS. The current technological advances, clinical investigations, and access to increasingly valuable national registries will allow clinicians to improve the quality of interventions offered to elders with CAD and AS.

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Emergency Medicine

10

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10.1 Introduction

The Emergency Department (ED) provides acute care to America's ill and injured; yet, the specifics of emergency care delivery are rapidly evolving as our nation ages and its health system changes. The ED is superficially understood by many as a "health care safety net" and the most rapid portal of entry for patients with acute and potentially life-threatening events [1]. Yet, if you look deeper, every day the ED serves as the nucleus for prehospital systems, as an acute diagnosis and treatment center, and as the manager presiding over one quarter of all acute care outpatient visits in the USA [2]. This is especially true for older adult patients, who accounted for more than 23 million ED visits in 2016 [3]. Nonemergency department providers who understand the specifics of ED elder care can better navigate the system and optimize care when their patients utilize the ED.

The growing number of older adults requiring emergent care is disrupting business as usual for EDs. Today's ED model of care, design, and operations are based on principles from as far back as 1962. Unfortunately, this model no longer fits the demographics and complexity of our population, nor the rising expectations of efficient, effective, coordinated, and expert care now demanded from the ED. Outcomes of this traditional ED model of care show increased morbidity and mortality occurring in older adults despite their receiving more medical tests, increased admission rates, and concentrated physician attention [4, 5]. A model change is needed to improve ED care for older adults [6, 7].

Solutions for improving elder ED care range from enhanced geriatric training for ED staff, to providing specialized elder ED services, to the physical redesign of existing EDs with sections dedicated to older patients. In some situations, entire EDs dedicated to older adult care have been suggested [8], and in 2008 the first specialized GED was opened. Since this time there has been a surge in the development of entire GEDs or sections of EDs specifically dedicated to the older population. In 2018, the ACEP began formal voluntary accreditation of GEDs. Geriatric Emergency Department Accreditation (GEDA) occurs at three levels of excellence. Level 1 or gold is the highest designation, level 2 or silver is intermediate, and level 3 or bronze is a more modest level of geriatric service provision. As of September 2020, over 180 US Hospital EDs had been formally accredited and several international hospitals have also been accredited [9].

To facilitate enhanced geriatric ED care, the Society for Academic Emergency Medicine (SAEM), the ACEP, The American Geriatrics Society (AGS), and the Emergency Nurses Association (ENA) have collaborated on unprecedented joint recommendations for targeted elder ED improvements. The document they produced is termed the "Geriatric Emergency Department Guidelines" [10]. The guidelines serve as the basis for GEDA criteria.

In this chapter, we will discuss older adults as a special ED population, with unique needs, and detail-specific topics in ED elder care. Finally, we will discuss how the current ED model of care can shift to better fit the demands from the growing number and complexity of older adults in the ED.

10.2 Epidemiology and Demographics

The baby boom generation of 1946–1964 generates approximately 10,000 new 65-year-olds daily in the USA. From 2002 to 2010, the number of persons over age 65 years rose by 15%, constituting 13% of the population. In 2017, 22% of the US population was older than 65 [11]. Due to this aging

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demographic, in 2016 more than 20 million older adults visited US EDs. Many factors drive older patients to seek ED care. Of course, they come when they experience symptoms they perceive as an emergency. They come for acute injury and they come with slow deterioration in chronic conditions. Studies show older patients appropriately use emergency services and require ED care in high numbers [12, 13]. They come in spite of access to other sources of care. In fact, many older patients are referred to the ED by their primary care physicians to undergo complex diagnostic evaluations, or to receive treatments not available in the office, same day sick visits, and off-hours care [14]. Unfortunately, there are fewer EDs available every year. From 1993 to 2003, the number of US hospitals fell by 11% decreasing the total number of EDs by 9% [12].

Older people are more difficult to evaluate, stabilize, treat, and find disposition than any other segment of the population. This means that in addition to the resource mismatch of more and more older patients presenting to fewer EDs, they present more frequently, sicker, and with a higher degree of complexity. Elder ED evaluations take 19–58% longer, with admissions in up to 33% for patients 65–74 years old, and reaching as high as 47% for those over 75 [13, 15]. Those over 85 years' experience 823 ED visits per 1000 persons with an even higher rate of admission [16].

Equally important in the strain of elder ED visits is the fact that ED expectations are increasing. EDs are expected to more fully evaluate and treat every patient, as part of the mandate to decrease hospital admissions. EDs are tasked to deliver definitive care, discharge more patients, and when admitting, to more fully evaluate and to initiate earlier more comprehensive treatments. The traditional ED model of care developed for evaluation and treatment of one easily identifiable problem, with quick disposition to definitive care may be inadequate and obsolete for older patients. Yet we have not developed a new system and our evolution is slow. This is precipitating a crisis in the traditional model of ED care.

10.3 What the ED Is for Older Adult Care?

The ED serves as a nucleus for prehospital systems otherwise known as Emergency Medical Systems (EMS). EDs receive ambulance transports from community, municipal, and private ambulance providers. Older adults use EMS services in high numbers and are at excess risk for adverse events [12]. Older patients transported by EMS are often acutely ill and 30% require high-intensity care. The ED does not usually hire, train, or set the standards of practice for providers in the prehospital system. Yet, designated EDs offer telemetry radio communications with paramedics through which they direct options for care including recommending:

- The site for care, that is, where the ambulance will take the patient,
- Specific medical interventions needed,
- Activation of special paths of care such as for stroke or myocardial infarction (MI).

10.3.1 Centers of Excellence

Some hospitals and EDs provide centers of excellence in the care of specific problems. It is common for hospitals to carry designations such as trauma, stroke, or chest pain centers. Various levels of intensity exist in each of these center designations signifying increasing levels of service. Examples:

- Acute ST segment elevation myocardial infarction (STEMI) centers are hospitals with a cardiac catheterization lab available following a protocol to speed care of acute STEMI patients from the ED door to opening of the vessel (door to balloon/stent time).
- Trauma centers are hospitals with protocols and personnel for rapid surgical treatment of the myriad of traumatic injuries such as rapid access to a neurosurgeon. Trauma center ED personnel are specially trained; they have specific equipment, policies, and protocols. Imaging modalities and surgical personnel are readily available, and access to operating rooms and intensive care units (ICUs) are prioritized.

The concept of a GED has developed in acknowledgment that older ED patients have unique presentations, needs, dispositions, and outcomes. Care improves and outcomes are enhanced when these unique needs are met in a formal way. A GED may be either a separate space designated for older adults, or simply integrate best practices for older adults throughout the existing ED space through the use of special personnel, policies, protocols, or procedures.

GEDs embrace a variety of best practices including:

- Ensuring geriatric-focused education and interprofessional staffing
- Providing standardized approaches to care that address common geriatric issues
- Ensuring optimal transitions of care from the ED to other settings (inpatient, home, community-based care, rehabilitation, nursing home care)
- Promoting geriatric-focused quality improvement (QI) and enhancements of the physical environment and supplies

Becoming a geriatric ED will improve the care provided to older people in your ED and ensure the resources to provide that care are available. It also signals to the public that your institution is focused on the highest standards of care for your community's older citizens.

10.3.2 Ambulance Transport Issues

Older patients are far more likely to present to the ED via ambulance compared to younger patients [4], and EMS personnel are often the first point of contact for these patients. EMS workers, however, receive little to no specialty training for this older population compared to other unique populations such as children [6]. There are compelling reasons, however, to train EMS personnel in care for older people. Paramedics are the first point of contact for older patients and can bridge a vital communication gap given the correct tools. Hearing or visual impairment, dementia, and limited understanding of a complex history are a few confounding factors that make communicating an accurate history challenging for older patients. EMS providers may be the only personnel who can obtain history from caregivers and witnesses to events such as syncope/falls/seizures. They are often the only link to establish a baseline mental status, goals of care, and medication lists. When transporting from nursing or post-acute facilities, EMS personnel obtain standardized transport forms and portable health information that can decrease redundant tests and delays in diagnoses. EMS deficiencies in geriatric-specific education have been acknowledged. The AGS and the National Council of State EMS Training Coordinators have developed an optional course, "Geriatrics Education for EMS," which is now available to interested EMS providers [17].

10.3.3 The ED as an Acute Diagnosis and Treatment Center

The ED serves as an acute diagnosis and treatment center for its medical community. Complex older patients often require advanced laboratory and imaging services unavailable in standard medical offices. Providers refer patients to the ED in large numbers to receive such services in a timely manner. Patients unwilling to wait for these services often present directly to the ED in an effort to receive immediate testing and treatment for their medical concerns. Treatments such as intramuscular or intravenous medications, blood transfusions, wound care, splinting, control of blood pressure, blood sugar, infectious symptoms, and pain management, to name a few, are often more available and accessible through the ED than in a clinic or private office setting. Some institutions are capable of obtaining subspecialist consultations in the ED. Sometimes the demand for ED evaluation and treatment is seen as more for convenience than necessity. However, even the most experienced emergency physicians are often unable to determine the urgency for care, until after significant evaluation and testing has been performed.

10.3.4 The ED as Governor of Disposition to Inpatient Versus Outpatient Care

The ability to perform and the level of reimbursement for advanced diagnostics and treatments have shifted evaluations which historically took place in the inpatient setting, into the ED. Now, a CT of the abdomen performed in the ED often prevents the admission of patients for serial abdominal exams to exclude appendicitis, cholecystitis, or diverticular abscess. Initiation of IV antibiotics in the ED can prevent admission for conditions from cellulitis to pneumonia. Advanced imaging can exclude acute stroke, spinal cord compression, and intestinal ischemia. Such determinations allow safer dispositions of patients to outpatient evaluation and care. This is a huge driver of reimbursement, and hospital administrators now utilize the ED to ensure best allocation of resources to reimbursement for populations of patients in a strategy termed population health [18].

10.4 Age-Related Issues and How They Impact Emergency Care

10.4.1 Age-Related Physiologic Changes

- Cardiac: as one ages, there are progressively fewer cardiac myocytes, decreased ventricular compliance, higher incidence of electrophysiologic abnormalities (sick-sinus syndrome, arrhythmias, bundle branch blocks, etc.), increased systolic blood pressure, and decrease in maximal heart rate and reduced cardiac output reserve [19]. These changes lead to a decreasing ability of older adults to compensate for increased cardiac demands, thus leaving older patients sensitive to volume, orthostatic, and stress changes. In the ED, these changes alter our evaluation of syncope, dyspnea, weakness, and hypotension. They result in a higher burden of disease, chronic symptoms, and lack of reserve to what in younger patients would be minor events. See Chap. 19 Cardiology for additional information.
- Pulmonary: Chest wall changes such as kyphosis, vertebral compression, intercostal muscle weakness, costochondral cartilage calcification, and progressive respiratory muscle strength decline can reduce inspiratory and expiratory force by as much as 50%. Lung changes lead to decreases in ventilatory responses to hypoxia and hypercapnia by 50% and 40%, respectively. Decline in T-cell function, mucociliary clearance, coordinated swallowing, and cough reflexes (especially in those with

neurologic dysfunction) have a large impact on respiratory issues. These changes specifically affect trauma evaluation, dyspnea evaluation, and the severity and treatment of respiratory infections, such as pneumonia. More use of noninvasive respiratory support is called for in the older population. See Chap. 25 Pulmonary for additional information.

- Renal: Glomerular filtration rate declines by 45% by age 80 which makes medication choices and dosing potentially precarious. Renal tubular function declines as well leading to an inability to conserve sodium and compensate for fluid losses resulting in a higher incidence of recurrent dehydration. The use of contrast agents for scanning can severely damage elder kidneys and must be evaluated prior to infusion of contrast adding to both the time and cost of ED evaluations requiring these agents. Additionally, the evaluation of orthostatic hypotension and syncope are very common in older people seen in the ED provider education must ensure awareness of these physiologic changes. Understanding these changes is critical in managing a geriatric patient's medication regimen, as well as underscoring the need to monitor hydration status. See Chap. 27 Nephrology for additional information.
- Lower Urinary Tract: Increased collagen in the bladder, and benign prostatic hypertrophy in males lead to impaired bladder emptying in older adults. Urinary tract infections lead to 30–50% of all community-acquired bacteremia in older people. These changes are impactful when seeking a source of infection in a febrile older patient.
- Gastrointestinal (GI): Constipation increases with age, from 4% in the young, 19% in middle-aged, and up to 34% in the older. This is attributable to sedentary lifestyle, diet/dehydration, systemic illness, and medications. Therefore, constipation management should focus on the external cause with appropriate modification or in addition to a patient's medication regimen.
- Hepatobiliary: The liver realizes a decrease in the number of hepatocytes and hepatic blood flow up to 40% after the age 60. The metabolism of some drugs is altered and older people may be increasingly sensitive to certain drugs requiring mediation regimen changes. Importantly, biliary disease is the most common reason for abdominal surgery in older people and up to 80% of nursing home residents over 90 years have biliary stones.
- Body Composition: Lean muscle decreases by up to 40% by age 80 with even greater declines in strength. Combining with decreases in activity, resting body energy expenditure also decreases. Older people are susceptible to protein-energy malnutrition when stressed. Finally, aging changes in the skin's dermis and epidermis make both wound repair and healing difficult.
- These changes make significant stresses such as infections, injuries, and/or surgeries potentially catastrophic. At best, emergency physicians need to take these changes into account when evaluating the treatment recommendations and prognosis of a given older patient.
- Central Nervous System: The prevalence of dementia increases with age from 1.5% in ages 65–70 and doubles every 5 years to at least 25% by age 85. As discussed in the following section, both dementia and delirium have significant negative impacts on the quality-of-life of affected patients, both increase the need for and cost of care, and the length of hospital stays.
- Hematologic: While the steady state RBC and neutrophil counts are often in a normal range, the hematopoietic system's response is impaired during stresses that challenge the older body to mount a proper WBC response and check infections. Unchecked bacterial growth may then advance resulting in older patients presenting to the ED in extremis.

10.4.2 Age-Related Sensory Challenges (e.g., Sight, Hearing)

Visual acuity, depth perception, sound sensitivity at high frequencies, and speech discrimination all decrease with age. Put into unfamiliar surroundings, and the typical noisy ED with monotone walls, curtain dividers, and fluorescent lighting; and many older patients will become confused and either lethargic or agitated.

10.4.3 Atypical Disease Presentations

The older patient presents atypically compared to a younger adult with the same disease process. However, within the older group, these "atypical" presentations become typical for them. These variations must be understood to take optimal care of this population. For example, many frail older people manifest alteration of mental status as the primary symptom of systemic infections [17]. Emergency providers need to know these presentations but most do not receive specific training or practice according to this paradigm.

10.4.4 Polypharmacy in Older People

- Older ED patients often take from 6 to 8 concurrent prescription and over-the-counter medications [20]. From 7% to 10% of elder ED visits involve an adverse drug event. Additionally, from 13% to 25% of ED prescriptions to older patients pose a potential drug–drug or drug–disease interaction, and one-fifth of ED patients report mild to moderate adverse drug events from ED prescriptions [21]. This is critical for both identification of drug-related problems in older people and ensuring ED prescription treatments do no harm. See Chap. 6 Medication Management for additional information.

The problem of controlling an acutely agitated older patient is significant and sedatives from the ED often have unanticipated and long-lasting effects. ED policies should include pathways for old-age behavior control during acute change in mental status [22]. Use of Beers criteria reduces risk of ED visit-related adverse drug events. Targeting high-risk medications (e.g., warfarin, insulin, and digoxin) is also important in these patients [23]. See Chap. 5 Medication Management to learn more about managing this significant ED challenge.

10.4.5 Mobility Challenges in Older People

Immobility leads to deconditioning, exacerbating the decline in body composition discussed above and increasing risk of falls. Additionally, falls are among the most common reason for geriatric ED presentations. However, in the typical ED flow, patients are carried or wheeled into and out of the ED, and providers must make a special effort to observe gait and mobility. Traumatic injuries and the resulting musculoskeletal injuries cause significant morbidity. Seemingly, small injuries may make completing simple activities of daily living difficult or not possible and oftentimes otherwise healthy geriatric patients may require home assistance or temporary nursing home placement due to these seemingly minor issues. This awareness does not fit with the usual flow of the ED and providers often discharge older people home without attention to need for home services. See Chap. 8 Tools for Assessment for tips on quick and reliable gait assessments and identifying functional deficits.

10.5 Topics in ED Care for Older Adults

10.5.1 Altered Mental Status

Delirium is a change in cognition with an acute (hours to days) onset, fluctuating course, and disturbance in attention (the ability to direct, focus, sustain, and shift attention); and either disorganized thinking or an altered level of consciousness [24]. Consciousness alteration is either hypoactive, hyperactive, or mixed. Hypoactive delirium is the most common presentation and it is missed in the ED setting in about 76% of cases [22]. Metabolic abnormalities, stroke, seizure, infection, hypoxia, medications, and intoxication are a few of the most common causes of delirium and it is vital to keep a wide differential given the danger of missing a life-threatening condition. When missed in the ED, delirium is nearly always missed by the hospital physician (internist or hospitalist) during admission [22]. Delirium is a harbinger of poor outcomes and carries a strong association with 12-month mortality independent of any other confounding comorbidities [20, 25]. Between 7% and 10% of ED older people present with delirium and some studies estimate that the direct and indirect costs from the sequelae of delirium are as high as $100 billion annually [26]. Delirium in the ED is an independent predictor of 6-month mortality [27].

Up to 50% of older people with delirium will also have underlying dementia. This emphasizes the need for accurate assessments that will capture shifts from a patient's baseline mental status and minimize a delayed or missed diagnosis due to coexistence of the two states [22]. In the ED, a thorough history from caregivers or EMS is crucial in assessing the source of delirium. The ED evaluation includes rapid assessment of the Airway, Breathing, and Circulation (ABCs), Recognition and treatment of abnormal vital signs, and a prompt point of care blood sugar are essential in any patient with altered mental states [28]. In addition to targeted labs and imaging that focus on treatable causes of delirium, EDs must complete a careful examination to identify the cause of delirium [22]. However, EDs often fail at the assessment of elder mental status or the recognition of its alteration, causing delays of care, missed diagnosis, and failure of rapid delirium treatment [29]. Many have argued that EDs must improve evaluation and treatment of acute delirium in the ED to decrease morbidity and mortality, and even further, that EDs should be actively screening for delirium and dementia [10]. When performed optimally, this screening can result in interventions that will enhance care and decrease length of hospitalization for older people admitted from the ED.

10.5.2 Dyspnea

Dyspnea is a broad presenting complaint in ED older people that requires rapid assessment to rule out life-threatening emergencies such as MIs/ischemia, pulmonary embolisms, and dysrhythmias while still keeping in mind more common causes such as pneumonia, COPD exacerbations, heart failure (HF) exacerbations, and bronchitis. This acuity approach is a chief difference between dyspnea evaluations in the ED versus the office setting. Altered mental status, agitation, seizure, headache, and lethargy may indicate hypercarbia and/or impending respiratory failure in an older patient with dyspnea [30]. Older people often present with mixed pictures blending features of HF and COPD. Clinical uncertainty between these diagnoses exists in about 30% of ED older people with severe dyspnea and is associated with increased morbidity and mortality [31]. Differentiation often requires advanced diagnostic testing. Treatment is based on stabilization of breathing and ventilation which may blend treatments of both conditions before results of testing can be obtained. Bronchodilator use in patients with HF is associated with need for aggressive interventions and monitoring [32].

The diagnosis of pulmonary embolism is often reserved for the ED as CT imaging is the diagnostic procedure of choice and making the diagnosis of PE in the ED is associated with a substantial survival advantage [33]. Dyspnea may be the only symptom of MI in older people and is the most common presentation of MI in patients over 80 years of age. Nausea, disorientation, and lethargy can also be atypical presentations of an older patient with myocardial ischemia and ED providers should have a low threshold to rule out a cardiac etiology with such symptoms. Direction to EMS or ED with STEMI centers for these patients reduces treatment delays and improves long-term outcomes [34].

10.5.3 Stroke

Correctly identifying a stroke sets into motion a cascade of diagnostic and therapeutic interventions that are time-critical. An accurate history establishes the timeline of a change in mental status or physical function and determines whether an otherwise eligible patient may benefit from thrombolytic therapy. The time from symptoms onset to thrombolytic therapy was increased to 4.5 h in the 2012 AHA/ASA guidelines for the management of acute ischemic stroke, but many centers have additional administration criteria [34]. Also, current guidelines allow for a 6 to 24 h window for mechanical thrombectomy if CT-perfusion or MRI with diffusion-weighted imaging finds susceptible lesions [36].

Door-to-imaging time of less than 20 min and door-to-needle time of less than 60 min has been established as the standard of care for thrombolytic therapy and, unsurprisingly, a lack of corroborating information from bystanders can lead to delays and disqualification for therapy if a correct time of onset of symptoms cannot be established [35, 36]. The proliferation of primary stoke centers starting in 2000, meant that by 2010, 49% of all stroke patients had access to stroke center care [37].

Typical symptoms include unilateral paralysis of the face, arms, legs, acute changes in mental status, difficulty speaking, or severe headache and dizziness. Atypical presenting symptoms may include pain, palpitations, confusion, or shortness of breath [38]. It is equally important to rule out other etiologies of illness that may mimic the symptoms of a stroke including seizure, ingestions, hypoglycemia, and hemorrhagic intracranial bleeding. Appropriate EMS activation and rapid delivery of patients to the ED of a primary stroke center are associated with improved evaluation and treatment of acute ischemic strokes [39].

10.5.4 Sepsis

In the older patient, atypical presentations of infection can delay identification and treatment of the source, yet they account for the majority of sepsis cases in the US and are more likely than younger patients to die [40]. Older patients may not have a white count elevation (although a left shift will typically still be present) in response to an infection. They may be either hypo, normo, or hyperthermic, they may not have chills or rigors, and their tachycardia may be blunted by beta-blocker therapy or aging physiology [41]. Immune senescence and comorbidities also make the older patient more prone to infection [42]. In older people, normal vital signs and lab values do not rule out serious infections and non-specific findings such as shaking chills, altered mental status, abdominal pain, and vomiting are all predictive of bacterial infection as are the presence of diabetes mellitus and other major comorbidities [43, 44]. Pneumonia, urinary tract infection, and bacteremia are the most common causes of infection in this population [45]. After the primary evaluation for vital sign instability a thorough physical exam should search for signs of hypoperfusion including altered mental status, poor capillary refill, and dry mucus membranes, and decreased urine output. Surviving Sepsis Guidelines strongly recommend IV fluid resuscitation with 30 ml/kg of crystalloids within the first 3 h and IV broad-spectrum antibiotics within 1 h of sepsis recognition [46].

10.5.5 Syncope

Syncope is defined as a transient loss of consciousness (LOC) and postural tone due to rapid global cerebral hypoperfusion with prompt return to full pre-event function. Syncope in the older patient can be difficult to distinguish from seizure, stroke, hypoglycemia, hypoxia, or drug effect. Older patients present more often, are hospitalized at higher rates, and have increased mortality associated with syncope [47, 48]. Nearly 60% of older patients who present with syncope will be admitted to the hospital but in a third of cases no clear etiology is discovered even after full hospital evaluation [47]. The most common causes in older people include neurally mediated syncope, orthostatic hypotension, dysrhythmia, and carotid sinus hypersensitivity [49].

A focused history looking to determine etiology of syncope, with an evaluation of medication regimen, and potential resulting trauma or contributory illness should be included in the initial survey.

The goal of the initial evaluation should be to:

1. Distinguish syncope from other causes of transient LOC
2. Determine need for further diagnostic evaluation
3. Institute emergent treatment
4. Diagnose the etiology
5. Establish prognosis—risk stratify those in danger of short-term adverse events
6. Appropriately stratify to admit those at high risk, observe the intermediate risk, and discharge those at low risk with reasonable follow-up [50].

There are a number of ED clinical decision rules and risk-stratification tools including the San Francisco Syncope Rule to guide focused evaluations and predict high-risk patients who would benefit from admission although none have been shown to outperform emergency physician judgment [51, 52]. Excellence in elder ED syncope care generally requires cooperation with a multidisciplinary hospital team and assurance of prompt follow-up.

10.5.6 Trauma

Traumatic injuries are a leading cause of death among older people and one contributing cause could be the failure to transport patients to a trauma center. Failure of EMS trauma center transport in older people is well-documented and usually based on an inaccurate index of suspicion for traumatic injury. However, even obviously severely injured older people are less likely than younger patients to receive care in a trauma center [53].

Because of widely acknowledged physiologic changes that occur with aging such as cerebral atrophy, thinning skin and osteoporosis, even relatively benign mechanisms of injury can cause intracranial hemorrhages, intrathoracic or intra-abdominal organ injuries, with hemodynamic compromise, and significant fractures [54, 55]. This is especially true in a patient on anticoagulants [56].

The second challenge is recognizing that an older person's vital signs can be deceptively normal in trauma [57], and could in fact be signs of shock compared to baseline vital signs that may be unknown to paramedics. Not only is hypotension not always an accurate predictor of shock, but there is a phenomenon of poor end-organ perfusion in the setting of normotension referred to as *occult hypotension* [58].

Guidelines for field triage now have updated standards that take into account the physiologic differences of the older patient [59]. They highlight the following issues:

(a) Significantly increased risk of injury/death after age 55 years
(b) SBP <110 might represent shock after age 65 years
(c) Anticoagulation carries a high risk of rapid deterioration in patients with head injury
(d) Low-impact mechanism (e.g., ground level falls) might result in severe injury

Older patients have special EMS transport needs. Padding is often required under areas prone to skin tears or pressure ulcers. In older people, cervical injuries can occur with seemingly minimal insults. EMS providers determine need for backboards and cervical collars and can ensure additional padding and stabilization allowing for more comfortable and safe transport.

As with younger patients, the "golden hour" between a traumatic injury occurring and presenting to a trauma surgeon is crucial and missing subtle signs of a traumatic injury could significantly delay lifesaving interventions. Just as in pediatric patients, adjusted vital sign parameters are required for older patients. EMS workers need additional training to recognize these abnormalities and to adjust their index of suspicion for traumatic injuries based on low-impact mechanisms. Bringing the patient to the right place for the right evaluation on the initial transport should be the standard for every patient regardless of age.

10.5.7 Pain Management

Pain is under-recognized and undertreated in older patients, despite older adults experiencing moderate to severe pain in up to half of their ED visits [60, 61]. Barriers to recognition of pain in the older patient include cognitive impairments, communication difficulties, and language/cultural differences. Older adults can also have atypical disease presentations, multimorbidity, and polypharmacy. Adding to this, inconsistent pain score documentation and reassessment after medication administration can leave patients with undertreated pain. Effective pain management in older adults should include an initial thorough pain assessment and then multimodal treatment followed by frequent reassessment [61]. Educational and QI initiatives directed at ED providers and nurses can reduce documented pain scores while shortening the time to reassessment [62]. Programs for specific conditions, such as hip fractures, which hospitalize 300,000 patients aged 65 and older per year, can also improve pain management [63]. Multidisciplinary fracture programs that treat pain with a multimodal approach (e.g., opioids, NSAIDS, fascia iliaca blocks, ice packs) reduce both morbidity and mortality while reducing opioid administration [64].

10.6 Failures in ED Older Adult Care

The traditional ED model continues to focus on finding, fixing, and dispositioning a patient with one acute problem. This antiquated model does not adequately respond to the medically complex, often functionally impaired older population. The crisis of course becomes clear when we view failures in ED elder care. Older ED patients are at greater risk for adverse health outcomes, with a mortality rate around 10%, admission rate between one-third and one-half, and a rate of ED returns of up to 26% [4, 65, 66].

The aging population translates to large volumes of older adults utilizing EDs underprepared for this population's unique demands [67]. Our older, medically complex patients often become a bottleneck in ED throughput (the term for rapid movement of patients in and out of the ED). Older patients are disadvantaged from triage to disposition by this ED model. They do not usually provide a quick history, they often have more than one issue that needs attention, they are taking many medications, have more than one provider, and many present with multiple comorbidities. All these confound the ED triage process. As previously discussed, pre-hospital information may help close the communication gap for these patients. Electronic medical records with up-to-date histories, medications and goals of care can speed the triage process for these patients. Pre-registration prior to ED arrival can also decrease waiting time. In older patients with established primary care, a call from their PCP is invaluable in understanding the patient in the context of their overall health. PCPs need to do more than simply provide the PMH and current complaint, but add goals of care, expectations of the ED visit, and optimal follow-up plans dependent on ED findings. It is important that ED providers accept and encourage calls from PCPs and call the PCP after evaluation when patients are being discharged to the community; these hand-offs are in everyone's best interest, most importantly the patient's.

Departments should establish protocols to encourage and clarify communications between PCPs and emergency physicians that enhance transitions of care to and from the ED.

10.7 New Initiatives/Innovations for Older Adult ED Care

In order to improve population -specific care, one needs to understand the factors making the population unique as detailed above. Then these issues are studied in light of existing resources, potential initiatives, and the cost reimbursement issues which could offset enhancements in personnel and operations. From an administrative perspective, geriatric emergency care requires several unique features:

- Strategic resource planning for the demographic demand
- Improving quality of care along known and expected processes
- Potential revenue, cost, and recidivism implications

10.7.1 Strategic Resource Planning

10.7.1.1 Increased ED Resource Utilization

- *ED visits*: Adults over age 65 comprise 13–15% of the total US population [67]; however, they represent up to 21% of all ED encounters [68]. As the older adult population continues to increase, their disproportionate share of visits will increasingly strain the ED.
- *Length of stay*: Older people stay in the ED from 19% to 58%, longer than other age groups [13].
- *Higher rate of hospital admission*: The admission rate for older adults is 2.5–5.6 times higher than for younger adults [13].
- *ED "Boarding"*: Boarding refers to the continued presence of a patient that is already admitted to the hospital but still in the ED awaiting a bed. This boarding is typically due to hospital administration choices lowering the priority of ED patients for access to beds and other factors out of control of the ED. Boarding is particularly dangerous for older people leading to pressure ulcers, delirium, increased mean hospital LOS, and even death [69]. These poor outcomes are proportional to boarding time and independent of diagnosis and comorbidities. Administrators and clinicians from all specialties must work to solve this serious problem.
- *Appropriateness of elder ED utilization*: Investigators have shown older adult ED use is necessary and associated with need for emergent evaluation, treatment, procedures, ICU admissions, and hospitalization [69]. This means diversion to another setting is often not a good option and we should prepare to treat these patients in the ED setting. That said, same day appointments and extended clinic hours should be part of health system planning to ensure the precious resources of the ED are available for those in real need.
- *Appropriateness of elder EMS utilization*: Older people's demand for ambulance transport is appropriate and linked to stabilization of life-threatening conditions [13], and EDs must prepare for this demand.

10.7.1.2 Increased Medical Complexity

Older adults often present a high degree of medical complexity with multiple medical comorbidities. Community-dwelling older people have an average of 3.6 comorbidities and nursing home residents an average of 4.6 comorbidities; this is starkly different than oftentimes healthy younger ED patients [70]. The ED setting must shift from its focus on a primary complaint and prepare to address the multiple simultaneous issues present in older patients.

10.7.2 Improving Quality of Care for Specific Processes and Populations

10.7.2.1 Disease-Specific Processes and Centers

Approaching individual high -intensity medical conditions with standardized and evidence-based practices is cost effective and shows improved patient outcomes. This approach is also evidenced by the success of nationally recognized individual certification programs such as Advanced Cardiac Life Support (ACLS), Advanced Trauma Life Support (ATLS), Pediatric Advanced Life Support (PALS), as well as institutional certifications by the Joint Commission, American Heart Association, and/or American Stroke Association certifications of Stroke Centers, STEMI Centers, and Heart Failure Centers [71].

10.7.2.2 Population-Specific Processes and Centers

Knowing that children have unique emergency needs better met with specific training of personnel, policies, protocols, equipment, and procedures; ACEP approved guidelines for the care of children in the ED in 2000 [72]. A recent survey showed that 10% of US hospitals have a separate pediatric ED (~550 pediatric EDs) [73]. Yet according to 2060 U.S. census projections, there will be more adults over 65 years than children under 18 years. Clearly, the benefit derived from age-specific ED care realized by the pediatric population should be targeted toward the soon-to-be larger geriatric population.

10.7.3 Potential Revenue, Cost, and Recidivism Implications

Hospitals and health-care systems are struggling to adapt to ever changing/increasing economic pressures including the rising costs of health care, changing care models including accountable care organizations, payer-mix changes, value-based purchasing replacing the Centers for Medicare and Medicaid Services (CMS) fee-for-service reimbursement model [74]. The balance of excellent medical treatment and economic survival are often surprisingly at odds and may have site-specific variations. One hospital may find chest pain admissions economically favorable, while another may find it beneficial to invest in elaborate ED testing for risk stratification and expedited discharge. In relation to the geriatric population, CMS's future direction will likely have a significant impact on how hospitals approach older patients. Additionally, payer-mix and supplement insurance issues will affect cost recovery and likely affect approaches to inpatient treatment vs community-based care as sustainability/profitability are taken into account.

From a direct cost standpoint, a recent study found that by deploying a comprehensive approach to geriatric patients, including social workers, pharmacists, and emergency physician training, EDs can achieve a 3% reduction in the rate of older patient admissions. This reduction corresponded to a multimillion dollar cost reduction at the hospital studied [75]. While costs and readmission rates have been shown to be reduced with GEDs [76], recidivism (return visit within 30 and 180 days from initial visit) has not been reduced [77].

Clinical excellence and economic drivers appear most at odds when labeling escalating disease processes and critical events, such as sepsis or strokes, as recidivism. Studies show that in the first 180 days after ED discharge 5% of older people die and 20% are hospitalized [78]. From a medical standpoint, disease progression is often unavoidable and return care is oftentimes necessary and appropriate. Where and when is this failure of prior care as opposed to excellent care that could not anticipate nor prevent progression to morbidity or mortality? Studies investigating "appropriate recidivism" are needed on this important topic.

Finally, hospitals can market their geriatric EDs and attract patients that will require higher reimbursing specialists, thus increasing revenues to the hospital system in addition to increasing their ED visits and related revenue. The attractiveness of these higher revenues can be augmented by concomitantly decreasing costs. With Medicare reimbursement rates being reduced for iatrogenic complications, enhancing geriatric care may have significant benefits with better staff performance decreasing predictable and common complications experienced by ED older patients.

10.7.4 The Movement Toward Geriatric Emergency Department Care

In the existing landscape of EDs, there is a movement toward care that is increasingly geriatric-specific. From traditional departments with: from no changes → to those with modifications made to existing spaces "Geri-Friendly" → to building an entirely specific GED space.

Over the past several decades, awareness is growing and shifting EDs toward enhanced geriatric care. This is seen with increasing numbers of both GEDs and Geri-friendly EDs. As individual institutions realize the need to improve geriatric care each ED will need to examine its goals and opportunities for elder care improvement. As discussed above, given payer-mix considerations, cost, and quality issues, some EDs may seek to increase admissions while others may seek to decrease admissions. There is no one "cookie-cutter" approach to enhancing the geriatric care provided by every ED; however, there are guidelines to assist in tailoring a geriatric focus for every ED. Reference to the GED Guidelines can assist hospitals in this elder care improvement process.

10.8 The GED Guidelines and Accreditation

To help facilitate EDs' movement toward better geriatric care, representatives from the ACEP, AGS, ENA, and SAEM created research and consensus-based best practices, published as the GED Guidelines. The purpose of this work "is to provide a standardized set of guidelines that can effectively improve the care of the geriatric population and which is feasible to implement in the ED" [10].

In 2018, ACEP launched its geriatric ED accreditation program to standardize geriatric emergency care [78, 80]. The three levels of accreditation are defined by the GED Guidelines. A Level 1 GED, the highest level, provides multidisciplinary geriatric assessment and adheres to 20 best practices. As of 2019, 73 ED have achieved accreditation.

The GED guidelines are divided into six principle categories and include 40 specific recommendations. The six categories are staffing and administration; follow-up and transitions of care; education; quality improvement; equipment and supplies; and, policies, procedures, and protocols.

10.8.1 Administration, Planning, and Oversight

Create a hospital-based Acute Care of Older people (ACE) team including a medical director, nurse manager, staff physicians, staff nurses, and medical-staff specialists, and ancillary services (case management, social services, OT/PT, pharmacists). The overall goal is to coordinate resources and enhance care; such efforts have proven to have a positive effect on the experience of older ED patients [81]. Such a coordinated team has the potential to truly transform the role of emergency care for older patients. The long-standing "safety-net" role of the ED can expand and evolve with the ED as a partner coordinating and optimizing patient care. The new GED becomes more integrated into the broader health-care system and contributes to optimizing the health-care system while reducing overall costs of care [14].

10.8.2 Staffing

The geriatric emergency medicine literature often draws parallels to specialty care for other unique populations including pediatrics, fast-track care, and trauma. Going beyond the physical modifications of the environment—the specialized personnel in these areas are trained to accommodate particular needs. Geriatric nurse practitioners, care coordinators, and physicians with geriatric training would be part of an interprofessional team approach to care improving evaluations and screening for high-risk patients. This specialized staff is more efficient and effective at all levels of care for this population. Expansion of advanced practice providers with specialized training in addition to geriatric-fellowship trained physicians would improve care for older people [82, 83].

10.8.3 Education

The GED should create an interprofessional educational program regarding the specific needs of the geriatric population and should regularly reassess and updated accordingly. A peer review, case-based structure is highly encouraged from cases within the local ED. Finally, the GED should ensure EMS personnel are included and patient self-management materials would be distributed to patients and their families.

Many avenues to increase GED education exist currently for all care providers in the specialty of emergency care. Seven Geriatric Emergency Medicine fellowships in the US and Canada [84]. EMS staff can take the course Geriatric Education for EMS (GEMS) by the National Association of Emergency Medical Technicians [85]. RNs can participate in the Geriatric Emergency Nursing Education Course (GENE) [86]. Such courses increase provider knowledge, self-assessed confidence, and the use of GED protocols. Additionally, there are a number of online resources available including:

- Geri-EM: Personalized E-Learning in Geriatric Emergency Medicine at www.geri-em.com.
- Academy of Geriatric Emergency Medicine (AGEM): A community within the SAEM for educational and training resources at http://community.saem.org/communities/community-home?CommunityKey=0a948e78-7b61-474f-8f8a-45338fbc5e19.
- Many of the professional organizations (ACEP, SAEM, AGS, etc.) offer additional valuable resources.

10.8.4 Policies, Procedures, and Protocols

The GED drives implementation of comprehensive, documented elder care processes. In formalizing and implementing these standards, improved care is realized. Specific tools exist to:

- Improve elder: triage/initial evaluation and treatment
- Optimize patient safety
- Enhance sedation/analgesia
- Promote DNR/palliative care
- Screen for at-risk conditions such as delirium/falls/frailty/suspected abuse/neglect
- Avoid never-events with catheter guidelines, wound care/decubiti prevention
- Enhance medication review/management
- Optimize transition of care/follow-up

These policies and procedures will support clarity for the patient, families, and health-care providers and ensure comprehensive care. While the front-end efforts are significant, having standardized care allows for long-term efficiency, makes the growing numbers of complex geriatric patients more manageable, and improves the quality of their care.

The GED guidelines provide tools to operationalize this work including Triage Risk Screening Tools, the Beers Criteria for medications, the Katz Activities of Daily Living Index, the Geriatric Depression Scale, the Confusion Assessment Method, the Mini-Cog Mental Status Evaluation, and the Short Michigan Alcoholism Screening Tool–Geriatric Version. Many of these are described in detail in Chap. 8 in this text. Further, study of ED-specific elder screening tools is needed to develop tools for optimal use [87].

We know older ED patients are at greater risk for adverse outcomes shortly after their visit [4]. It is critical to avoid known ED iatrogenic harms such as catheter-associated UTIs, decubitus ulcers, and delirium. Frailty is useful as an elder risk assessment metric. Frailty is loosely defined as a combination of chronic conditions making an elder particularly vulnerable to environmental stressors. Several geriatric specialists have suggested short screening exams to assess for frailty and delirium [29]. For further information, please see Chap. 1 Frailty. The additional time required to assess an acute or chronic change in mental or functional status may mean the difference between admission and discharge. We know that in this population such a distinction carries very real differences in morbidity, mortality, and quality of life.

10.8.5 Quality Improvement

To promote overall GED success it will be important to create processes to capture and monitor relevant QI data. Recommended data elements include: patient volume, admission rate, readmission rate, deaths, suspected abuse/neglect, transfers, admissions requiring ICU transfer within 24 h of admission, return ED visits, completion of at-risk assessment. The area of improved GED QI is evolving. Attempts to standardize a QI process have had varying success. Studies of ED elder screening tools show their use may be helpful in linkage to and completion of follow-up evaluation. Additionally, disease-specific elements are recommended relating to falls, urinary catheters, medication management, and delirium/restraints [70].

High-priority research questions requiring an analysis of patient-oriented outcomes have shaped and prioritized future research as minimum standards of care for geriatric ED quality indicators. Simple geriatric patient triage screening tools identify patients with an increased risk for repeat ED visits, inpatient care, and nursing home admission [88].

10.8.6 Follow-Up/Transitions of Care

Older adults have high rates of social admissions, ED revisits, and hospital readmissions. Enhanced transitions of care help to break this cycle [79]. GEDs are designed to provide a high level of transition connectivity and enhanced patient safety. GED personnel are knowledgeable about community resources and facilitate the most appropriate patient placement to home, nursing home, rehab facility, observation, or admission. In discharged patients, we can ensure appropriate follow-up ranging from simple telephone call back systems to telemedicine encounters [89]. These ancillary services can also prevent hospital admission for a patient who may need slightly closer monitoring or medication titration but may not need round-the-clock inpatient care [76]. GEDs create discharge protocols to appropriately communicate relevant clinical information to patients and/or caregivers and ensure this information is presented understandably.

The Follow-up/Transitions of Care category extends the Staffing/Administration discussion and formalizes it by reaching into the community, emphasizing the opportunity to coordinate and optimize care. The importance of this is underscored by the Institute of Medicine when it cited that "ineffective transitions of care put the patient's safety at great risk" [5]. Inpatient/outpatient continuity of care is declining. In 1996, 44.3% of admitted patients were seen by their PCP during their inpatient stay, while in 2006 only 31.9% of admitted patients saw their PCP while inpatient [88]. This makes effective transitions of care all the more critical.

Whether returning patients to their home, nursing home, or a skilled nursing facility, ED providers need to improve communication of what occurred in the ED and help establish a safety net to prevent return visits. Care coordinators and geriatric advanced practice nurses provide invaluable communication between a patient's caregivers and PCP to ensure clear treatment goals and establish follow-up visits [90]. Any currently practicing ED physician understands the frustration of receiving a patient from a nursing home without any collateral information, and likewise physicians must anticipate the confusion of a caregiver who receives a patient with vague discharge instructions and possibly a new prescription.

10.8.7 Physical Design

The physical design of the ED provides opportunities for improved care. A patient with visual, hearing, or physical impairments benefits from improved lighting, quieter areas to communicate, more comfortable mattresses, and modified lavatory facilities. Not only does this enhance patient satisfaction and safety but design prevents some never-events, promotes efficiency, and optimizes treatment [7].

In geriatric EDs, the most common modifications include beds, mattresses, better lighting, skid-proof flooring, visual aids, handrails, corridor safety, assisted listening devices, and recliners. Additionally, observation units for patients whose evaluation goes beyond a typical ED stay, as is often the case for older patients, would improve satisfaction and reduce disorientation.

10.8.8 Equipment/Supplies

"Geriatric patient care requires equipment designed for a patient population with specific needs" [10]. Physical and structural changes enhance safety and comfort and also reduce iatrogenic complications. Items such as extra soft or pressure-redistributing foam mattresses reduce skin breakdown and pressure injury. Suggested starting point items include furniture such as reclining chairs with sturdy armrest to prevent falls. Equipment including body warmers, fluid warmers, nonslip fall mats, and bedside commodes all assist with comfort and safety. Lighting is important and emphasizes contrast between walls and floors. Rooms should be private or have acoustically enhanced drapes and sound absorbing materials. Signs should be large and clear.

10.8.9 Implementation

Given the scope of the GED Guidelines, EDs have varied in their application. Overall guideline compliance among EDs that self-identify as "Geriatric" or "Senior" oriented is low [78]. Four geriatric ED models of care have been described [80]. Geriatric ED units are dedicated spaces with specialized staff for care of older patients. The dedicated staff (e.g., geriatric practitioners, social workers, physical therapy, occupational therapy, palliative medicine, and pharmacists) can perform geriatric assessments in a space designed to best treat older patients. The geriatrics practitioner model incorporates similar ancillary services, but without a dedicated space. Generally, existing ED providers receive education on geriatric care. Patients are also evaluated by other services concurrent with the ED workup. A hybrid between these two models is the geriatric-focused observation unit. EDs with this model have a space with observation beds allowing for stays typically between 4 and 24 h. During this time, existing inpatient staff can perform geriatric assessments. These observation units reduce admission rates, readmission rates, and functional decline after ED discharge [80]. The geriatric champion model involves a single person or small group of providers who lead the creation and implementation of care coordination pathways in the ED. While short-term smaller evaluations of these models have showed some beneficial outcomes, there is a lack of randomized controlled trial data to adequately compare these models with usual care. Implementation of the GED Guidelines currently is linked closer to individual ED, hospital, and community resources.

10.9 Summary: Improving Current and Future Care

Older people in the ED are a special population that is growing, has appropriate high utilization, and suffers significant morbidity and mortality despite high admission rates. A significant change in the current ED model is now being implemented through ACEP GEDA, to meet the increasing demands for high quality and optimal performance expected of the modern ED. By developing, customizing, and deploying the above GED guidelines, an ED can effectively become more geriatric patient-friendly and thus enable comprehensive and quality care to the growing geriatric population. Access to an interprofessional team can enhance elder emergency care. Such a team can help ensure optimal protocols for the planning and coordination of care during emergency evaluation and treatment, the availability of physical plant modifications and equipment, the education of optimal elder care for all ED staff, and the provision of quality transitions of care on ED discharge. This interprofessional collaboration can support the successful implementation of the GED guidelines and improve emergency care for older adults. We must respond quickly to implement known strategies improving care to the vulnerable older people in our EDs.

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11 Geriatric Trauma and Emergency General Surgery

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11.1 Overview

The US older population has been rapidly growing, a result of the aging baby boomers and increasing life expectancy. By the year 2030, elderly Americans are expected to constitute 19% of the population [1], and approximately 41% of all annual in-patient surgeries in the USA are already being performed in the older population subset [2, 3]. As a result, trauma/acute care surgeons will frequently be faced with the care of older patients who often present with unique diagnostic and therapeutic challenges. Overall, trauma is a leading cause of morbidity and mortality in older adults, with falls, motor vehicle crashes, and burns constituting the most common mechanisms of injury. Geriatric emergency general surgery includes a diverse range of disorders with distinct disease processes, presentations, and management issues. The most common conditions include acute diverticulitis, mesenteric ischemia, acute cholecystitis, and acute appendicitis. Older adults also have distinct physical and social vulnerabilities, as well as unique goals for their care, that warrant a more thorough and individualized approach to surgery. In fact, studies show that compared to younger adults, older adult patients may more often prioritize the quality of life over longevity when it comes to their treatment goals [4].

11.2 Geriatric Trauma

Trauma is generally considered to affect primarily the young population, with the older population being perceived as sedentary and less active. However, the traditional norm is changing, and older adults are better maintaining their health, placing them at risk for trauma from an active lifestyle. These trends, in addition to falls, burns, and motor vehicle crashes that affect frail elders, result in trauma becoming a leading cause of morbidity and mortality in the elderly. Indeed, this has even resulted in the formation of a coalition on geriatric trauma, outlining future directions and strategies for advancing the optimal care of injured older adults, representing input from multiple major trauma, surgery, and geriatric societies [5].

There is a debate regarding the exact age definition of a geriatric trauma patient, whether the cutoff should be as low as 50, or as high as 70 years old. Despite this, it is estimated that over 500,000 geriatric trauma patients (over the age of 65 years) are admitted to the hospital every year, accounting for one quarter of all trauma admissions in the USA [6, 7]. The number of geriatric trauma patients is increasing [8] and is already having a significant impact on our health-care system. By 2050, 40% of all trauma patients are expected to be older adults [9, 10]. Elderly trauma patients present unique challenges: the mechanism of injury is different, they have decreased physiological reserves, and they have comorbidities treated with multiple medications, further complicating their presentation, clinical course, and outcomes. As a group, they experience higher mortality, higher complication rates, and slower recovery. Trauma surgeons in sync with multidisciplinary teams must be prepared to provide geriatric-specific, high-quality, and cost-effective trauma care for these older adults currently in need, and in the future. These service lines will be tailored to the geriatric trauma patient and exist within the trauma bay, intensive care units (ICUs), and general ward. This infrastructure will allow transitions of care both for in-hospital and outpatient care resulting in overall better patient outcomes.

11.2.1 Mechanisms of Injury in Older Adults

The mechanisms of injury in the older adult population are distinctly different from their younger counterparts. The

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three leading mechanisms of injury in older adults are falls, motor vehicle collisions (MVC), and burns. Falls are the most common mechanism of injury in geriatric trauma patients and account for over 50% of all unintentional injuries in older adults [11]. Although falls from a standing position on a level surface are considered to be a low impact or benign mechanism of injury, they are associated with a significant morbidity (e.g., hip fracture, cervical spine, or head injury) reaching as high as 40% [12, 13]. There are many reasons for the increased number of falls, including aging itself, vision impairments, mobility impairments, gait disturbance, comorbid conditions, environmental and occupational factors, and medications, and the etiology of a fall is often multifactorial [14, 15].

Elderly drivers suffer a higher mortality rate following MVC [16]. MVC-related mortality in geriatric patients is five times higher than their younger counterparts [11, 16, 17], and it is the most common cause of trauma-related mortality in older adults. The older driver has the second highest rate of MVC per mile driven, second only to teenagers despite adhering to low-risk driving conditions (e.g., driving during the day, avoiding poor weather conditions). This high crash rate is attributed to several aging-related conditions, including decreased visual acuity and nighttime vision and slower cognitive-visual processing, as well as associated medical conditions (e.g., arthritis), cognitive impairment, and adverse medication effects (e.g., benzodiazepines). In contrast to young adults, speeding and alcohol use are uncommon causes of MVC in older adults. Approximately 25% of older adults involved in an MVC sustain a chest injury, most commonly rib fractures, which can be devastating and lead to pneumonia and respiratory failure. Following an MVC, older adults are also more likely to suffer fractures than younger crash victims, including the cervical spine, hips, and extremities.

Burn-related injuries are the third leading cause of mortality in geriatric trauma patients. Every year 2000 older adults die from burn-related injuries in the USA. Among all the burn patients, the highest mortality exists in geriatric patients, accounting for 13–20% of overall admissions in burn units [18, 19]. The most common causes of burns are smoking in bed, ignition of clothing, and immersion in hot water bath. Burns in older adults occur primarily at home and most common locations are kitchen, bathroom, and living room. Similar to all age-related injuries, sensory, cognitive, and physical impairments in older adults are chiefly responsible for these injuries. Burns in older adults also tend to be more severe as older adults may have a reduced ability to recognize the severity of the situation, as well as a limited ability to escape [18, 19]. Importantly, the reduced body mass in older adults results in deeper thermal injuries. Elderly patients have decreased follicular adnexal concentrations, thickened epidermises, accumulation of photodamage, concomitant flattening of rete ridges, loss of dermal papillae, and flattening of the dermal–epidermal junction by over a third, leading to reduced nutrient and oxygen delivery to the epidermis. This confers an increased susceptibility of geriatric patients to burns, with an increased risk of dermal–epidermal separation, deeper wounds, and delayed wound healing following burns [20–22].

11.2.1.1 Key Points

- Minor trauma can cause major injuries and death.
- Standing falls from a level surface are the most common mechanism of injury in the geriatric population.
- MVC-related mortality is five times higher in older adults compared to young adults.
- Among all burn patients, older adults suffer the highest mortality.

11.2.2 Impact of Age-Related Physiologic Changes and Comorbidities

Physiological changes secondary to aging combined with comorbidities significantly increase the trauma-related morbidity and mortality [23]. Age-related changes in the cardiovascular, respiratory, musculoskeletal, and neurocognitive systems directly impact prehospital triage, primary survey, and management [24].

Aging-associated changes in the cardiovascular system include a decrease in cardiac function and an increase in the stiffness in the aorta and peripheral vasculature. There is also a decrease in both maximum heart rate and tachycardic response, which may be due to slower conduction velocity and lower endogenous response to catecholamines [25]. These changes pose a major challenge to the management of trauma patients. Due to a lower tachycardic response in older adults to hemorrhage, pain, or anxiety, the heart rate may be a poor indicator of shock and hypoperfusion [13, 26]. Elderly patients have a higher baseline blood pressure, so a normal blood pressure may be falsely reassuring in geriatric trauma patients [27, 28]. Elderly trauma patients also tend to collapse very quickly without any warning signs [11]. Therefore, a heart rate above 90 beats per minute (rather than 130 beats per minute) and a systolic blood pressure less than 110 mmHg (rather than 95 mmHg) are more sensitive indicators of serious injury in the older trauma patient.

With aging, there is a loss of lung and chest wall elasticity, from the age-related loss of elastin and changes in cross-linking, which forms part of the supporting structure of the lung parenchyma. The loss of elasticity reduces lung recoil, which negatively impacts washout and adequate ventilation. In addition, the alveolar airspaces dilate in many elderly people, resembling a senile form of chronic obstructive pulmonary disease (COPD), without excessive inflammation or destruction of alveolar septal walls [29–32]. Moreover, calcification of the intercostal cartilages and degeneration of intervertebral disc space restricts the thoracic volume that limits the ability of the lung to expand and function effectively [33]. The alveolar compliance decreases in older adults due to collagen deposition and surfactant reduction. Older adults have diminished respiratory reserve, with lower forced expiratory volume (FEV1), lower baseline pO_2, and lower baseline alveolar-arterial oxygen gradient. Elderly patients also suffer from reduced alveolar surface area and pulmonary capillary density, both of which contribute to significantly decreased diffusing capacity and increased ventilation-perfusion mismatch. Older patients have attenuated responsiveness to hypoxemia and hypercapnia [34–36]. In face of these changes, even a simple pneumothorax or hemothorax in older adults can be catastrophic. Administration of supplementary oxygen is necessary in elderly trauma patients and ICU admission of geriatric patients should be considered to allow for an early detection of respiratory failure [37]. Chest wall injuries with rib fractures in elderly are poorly tolerated and associated with a higher mortality rate [38]. Narcotics should be used with caution in these patients as even low doses may result in a severe respiratory depression. In summary, older adults have a blunted response to hypoxia, hypercarbia, and acidosis and may be unable to compensate for these metabolic challenges. They may maintain a normal respiratory rate despite progression of hypoxia and hypercarbia, complicating clinical assessment and leading to a false sense of security.

Changes in musculoskeletal system begin after the age of 30 years, and after the age of 50, there is a 10% loss in muscle mass with every decade of life. Decreased anabolic hormones, malnutrition, and decreased activity are responsible for these changes [39]. Although sarcopenia is an important indicator of patient's health status, studies have shown that frailty assessment may be a more effective screening tool than simply sarcopenia assessment alone [40]. Ligaments and joints become stiffer and less flexible leading to a decreased joint stability. Lower bone density and osteoporosis facilitates fractures and complicates bone healing. Cervical osteophytes secondary to osteoarthritic changes decrease the neck flexibility, which makes neck extension difficult for intubation. Therefore, care in intubation and early stabilization of fractures and mobilization are necessary in geriatric trauma patients to avoid devastating complications.

Aging-related changes in the dura and veins increase the risk of subdural hemorrhage from head injury in older adults. Brain atrophy, which accompanies aging and is represented by global reductions cortical thickness, surface area, and volume, results in a larger intracranial space for asymptomatic accumulation of blood, delaying the development of signs and symptoms [41]. Age-related changes in cerebrovascular autoregulation may compromise the brain's ability to protect itself from hypotension; this is particularly relevant when considering therapeutic hypotension. Lastly, the presence of cognitive impairment and/or delirium is more common in older adults and further complicates assessment.

11.2.2.1 Key Points

- Aging is associated with a physiologic decline that affects all organ systems.
- With aging there is a decrease in cardiac reserve, lung and chest wall elasticity, a loss of musculoskeletal mass and mobility, and changes in the brain and dura.
- These changes predispose elderly trauma patients to subtle presentations of serious injury, rapid hemodynamic collapse, need for prolonged respiratory support, and difficulty in intubation.

11.3 Geriatric Trauma Assessment and Initial Management

11.3.1 Geriatric Trauma Triage

Appropriate triage of trauma patients is important because it allows for maximized benefit of available resources to achieve the best outcomes. Studies demonstrate that even with a mild injury, older trauma patients have a significantly higher mortality compared to their younger counterparts [42]. It is still unclear whether the decrease in physiological reserve related to aging, associated comorbidities, or other unidentified factors is responsible for this difference. However, it is well recognized that improved outcomes can be achieved with an aggressive trauma care in patients who have survivable injuries.

As noted, geriatric trauma patients are a unique population with distinct characteristics that pose a challenge for appropriate triage. Currently, older adults are under-triaged, likely a result of an apparent benign mechanism of injury (e.g., after a level fall), subtle presentation of injury, and the use of traditional triage tools which depend upon classic physiologic criteria (e.g., blood pressure, pulse) to activate the trauma team [43]. Due to their inherent higher vulnerability to morbidity and mortality, and lack of triage criteria for older adults, several studies have suggested that all geriatric trauma patients should be transferred to high-level trauma centers regardless of their injury severity. The potential result of this approach is that it may result in a significant overtriage and overwhelm current trauma centers [44]. The early identification of geriatric trauma patients who will benefit from aggressive therapy and early postinjury rehabilitation is a key step in matching resources to needs and improving outcomes, and geriatric-specific trauma guidelines are evolving.

According to the guidelines of the American College of Surgeons Committee on Trauma, patients age of 55 years and older are associated with higher mortality and morbidity rates and should be directly transported to a trauma center regardless of the severity of injury [23]. The latest version of the National Trauma Triage Protocol (NTTP) has recommended that geriatric trauma patients age of 65 and above with SBP <110 mmHg should be triaged to a trauma center. The most accurate predictor of mortality in geriatric trauma patient is Injury Severity Score (ISS); however, this variable cannot be used for the triage of geriatric patients because it is unavailable in the field. In its absence, physiologic parameters remain the only available measures for the field triage. More recently, shock index >1, which is a simple ratio of heart rate and systolic blood pressure, has been demonstrated to be an accurate predictor of mortality in geriatric trauma patients and may thus be appropriate for use in the field triage [45]. However, the impact of this change on triage performance is yet to be determined.

11.3.2 History

Obtaining a history is helpful, although in many instances it may be difficult. As possible, the following questions should be obtained: events immediately leading to the trauma, chronic conditions and medications, usual level of function and cognition, and the presence of advance directives. Although discussed later, an understanding of a patient's goals of care, preferences, and values is a critical component of geriatric trauma care.

11.3.3 Initial Assessment

It is important to maintain a high index of suspicion for significant injury in the geriatric trauma patient and conduct a careful assessment and implement close monitoring. For initial assessment, the standard primary survey should be utilized, with special attention to the aging-related physiologic responses that may otherwise delay the recognition of serious clinical problems. In addition to blunted responses to hypoxia, hypercarbia, acidosis, and hemodynamic challenge, older adults may have diminished pain perception. This may hide from clinical view the presence of serious injuries, including chest, abdominal, and skeletal fractures. The impact of medications, such as anticoagulants and beta blockers, and comorbid conditions, including osteoarthritis, and heart failure should also be directly assessed and managed. For example, airway management can be complicated by cervical osteoarthritis, and preexisting conditions such as myocardial ischemia can be the cause of hypotension, rather than hemorrhage.

When evaluating an older adult with a fall, specific attention should be paid to the assessment of any other associated injuries, such as cervical, rib, or pelvic fracture, as well as an otherwise unrecognized condition that may have contributed to the fall. Falls may result from pneumonia, sepsis, cardiac disease, medications, or other conditions [46]. The presentation of acute illness in older adults may be very subtle and limited to a functional impairment (e.g., fall) or exacerbation of an underlying chronic condition (e.g., heart failure). Older adults may not be febrile with an acute infection and may not complain of chest pain with acute cardiac ischemia. Therefore, even in patients with no signs of infection, sepsis, or acute ischemia, a high index of suspicion should be maintained, and contributing etiologies for a fall should be evaluated.

One of the most dreaded complications of falls in older patients is a traumatic brain injury. Low threshold should be maintained for suspecting an intracranial injury, particularly in patients with headache, drowsiness, or confusion [47]. Hip fracture is another major complication that carries significant morbidity and mortality. It is essential to promptly evaluate geriatric patients with falls for hip fractures while in the ED and if necessary to expedite emergency surgery. Although attention should be paid to correction of underlying electrolyte imbalances and stabilization of comorbidities, it is critical not to unnecessarily delay surgical repair of a hip fracture.

11.3.4 Risk Assessment in Trauma Patients

While it is well recognized that aging is associated with a physiological decline, this decline is not uniform across all individuals or even an individual's organ systems. The frailty index has recently emerged as an index of the physiological age and reserve of an individual and studies have demonstrated that frailty is an accurate predictor of morbidity and mortality in trauma patients. In fact, the use of age alone for clinical decision may be misleading, and in geriatric trauma patients, the frailty index has been shown to be superior to age in predicting the outcomes [48, 49].

Several models have been developed and validated to assess the frailty score of an individual (see Chap. 1, Frailty). The most common ones include Fried's frailty and Rockwood's frailty model. While both these models have been well validated in the literature, the practicality of these indices in a trauma cohort of patients is questionable due to their cumbersome nature. To improve the practical applicability of frailty score, studies have derived a simple 15-variable Trauma-Specific Frailty Index (TSFI) that has been shown to be as accurate as a 50-variable questionnaire in predicting the outcomes in geriatric trauma patients (Table 11.1) [49, 50]. The TSFI has been shown to predict mortality as well as discharge disposition in geriatric trauma patients [51, 52]. The TSFI has been well validated in the literature and was found to accurately diagnose the frailty

Table 11.1 Trauma-specific frailty index

Fifteen-variable trauma-specific frailty index			
Comorbidities			
Cancer history	Yes (1)	No (0)	PCI (0.5)
Coronary heart disease	MI (1)	CABG (0.75)	
	Medication (0.25)	None (0)	
Dementia	Severe (1)	Moderate (0.5)	Mild (0.25)
	No (0)		
Daily activities			
Help with grooming	Yes (1)	No (0)	
Help managing money	Yes (1)	No (0)	
Help doing housework	Yes (1)	No (0)	
Help toileting	Yes (1)	No (0)	
Help walking	Wheelchair (1)	Walker (0.75)	Cane (0.5)
	No (0)		
Health attitude			
Feel less useful	Most time (1)	Sometimes (0.5)	Never (0)
Feel sad	Most time (1)	Sometimes (0.5)	Never (0)
Feel effort to do everything	Most time (1)	Sometimes (0.5)	Never (0)
Falls	Most time (1)	Sometimes (0.5)	Never (0)
Feel lonely	Most time (1)	Sometimes (0.5)	Never (0)
Function			
Sexually active	Yes (0)	No (1)	
Nutrition			
Albumin	<3 (1)	>3 (0)	

status of geriatric trauma patients and predict failure-to-rescue in this injured patient cohort. Specialized geriatric trauma centers should take into account failure-to-rescue as an indicator of health-care quality, and frailty status identified using the TSFI as a reliable triage and prognostic tool [53, 54]. On a related note, the Geriatric Trauma Outcome Score (GTOS) was developed as a prognostic tool predicting mortality 24 h after injury in geriatric patients, where GTOS = [age] + [ISS × 2.5] + [22 if transfused any PRBCs by 24 h after admission]. It was found to accurately predict in-hospital mortality (IHM) for the injured elderly [55, 56]. The GTOS II can also reliably predict unfavorable discharge outcomes in geriatric trauma patients [57].

11.3.5 Management of Geriatric Trauma Patients

The ongoing management of geriatric trauma patients involves several domains, including identification of patient's baseline status (preinjury), patient/family's goals of care, patient's anticipated prognosis and recovery, and early and ongoing discharge planning. Close monitoring is essential for early identification and management of associated injuries and impact of comorbidities and medications. Comprehensive delirium prevention and management protocols should be implemented (see Chap. 2, Delirium). Careful analgesia is important to optimize patient's functioning and reduce the incidence of delirium. Optimizing cognition, sleep, nutrition, managing constipation, and preventing skin breakdown are key elements of care. Collaboration with geriatricians (in consultation or comanagement models) and/or palliative care teams offers the opportunity to optimize care and improve clinical outcomes for older adults.

11.3.6 Outcomes of Care for Geriatric Trauma Patients

During the past couple of decades, quality of health-care services and outcomes has become increasingly important. Outcomes including IHM, posthospitalization mortality (PMH), in-hospital complications, functional status, and ICU and hospital length of stay have been extensively studied in geriatric patients. Multiple factors help determine these outcomes in geriatric trauma patients such as demographics, injury severity, and general clinical condition, which is a cumulative effect of age, comorbidities, decline in physiologic reserve, cognition, and functional ability of the patient. Elderly patients who are admitted to the hospital for an acute illness or after a traumatic injury are more prone to develop functional disability and be discharged to skilled nursing facilities for long-term care than younger adults. It has been reported that more than 90% of geriatric trauma patients require skilled nursing care facilities at least 1 year after the injury. Complications resulting from a functional decline after injury include loss of independence, falls, incontinence, depression, malnutrition, and lack of socialization. Early evaluation of general clinical condition, injury severity, and functional and cognitive impairments through a team assessment can enable a rapid and appropriate management utilizing geriatric principles to minimize the risk of adverse outcomes.

11.3.7 Transition of Care

The primary objective for any trauma patient admitted to the hospital is a safe transition to a level of care that meets their needs and goals of care and allows for the highest level of independence. The discharge site may be their home (often with family and home health services support) or an inpatient facility (including skilled nursing facility or rehabilitation hospital). A successful transfer requires comprehensive planning that should begin at the time of hospital admission and demands the early and ongoing assessment of patient's physical, cognitive, social, and financial situation by the physician, nurse, case manager, therapist, and the social worker. The discharge of these patients to these facilities is often limited by financial restrictions, insurance coverage laws, reimbursement rules, and Centers for Medicare & Medicaid Services (CMS) regulations. These issues require a close communication among the health-care providers, case manager, and social worker to allow a timely and appropriate discharge of these patients. An appropriate discharge plan is essential to ensure patient safety, to idealize patient outcomes, and to prevent readmissions.

A key element of the disposition of the patient is the assessment of functions associated with activities of daily life. The most commonly utilized tool to assess and document functional independence is Functional Independence Measure (FIM) instrument. It is composed of 18 elements which assesses 13 motor skills and 5 cognitive skills, each scaled from 1 to 7 with 1 meaning total assistance and 7 meaning total independence. This score is the most widely accepted and utilized of all functional assessment tools and also recognized by the CMS [58–60].

11.3.7.1 Key Points

- Transition of care from the hospital is challenging as a large number of geriatric patients require transfer to a rehab facility or a skilled nursing facility.
- Close communication and a strong working relationship among the health-care providers are essential to ensure a safe and appropriate discharge of these patients.

11.3.8 End-of-Life Care in Older Adults

Withdrawal of care is a common occurrence in the geriatric trauma patients who are admitted to the ICU. Despite its frequency, it remains a complicated and challenging situation for health-care providers. Most common causes for withdrawal of care include reduction of patient suffering, anticipated poor quality of life, and brain death [61]. It is important to understand that withdrawal of care should not always be viewed as a symbol of failure or defeat. Understanding the issues associated with end-of-life situations and palliative care is of paramount importance to improve the care of dying patients.

A patient-centered approach should be utilized to establish the goals of the treatment in geriatric patients. This requires an in-depth discussion with the patient and their families about the likely outcomes and subsequent quality of life. There are numerous prognostic models that predict mortality and may help in informed decision-making; however, none of these models is 100% accurate. The decision for withdrawal of care should be based on risk–benefit analysis and patient's autonomy and wishes.

While advising patients and their families in arriving at a decision, there should be ongoing communication and a consensus should be achieved before reaching a final decision. One of the most significant concerns for patients and their families regards symptoms of pain, nausea, agitation, and respiratory decline in the final stages of life. While talking to the family, it is essential to understand what the family knows and what they wish to understand and then communicate the information they need to make an informed decision. These decisions can cause significant distress and grief for the family so the physicians should understand their feelings, express empathy, and offer their support. The hallmark of palliative care is the relief of these symptoms to ensure that the patient is comfortable during the final days, and this should be discussed with patients and their families. Although all trauma/acute care surgeons should be skilled in these conversations, collaboration with a palliative care team is strongly recommended. Chapter 6, Palliative Care and End of Life Issues, provides an in-depth discussion of this subject.

11.3.8.1 Key Points

- End-of-life decisions and withdrawal of care remain a challenge for geriatric patients.
- A patient-centered approach should be exercised to establish the goals of the treatment.
- An honest open communication between patients, their families, and caregivers is the cornerstone for high-quality end-of-life care decisions.

11.4 Geriatric Emergency General Surgery

Emergency general surgery (EGS) includes a diverse range of disorders that often presents a unique diagnostic and therapeutic challenge for the caregivers. Aging is associated with anatomical and physiological changes that further complicate the management of emergency general surgery in the older adult population. As the US population continues to age, acute care surgeons are likely to see an increase number of these patients. It is essential for acute care surgeons to have a thorough understanding of the differences in the disease process, its presentation, and management to provide optimal care for these patients. In addition, it has been shown that surgeons who perform lower volumes of geriatric-specific EGS procedures annually are associated with higher odds of patient death and failure-to-rescue, underscoring the need for focused care of elderly surgical patients by specialized surgeons and centers [62].

11.4.1 Clinical Presentation of Elderly Patients

Primary evaluation of the older adult patient with a suspected surgical emergency is challenging. Presentation of older adult patients is often atypical, delayed, and vague. Preexisting cognitive impairment or neurologic deficits (i.e., dementia, delirium, prior stroke, and neuropathy) are contributing factors for the atypical or delayed presentation of the patient or the ability to be detected by primary care providers [63]. Moreover, the history of present illness may be difficult to obtain as it is often complex, deficient, and imprecise. Physical examination similarly may be misleadingly benign and therefore not alert the surgeon to a serious underlying condition. Among patients hospitalized to an ICU; altered mental status, absence of peritoneal signs, analgesics, antibiotics, and mechanical ventilation all contribute to delays and difficulties in surgical evaluation and treatment. All of these factors contribute to increased rates of morbidity and mortality among older adults with surgical conditions [64, 65].

11.4.2 Frailty and Emergency General Surgery

During the past few decades, quality of health care has become an important focus of outcomes research. The objective of such research is to bring to light best evidence-based practices that help improve patient outcomes. Countless studies have examined outcomes after general surgery in older adults. Predominantly, these studies have looked at mortality and complications as outcomes. The association of age and adverse outcomes is well established and validated. However, more recently the focus has shifted from age to functional status as a predictor of postoperative outcomes in patients undergoing general surgery. The use of objective measures of preoperative assessment helps in informed decision-making, which is crucial for geriatric patients undergoing emergency general surgery and their families. The American College of Surgeons (ACS) has developed a surgical risk calculator based on multi-institutional National Surgical Quality Improvement Program (NSQIP) data that allows one to accurately estimate the risk of most common surgical procedures and will help in informed decision-making [66]. This risk calculator is based on 21 preoperative risk variables and also allows to adjust for surgeon's estimation of an increased risk using the Surgeon Adjustment Score (SAS). Several studies have shown that the NSQIP calculator reliably predicts the postoperative complication risk of surgical patients and aids clinicians and patients to make decisions using empirically derived patient-specific postoperative risks [67]. While accurate, the ACS NSQIP calculator does not incorporate several components of frailty that contribute significantly to the final postoperative outcomes of surgical patients. Studies have also shown that for patients undergoing emergency general surgery, frailty index better predicts complications and the addition of these additional variables to the NSQIP calculator may significantly improve the predictability of the NSQIP calculator [68].

Several models exist for the calculation of frailty index. The most comprehensive frailty questionnaire is the Rockwood frailty model based on 70 variables that assess the cognitive, physiological, physical, and social well-being of the individual. The Rockwood frailty index has been validated in patients undergoing an elective surgery. More recently, a modified 50-variable Rockwood frailty index has been shown to reliably predict morbidity in patients undergoing emergency general surgery [69]. Interestingly, using the 15 strongest predictors out of the 50 variables, a similar predictability can be achieved. The use of this 15-variable EGS-specific frailty index allows for a more rapid yet accurate assessment of frailty status of patients undergoing emergency general surgery (see Table 11.1). For each question in the frailty index, a patient receives a score varying from 0 to 1. The sum of final score is then divided by 15 to calculate the frailty index of the patients. Patients with a frailty index of >0.325 are considered frail and are at high risk for morbidity following emergency general surgery. This new EGS-specific frailty index (EGSFI) was found to be a strong and reliable predictor of postoperative complications and mortality among frail patients, proving it to be a simple and reliable bedside tool to determine the frailty status of patients undergoing EGS [70, 71].

11.4.2.1 Key Points

- Several risk assessment tools for geriatric patients undergoing emergency general surgery exist.
- Preoperative risk assessment aids the clinicians and patients in informed decision-making.
- Frailty can be assessed in patients undergoing an emergency general surgery using a simple 15-variable EGSFI.

11.4.3 Acute Diverticulitis

Diverticular disease is a common disorder in elderly resulting in 312,000 hospital admissions and 1.5 million days of inpatient care every year in the USA [72]. Over 75% of patients above 70 years of age in the western countries have colonic diverticulosis with left hemicolon being the most common site (sigmoid diverticulosis 95%) [73]. As individuals age, a variety of physiologic alterations manifest, many of which affect structural components of the colon, intraluminal pressure, colonic motility, and electrophysiology [74].

11.4.3.1 Age-Related Changes

Structural components of the extracellular matrix of the colonic wall are important in maintaining the strength and integrity of the colonic wall. Age-related changes take place in these components, such as damage and breakdown of mature collagen and replacement with immature collagen. These changes decrease the compliance, leading to a stiffer tissue that is more vulnerable to tears, especially under conditions of increased luminal pressures [75]. Age-related neural degeneration can lead to the reduction of neurons in the mesenteric plexus and the intestinal cells of Cajal (the so-called intestinal pacemaker cells), which induces smooth muscle dysfunction. Age-related functional changes in the colon such as increased uncoordinated motor activity and high amplitude propagated tonic and rhythmic contractions result in segmentation, which significantly increases colonic intraluminal pressure. The pathogenesis of diverticulosis has also been associated with a lack of dietary fiber. Other risk factors associated with diverticulosis are obesity, smoking, non-steroidal anti-inflammatory drugs (NSAIDs), and aspirin.

Up to 80% of diverticulosis patients are asymptomatic. Other symptoms vary from mild to severe fecal peritonitis with septic shock. In mild cases, patients present with lower abdominal pain and tenderness most commonly localized to the left side with loose stool or constipation. Elderly patients with intra-abdominal sepsis tend to present to physicians with less acute and delayed symptoms compared to younger patients. The classic triad of acute diverticulitis is lower abdominal pain, fever, and leukocytosis; however, this triad is only seen in less than half of cases. It is important to note that only 50% of elderly patients with intra-abdominal infection will present with nausea, vomiting, and fever. Cutaneous and visceral pain sensitivity decreases with age which can explain why elderly patients with abdominal sepsis present with a benign abdomen. The absence of definitive findings such as guarding and rigidity can decrease a physician's alertness to the presence of intra-abdominal sepsis. Thus, it is important that physicians maintain a high level of suspicion during physical examination of elderly patients [76].

The gold-standard imaging test for the diagnosis of acute diverticulitis is computed tomographic (CT) scan which has a high sensitivity and specificity for the diagnosis of acute diverticulitis [77, 78]. The use of colonoscopy and sigmoidoscopy should be avoided in the acute stage of the disease as it may lead to perforation of the inflamed bowel. Colonoscopy is usually recommended 4–6 weeks after the acute phase of the inflammation to rule out other coexisting diseases, such as cancer.

Conservative management for acute uncomplicated diverticulitis is successful in 70–100% of cases [79]. Geriatric patients with acute diverticulitis can be managed safely with outpatient therapy. For these patients, the treatment of choice is 7–10 days of oral broad spectrum antibiotics [80]. Hospitalization is indicated only in patients who require analgesia, are unable to tolerate any diet, or in cases of complicated diverticulitis. The patient should be made nil per os (NPO) and broad spectrum antibiotics should be administered intravenously. These patients are followed serially with white cell counts, abdominal examination, and repeat CT scans (Fig. 11.1).

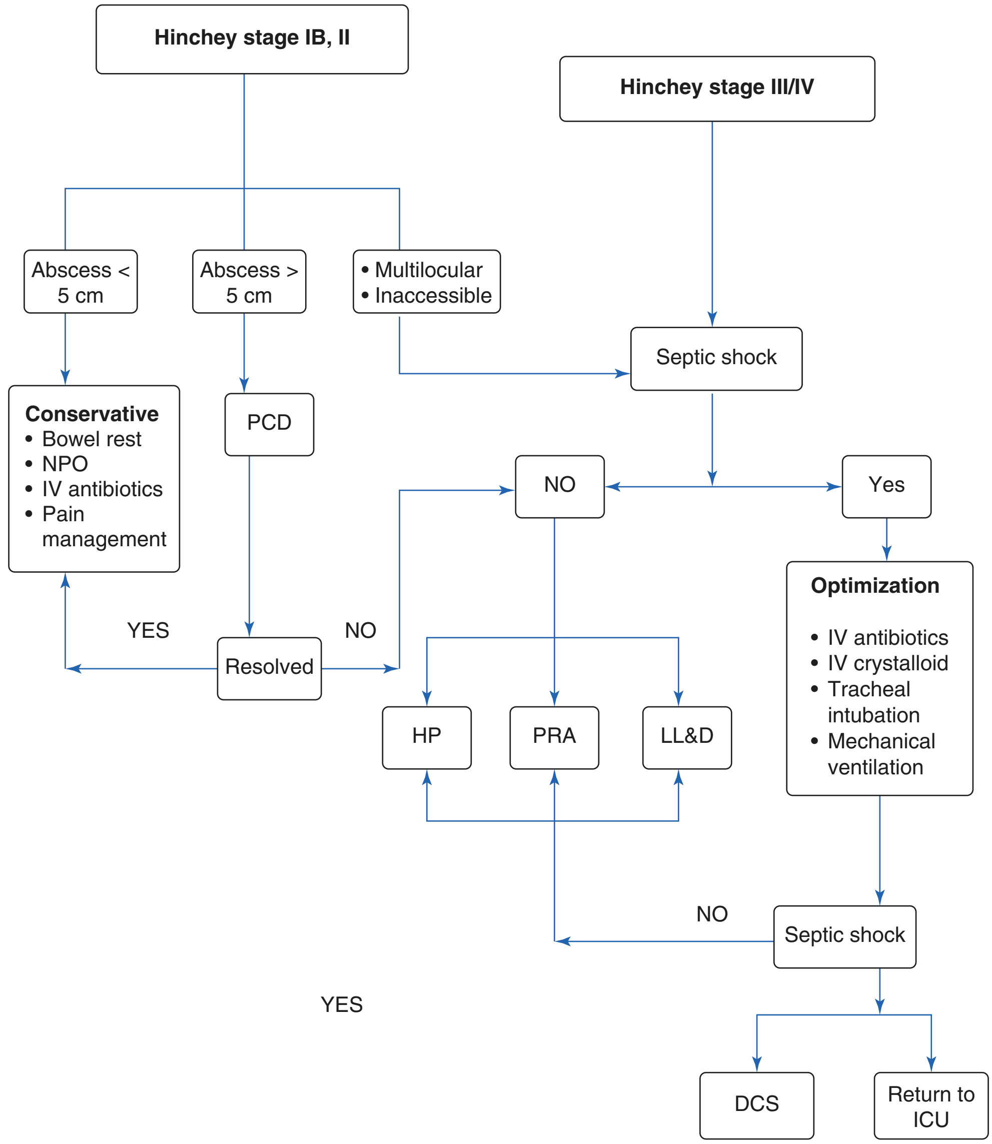
11.4.3.2 Key Points

- Several anatomical and physiological changes in the colon associated with advancing age predispose older adults to diverticular disease.
- The presentation of acute diverticulitis in older adults is subtle compared to younger counterparts.
- Medical management with bowel rest, analgesics, and antibiotics remains the cornerstone treatment of acute diverticulitis.

11.4.4 Mesenteric Ischemia

Mesenteric ischemia is a rare condition in the general population but a relatively common disorder in older adults [81]. Despite the recent improvements in diagnosis and treatment, it is still associated with significant mortality rates of around 60% [82]. Approximately 50% of elderly patients have a degree of atherosclerosis of the celiac, superior, and inferior mesenteric arteries, which can precipitate acute mesenteric ischemia [83]. The superior mesenteric artery is most commonly implicated in acute mesenteric ischemia. Arterial embolism, arterial and venous thrombosis, and nonocclusive ischemia are the main causes of acute mesenteric ischemia [83]. Typically, acute mesenteric ischemia presents with poorly localized severe abdominal pain, classically described as "pain out of proportion" due to the absence of associated findings on physical examination [84]. The presence of these clinical features with preexisting comorbidities such as atrial fibrillation, ischemic heart disease, and atherosclerosis should increase physicians' suspicion to consider mesenteric ischemia as a potential diagnosis. Of elderly patients, 30% will present with nonspecific symptoms such as nausea, vomiting, or diarrhea that can mislead the diagnosis of mesenteric ischemia to a more benign disorder like gastroenteritis [84]. Ultimately, patients develop distention, shock, abdominal tenderness with guarding, and perforation [85]. Leukocytosis with a white blood cell count greater than 15,000/μ is present in only 75% of the patients. Metabolic acidosis and elevated serum lactate and amylase may be present if infarction has occurred. Fecal occult blood is reported in 50–75% of the patients. Gross bleeding, however, occurs on rare occasions. As there is no definitive lab test and usually physical examination reveals nonspecific findings, physicians should maintain a high level of suspicion [86].

Fig. 11.1 Management of acute diverticulitis



NPO-nil per os, PCD-Percutaneous Drainage, HP-Hartmann Procedure,
PRA-Resection and Primary Anastomosis, LL & D-Laparoscopic Lavage and Drainage
DCS-Damage Control Surgery

Plain X-ray films may initially be unremarkable but they may demonstrate intestinal distention and air-fluid levels. According to recent studies, CT angiography has a sensitivity of 80% for diagnosing acute mesenteric infarction. Findings on CT scan indicative of mesenteric ischemia include thromboembolism in mesenteric vessels, portal venous gas, pneumatosis, diffuse bowel wall thickening, and mesenteric edema. Selective mesenteric angiography has a sensitivity of 90–100% and is recommended if mesenteric ischemia is strongly suspected. However, due to the high prevalence of renal atherosclerosis in elderly, angiography can result in renal toxicity and should be kept in mind [83, 85]. A recent study has demonstrated that day-of-surgery lactate level more than 5.4 mmol/L and pressor requirement were independently predictive of death in elderly patients with acute mesenteric ischemia [87].

11.4.4.1 Key Points

- Vague nonspecific clinical signs in geriatric patients can be deceiving.
- Comorbidities have a strong association with acute mesenteric ischemia.
- Early diagnosis and treatment of mesenteric ischemia in older adults is crucial.

11.4.5 Acute Cholecystitis

Biliary tract disease including cholecystitis is the most common indication for abdominal surgery among elderly with abdominal pain [88]. The prevalence of gallstones increases sharply with age. About 15% of men and 24% of women have gallstones by the age of 70. By age 90, this increases to 24% and 35%, respectively [89]. Gallbladder disease in older adults tends to be more severe compared to their younger counterparts as evidenced by the fact that a higher proportion of elderly patients undergo cholecystectomy for acute causes rather than elective cholecystectomy [39]. Biliary tract disease in older adults is further complicated by the greater incidence of common bile duct stones. Common bile duct stones are found in patients undergoing cholecystectomy in up to 30% of those in their 60s and in up to 50% of those in their 70s [90]. Age-related changes in the biliary tract such as decrease bile salt secretion, increased cholesterol precipitation of the bile, increased common bile duct diameter, and decrease in gall bladder contractility are thought to account for the increased incidence of gallstone disease [91–93].

Acute cholecystitis presents a unique set of challenges in the geriatric population. The typical presentation of acute cholecystitis includes severe right upper quadrant or epigastric pain, fever, nausea, and vomiting [39]. Laboratory values usually reveal leukocytosis with an increased number of band forms and may demonstrate a mild rise in transaminases, bilirubin, and alkaline phosphatase (AP) [94]. Diagnosis of acute cholecystitis in older adults can be challenging as they commonly have a delayed and atypical clinical presentation. Abdominal pain remains a common presenting symptom but nausea, vomiting, fever, or leukocytosis is often absent. Symptoms are usually misleading and the clinical presentation is often blunted because of age-related physiological changes, mental illness, cognitive disability, dementia, or associated medications [95]. Around 40% of elderly patients presenting with acute cholecystitis do not develop fever and more than 50% may have negative peritoneal signs on examination. Absence of these signs does not indicate milder form of the disease as 40% of the patients have severe complications [96]. The estimated diagnostic accuracy of clinical examination in acute abdominal pain in patients over the age of 80 is only 29%, which is significantly low compared to younger patients [97]. Approximately 12% of elderly patients with acute cholecystitis present in septic shock [98]. Surgical risks and complications of acute cholecystitis occur in more than 50% of all patients older than 65 years. Complications include acute ascending cholangitis, gallbladder perforation, emphysematous cholecystitis, biliary peritonitis, carcinomatous changes, and gallstone ileus [99]. Acute ascending cholangitis is a disease of older adults and rarely occurs before the age of 40. Most patients with acute ascending cholangitis present with Charcot's triad (i.e., fever, jaundice, and right upper quadrant pain) and occasionally as Reynold's pentad (i.e., Charcot's triad plus shock and mental status changes) [100].

Liver function tests remain the most important laboratory investigation in patients with suspected gall bladder disease. Patients with acute cholecystitis can present with a mild elevation in serum ALT and AST levels; however, the most significant abnormal laboratory values include the levels of bilirubin (total and fractionated) and AP. Ultrasound is the diagnostic gold standard for the diagnosis of acute cholecystitis.

Asymptomatic gallstones are a common feature in older adults. Most patients with gallstones never develop acute cholecystitis. Among patients who experience a single episode of biliary colic, nearly half will never experience a second episode of colic within 5 years [101]. Based on these facts, conservative management of biliary colic may be considered appropriate for most elderly patients. Differentiating biliary colic from acute cholecystitis can be challenging in older adults patients with diabetes mellitus. The presentation of acute cholecystitis in elderly patient with diabetes associated neuropathy is minimal. In such patients, gangrenous cholecystitis can present with minimal symptoms and negative peritoneal signs can be misinterpreted as a recurrent attack of biliary colic [95]. Therefore, a very low threshold for suspicion should be maintained for these patients.

The gold standard for the management of acute cholecystitis is laparoscopic cholecystectomy. The rate of emergent cholecystectomy in patients older than age 65 is 37.6% compared to 3.3% in younger patients [102]. Postoperative morbidity, particularly cardiovascular and pulmonary complications, is significantly greater after emergent cholecystectomy compared to elective cholecystectomy in elderly patients. For patients who are nonoperative candidates or who cannot tolerate anesthesia in emergent settings, nonoperative management with antibiotics has been shown to be a viable option. However, recent studies have shown that the primary disease process is often not controlled adequately, and acute calculous cholecystitis patients treated with percutaneous cholecystostomy with or without adjuvant antibiotics suffer from much higher emergent gallstone-related readmissions, usually requiring emergent cholecystectomies. Subsequently, these emergently readmitted patients tend to suffer worse operative courses with concomitant higher procedure-related complication rates than if they had been operated on initially. Early cholecystectomy should be considered for all elderly patients with acute cholecystitis regardless of frailty status of the patient [89, 103–105].

11.4.5.1 Key Points

- The presentation of gall bladder disease in older adults is extremely subtle compared to younger counterparts.

- Early laparoscopic cholecystectomy is the gold-standard treatment for acute cholecystitis across all age groups.
- Biliary tract decompression with cholecystostomy and antibiotics has shown to be effective in nonoperative candidates with acute cholecystitis.

11.4.6 Acute Appendicitis

Acute appendicitis is the most common emergent abdominal surgery performed with a lifetime incidence of 7% [106]. Generally, appendicitis is considered to be a disease of the young with only 5–10% of cases occurring in the geriatric population. However, the incidence of the disease in older adults is increasing due to an increase in the geriatric population. Acute appendicitis is the third most common cause of abdominal pain in elderly [39]. The pathophysiology of appendicitis in older adults is similar to the young; however, there are several differences in older adults that predispose them to increased progression and early perforation. The lumen of the appendix is narrowed and atherosclerosis compromises the blood flow to the appendix [107, 108]. As a result, even mild increases in intraluminal pressure can lead to gangrene and perforation [106]. The reported incidence of perforation in elderly patients with acute appendicitis is as high as 70% [109]. The blunted inflammatory response in older adults prevents the development of significant clinical features of acute appendicitis and delays the presentation. This delay is further complicated by the delay in the time from presentation to the operating room and is associated with increased morbidity and perforation rates [110–112]. The diagnosis of acute appendicitis in older adults is often delayed due to other suspected etiologies. Age-related physiological changes, atypical presentation, and a delay in seeking medical help lead to a delay in diagnosis and treatment. Due to these reasons, acute appendicitis is the leading cause of intra-abdominal abscess and fever of unknown origin in elderly. The prognosis of uncomplicated appendicitis in both the young and old age groups is equal; however, when perforated appendicitis occurs, older adults have a mortality rate of 33–50% [106].

The use of scoring systems such as Alvarado score (a 10-point assessment using signs, symptoms, and laboratory values) can aid in the diagnosis of acute appendicitis; however, these scoring systems lack the sensitivity to safely exclude acute appendicitis. Therefore, there has been a recent trend in the use of imaging such as CT scan and magnetic resonance imaging (MRI) for the diagnosis of acute appendicitis. The sensitivity of these diagnostic modalities for acute appendicitis is nearly 100% and has been validated even in the geriatric cohort of patients [113]. As the presentation of acute appendicitis in older adults is significantly delayed, early use of imaging modalities may help reduce the time to the operating room in these patients.

Laparoscopic appendectomy is safe and remains the gold standard for the treatment of acute appendicitis in older adults [114]. More recently, antibiotics have gained popularity for the treatment of acute appendicitis. A randomized control trial demonstrated that the antibiotics are a safe first-line therapy in the treatment of acute appendicitis for all age groups [115]. However, more recent literature shows that initial nonoperative management of acute uncomplicated appendicitis in the frail elderly population leads to worse long-term outcomes, including higher overall complication rates, higher mortality rates, and very high eventual emergent appendectomy rates, with appendectomies performed emergently after failed nonoperative management conferring higher procedure-related complication rates than if the patients were managed operatively on initial admission [116]. The morbidity and mortality associated with acute appendicitis in older adults remain high. Elderly patients have significantly higher complications and mortality compared to their younger counterparts [117]. Regardless of the mode of intervention, elective colonic screening is strongly recommended, as the incidence of caecal or appendiceal neoplasm in patients aged 55–65 years presenting with acute appendicitis ranges from 1.6% to 24%. Similarly, the odds ratio for colon cancer saw a 38.5-fold increase among patients older than 40 years of age who present with acute appendicitis compared to those younger than 40 years old [118–122].

11.4.6.1 Key Points

- The presentation of acute appendicitis is delayed in older adults and is associated with a higher incidence of gangrene and perforation.
- Laparoscopic appendectomy remains the gold-standard treatment for acute appendicitis; however, recent data suggest that the use of oral antibiotics for the treatment of acute appendicitis is safe and effective.
- The overall morbidity and mortality after acute appendicitis in older adults are high compared to their younger counterparts.

11.5 Perioperative Care in Emergency Surgery

In recent years, interest has grown in the impact of surgery in older adults. As the baby boomers continue to age, the number of geriatric patients undergoing surgery is increasing. It is therefore crucial that health-care providers gain substantial knowledge and understanding of the care of older adult patients. It is also important for health-care providers to understand the differences in older adult patients compared to their younger counterparts and how management needs to be modified to improve outcomes. Pre- and postoperative care is critical in elderly as they have higher rates of morbidity, which can alter the potential benefits of surgery in this population.

11.5.1 Preoperative Care

Preoperative assessment is performed to identify risk factors that lead to adverse outcomes. The pathophysiology of disease and the actual surgical procedure are important prognostic factors. However, the most important factors in the determination of postoperative morbidity and mortality are related to the general health and physiological reserve of the patient [123]. Diminished physiologic reserves have a direct impact on the patients' ability to bear the additional stress of surgery and the possible postoperative complications. In addition, comorbid status has a major impact on surgical outcomes. The identification of these risk factors allows for optimization of these factors prior to surgery and has been shown to substantially improve the surgical outcomes in these patients.

11.5.2 Postoperative Care

11.5.2.1 Delirium

Delirium is defined as a state of temporary altered mental status. Two types of delirium usually present in the postoperative phase; emergence delirium (ED) and postoperative delirium (POD). ED is a benign cognitive disorientation that can occur during the transition from anesthesia to wakefulness and resolves within minutes or hours, while POD is an acute organic brain syndrome that usually develops within the first few postoperative days [124, 125]. POD is an acute disorder but has been associated with a wide range of negative long-term outcomes for older adults, despite that patients may initially recover completely. Approximately 15% of all elderly patients experience POD after elective procedures with a higher incidence (30–70%) among elderly undergoing emergency operations, those diagnosed with frailty, and those on polypharmacy [126, 127]. POD can prolong the hospital length of stay and the postoperative dependence of elderly people. It is also associated with reduced function and independence, increased short- and long-term mortality, and prolonged cognitive impairment in survivors [123]. The definitive mechanism that underlies delirium is not clearly known; many hypotheses however agree that delirium is the final clinical consequence of complicated neurotransmitter abnormalities. Several associated factors for delirium have been identified which include infection, inflammation, metabolite disturbances, substance withdrawal, medications, discomfort, restraints, environmental disturbances including sleep disruption, and severe pain with inadequate analgesia. There are several criteria to diagnose delirium: disturbed consciousness, cognitive changes, rapid onset and fluctuating course, presence of a causal medical condition, or change of substance usage [123, 128]. Delirium is discussed fully in Chap. 2.

11.5.2.2 Infection

Postoperative infections are an important cause of morbidity and mortality in elderly patients. Although the mechanism of how the aging process decreases the immunologic response is still unclear, it is well demonstrated in literature that elderly patients have diminished immune function that makes them more vulnerable to infection [129]. The most common sites of postoperative infection are the urinary tract, lungs, and surgical site [129]. Urinary tract infection (UTI) is typically due to prolonged bladder catheterization. Approximately 25% of hospitalized patients undergo urinary bladder catheterization and 10–27% develop UTIs [130]. Around 80% of patients with nosocomial UTIs undergo urinary bladder catheterization. There is an increase in the need for urinary bladder catheterization in elderly patients for several reasons including medication side effects, neurogenic bladder, or obstruction secondary to spinal cord injury/disease, multiple sclerosis, enlarged prostate, or cerebrovascular accident. Urinary catheters may also be used to provide supportive care for incontinent patients with open wounds located in the sacral or perineal regions (e.g., pressure ulcer). Although UTIs and respiratory tract infections are the most common infections leading to delirium, the correlation with asymptomatic bacteriuria as a cause for delirium is still unknown and somewhat controversial. Elderly patients usually present with the classic symptoms of dysuria, fever, and frequency, which are commonly present in younger people, but they may present with more vague presentations such as an acute confusion state, decreased mobility, or newly developed urinary incontinence. Postoperative confusion may be the first and only sign of a UTI in elderly. It is important to recognize that diagnosis of UTI in the absence of dysuria, frequency, or urgency is challenging. It is therefore necessary to examine the patient completely for other possible diagnoses and obtain objective laboratory data. The diagnosis should be made based on both the laboratory and clinical presentation of the patient.

One of the most important preventive strategies in older adult patients is to minimize the use of urinary catheters and early removal of the catheters [129]. Many other strategies have been attempted to minimize bacterial colonization and subsequent infection such as disinfecting the skin regularly and using disinfectants in the collecting system. Hospitals should develop guidelines and protocolize the process of urinary catheterization regarding appropriate indications for insertion, maintenance techniques, and indications for removal and replacement. Hospital systems should also educate staff about these indications and follow up via quality improvement programs.

Patients in the ICU are at risk for dying not only from their primary disease but also secondary to in-hospital complications such as nosocomial infections. Nosocomial pneumonia (NP) is the second most common nosocomial infection which occurs primarily in patients undergoing general surgery. Ventilator-associated pneumonia (VAP) is defined as pneumonia occurring more than 48 h after patients have been intubated and received mechanical ventilation. Diagnosing VAP requires a high clinical suspicion combined with bedside examination, radiographic examination, and microbiologic analysis of respiratory secretions. It is the leading cause of postoperative mortality in elderly patients [131]. Although NP has the same presentation and management in all age groups, certain risk factors including age and depleted physiological reserve make older adults more vulnerable to develop NP. Also nasogastric tubes, tracheal intubation, dementia, aspiration, recent chest or abdominal surgery, and immobility can increase the risk for developing NP [131]. Underlying comorbidities, malnutrition, and impaired immune function increase the mortality associated with postoperative pneumonia in older adults [129].

Surgical site infection (SSI) is an important postoperative complication and is the most common nosocomial infection in surgical patients, accounting for 38% of nosocomial infections in this patient population [132]. It has a huge impact on morbidity and is also associated with substantial economic burden on the patients and the health-care system [133]. Most significantly, older adult patients with SSI have three times higher mortality than that of older adult patients without infections [133, 134]. SSI can be defined as infection related to an operative procedure that occurs at or near the surgical incision within 30 days of the procedure or within 1 year if prosthetic material is implanted at surgery. It is related to the operative procedure and technique as well as patient-specific factors. Advanced age is considered a host-derived risk factor for surgical site infection [135]. SSI is caused by organisms introduced into the surgical wound at the time of the operative procedure [133]. Most of these organisms originate from the patient's own flora; however, exogenous sources of bacteria can also lead to an infection. SSI can be prevented by the application of preventive practices such as appropriate antibiotic selection and administration, intraoperative maintenance of normothermia, the avoidance of shaving the surgical site until just prior to incising the skin, and ensuring perioperative euglycemia [135, 136]. Close monitoring of surgical wounds postoperatively is necessary to ensure the early detection and treatment of wound infections. Treatment of SSI involves opening the incision and allowing adequate drainage. The use of antibiotics should be guided by culture and sensitivity test [133]. Chapter 24, Infection and Immunity in Older Adults, provides a detailed discussion about the complexities of infections in seniors.

11.5.2.3 Cardiac Complications

Myocardial Ischemia and Infarction

Cardiac complications such as myocardial infarction and heart failure are the most common causes of postoperative morbidity and mortality that occur in 1–5% of patients undergoing noncardiac surgery [137, 138]. At least 10% of all perioperative deaths result from myocardial complications. The most common postoperative cardiac complications in older adult patients are myocardial ischemia and myocardial infarction. Older adults are also more vulnerable to have postmyocardial infarction and heart failure [139]. The mortality associated with perioperative myocardial infarction is approximately 30% [123]. Comorbid conditions such as hypertension, diabetes mellitus, and history of cardiac or renal failure are risk factors for higher incidence of perioperative myocardial infarction (5.1%), cardiac death (5.7%), or ischemia (12–17.7%) in elderly patients [139].

The majority of perioperative myocardial infarctions occur during the first 3 days postoperatively and predominantly on the first postoperative day [140]. Although chest pain is the most common presenting symptom of myocardial ischemia in young patients, elderly patients may present with minimal chest pain which may be misleading. Myocardial ischemic events are silent in over 80% of elderly patients [141]. Diagnosis of cardiac ischemic attacks during the postoperative period is often missed because of incisional pain, residual anesthetic effects, postoperative analgesia, and the lack of typical angina pain by elderly patients. Atypical presentations such as tachycardia hypotension, dyspnea, respiratory failure, syncope, confusion, nausea, and excessive hyperglycemia in diabetics are more common presentations of myocardial ischemia in older adults.

Dysrhythmias

Postoperative arrhythmias are common and represent a major source of morbidity after both cardiac and noncardiac surgical procedures [142]. Postoperative atrial arrhythmias occur in 6.1% of elderly patients undergoing noncardiac surgery [143]. Electrolyte disturbances and increased sympathetic nervous system activity postoperatively may lead to cardiac dysrhythmias, although myocardial ischemia or congestive heart failure should be taken into account [144].

The only proven preoperative risk factor for developing an atrial arrhythmia following surgery is age greater than 60 years [144]. Patients aged more than 60 years and undergoing elective thoracic surgery are independently associated with a higher risk for developing atrial fibrillation [143]. Cardiac arrhythmias may also be stimulated by pulmonary disease such as pneumonia or pulmonary embolism, volume overload, hyperthyroidism, or sympathomimetic drugs. Atrial arrhythmia onset peaks 2–3 days following surgery. Perioperative atrial arrhythmias are usually well tolerated in younger patients, however in elderly can be associated with hemodynamic instability in elderly patients. The complications of atrial fibrillation include stroke and congestive heart failure. Atrial fibrillation is also associated with higher inpatient mortality when accompanied by myocardial infarction (25% vs. 16%) [145]. Management of atrial fibrillation consists of heart rhythm and rate control and against thromboembolism.

Cardiac issues are discussed in depth in Chap. 21, Cardiovascular Disease.

11.5.2.4 Pulmonary Complications

Postoperative pulmonary complications are common, especially in elderly patients with comorbidities. Nearly 5% of all patients undergoing noncardiac surgery experience significant pulmonary complications, which are a common cause of postoperative morbidity and mortality. They account for up to 40% of all postoperative complications and 20% of potentially preventable deaths [146]. The most common pulmonary complications are lung collapse, hypoxemia, hypoventilation, acute respiratory distress syndrome, and pneumonia. Development of these complications can extend the ICU stay and increase mortality. Patients of 70 years of age and above have a higher risk of respiratory complications including bacterial pneumonia, noncardiogenic pulmonary edema, and respiratory failure requiring intubation compared to younger patients [147]. Age-related alterations in pulmonary function combined with postoperative pulmonary pathophysiologic changes place older adult patient at greater risk for complications. Clinical predictors of adverse pulmonary outcomes include the site of surgery (chest, abdomen), duration and type of anesthesia, COPD, asthma, preoperative hypersecretion of mucus, chest deformation, and perioperative nasogastric tube placement [148].

Aspiration

Aspiration is defined as the inhalation of oropharyngeal or gastric contents into the larynx and lower respiratory tract. Normal deglutition is a smooth coordinated process that involves a complex series of voluntary and involuntary neuromuscular contractions. Age-related changes affect each phase of the swallowing process, increasing the risk of aspiration in older adults [149]. Other risk factors in older adults that make them particularly vulnerable to oropharyngeal aspiration include dysphagia, poor oral hygiene, altered level of consciousness, and gastroesophageal reflux disease [149]. Dysphagia and recurrent pneumonia in elderly patients are alarming factors for physicians. Patients found to be aspirating should undergo swallow therapy, modification of dietary consistency, training in specific swallowing techniques, and upright positioning while feeding. Surgery is rarely indicated.

Chapter 27 provides an in-depth discussion of pulmonary and critical care issues.

11.6 Geriatric Specialists and Geriatric Specialized Centers

The physiologic differences in the pediatric population compared to the adults led to the eventual recognition of pediatrics as a specialty and the establishment of pediatric centers including pediatric trauma centers. Similar to the pediatric population, geriatrics has matured as a specialty, and the geriatric patient population is now being recognized as a specialized population that should receive care in the hands of specialists trained in taking care of these patients and at specialized geriatric centers dedicated to geriatric care [150]. There is emerging evidence that suggests that centers which handle higher volume and higher proportion of geriatric patients have better outcomes [151]. Indeed, in 2019, the ACS (The Coalition for Quality in Geriatric Surgery Project) launched its new Geriatric Surgery Verification (GSV) at the ACS Quality and Safety Conference [152]. The GSV Program provides hospitals with a validated list of 30 evidence-based and patient-centered standards for geriatric surgery that hospitals can implement to continuously optimize surgical care for this vulnerable population. These standards define the resources and processes that hospitals need to have in place to perform operations effectively, efficiently, and safely in older adults, while also always prioritizing what matters most to individual patients with regard to their needs and treatment goals. For instance, the standards include recommendations for improving communications between patients and their health-care team, managing medications, screening for cognitive, nutrition, and mobility decline, and ensuring proper staffing is in place, among other concerns.

Many academic centers now have a geriatric program that provides a consultation service for inpatients. These geriatric programs rely on an interdisciplinary collaboration of physicians, surgeons, nurse practitioners, pharmacists, social workers, physical and occupational therapists, and geriatricians to meet the needs of geriatric patients. Some centers have dedicated geriatric units to provide care for elderly patients transferred from other services. Along with the inpatient care of elderly patients, these geriatric programs also emphasize and provide early rehabilitation services for these patients. The effectiveness of these geriatric programs has been evaluated in several randomized controlled trials. The largest trial randomized over 1300 frail patients to receive geriatric inpatient care or usual inpatient care [153]. Patients who received geriatric inpatient care had significantly reduced morbidity and improved functional recovery quality of life at the time of discharge compared to the patients who received usual inpatient care. The overall 1-year mortality and total costs were similar between the two groups.

As the US health system transitions from a fee-for-service model to a fee-for-quality model, comprehensive geriatric programs and appropriate follow-up services represent a promising approach that can yield substantial benefits without incurring extra costs to the overall health system.

11.6.1 Key Points

- Geriatric patients are a distinct patient population that require specialized care.
- Several hospitals have developed interdisciplinary geriatric programs to provide comprehensive geriatric assessment and care for elderly patients.
- The use of geriatric programs is associated with improved functional recovery and rehabilitation.

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Special Evidence-Based Considerations in Geriatric Gynecologic Care: Pelvic Floor Disorders

12

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12.1 Introduction

A quarter of women in the USA have at least one pelvic floor disorder: urinary incontinence (UI), fecal incontinence (FI), or pelvic organ prolapse [1, 2]. This prevalence increases with age such that nearly half of women over age 80 have symptoms of one or more pelvic floor disorders, and one in five of these women over age 80 will have undergone at least one surgical procedure for prolapse or UI [1–3]. With a projected 9% increase in the proportion of the US population over age 65 by the year 2060, there will be an unprecedented number of older women with symptomatic pelvic floor disorders [4]. Providers must be prepared to treat these women and restore the quality of life. Costs of ambulatory care for these disorders were estimated at more than $400 million per year in 2005–2006 and are increasing [5]. Good geriatric gynecological care is critical to optimizing outcomes for vaginal atrophy, pelvic organ prolapse, UI, FI, and perioperative management.

12.2 Atrophy/Genitourinary Syndrome of Menopause

The urogenital consequences of decreased estrogen levels affect approximately half of postmenopausal women [6–10]. Symptoms associated with the genitourinary syndrome of menopause include vaginal and vulvar complaints (e.g., itching, dryness, burning, malodorous discharge, feeling of pressure, dyspareunia, and postcoital bleeding) as well as urinary complaints of dysuria, urgency, frequency, nocturia, incontinence, hematuria, and recurrent urinary tract infections (UTI) [9–12].

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Many of the symptoms of pelvic floor disorders are related to estrogen withdrawal [6, 9]. Estrogenic stimulation of the vagina results in a thicker epithelium with increased glycogen. When these epithelial cells are sloughed as a part of normal exfoliation, the glycogen is hydrolyzed into glucose, which is then converted into lactic acid by lactobacilli [6, 9]. Lactic acid lowers vaginal pH to between 3.5 and 4.5 and is an essential component in vaginal health and defense against vaginal and UTI [6, 9]. Without estrogen, the vaginal epithelium thins, there are fewer lactobacilli, the pH rises, and other, less-desirable bacteria can proliferate more easily [6, 9]. Decreases in estrogen also result in decreased elasticity, vaginal blood flow, and lubrication [9]. This lack of lubrication is often the first symptom and can present even before other clinical symptoms and signs appear [6, 9].

Objective findings of atrophy (Fig. 12.1) include a pH >4.6, pale and smooth/shiny vaginal epithelium, petechiae, friability, dryness, ulceration, and poor rugation [6, 9, 13]. Urethral caruncles or eversion of urethral mucosa may appear [9]. The Vaginal Physical Examination Scale has been recommended, in combination with pH testing, for objective clinical evaluation and includes the findings of petechiae, vaginal wall friability, conization (decreased elasticity), and absence of rugae [13, 14]. These objective measures should be combined with subjective measures, specifically vaginal dryness, itching/irritation, and dyspareunia (components of the most bothersome symptom tool) for complete clinical evaluation [13].

It is important to remember that age-related vaginal atrophy is a diagnosis of exclusion, and other etiologies including lichen sclerosis, lichen planus, sexually transmitted infections, and neoplasia must be considered before attributing symptoms, such as hematuria, postmenopausal bleeding, itching, or discharge, to estrogen deprivation [15]. Thorough history and physical examination are paramount to developing the correct diagnosis.

In addition to the effect on the vagina, lack of estrogen also impacts other tissues in the pelvis. Autonomic and sensory neurons in the vagina are responsive to estrogen, and

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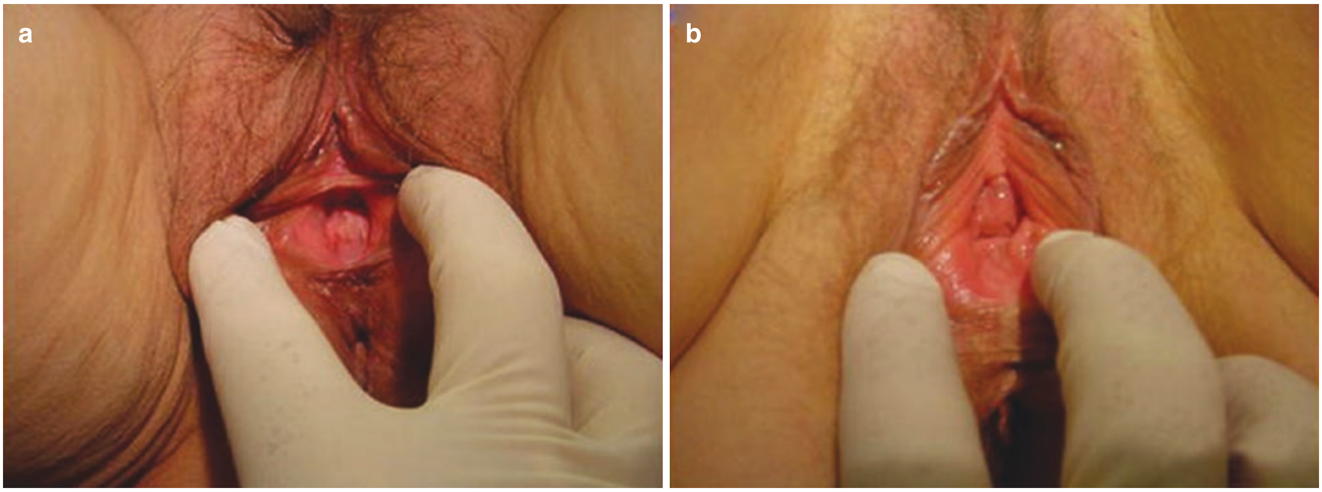

Fig. 12.1 Effect of topical estrogen therapy: Both images are from 64-year old G2P2002 women who underwent two vaginal deliveries. (**a**) Patient discontinued estrogen therapy 5 years previously. (**b**) Patient on estrogen continuously since menopause. (Images courtesy of Dr. Murray A. Freedman © 2008)

treatment with topical estrogen has been shown to decrease innervation density, which may partially explain symptom improvement with estrogen therapy [16]. The female lower urinary and genital tracts are both embryologically derived from the urogenital sinus, and estrogen receptors have been found in the vagina, urethra, and bladder trigone [11]. These receptors may contribute to the impact of estrogen deprivation on lower urinary tract (LUT) symptoms, and treatment with topical estrogen has been shown to improve nocturia, recurrent UTI, frequency, urgency, and incontinence, both urgency and stress urinary incontinence (SUI) [11, 12].

Treatment improves symptoms of the genitourinary syndrome of menopause and can be either hormonal or nonhormonal [12, 15, 17]. Nonhormonal treatments, such as pH-balanced gels, water-based moisturizers, or hyaluronic acid, can work well for patients with few, minor complaints, whereas patients with more than two symptoms get better relief from vaginal estrogen therapy [12, 15]. Selective estrogen receptor modulators (SERMs), like ospemifene, which is an estrogen agonist in the vagina but not the endometrium, and tissue selective estrogen complexes (TSEC), which combine an estrogen and a SERM, are effective in treating problems like moderate-to-severe dyspareunia (ospemifene) or vaginal symptoms and maturation index (conjugated equine estrogens with bazedoxifene) [15, 18–21].

There are many commercially available preparations of vaginal estrogen in the USA, and all are considered safe and efficacious at the approved dose and frequency [12, 15, 22]. Delivery options such as vaginal creams, vaginal tablets, pessaries, and ovules/rings are available, and the hormones can include conjugated equine estrogens, estradiol, estriol, or promestriene [12, 15, 17]. Some conjugated equine estrogen products have been associated with slightly higher rates of side effects like bleeding, breast tenderness, and endometrial hyperplasia, but they are still considered safe and effective [12, 15, 17].

Concerns about hormone use have decreased the percentage of women using systemic estrogen therapy and have arguably been detrimental to the urogenital health of women [23]. While systemic estrogen levels are low and within the normal, postmenopausal range for women using low-dose vaginal estrogen, some studies have shown elevation in estrogen levels above pretreatment baselines, although systemic absorption decreases as the vagina becomes more estrogenic [12, 15, 17, 22, 24]. For many women, this change is likely insignificant; however, for women with a history of estrogen-sensitive cancer, particularly those taking aromatase inhibitors, vaginal estrogen is not recommended as a first-line therapy for genitourinary syndromes [12, 15, 17]. The risks and quality-of-life benefits can be discussed and balanced on an individual basis if nonhormonal treatments are insufficient for symptom relief [12, 15, 17].

While there are no long-term data to confirm endometrial safety for women with a uterus, most expert recommendations and current guidelines state that treatment with a progestin is not indicated for women using low-dose vaginal estrogen therapy [12, 17, 25, 26]. Low-dose estrogen does not appear to increase the risk of endometrial pathology significantly and there are potential increased risks of thrombosis and breast cancer with the progestin [15]. As always, any postmenopausal vaginal bleeding should be thoroughly evaluated [25].

In spite of the prevalence of symptoms, adverse effect on the quality of life, and the availability of effective treatments, vaginal atrophy is underreported [6, 9, 15, 17, 27]. Increasing awareness by asking about specific atrophy symptoms and consequently getting treatment to affected women is an important way of improving the urogenital health and general quality of life for older female patients [15].

12.3 Prolapse

Pelvic organ prolapse is a bothersome condition that has a significant negative impact on quality of life. By age 80, 12.6% of women will undergo surgical treatment for prolapse, and the actual prevalence is even higher when symptomatic women managed nonsurgically are included [3]. Prolapse is undoubtedly a multifaceted problem with many different biological, lifestyle, and other inciting factors [28]. Older age, white race, higher parity, prior hysterectomy or prolapse/incontinence procedure, obesity, frequent heavy lifting, chronic constipation, chronic coughing, and smoking have all been linked with greater risk of prolapse [28].

Symptoms of prolapsed tend to be related to the most advanced portion of the prolapse and are often pelvic pressure, heaviness, or feeling a bulge. Pelvic pain and low back pain are not associated with greater degree of prolapse and many women will not experience symptoms of prolapse until the leading edge is at the hymen or beyond [28].

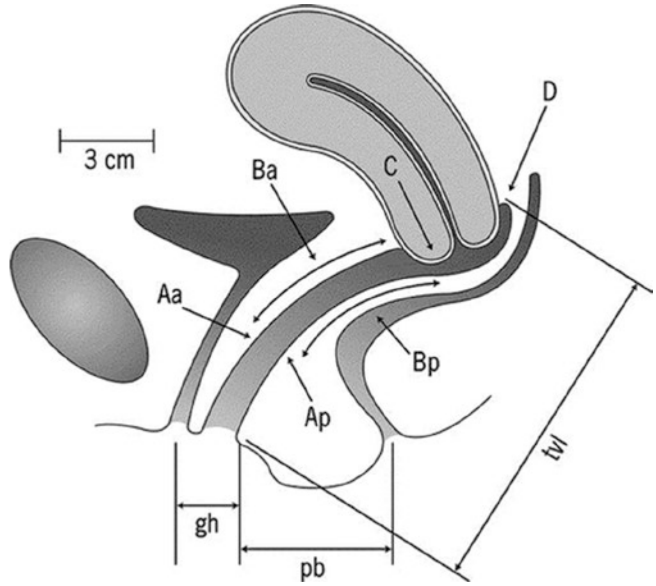

Fig. 12.2 Diagrammatic representation of the pelvic organ prolapse quantification system for staging prolapse by physical examination findings, showing the 6 sites (points Aa and Ba anteriorly, points Ap and Bp posteriorly, point C for the cervix or apex, and point D for the cul-de-sac), genital hiatus (gh), perineal body (pb), and total vaginal length (tvl) used for pelvic organ prolapse quantification. (Reprinted from Weber and Richter [28]; modified from Bump et al. [29])

12.3.1 Evaluation

Use of a Sims speculum or the posterior blade of a Graves speculum can allow the examiner to inspect the anterior and posterior compartments separately, and the apex can be examined digitally or by retracting the anterior and posterior compartments simultaneously. Rectovaginal examination can also be useful in evaluation of the posterior compartment, including differentiating between rectocele and enterocele [28].

The pelvic organ prolapse quantification (POPQ) system is widely used in the research setting as it allows for standardization of physical findings by defining the locations of points on the anterior, posterior, and apical vagina as well as genital hiatus and perineal body (Fig. 12.2) [29]. While the entire POPQ does not necessarily need to be performed in the clinical setting, identification and recording of key attributes including the leading edge of the anterior, apical, and posterior compartments is important and clinically relevant [28]. Stages of prolapse are 0-IV based on the leading edge, for example, most severe portion, of the prolapse with 0 being no prolapse (apex is within 2 cm of total vaginal length) and stage IV being total eversion within 2 cm of the total vaginal length [29].

Pelvic organ prolapsed presents along a spectrum from asymptomatic women with minimal anatomic findings to severely bothered patients with total vaginal vault prolapse or uterine procidentia. Generally speaking, asymptomatic patients do not require treatment, and surgery should not be performed unless the patient's symptoms warrant the potential risks of intervention [28]. Whereas in the past, some thought that early surgical treatment of prolapse may prevent progression, observation of a cohort treated for SUI showed that only 2% of asymptomatic women with stage II prolapse had any anatomic worsening of their disease and none underwent surgical treatment in the 5- to 7-year follow-up period [30].

12.3.2 Nonsurgical Treatment

For women who are symptomatic, nonsurgical management options include pessaries and pelvic floor muscle training (PFMT). These options can be very appealing for women who have less bothersome symptoms or significant surgical risk, but they should be considered and offered to all women. Adjunct therapies to optimize other aspects of disease should also be considered including lifestyle changes, like weight loss, as well as treatment of chronic constipation and defecatory dysfunction [28].

The pessary is a very useful device for the nonsurgical treatment of prolapse, and most women can be successfully fit. Of Medicare beneficiaries with a prolapse diagnosis, 11–13% were treated with a pessary [31]. While there are many different designs and sizes, the two main categories are support and space-filling, and the ring with support and Gellhorn pessaries are probably the most useful in each of these respective categories (Fig. 12.3) [28, 32]. The ring with support is often the first choice because of its ease of use and ability for many patients to remove, clean, and manage it themselves. For women who cannot retain the ring with support, a Gellhorn is often an effective option, but it tends to require provider visits for removal and cleaning [32]. Women who are sexually active and use a pessary should be able to remove and reinsert the pessary themselves since most, if not all, pessaries are not compatible with vaginal intercourse [32]. Vaginal epithelial health is an important consideration with pessary use, and vaginal estrogen therapy should be considered if needed, although many women may not require it. Periodic inspection of the vagina for abrasions and ulcerations is essential, and compliance with follow-up is key to identifying problems before they result in severe complications [28, 32]. While there are no data-driven guidelines on follow-up intervals, typically every 3–6 months for a patient unable to remove her own pessary is reasonable, and that can be extended as long as 1 year for a woman who is able to remove and clean the pessary frequently herself [32, 33]. Usually minor abrasions or ulcerations can be resolved by leaving the pessary out and applying vaginal estrogen cream for several weeks. More significant complications, such as fistula formation, typically only result from extended neglect [32]. Vaginal discharge and unmasking of occult SUI can also be bothersome side effects of pessary use [32, 34].

PFMT can be effective in reducing symptoms for women with mild to moderate (usually stage I to II) prolapse [32]. This treatment usually involves working on isolation of pelvic floor muscles and doing exercises which strengthen and improve muscle bulk. Studies have shown both symptomatic and anatomic improvements with PFMT for patients with stages I, II, and III prolapse [32, 35]. Success of these treatments is likely dependent, however, on having motivated patients who are willing to comply with the exercise program.

For women who desire more than nonsurgical management for their prolapse symptoms, there are many surgical treatment options available. These options include both obliterative and reconstructive procedures.

12.3.3 Surgical Treatment

Obliterative procedures, such as the Le Fort colpocleisis with levator plication and high perineorrhaphy, have many advan-

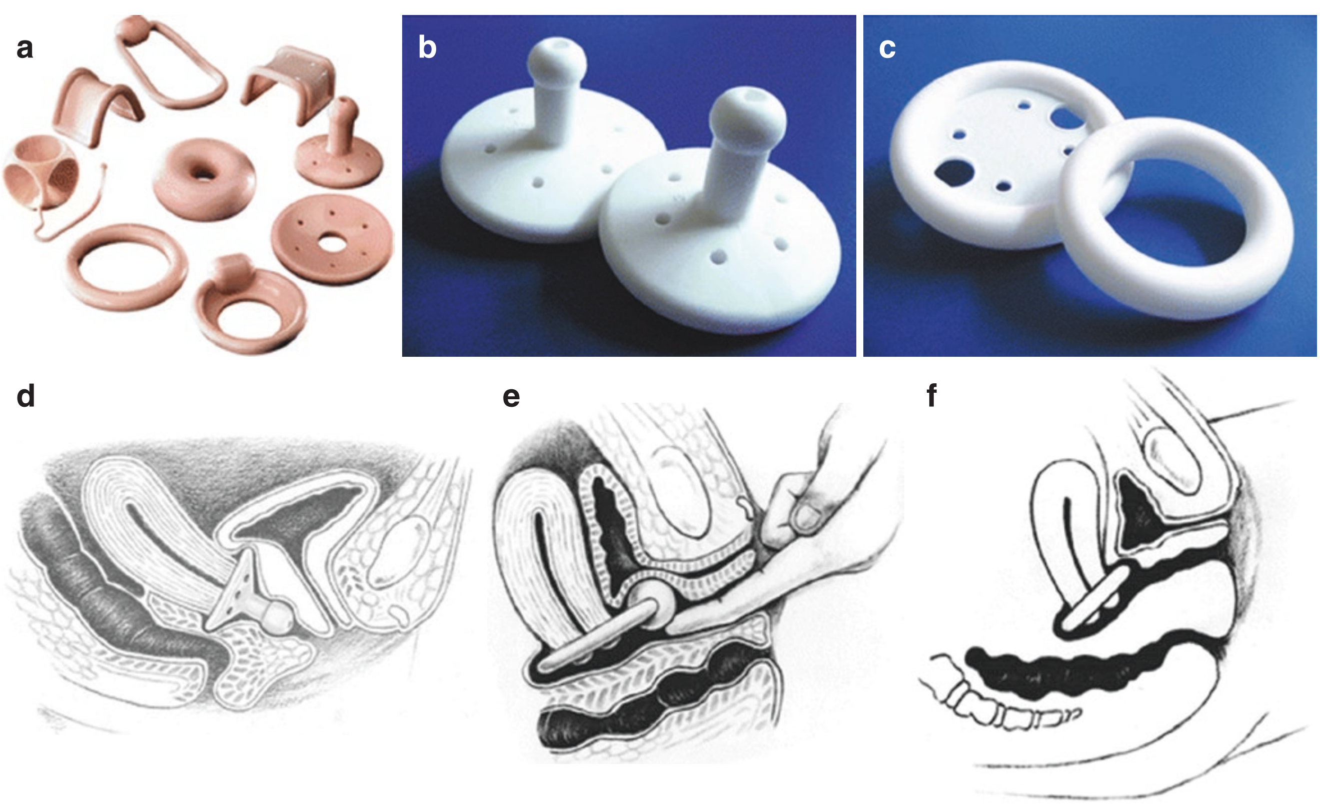

Fig. 12.3 Pessaries : (**a**) an assortment of pessaries, (**b**) Gellhorn pessaries, (**c**) ring and ring with support pessaries, (**d**) Gellhorn pessary in position, (**e**) Ring with incontinence knob pessary in position, (**f**) Ring pessary in position. (Images **a**, **d**, **e**, **f**, Photographs provided by CooperSurgical Inc.; Images **b**, **c**, Photographs provided by BIOTEQUE AMERICA, INC)

tages for women who do not desire preservation of the ability for vaginal intercourse. These procedures tend to be shorter and less morbid than reconstructive repairs and are highly effective [28, 36–40]. Success rates range from 91% to 100%, which is outstanding for efficacy of prolapse repair [39]. Patient-centered outcomes are excellent with 90–95% of patients experiencing improved quality of life, satisfaction with outcome, and willingness to recommend the procedure to others [36, 37, 39]. Postsurgical regret, although very uncommon (approximately 5–10%), is not zero risk [28, 36, 41]. UTI is the most common postoperative complication, and women who underwent simultaneous colpocleisis and midurethral sling do not have increased complications in the immediate postoperative period [38].

Reconstructive repairs can be performed vaginally or abdominally, and can be performed with native tissue or using augmentation with mesh, fascia, or biologic grafts. Minimally invasive options include vaginal, laparoscopic, and robotic approaches. Currently, no clinical trials have definitively shown which methods of prolapse repair are the most effective.

Vaginal native tissue or "traditional" repairs can be performed in all three compartments: apical, anterior, and posterior. The two most common methods used for apical support are the high uterosacral ligament suspension (USLS) and sacrospinous ligament fixation (SSLF) (Figs. 12.4 and 12.5) [42–45]. These methods were compared head-to-head in the Pelvic Floor Disorders Network's Operations and Pelvic Muscle Training in the Management of Apical Support Loss (OPTIMAL) trial and were shown to have similar outcomes for anatomic and functional success as well as adverse events [45]. The types of adverse events did differ, however, with ureteral obstruction being more likely with uterosacral suspension and buttock pain being more likely in the sacrospinous suspension groups. Usually, ureteral obstructions can be identified on intraoperative cystoscopy and can be resolved without any lasting repercussions. The buttock pain from sacrospinous suspension generally resolves without intervention in most patients by 6 weeks postoperatively; however, a small subset (<5%) may require interventions including physical therapy or trigger point injections for the pain [45, 46]. With the strict definition of success used for the OPTIMAL trial, approximately 60% of patients were considered to have successful outcomes, 5% of patients required [underwent] repeat surgical treatment. At 5 years, the eOPTIMAL trial showed a continued similarity in outcomes for anatomic and functional success between USLS and SSLF groups. The rates of failure defined by the composite outcome increased over this time period, although not statistically significant between the two procedures. The proportion of women who underwent any retreatment for prolapse by 5 years was <12% for either procedure [47]. To date,

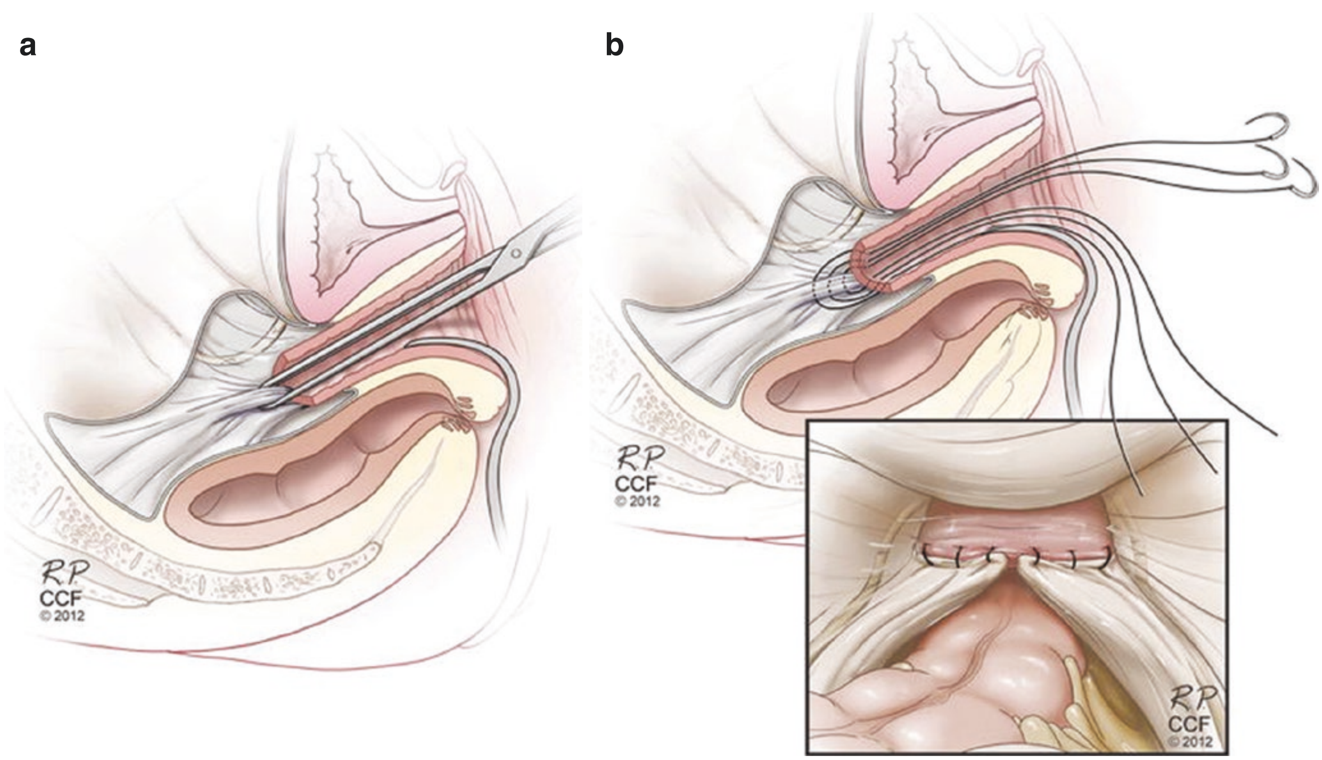

Fig. 12.4 High uterosacral ligament suspension technique. (Reprinted with permission, Cleveland Clinic Center for Medical Art & Photography © 2004–2015 All Rights Reserved)

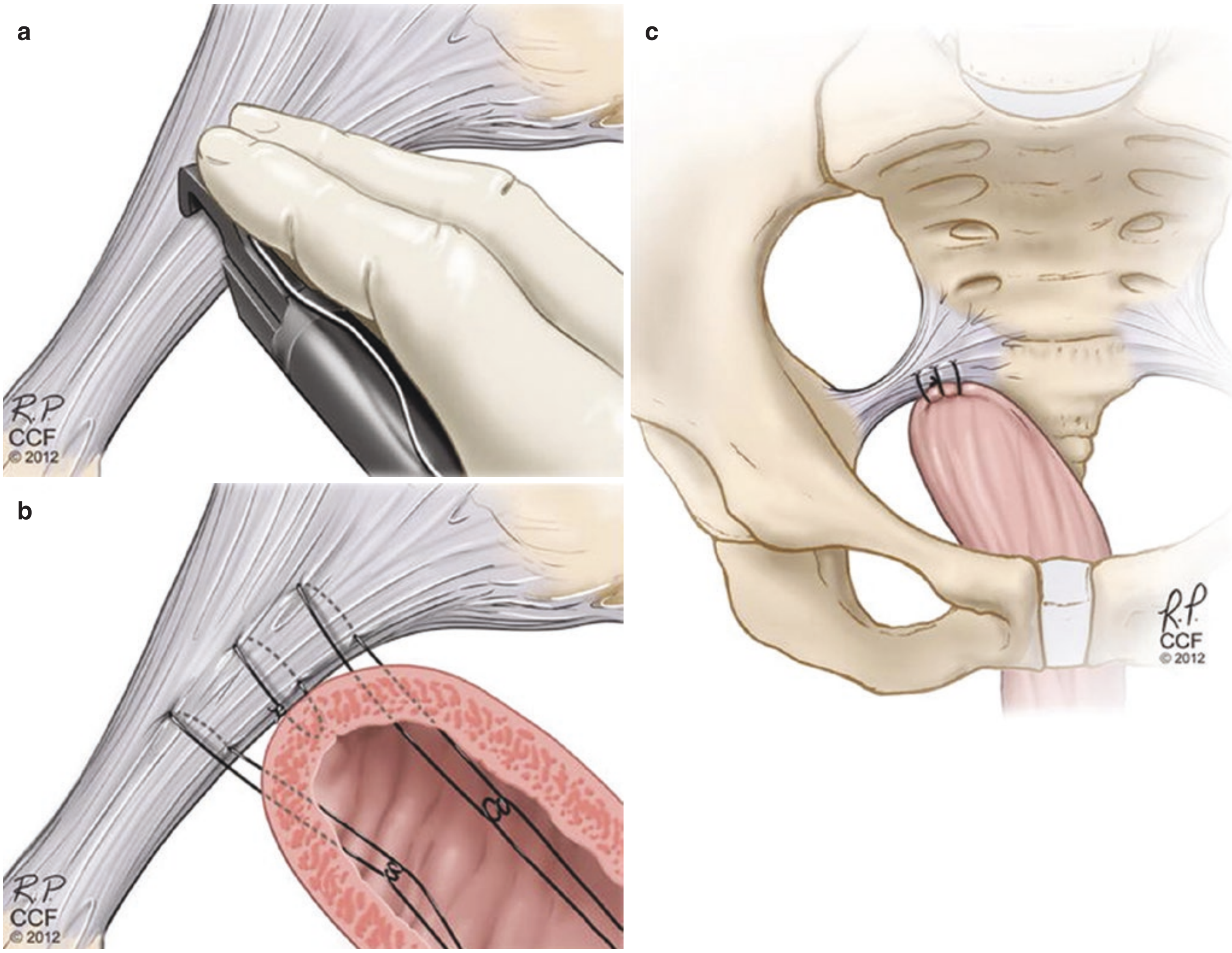

Fig. 12.5 Sacrospinous ligament suspension. (Reprinted with permission, Cleveland Clinic Center for Medical Art & Photography © 2004–2015 All Rights Reserved)

no data exists on the impact of age on surgical outcomes [48].

Suspension of the apex is critical to the success of prolapse repairs. In addition to appropriate apical suspension, other defects should also be addressed including enterocele, cystocele, and rectocele. Enterocele can be repaired with cephalad purse-stringing of the enterocele sac, with or without excision of the sac, and reapproximating the anterior and posterior apical vaginal connective tissue [28]. Anterior colporrhaphy is the preferred native tissue repair for the anterior compartment defects, but paravaginal repairs can also be considered when appropriate for surgeons with sufficient expertise [28]. Posteriorly, traditional colporrhaphy is recommended with perineorrhaphy as needed. Care must be taken not to overcorrect or narrow the vagina, which could cause pain or worsened sexual function [28].

In light of apparent failure rates with native tissue repairs, there was keen interest in the possibility of improved results with mesh augmentation. Popularity of mesh augmentation grew more quickly than the data supporting its use, and concerns about safety and efficacy were raised [49, 50]. In recent years, vaginal repairs augmented with mesh have become a topic of controversy. In April 2019, the U.S. Food and Drug Administration ordered manufacturers of all mesh products indicated for transvaginal pelvic organ prolapse repair to immediately stop selling and distributing their products in the US. Nearly all of the original vaginal mesh products have been discontinued, and those that remain are being rigorously investigated to assess their clinical outcomes.

From the existing data, it appears that mesh augmentation may improve outcomes in the anterior compartment, but further study is needed [49–51]. There are not currently data to support the use of vaginal mesh for apical and posterior support [49, 50, 52, 53].

Abdominal sacrocolpopexy, which can be performed open, laparoscopically, or robotically, is a procedure in which a graft is used to pull the vagina up to the sacrum, and it has been considered the most durable prolapse repair

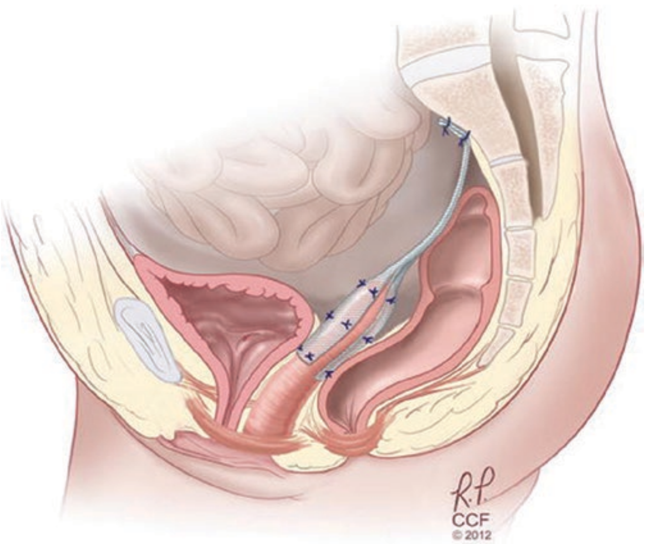

Fig. 12.6 Sacrocolpopexy with mesh attached to anterior and posterior vagina as well as sacrum. (Reprinted with permission, Cleveland Clinic Center for Medical Art & Photography © 2004–2015 All Rights Reserved)

option (Fig. 12.6). Longer-term studies have shown, however, that even with sacrocolpopexy, success rates decrease over time [54]. At 5 years, nearly a third of women in the eCARE trial met treatment failure criteria, but only 5% had undergone a repeat procedure. Additionally, mesh exposure rate was about 10% and exposures continued to occur throughout the extended study period. Minimally invasive abdominal sacrocolpopexy can be performed laparoscopically or robotically and has similar prolapse outcomes as an open abdominal procedure [55, 56]. Minimally invasive procedures have longer operating times but less blood loss and shorter hospital stays than open procedures [55, 57]. When comparing laparoscopic and robotic modalities, laparoscopy has been shown to offer decreased cost, shorter operative time, and less pain at 1 week postoperatively [58]. One study also showed less blood loss, lower rate of bladder injury, and decreased reoperation rate with laparoscopic as compared to robotic sacrocolpopexy [59].

Older patients undergoing urogynecologic surgery have been shown in some studies to have similar outcomes as younger women [60, 61]. Much like with midurethral slings, however, some studies did find higher rates of complications for older patients [62]. Even so, the overall rates of complications are low, and chronological age should not be the only factor in surgical decision making.

12.3.4 Urinary Function

UI is a common pelvic floor disorder which affects 49.2% of adult women, and increases to above 60% prevalence in women over age 70 [63]. Prevalence of incontinence starts off gradually in young adults, reaches a peak in midlife, and climbs steadily in the older population [64, 65]. While the overall prevalence increases with age, the distribution of incontinence types changes from more stress incontinence in younger women to more urgency and mixed incontinence in older women [63]. Older women also tend to have more severe incontinence than younger women [63, 66]. UI is not considered a normal part of aging and has a huge impact on patients' lives [67]. UI has been associated with functional decline, fall risk, nursing home placement, depressive symptoms, and frailty [67, 68].

Even when incontinence is significantly bothersome, many women do not seek care [67, 69]. Patients are often reticent to mention these issues to providers, who must initiate the conversation.

The burden of disease for urinary incontinence is significant—economically and emotionally. UI severity has been associated with major depression, medical comorbidity, and decreased quality of life, particularly in those with nighttime and coital symptoms or comorbid FI [69–73]. The financial cost of UI is estimated at more than $16 billion in 1995 dollars, $7.6billion of which was for women over age 65 [74]. In spite of a 15% decrease in the cost per capita, Medicare costs for female beneficiaries nearly doubled from 1992 to 1998, due to an increase in the number of patients requiring treatment [75].

12.3.5 Definitions

The terminology for UI was standardized by the International Continence Society [76–81].

Urinary Incontinence
The complaint of any involuntary leakage of urine.

SUI
The complaint of involuntary leakage on effort or exertion, or on sneezing or coughing.

Urinary Urgency
The complaint of a sudden, compelling desire to pass urine which is difficult to defer.

Urgency urinary incontinence (UUI)
The complaint of involuntary leakage accompanied by or immediately preceded by urgency.

Mixed urinary incontinence (MUI)
The complaint of involuntary leakage associated with urgency and also with exertion, effort, sneezing, or coughing; applies to people with symptoms of both SUI and UUI.

Overactive bladder syndrome (OAB)
Urinary urgency, with or without urgency incontinence, usually with increased daytime frequency (e.g., the complaint by the patient of voiding too often by day) and nocturia (complaint of waking up once or more at night to void) in the absence of UTI or other obvious pathology.

Other pertinent types of incontinence include [80]:

Functional Incontinence
Untimely urination due to physical disability, lack of access to a toilet, or problems in thinking that prevent a person from reaching a toilet.

Overflow Incontinence
Unexpected and near continuous leakage of small amounts of urine because of a distended bladder which is not emptying properly; the etiology is from either outlet obstruction or inadequate detrusor contraction. Causes include neurologic impairment, fecal impaction, and medication adverse effects.

12.3.6 Impact of Age

Age-related changes are important contributors to UI in older patients, but they can be difficult to delineate from comorbidities and confounding factors, like parity [82]. There are, however, many age-related changes in the anatomy and physiology of the LUT [68, 82, 83]. Detrusor contractility weakens, urethral closure pressure decreases, urethral blood flow and vascular density decrease [68, 82, 83]. Older patients also tend to have more detrusor overactivity (DO), higher post-void residual (PVR) volume, lower volume voids, and decreased flow rate [82]. These changes accompany the previously discussed increases in urgency UI, frequency, and nocturia [82]. Additionally, medical comorbidities, neurologic/psychiatric status, functional and environmental issues, and medications impact UI and make it a multifactorial geriatric syndrome [68, 82]. This complexity is clinically relevant as addressing those components may improve symptoms without any other interventions [82, 84].

Other risk factors for UI include female gender, white race, and elevated body mass index (BMI) [63, 85, 86]. Hysterectomy, smoking, thyroid disease, depression, decreased physical activity, arthritis, diabetes, and childbirth have also been linked [63, 85, 86]. Both vaginal and cesarean delivery have been associated with an increased risk of UI, but the impact of parity is stronger in younger women and appears to dissipate by age 65 [87, 88]. Neurological status, chronic cough, menopause, collagen integrity, and medication use are also important factors [85]. Persistence of UI has been associated with increased age, white race, higher parity, elevated BMI, decreased physical activity, type 2 diabetes, stroke, and hysterectomy, yet the greatest increased odds of UI were associated with older age, white race, and obesity [89].

12.3.7 Evaluation

In the initial evaluation of UI, patient history is essential to differentiate the type of incontinence (SUI, UUI, MUI, overflow), and urinalysis is also recommended to rule out hematuria, pyuria, bacteriuria, and glycosuria [67]. Physical examination is useful for the evaluation of anatomy, atrophy, pelvic floor tone, strength, and coordination. PVR , simple cystometrics, and complex urodynamics can also be useful but are usually not needed in the initial evaluation of most patients [90].

12.3.8 Nonsurgical Treatment

12.3.8.1 Contributing Factors

Like other geriatric syndromes, UI often has more than one cause, and successful treatment often entails addressing several of these factors [68]. For many older women, especially those who are frail, simply addressing contributing factors regardless of UI type (SUI, UUI, MUI) will improve bladder control. Contributing factors include: ensuring there is adequate access to toilets which may mean improving the patient's mobility or adapting the environment; and if the patient is cognitively impaired, recommending prompted toileting. Prompted toileting differs from scheduled toileting because the patient is asked if they need to use the toilet on a schedule (typically every 2–3 h) but regardless of the response (yes or no) she is taken to the toilet and praised if able to void. Other contributing factors include comorbid disease and medications. Medical conditions that contribute to UI and may require referral to a primary provider to optimize treatment include: heart failure, chronic obstructive pulmonary disease, and chronic cough. Many medications contribute to UI (Table 12.1) and should be reduced or minimized, if possible.

12.3.8.2 Urgency and Urgency Incontinence

Urinary urgency, overactive bladder syndrome, and urgency incontinence become increasingly prevalent with age and have a negative impact on quality of life [63, 91]. In many patients, these irritative symptoms persist and necessitate management as a chronic disease process rather than as an acute illness [92]. First-line management options include lifestyle modification and behavioral therapy; and then adding medications when symptoms are not adequately controlled.

Lifestyle modifications involve changing habits that may be contributing to urinary urgency or incontinence. Limiting

Table 12.1 Medications commonly associated with urinary incontinence

Medication/class	Adverse effects/comments
ACE[a] inhibitors	Cough (stress UI)
Alcohol	Frequency, urgency, sedation
α Adrenergic agonists	Outlet obstruction
α Adrenergic blockers	Stress leakage
Anticholinergics	Impaired emptying, constipation
Cholinesterase inhibitors	Increased uninhibited contractions
Calcium channel blockers	Impaired detrusor contraction
Estrogen (oral, transdermal)	Stress and mixed UI
GABA[b]-ergics (gabapentin, pregabalin)	Edema, nocturnal diuresis
Loop diuretics	Polyuria, frequency, urgency
NSAIDs[c]/thiazolidinediones	Edema, nocturnal diuresis
Sedative hypnotics	Sedation, delirium, immobility
Opioid analgesics	Constipation, sedation, delirium
Antipsychotics	Anticholinergic effects, sedation

From Reuben et al. [226]
[a]Angiotensin-converting enzyme
[b]Gamma-aminobutyric acid
[c]Nonsteroidal anti-inflammatory drugs

caffeine, which is both a diuretic and a bladder irritant, discouraging extremes of fluid intake (too much or too little), and restricting fluid intake several hours before bedtime can be helpful [67, 91]. Constipation that places pressure on the urethral sphincter (obstruction) or places pressure on the bladder should be treated [68]. Smoking causes chronic cough and patients should be encouraged to quit. Studies in bariatric patients have shown that even a 5% weight loss can bring a significant improvement in UI, with more weight loss conferring even greater benefit [93, 94].

Behavioral therapy involves teaching the patient techniques to reduce urgency and incontinence episodes. These can include isolating and strengthening appropriate muscle groups with Kegel exercises, learning stress strategies, urge suppression techniques like "freeze and squeeze," and using voiding schedules to increase the amount of time between voids [67]. Behavioral techniques can be very effective but do require a cognitively intact and motivated patient [67, 91, 95].

Antimuscarinic medical therapy, including oxybutynin, tolterodine, solifenacin, darifenacin, fesoterodine, and trospium can be effective, but side effects, cost, and drug interactions must all be considered [67]. The maximum dose of trospium, solifenacin, and fesoterodine must be reduced for many older women based on creatinine clearance which frequently declines with age. Due to their anticholinergic properties (which inhibits detrusor contractions), antimuscarinics have significant side effects which contributes to low adherence (less than one third) 1 year after initiation of antimuscarinic therapy [96]. Side effects include dry mouth, constipation, blurry vision, and the potential for cognitive impairment. Cognitive side effects are a significant concern in the older population, particularly in patients who may already have some level of cognitive impairment. Most of the antimuscarinics have not been shown to cause impairment; however, several studies have demonstrated cognitive changes with oxybutynin [91, 97–101]. In July 2014, the American Urogynecologic Society published a Consensus Statement regarding the association of anticholinergic medication use and cognition in women with overactive bladder. It was concluded that the available evidence has shown an increased risk of cognitive impairment and dementia. With this in mind, providers should "counsel on the associated risks, prescribe the lowest effective dose, and consider alternative medications in patients at risk" [102].

Recent studies continue to demonstrate an association of increased risk of the development of dementia with exposure to anticholinergics [103, 104]. A recent nested case-control study demonstated an association of an increased risk of dementia with "strong anticholinergic drug" use. Notably, "associations were stronger in [dementia] cases diagnosed before the age of 80 years" for bladder antimuscarinic exposure. This observational study stated that associations were shown, but it was not able to evaluate causality. Prospective studies are needed to further investigate any association [105]. When possible, the use of extended release antimuscarinics is preferred over immediate release as the longer-acting formulations have better efficacy with fewer side effects [106]. The impact of side effects on chronic issues like cognitive impairment, constipation, dry mouth, and mobility must be considered before starting antimuscarinic therapy in any patient, but especially in an older patient. The American Geriatric Society (AGS) developed the Beers Criteria for Potential Inappropriate Medication (PIM) Use in Older Adults (≥65 yo) in 2011. Since that time, AGS has updated the recommendations with evidence-based reports. As an explicit list of PIMs to take special care in prescribing, the Beers Criteria is widely used in clinical and research practices [107].

In addition to antimuscarinics, mirabegron, a β3-adrenoceptor agonist, has been shown to be effective and well tolerated in the older population with hypertension being the most common adverse effect; blood pressure should be monitored during initiation of therapy [108]. Other reported adverse events in mirabegron-treated patients include headache, nausea, dizziness, and tachycardia (including atrial fibrillation). Mirabegron is renally excreted and the maximum dose must be reduced if creatinine clearance is less than 25 ml/min. Because it is not anticholinergic, the side effect profile of mirabegron may be preferable for some patients. Not yet on the market, vibegron is a new β3-adrenocepter agonist that has yielded favorable outcomes in early phases [109]. A New Drug Application (NDA) has been accepted and it currently under review by the FDA. With limited published data, it is unclear how vibegron will compare to mirabegron or to medications from the antimuscarinic class in terms of efficacy. Future long-term studies are needed to determine the side effect profile and drug-drug interactions as well. Vaginal estrogen treatment can also improve LUT symptoms including urgency, frequency, nocturia, and incontinence, so treatment of vaginal atrophy should be considered [12, 67, 110].

12.3.9 Procedure-Based and Surgical Treatment

When urgency symptoms are refractory to first-line therapies such as behavioral therapy, lifestyle interventions, second-line pharmacotherapies can be considered. If symptoms are not adequately controlled more invasive third-line therapies may be considered. These therapies include neuromuscular toxin, botulinum, and neuromodulation of sacral and tibial nerves.

Percutaneous tibial nerve stimulation (PTNS) involves using a small needle inserted near the ankle to stimulate the posterior tibial nerve [111]. These 30-min stimulation treatments are performed weekly for 12 weeks and additional treatments can be repeated as needed [111]. This technique has been shown to improve OAB symptoms up to 24 months [111].

Sacral neuromodulation (SNM) involves a staged procedure where a lead is placed into the S3 foramen. Test stimulation is typically performed for 2 weeks, and if the patient has at least a 50% improvement in symptoms, a permanent neurostimulator is implanted and connected to the lead [112, 113]. The neurostimulator provides continuous stimulation of sacral nerves to modulate neural signals to and from the bladder, anal sphincter, and pelvic floor (Fig. 12.7) [114]. SNM is FDA approved for the treatment of OAB, urgency UI, nonobstructive urinary retention, and FI (section to follow), and appears to be as safe and effective in older patients as younger ones [67, 112, 113, 115].

Botulinum toxin is an FDA-approved treatment for refractory OAB, which has been shown to improve symptoms and quality of life [116–118]. Botulinum toxin works at the presynaptic cholinergic junction by inhibiting the release of acetylcholine and thus causing temporary detrusor muscle paralysis [119]. It is administered cystoscopically by injecting the toxin into multiple points in the detrusor or suburothelially (Fig. 12.8) [118, 120]. Potential adverse events include urinary retention and UTI. Patients that receive this therapy must be willing to self-catheterize if needed [117]. Botulinum toxin has been shown to be effective in the older population [121]. The Refractory Overactive Bladder: SNM vs Botulinum Toxin Assessment (ROSETTA) trial, a comparative effectiveness trial between botulinum toxin and SNM for patients with refractory OAB, is currently in follow-up [122].

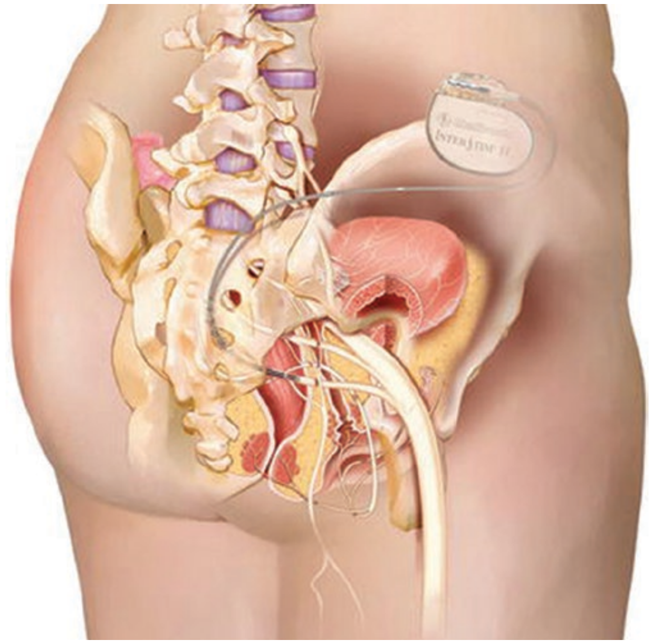

Fig. 12.7 Sacral neuromodulation device —permanent placement. (Reprinted with the permission of Medtronic, Inc. © 2014)

12.4 Stress Urinary Incontinence

SUI affects 15–20% of women over the age of 65 [63, 65]. It is very costly from an economic perspective [123, 124] with annual out of pocket costs per woman at nearly $750 (in 2006 dollars) [123].

12.4.1 Evaluation

Evaluation for SUI can be straightforward with a good history and physical examination. Leak with Valsalva maneuver on exam or simple cystometrics using a bladder fill and cough stress test can be sufficient, and complex urodynamic testing is not needed for women with uncomplicated, demonstrable SUI [125].

12.4.2 Nonsurgical Treatment

Conservative management options for SUI include behavioral therapy and urethral or vaginal inserts [126]. Some women have symptom improvement with continence pessaries, continence tampons, or urethral inserts, but the

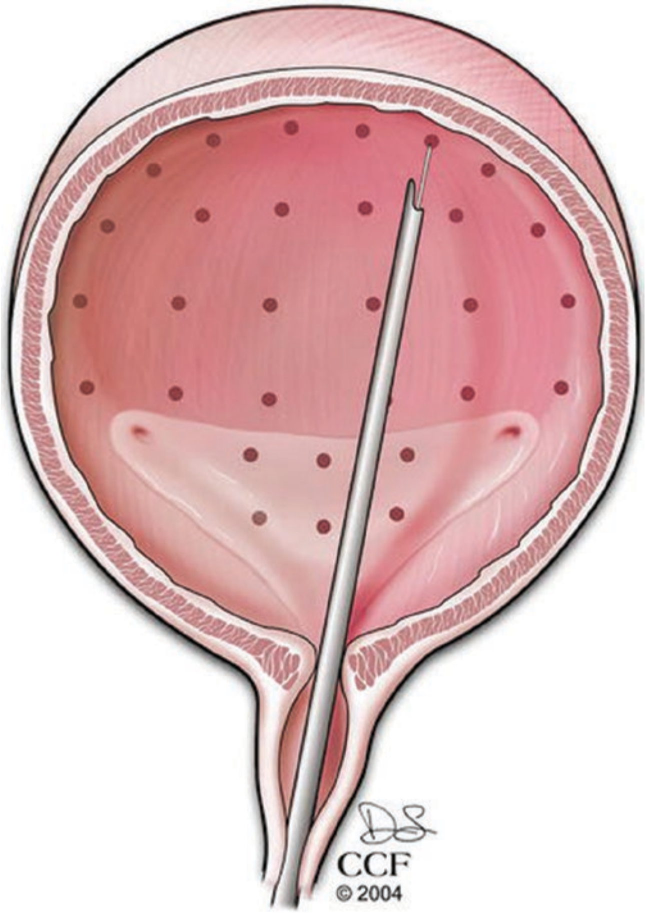

Fig. 12.8 Sites of botulinum toxin injection during cystoscopy. (Reprinted with permission, Cleveland Clinic Center for Medical Art & Photography © 2004–2015 All Rights Reserved)

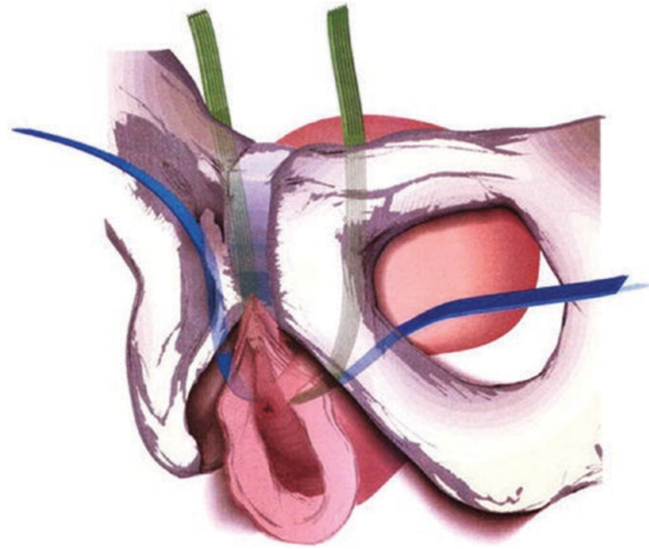

Fig. 12.9 Retropubic (*green*) and transobturator (*blue*) midurethral slings. (From Richter et al.[227] Copyright © 2010 Massachusetts Medical Society. Reprinted with permission from Massachusetts Medical Society)

cure rates are lower than with behavioral therapy [126, 127]. PFMT and bladder training have been shown to improve objective and subjective cure rates for SUI and are a good initial option for treatment [126]. If a woman does not improve with conservative therapy, she can consider more invasive options.

12.4.3 Surgical Treatment

SUI can be managed surgically with procedures such as polypropylene midurethral sling placement (Fig. 12.9), pubovaginal sling (PVS), Burch colposuspension, and periurethral bulking. Studies have shown trends with an increase in the number of total incontinence procedures performed per year in the USA as well as a shift from inpatient to outpatient procedures with the advent of the synthetic midurethral sling [128, 129]. These increases are notable in women over age 52 [130]. Women over age 75, however, do not appear to be getting the same treatment as rates of polypropylene midurethral sling in this population have increased much more slowly than in younger women [131]. This disparity may stem from concerns regarding surgical complications in older patients with more comorbidities or questions regarding successful outcomes. In spite of comprising a significant proportion of the population suffering from UI, older women have been historically under-represented in clinical trials for SUI surgery [132]. More recently, however, many different studies have tried to evaluate the surgical treatment of SUI in older women [123, 133–157].

Results from studies of midurethral slings in older women have been inconsistent, which may be in part due to the heterogenous study populations and varied definitions of success. Some studies show greater risk of voiding dysfunction, outlet obstruction, de novo urinary urgency, UTI, need for catheterization, need for division of sling, and perioperative medical complications with lower rates of cure and satisfaction after midurethral sling in older patients, whereas others show no differences [124, 133, 134, 137–143, 145–147, 149–152, 154, 155, 157]. Older patients may also be more symptomatic than younger ones, and two studies showed that when differences in preoperative symptom bother were considered, age did not influence the quality of life outcomes postoperatively [124, 133]. One prospective, randomized clinical trial comparing immediate midurethral sling versus expectant management for 6 months in older women found a significant improvement in satisfaction, symptoms, and quality of life in the immediate surgery group [156]. Another study showed that urethral hypermobility was an important predictor of midurethral sling treatment success in older women [148]. In summary, the overarching theme of the results is that older women do significantly benefit from midurethral slings and have improved quality of life postoperatively, although their improvements may be less pronounced than in younger women.

A recent study specifically addressing patients with MUI was undertaken to determine whether combining behavioral and pelvic floor physical therapy with midurethral sling was more effective than sling placement alone with a primary outcome of subjective improvement as noted on patient-reported survey outcomes. Though a small statistically significant difference was noted in urinary symptoms at 12 months, it did not meet the prespecified threshold for clinical importance [158]. Importantly, age was not identified as an independent predictor for the failure of treatment [159].

The PVS using autologous rectus fascia is another option for older patients [153, 160, 161]. Age has not been associated with worsened outcomes for PVS, however, menopausal status has [161]. At 2 years postoperatively, one study showed good short-term outcomes for PVS with 85% of patients improved and satisfied, and another, smaller study showed 100% of 19 geriatric women with resolved SUI [160, 162]. Long-term results from Stress Incontinence Surgical Treatment Efficacy Trial (SISTEr) were less promising for PVS with only 27% continence at 7 years [161].

Treatment with Burch colposuspension was also studied in the SISTEr trial, which found that while patients who underwent the Burch procedure had lower success rates (38% at 2 years to 13% at 7 years) than those who underwent PVS they also had fewer UTI, less difficulty voiding, and less postoperative urgency incontinence [161, 163]. A subanalysis of the older patients in the trial revealed that older women had similar perioperative outcomes and worse 2-year outcomes than younger women [153].

Periurethral bulking is another option for SUI treatment that is typically used either as a primary treatment in a patient who is a poor surgical candidate or as a secondary procedure after failure of another procedure. Two studies have evaluated bulking agents after failed midurethral sling and found cure rates of 35–60% with few complications [164, 165]. Even with these modest success rates, one study showed 77% of patients were satisfied with the treatment and another showed negative pad tests (no leakage on a protective undergarment pad) in more than 70% of patients [165, 166].

12.5 Fecal Incontinence

FI is defined as the unintentional loss of liquid or solid stool and anal incontinence (AI) includes the leakage of gas [167]. Estimating the number of people affected by this condition is difficult because only one third of patients discuss their incontinence with their physicians [168]. FI is common with prevalence rates ranging from 7% to 15% in community-dwelling US populations [167]. The prevalence of FI is higher among care-seeking populations, home care populations, and adults in long-term care facilities [169]. In a study of community-dwelling adults over the age of 65, the rate of FI over 4 years was 17%. Controlling for age, comorbidity, and BMI, significant independent risk factors for incident FI in women were white race, depression, chronic diarrhea, and UI [170]. Other risk factors for FI are listed in Table 12.2 [171].

Table 12.2 Risk factors for fecal incontinence

Anal
Injury
Fistula
Rectal prolapse
Hemorrhoids
Anal carcinoma
Perianal infection
Congenital
Rectal
Proctitis
Rectal carcinoma
Rectal infection
Neurological
Central nervous system (stroke, dementia, spinal cord injury, tumor, multiple sclerosis, cauda equina)
Peripheral nervous system (pudendal neuropathy, diabetes mellitus)
Functional
Fecal impaction
Diarrhea
Irritable bowel syndrome
Physical disabilities
Psychiatric disorders
Metabolic, medication, malabsorption

12.5.1 Evaluation

A thorough history and physical examination is essential to establishing the diagnosis of FI and tailoring treatment options. The history should include duration of symptoms, frequency of incontinence, time of day, quality of stool, control of flatus, frequency of bowel movements, constipation or diarrhea, use of pads, and impact on quality of life. Consistency of lost stool may correlate with the severity of incontinence since solid stool is easiest, liquid stool more difficult, and flatus most difficult to control [172]. Thus those patients with loss of solid stool have the most severe incontinence. A thorough obstetrical history should also be obtained including number of vaginal deliveries, weight of babies delivered, use of forceps, and significant tears, repairs, or episiotomies.

The physical examination should start with the inspection of the anal verge area looking for any scars or deformities. The patient should be asked to squeeze to simulate holding in a bowel movement to see if there is uniform contracture of muscles. Making the patient strain, as if having a bowel movement, can show perineal descent, hemorrhoids, vaginal prolapse, or even rectal prolapse [172]. Innervation can be crudely checked by touching the perineal area with a Q-tip and monitoring for an anal wink and also with pinprick sensation.

A digital rectal examination should be performed to check for masses, blood, fistula, or rectocele [173]. During the rectal examination baseline tone represents the internal anal sphincter and the patient should be asked to squeeze for assessment of the external anal sphincter. The accuracy of digital examination is operator dependent but overall, rectal exams have been proven as reliable as anal manometry in assessing anal resting and squeeze tone [174]. The reported positive predictive value of digital examinations to identify low resting and squeeze pressures by experienced clinicians was 67% and 81%, respectively [175, 176].

Anorectal physiology testing involves manometry with rectal compliance testing, electromyography (EMG), and endoanal ultrasound (EAU). Manometry with rectal compliance testing is the preferred method for defining the functional weakness of the anal sphincter complex and for detecting abnormal rectal sensation [177, 178]. Rectal compliance is determined by inflating a balloon in the rectum and measuring the volume at the patient's first desire, strong desire, and maximum tolerable volume. Decreased compliance could represent a rectum that does not adequately store stool and may push the feces past the sphincter muscles even though sphincters are intact and supply adequate pressure, or it could be indicative of hypersensitivity in a woman sensitized by FI accidents. EMG assesses anal sphincter activity using a surface electrode or a concentric needle and can be helpful to distinguish between neurogenic and myogenic damage [171]. EAU assesses the structural integrity and morphology of the anal sphincters [171]. Whether a sphincter defect on EAU is the etiology of a patient's FI is still controversial as EAU has been shown to have low specificity for diagnosis [179, 180] and the degree of separation and size of tear shown on EAU may not correlate with symptom severity [181, 182].

12.5.2 Conservative Management

Conservative medical management for the treatment of FI may include dietary modification with the use of bulking agents or antidiarrheal drugs, pelvic floor exercises, biofeedback, and bowel management strategies.

Fiber is frequently recommended to normalize stool consistency especially in patients with diarrhea-associated FI [183]. One small randomized controlled trial showed that fiber decreased FI in this group [184]. Restricting the fluid intake with these products may further enhance their ability to increase stool bulk. Antidiarrheal drugs are often used to treat FI and systematic reviews have shown they improve FI symptoms with loperamide being more effective than diphenoxylate (which is also to be avoided in older people related to its anticholinergic adverse effects) [185, 186].

Pelvic floor muscle exercises (PFME) are nearly always recommended to patients but there is little consensus on how they should be taught [183]. In general, they involve patients practicing squeezing their pelvic floor muscles with the goal of strengthening these muscles and the squeeze pressure of the anal sphincter. These exercises may particularly benefit patients who have early fatigue of the external sphincter muscle on digital examination [183]. Biofeedback is an adjunct to PFME and is performed using visual, auditory, or verbal feedback techniques with manometry or EMG probe inserted into the anorectum to display pressure changes [179]. The goal is to counteract the most common physiologic deficits contributing to FI by improving strength and isolation of pelvic floor muscle contractions, the ability to sense and contract pelvic floor muscles in response to minimal rectal distention, and the ability to tolerate greater rectal distention without experiencing uncomfortable urge sensations [183]. Randomized control trials comparing pelvic floor exercises and biofeedback have yielded inconsistent results with two larger studies showing no benefit for biofeedback compared to pelvic floor exercises taught by digital rectal exam [187, 188], while another study showed biofeedback to be superior compared to verbally taught pelvic floor exercises [189]. Where high baseline severity, adherence to drug therapy, and being overweight were important predictors for treatment response, notably age was not found to be an independent risk factor [190].

Bowel management strategies for patients focus on trying to schedule bowel movements at the same time each day in order to prevent FI. Daily enemas or suppositories can be used at the same time each day, such as right after eating breakfast, to induce a bowel movement and empty the rectum. Bulking agents and/or antidiarrheal medications can be used to reduce stooling between the timed bowel movements [172].

Unfortunately for many patients, conservative strategies do not result in the desired improvement in patient FI symptoms. Current studies are underway to evaluate the efficacy of PTNS in patients who have failed to achieve satisfactory symptom control from two first-line conservative therapies (NCT03278613).

12.5.3 Surgical Management

12.5.3.1 Sphincteroplasty

Anal sphincter defects recognized during childbirth and repaired immediately are outside the scope of this chapter. Delayed sphincteroplasty is a surgical option for women being treated for FI who have disruption of the internal or external anal sphincter remote from delivery. The initial functional improvement after sphincteroplasty is good with studies reporting 70–80% improvement [191]. However, long-term (≥5 years) success is disappointing with rates ranging from 20% to 58% [179, 191]. Wound infection, occurring in 6–35%, is the most common complication [191, 192]. Predictors of long-term failure include deep infection, longer duration of FI symptoms, and advanced age at the time of repair [191, 192].

12.5.3.2 Sacral Nerve Stimulation

Sacral nerve stimulation (SNS) was approved by the FDA in 2011 for the treatment of FI, and results from the FDA-monitored trial have been encouraging. In this trial, 285 patients were screened and 133 were eligible for stage I. Of those, 120 (90%) proceeded to stage II permanent stimulation [193]. Results with follow-up over 5 years showed that 85% of patients maintained their treatment goal and 36% reported complete continence [194]. Other studies have demonstrated over 80% of patients achieving a ≥50% reduction in incontinence episodes per week with sustained long-term results up to 14 years [171]. The most commonly reported complications are pain and infection at the insertion site which have been reported in 3–11% of patients [195, 196].

12.5.3.3 Colostomy

A colostomy is an option to eliminate all episodes of FI although mucus can still leak in patients with a retained rectum. These procedures are infrequently performed for FI, but for some patients with incapacitating FI who are afraid to leave their homes due to fear of incontinence, this may be a reasonable choice [172].

12.5.4 Further Treatment Options

There are other, less-commonly used and investigational treatment options. Injection of an inert bulking agent around the anal canal has been shown to decrease FI in some patients [183]. Anal plugs commonly cause discomfort in patients but when patients are able to tolerate the devices they report improvement [197]. A mesh sling that is tunneled beneath the puborectalis muscle via a transobturator approach is being investigated [183]. A removable bowel-control device has been designed to help women with FI. The device is placed intravaginally with an inflatable balloon which is oriented posteriorly and can be connected to a hand-held pump. While inflated, the balloon occludes the rectum to help prevent unwanted stool from passing (Fig. 12.10). Early studies showed significant improvement at 4 and 12 weeks in FI by objective and subjective measures with the most common adverse event being vaginal cramping and discomfort [198]. New recently published data demonstrated that in women with successful fitting and initial treatment response, durable efficacy was seen at 3, 6, and 12 months by objective and subjective measures, with favorable safety [199].

12.6 Constipation

Constipation is a common contributing factor to both UI and FI that affects between 2% and 27% of the population in Western countries. In the USA, it accounts for nearly 92,000 hospitalizations per year and 2.5 million physician office visits [200–202]. Constipation can be defined as less than two bowel movements per week or straining for at least a quarter of the time [203]. The etiology of constipation is multifacto-

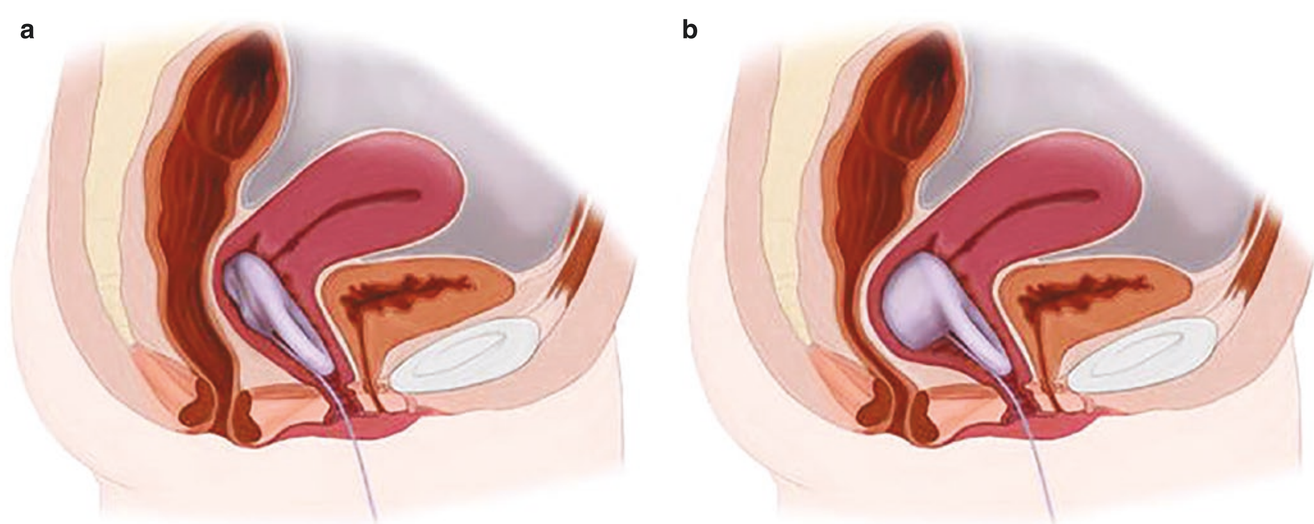

Fig. 12.10 Removable bowel control device which occludes rectum with inflatable balloon. (Reprinted from Richter et al. [198]. © 2015 by the American College of Obstetricians and Gynecologists. All rights reserved)

rial. The pelvic floor and anal sphincters, which should relax as the contents of the distal colon are propelled outward during evacuation, are intimately linked to defecatory function. Constipation may result from impairment of these coordinated efforts, or it may result from systemic illness, neurogenic disorders, or medications [204].

The mainstay of treatment for idiopathic constipation includes dietary modification, pharmacological agents, and behavioral therapy including biofeedback techniques. In general, a treatment pathway in recommended sequence is: (1). Exclude other pathologies and secondary causes (often medications). (2). Begin treatment with dietary and lifestyle modifications. (3). Move to osmotic laxatives or bulking agents—there is no consensus on order in which these should be tried. Note that bulking agents may cause fecal impaction in older patients with poor mobility and should be avoided. (4). Move to stimulant laxatives, suppositories, and/or enemas—some guidelines recommend medical supervision at this stage. Older patients with mobility impairment frequently require osmotic or stimulant laxatives to overcome the reduced colonic motility associated with their reduced activity. (5). Surgery, such as colectomy, should be used as a last resort or to treat identified disorders that require surgical correction [205].

While not yet FDA approved in the USA, SNS has been used for over 10 years for the treatment of constipation. A systematic review by Thomas et al. identified 13 studies for SNS treatment of chronic constipation. Success rates ranged from 42% to 100% and in those patients who proceeded to permanent implant, up to 87% showed an improvement in bowel symptoms [206].

12.7 Medical/Perioperative Gynecologic Surgery Risks

While many noninvasive and medical options are available for the treatment of pelvic floor disorders, surgery is a common treatment for many geriatric patients with these conditions. This section will examine some medical and perioperative considerations in older women undergoing pelvic floor surgery.

12.7.1 VTE Risk

With an estimated 900,000 events per year, venous thromboembolism (VTE) is a major problem in the USA [207]. People with VTE have worse survival than expected for others of the same age and gender [208]. VTE is predominantly a disease of older individuals as incidence increases exponentially with age [207]. Surgery is another important factor which increases risk [207]. Other risk factors include trauma (major or lower-extremity), immobility, lower-extremity paresis, cancer (active or occult), cancer therapy (hormonal, chemotherapy, angiogenesis inhibitors, radiotherapy), increasing age, venous compression (tumor, hematoma, arterial abnormality), previous VTE, pregnancy and the postpartum period, estrogen-containing oral contraceptives or hormone replacement therapy, SERMs, erythropoiesis-stimulating agents, acute medical illness, inflammatory bowel disease, nephrotic syndrome, myeloproliferative disorders, obesity, central venous catheterization, inherited or acquired thrombophilia [209].

The risk of VTE for patients undergoing gynecologic surgery is similar to rates during general surgery and averages 15–40% in patients who do not receive prophylaxis [209]. Both the American College of Chest Physicians (ACCP) and the American College of Obstetricians and Gynecologists (ACOG) have recommendations that stratify patients into risk categories based upon type of surgery, age, and other risk factors [209, 210]. The ACOG risk classifications are broken into four groups: low, moderate, high, and highest. Patients 60 years or older are at minimum in the high risk class, and preventative treatment with unfractionated heparin OR low molecular weight heparin OR intermittent pneumatic compression devices is recommended. Patients with prior VTE, cancer, or other hypercoagulable state are in the highest risk category, and recommended treatment is heparin plus or minus intermittent pneumatic compression devices [210].

In 2010, Soleman et al. evaluated 1104 patients who underwent surgery for pelvic floor disorders. All patients in the study wore intermittent pneumatic compression devices prior to surgery and during the hospital stay. Of the 1104 patients, 40 were evaluated with lower extremity ultrasound or chest computed tomography for suspicion of VTE. The overall rate of VTE in this population was 0.3% [211]. In 2014, Mueller et al. used the American College of Surgeons National database to review the charts of 20,687 patients undergoing pelvic floor surgeries and found 69 cases of VTE for a rate of 0.3% [212]. Identified risk factors in these patients included age, length of hospital stay, operative time, and obesity.

The geriatric population is at increased risk for VTE and pulmonary embolism from age alone, and those undergoing surgery should be evaluated for VTE risk and prophylaxed appropriately.

12.7.2 Morbidity

The physiologic changes and increased comorbidities in the geriatric population present unique challenges for perioperative management. There are four independent risk factors for increased perioperative complications: age, underlying medical disease, obesity, and malignancy [213].

The perioperative complication rate associated with general gynecologic surgery is between 0.2% and 26% [214]. Information on age as an independent risk factor and data specific to pelvic floor surgeries are limited. In a Cleveland Clinic study of 267 patients 75 years or older undergoing reconstructive pelvic surgery, the most common intraoperative complications were cystotomy (2.2%) and need for blood transfusion (2.2%). The most prevalent postoperative complications were pulmonary edema (6.7%), postoperative blood transfusion (6.0%), postoperative congestive heart failure (4.5%), and wound infection (4.1%). Of note, there was no effect of age on the complication rates in this study [215]. In a smaller study, the most common intraoperative complication was cystotomy (6.0%) while the most common postoperative complications were readmission (15%), ileus (7.0%), reoperation (4%), pneumonia (3.0%), and thromboembolic event (3.0%). Age was not an independent risk factor [214].

While age may or may not be an independent risk factor for complications in pelvic floor surgery, pelvic surgeons must advocate for the appropriate preoperative evaluations and prophylactic interventions.

12.7.3 Antibiotics

There are two major clinical categories of antibiotic use in surgical patients: perioperative prophylaxis and treatment of postoperative infections. Surgical site infection is the most common complication seen in up to 5% of patients [216]. Aseptic technique dramatically decreases surgical site infections but bacterial contamination of the surgical site is inevitable. Systemic antibiotic prophylaxis is based on the belief that antibiotics kill and decrease the number of bacteria that are inoculated into the wound [217].

The ACOG recommends broad-spectrum antibiotics for all urogynecology procedures including those involving mesh [217]. The most commonly used antibiotic is intravenous cefazolin with dosing based on patient weight. Other regimens are available if an allergic reaction is a concern (Table 12.3) [217].

There are no studies that suggest prophylactic antibiotics prevent UTI in patients undergoing urodynamics and prophylactic antibiotics are not recommended. Given the 8% prevalence of asymptomatic bacteriuria, which can cause detrusor instability and post-procedure UTI, pretest screening with urine culture or urinalysis is recommended. Positive urine cultures should be treated and the procedure postponed [217].

A UTI is one of the most common complications of patients undergoing pelvic floor surgery [218], and catheter-associated UTI is the most common nosocomial infection in the USA [219, 220]. It is estimated that up to 50% of patients undergoing pelvic floor surgery will require at least short-term postoperative catheterization [221]. One double-blind, randomized, controlled trial evaluating prophylactic antibiotics in patients undergoing pelvic floor surgery who required postoperative catheterization showed no reduction in the risk of postoperative UTI [218]. Thus, there is no benefit from prophylactic antibiotics for patients with catheters for less than 7 days.

Table 12.3 Antimicrobial prophylactic regimens by procedure

Procedure	Antibiotic	Dose (single dose)
Urogynecology procedures, including those involving mesh	Cefazolin Or Clindamycin plus Gentamicin or Quinolone or Aztreonam Or Metronidazole plus Gentamicin or Quinolone	1 g or 2 g (weight >100 kg) IV 600 mg IV 1.5 mg/kg IV 400 mg IV 1 g IV 500 mg IV 1.5 mg/kg IV 400 mg IV
Urodynamics	None	

From American College of Obstetricians and Gynecologists [217]

Aging affects drug absorption, distribution, metabolism, and elimination. The most important factors are metabolism by the liver and elimination through the kidney [222]. In general, surgical antibiotic prophylaxis will be the same in geriatric patients, but physicians need to be aware of renal insufficiency and hepatic dysfunction which may require dose adjustment or change in antibiotic selection [222].

12.7.4 Bowel Preparation

Mechanical bowel preparation was previously a common practice among abdominal and pelvic surgeons [223]. More recently studies have shown no benefits for bowel preparation. A 2011 Cochrane review for elective colorectal surgery with the use of bowel preparation showed no evidence that patients benefit from its use or from enemas [224]. A single-blind, randomized trial of vaginal prolapse surgery showed that mechanical bowel preparation did not improve surgeon assessment of the operative field and that bowel preparation patients had decreased satisfaction and increased abdominal symptoms [225]. Therefore, mechanical bowel preparation is not recommended prior to pelvic floor surgery.

12.8 Conclusion

Pelvic floor disorders, including vaginal atrophy, pelvic organ prolapse, urinary and FI, and perioperative morbidity are significant issues for older women. Further research is needed to clarify the prognosis, best treatment options, and methods of prevention for pelvic floor disorders in older women. Providers must be aware of these disorders and actively solicit symptoms from patients to identify women who may benefit from treatment.

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13 Geriatric Cross-Cutting Issues in Ophthalmology

Andrew G. Lee and Hilary A. Beaver

13.1 Introduction

A gray tsunami of aging baby boomers has entered into the health care system [1].The wave began in 2011 and will include nearly 77 million Americans until the last of that generation turn 65 in 2029. Although ophthalmologists already care for elderly patients, this chapter emphasizes several unique and interesting issues associated with visual loss in the geriatric population age 65 and older, and in the growing population of extreme elderly age 85 and older. In addition, traditional clinical measures of visual function (e.g., Snellen visual acuity and visual field testing) are often not sufficient to determine the true depth and breadth of the functional impact of visual impairment in older patients [1–33]. Many of our vision threatening and potentially blinding disorders occur with increasing frequency with older age [34–56], and reduced or poor visual function definitely affects other comorbidities, quality-of-life parameters, disability [11, 32, 57], falls and fractures [58–75], activities of daily living (ADLs) and independence [76–84], use of community support services, sense of well-being [85–87], and mortality in elderly patients [88].

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The impending demographic shift in the USA toward an older population will disproportionately affect some subspecialties in medicine and ophthalmology has a larger percentage of geriatric patients than most. We review in this chapter, specific issues in geriatric ophthalmology. Indeed, many of the most common ophthalmologic conditions are seen with increasing prevalence with age including age-related macular degeneration (ARMD), primary open angle glaucoma, diabetic retinopathy, and age-related cataract [34–56].

In addition to being aware of the diagnosis and treatment of these age-related conditions, ophthalmologists should recognize key potential comorbidities in the elderly including depression, dementia, hearing loss, falls and fractures, and elder abuse.

This chapter discusses the comorbidities in ophthalmology patients; describes some screening tools and tips for elderly eye patients; and proposes to use geriatric cross-cutting issues as a potential model for the teaching and learning of the Accreditation Council for Graduate Medical Education (ACGME) competencies in ophthalmology.

The ACGME competencies include medical knowledge, patient care, communication and interpersonal skills, professionalism, practice-based learning, and systems-based practice. Ophthalmologists should understand the unique needs of geriatric eye patients as they apply to the specific medical knowledge and patient care domains within ophthalmology. These include knowledge of the specific physiologic responses to disease in older versus younger patients and the age-related changes that may occur pathologically. One key competency for ophthalmologists caring for geriatric patients is a professionalism concept of avoiding "age-ism" in medical decision-making. Patients should be judged in a holistic manner without overreliance upon chronological age for high stakes decision-making including medical and surgical decisions for evaluation and treatment of the elderly. For example, elderly patients who are high functioning or still independent but suffering from visually disturbing cataracts may still be candidates for unilateral or bilateral cataract surgery even into the ninth and tenth decade of life. Likewise simple interven-

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tions such as reading or distance glasses can improve the vision and quality of life for older patients even in low mobility or institutionalized settings. Thus, functional age may be a better predictor of patient benefit from ophthalmic interventions in this setting than chronological age alone.

The system of care (i.e., systems-based practice) in the elderly is more likely to include an extended group of caregivers, upon whom the geriatric patient with physical and mental comorbidities is more dependent. In addition, the competency of communication and interpersonal skills that might include teaming up with patient caregivers, family, and primary care providers may have a special or significant impact on the logistics and outcome of specialized and specific ophthalmologic care. Ophthalmologists should be able to communicate effectively with caregivers about the specifics of topical drop therapy or the key component of a postoperative management protocol.

Specific comorbidities with visual loss in the elderly worsen the functional impact of both conditions (e.g., hearing loss and visual loss). Likewise, visual loss can precipitate new onset or worsen previous dementia or depression. Ophthalmologists therefore need to be aware of these comorbidities and rapid, inexpensive, and validated screening tests have been developed for use in the eye clinic to help identify such patients for referral and treatment. The practice-based learning competency related and age-specific evidence base should be known to the ophthalmologist caring for older adults so that systems-based evaluations and interventions can be made. These include unique circumstances related to specific geriatric care settings such as the emergency room, assisted care facilities, or skilled or unskilled nursing homes. The ophthalmologist is not expected to treat the comorbidities but should be able to recognize, triage, and refer. For example, patients with visual loss are at increased risk for falls and the associated potential morbidity and mortality of falling. Thus, ophthalmologists should be engaged in active safety and fall prevention procedures (e.g., falls checklist) for elderly patients with an identifiable risk factor like visual loss.

The development and implementation of these ACGME competencies align with the larger and more global evolution of the traditional doctor–patient relationship. In the past, the emphasis was on the physician and there was often a one way or markedly asymmetric “Doctor–patient” relationship with the capital “D” in “Doctor” and a small “p” for the patient. Over time, the modern care emphasis has shifted to a patient-centered approach with the “patient–Doctor” relationship evolving toward “Patient–doctor” and even more holistically to a “Person–doctor” or even “Person–person” dialogue. In this new paradigm of care, ophthalmologists do not have to be geriatricians but they do need to recognize specific geriatric syndromes in patients presenting with eye complaints [89].

An understanding of the geriatric cross-cutting issues in ophthalmology is important because geriatric eye patients are not just older adults but have different responses to disease and treatment; different systems-based care issues (e.g., caregivers and their needs, cognitive and competence questions, transportation and mobility concerns, and other non-ophthalmological comorbidities); different communication barriers and needs (e.g., hearing loss, cognitive loss and dementia, depression, and home-based, assisted care or nursing home care locations); and different effects of treatment on functional outcome.

13.2 Scope of the Problem

Visual impairment (defined as Snellen visual acuity worse than 20/40) occurs in up to 21% of persons aged 75 years or older. The Salisbury Eye Evaluation (SEE) project studied 2520 elderly patients (age 65–84) and found a prevalence of vision impairment (<20/40 but >20/200) of 11.4% in whites and 16.4% in blacks [33]. The risk of vision loss continues to increase with age. The Beaver Dam Eye Study of 4926 persons (age 43–86) reported vision impairment <20/40 in 21.1% age 75 years and older [7, 49–51]. The Melbourne (Australia) Visual Impairment Project reported vision <20/60 in 1.34% of 3271 persons and of those with visual impairment 89% were>60 years of age [90]. Of patients >75 years old, up to 52% have advanced cataracts [6, 7], 25% have nonexudative (i.e., “dry”) ARMD, 5% have exudative (i.e., “wet”) ARMD, and 2–10% have glaucoma [6–8].

13.3 Measuring Impact of Loss on Functional Ability

In one study of 1210 community-dwelling women (>75 years), women with poor vision were found to be significantly more likely to be physically dependent [91], and contrast sensitivity reduction alone was found to produce significant functional difficulty in the performance of daily living tasks [92]. Newer validated visual function instruments might provide more information about visual function than the standard Snellen acuity testing including the health-related quality-of-life (HRQOL) instrument; the Medical Outcomes Study Short Form 36-item health survey (SF-36) [93]; the Visual Functioning Scale (VF-14); the Activities of Daily Vision Scale (ADVS); and the National Eye Institute Visual Functioning Questionnaire (NEI-VFQ) [94–103].

13.3.1 Case Vignette 1

A 75-year-old man is brought in by his family for a chief complaint of bilateral "poor vision" over the past several months. He only responds to questioning during the history with very slow responses, and answers mostly "yes" or "no" to even open-ended questions. The patient's son accompanied the patient and was quite concerned because the father was no longer involved in his own finances and required help and encouragement to perform even his basic hygiene and ADLs. The son now has the power of attorney but his knowledge of the patient's care needs, medical and surgical history, medication and allergy lists seems quite limited. The son reported that the father was "not like this" 6 months ago. The patient has a very blunted affect and seems physically withdrawn in the chair. He has already seen three prior ophthalmologists. The son reported that he was told that his father "was just getting older" and had stable "dry" ARMD with bilateral geographic atrophy of the retinal pigment epithelium. On examination, the patient was barely able to read at a visual acuity of 20/70 OU. He had markedly constricted visual fields bilaterally with poor reliability indices. The fundus exam showed mild bilateral RPE atrophy in the macula but the remainder of the eye exam was normal.

In this case, we can see all of the ACGME competencies. In addition to the usual domains of medical knowledge and patient care, ophthalmologists could play an important role in diagnosing key comorbidities in a patient such as this 75-year-old man with ARMD. The blunted affect, withdrawn appearance, and limited answers to questioning suggest possible superimposed depression. One screening tool is the "Geriatric Depression Scale," a 15-item validated questionnaire that is rapid, simple to use, and inexpensive.

Alternatively, a single question for the patient, "Do you often feel sad or depressed?" only takes seconds to administer and has a reasonable sensitivity and specificity for depression.

Likewise, depression in the elderly can worsen, mimic, or even present with vision loss. Depression is a common comorbidity in elderly patient suffering from moderate-to-severe vision loss, and the vision loss alone can cause secondary depression. Depression is often under-recognized in the elderly and may lead to thoughts of suicide. Thus, simple screening by ophthalmologists might help to identify patients at risk for depression. Ophthalmologists should recognize that depression is not a "normal part of aging" and that these patients should be referred for evaluation and treatment.

Visual loss can cause secondary psychiatric issues (e.g., pathologic or physiologic grief reactions, anxiety, and depression); can be associated with significant, independent impairment of mood, and decreased self-sufficiency in instrumental ADLs; can worsen disability and depression [104, 105]; and can lead to decreased self-sufficiency in ADLs and impaired social relationships [80, 106].

In this particular case, the patient responded "yes" to a geriatric screening depression question ("Do you feel sad or depressed often?") and was appropriately referred to the primary care service. He underwent intensive counseling and was started on pharmacotherapy for depression. Fortunately, he returned to the ophthalmologist "a different man" and amazingly had 20/30 visual acuity OU with a full Goldmann visual field test OU.

13.3.2 Case Vignette 2

A 65-year-old woman presents with end-stage "wet" ARMD and macular disciform scarring OU. She lives in a nursing home and "doesn't hear very well" according to the nursing home caregivers. She also had not been eating well lately and seemed distant and depressed at the home. She was seen by an outside ophthalmologist and was told that "nothing more can be done" about the vision. Low vision aids did not improve the anorexia and depressive symptoms; she was able to use a magnifier for large print but she didn't seem very interested in reading of late.

During the exam she seems very hard of hearing, and the ophthalmic technician has to shout loudly to get any response from the patient during the history. The questioning is so loud that the technician can be heard in the next room with the door closed. The eye examination showed ARMD at 20/200 level OU.

As with depression and dementia and visual loss in the elderly, hearing loss is another potential comorbidity that should be recognized by the eye care provider. Hearing loss is a common comorbidity with vision loss in elderly and the combination of these sensory deficits is worse than either deficit alone. Hearing loss also makes it more difficult as in the case vignette to obtain an appropriate history, to test visual acuity accurately, and to communicate evaluation and treatment plans to the patient. However, many forms of hearing loss are amenable to treatment, and newer technology can help many patients better use their remaining hearing.

In this case, a formal audiology referral and assessment were made and she was prescribed new hearing aids. Amazingly, 1 month later she was seen again by her ophthalmologist. Her affect and mood were greatly improved, she became more engaged and active in her nursing home activities, and she was able to write a wonderful thank-you note which she sent to her ophthalmologist for referring her for the hearing aids "that have markedly improved her quality of life" even though her vision remained unchanged.

Hearing loss as a comorbidity with visual loss in the elderly can impact mortality rate [38]; impacts functional status [83, 107]; and is an interrelated deficit to vision loss that may increase the functional impact of either sensory deficit alone [107–111]. Vision and hearing loss have been shown to have strong independent effects on disability, physical functioning, mental health, and social function 1 year after initial evaluation [112–114].

13.3.3 Case Vignette 3

A 66-year-old college professor is brought in to the neuro-ophthalmology clinic by his wife with a chief complaint of "He cannot see and he has difficulty reading his teaching assignments." The patient, however, is asymptomatic and denies anything is wrong with his vision, and is slightly perturbed and defensive about being in the eye clinic. He has been seen by three different outside ophthalmologists and noted to have 20/20 visual acuity OU, Jaeger (J) J1 vision OU, and a normal eye exam including a full automated visual field. He has been given 10 pairs of reading glasses over the last 4 months. The wife wants to know "Why can't he see or read?" The neuro-ophthalmologist obtains the following additional history. He doesn't see road signs well and gets lost even in familiar areas. His wife states that "She won't drive with him anymore." His colleagues at work have noted that he often loses his place in the syllabus and rambles off topic during the lectures but everyone is afraid to say anything as he is a fully tenured Professor with a named chair. His students state that he is easily distracted in class, does not cover the assigned materials, and sometimes forgets to come to class altogether. He previously had won the faculty teaching award six times, but now the students have complained to the Dean. The wife states that he used to write all of the checks and do all of the home finances and bills but now often gets confused and sometimes writes the "date" in the "amount" line on the checks.

The neuro-ophthalmologist asks the patient to draw a clock (Fig. 13.1). The instructions given to the patient are as follows:

1. Draw a clock face on this circle
2. Put in the correct clock numbers (1 through 12 o'clock)
3. Draw the clock hands to show the time of 11:10 AM

The clock draw test is a rapid, inexpensive, and validated screening tool for visuospatial ability in patients suspected of having neurodegenerative disease (e.g., Alzheimer's disease) as the cause of their visual complaints. The patients often have no insight into their deficits and may deny having any problem. In this setting, the chief complaint might be "Brought in by spouse" or "Can't read" despite many new glasses & 20/20 OU. Another common visual presentation of visual variant of Alzheimer disease (VVAD) is a homonymous hemianopsia or cortical blindness with reportedly negative neuroimaging (e.g., brain MRI). Careful review of these neuroimaging studies, however, might reveal subtle posterior cortical atrophy (PCA) in the occipital lobe and visual association cortex corresponding with the homonymous hemianopic field defect. Later the more typical loss of executive function and memory loss will develop but some patients present with visuospatial complaints in the visual variant of Alzheimer's disease, or PCA. Formal neuropsychologic testing by neuropsychologist consultation might reveal deficits predominantly in visuospatial domains, but also deficits in more typical neurocognitive domains for Alzheimer's disease, or may direct attention toward other neurodegenerative disorders.

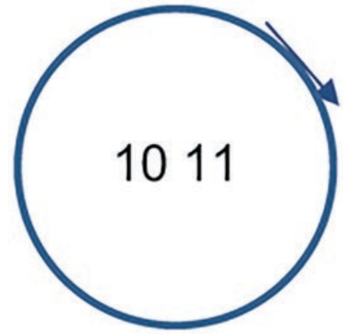

Fig. 13.1 This drawn clock is a fail as there are no numbers in the remaining quadrants, there is only one clock hand, the time is not shown by clock hands, and the numbers 10 11 are out of sequence and not in the right location

Visual loss is associated with and may worsen dementia or delirium [115–117]. Dementia can present with visuospatial complaints. The symptoms typically center around visual processing, including getting lost in familiar areas, reading difficulty (despite normal distance and near visual acuity), difficulty with simultaneous (e.g., simultanagnosia) or complex visual tasks (e.g., driving), or loss of calculation and visual multitasking abilities. Visuospatial abnormalities present in reading due to the complexity of processing multiple letters in a word, multiple words in a sentence, and multiple sentences in a paragraph. If asked specifically, the patient may agree that they can see the words, but by the time they get to the end of the sentence or paragraph they do not know what they have read, in part from the additional effort it takes just to track along a written phrase. To make matters more complex, preexisting vision loss may worsen dementia symptoms (loss of visual cues analogous to "sundowning") and sometimes as in our case vignette, the vision loss may be the presenting or only sign of Alzheimer dementia (i.e., visual variant Alzheimer dementia or PCA).

Reyes-Ortiz et al. found that the mini-mental status exam (MMSE-blind) declined more among older Hispanics with near vision impairment than among those with normal near vision [118]. Anstey et al. reported an association between memory loss over 2 years with vision impairment [119].

In this case, the patient was referred after the abnormal clock draws to cognitive neurology. Formal neuropsychological testing confirmed findings consistent with Alzheimer's dementia and treatment was started in the hope of slowing the progression of the dementia. The patient was counseled on the diagnosis and eventually met with the Dean and elected to take retirement.

The patient was also advised to discontinue driving. The task of driving is very complex and involves not only visual acuity but also visual processing, the cognitive ability to recognize ongoing and simultaneous tasks and challenges (e.g., oncoming traffic, children, animals, and changing visual spatial position of intersecting streets), and the rapidly employed motor response to those tasks. Visual loss can impair the older person's ability to drive and legal requirements vary from state to state [7, 20, 120–125]. Unfortunately, decreased Snellen visual acuity is not the only factor for successful driving and other visual factors might impact the ability to drive safely (e.g., dynamic vision, visual processing speed, visual search, light sensitivity, and near vision). Although most states require vision screening for driver's license renewal, some do not and there is considerable variation in the frequency and level of testing. In cases of cognitive processing deficits, neurology and neuro-psychology consultation are helpful in explaining to the patient and family the need to stop driving.

In one study, elderly patients were five times more likely to have received advice about limiting their driving; four times more likely to report difficulty with challenging driving situations; and two times more likely to reduce their driving exposure. Cataract patients were also found to be 2.5 times more likely to have had an at-fault crash in the prior 5 years. The Useful Field of View test had been validated as a tool to evaluate a patient's risk of motor vehicle accident while driving; impairment of useful field of view was associated with both self-reported and state-recorded car accidents. In another study, glaucoma was a significant risk factor for state-recorded crashes [123] as were other age-related visual problems [121].

13.3.4 Case Vignette 4

A 70-year-old woman with Fuchs corneal dystrophy and glaucoma presents to her ophthalmologist with a chief complaint of blurred vision OU. The visual acuity is 20/80 OU and she has stable intraocular pressures. She is on treatment with timolol drops OU. She has glaucomatous optic disc cupping at 0.9 OU and stable longstanding glaucomatous nerve fiber layer visual field loss OU. She had prior stable penetrating keratoplasty (PKP) OU with clear corneal grafts OU and she had stable intraocular lenses OU after uncomplicated cataract extraction. The ophthalmologist notes "stable eye exam" in the impression but the patient noted to the ophthalmic technician that she has several recent falls (twice in the last 3 months), once requiring a visit to the emergency department.

Visual loss is an independent risk factor for falling in the elderly. Falls are a common cause of morbidity and mortality in the elderly with up to 25–35% of older persons suffering a fall [64, 73, 74]. Each year up to 7% of patients >75 require an emergency room visit after a fall [58–75] and up to 40% of falls may result in hospitalization [67, 68]. Poor vision is a risk factor for falls [6, 58–74]. Nevitt et al. reported a threefold risk for multiple falls with poor vision [64] and decreased contrast sensitivity, poor depth perception, [58] and impaired visual acuity are associated with an increased risk for fracture [60]. In the Beaver Dam Eye Study 11% (943) of 2365 persons >60 with vision <20/25 had a fall in the prior year compared with only 4.4% of those with normal visual acuity [6].

We generally recommend an array of potential fall countermeasures for patients and family members to consider including:

- Avoiding the use of bifocals, progressive, or multifocal lenses in patients with a history of falls, Parkinson disease, downbeat nystagmus, significant inferior visual field defects, or progressive supranuclear palsy (PSP)
- Increasing lighting and decreasing glare
- Increasing contrast at danger areas such as corners and on stair steps
- Removing floor obstacles, minimizing clutter, and reducing floor hazards (e.g., anchoring loose rugs and eliminating uneven surfaces); this can be accomplished with an in-home home health evaluation
- Utilizing well-designed hand rails and assistive furnishings (e.g., use of nonskid flooring)
- Using appropriate walking devices (stable walker and cane types)
- Avoiding improper footwear (e.g., high-heeled shoes) [16]

A number of visual problems have been noted to be associated with falls including: decreased visual acuity, glare, altered depth perception, decreased night vision, and loss of peripheral visual field (including glaucomatous visual field defects). Ophthalmologists should be cognizant of visual loss as a risk factor for falls, as prevention of falling in the elderly is easier and cheaper than dealing with a fall after the fact. One mnemonic device for falls is "I HATE FALLING" (Table 13.1).

Vision plays an important part in stabilization of posture, and visual impairment may increase the risk for falls inde-

Table 13.1 I HATE FALLING mnemonic device

I—Inflammation of joints (or joint deformity)
H—Hypotension (orthostatic blood pressure changes)
A—Auditory and visual abnormalities
T—Tremor (Parkinson's disease or other causes of tremor)
E—Equilibrium (balance)
F—Foot problems
A—Arrhythmia, heart block, or valvular disease
L—Leg-length discrepancy
L—Lack of conditioning (generalized weakness)
I—Illness
N—Nutrition (weight loss)
G—Gait disturbance

*Adapted from Protocols in Primary Care Geriatrics, Mobility failure, 1997, p. 35, John P. Sloan. With permission of Springer [126]

pendently of environmental hazards. Lord et al. found that wearers of multifocal lenses have impaired edge-contrast sensitivity and depth perception, and that the use of multifocals increased the risk of a fall (up to 35%). In the Blue Mountains Eye Study, the 2-year risk of fractures in patients with visual acuity loss, the visual field deficits, and the presence of posterior subcapsular cataracts was found to be significantly higher than in persons without these findings at baseline.

In addition, correcting visual problems might be an important intervention strategy for elderly persons negotiating stairs and reducing falls.

As vision loss increases the risk for falling in the elderly, ophthalmologists who recognize the risk factor should ask about falls in their older patients, as fall prevention is superior to fall treatment. The importance of preventing the fall cannot be overemphasized. As the fall can lead to an irreversible vicious cascade of events fall → fracture → hospitalization → loss of mobility and independence → nursing home or death. A fall checklist could be given to patients and families for all our vision-impaired elders seen in the ophthalmology clinics. A normal eye exam does not protect patients from falling and can provide a false sense of security to the ophthalmic provider about fall risk in an elderly patient. Even patients such our case vignette with stable eye exams do not necessarily mean that the patient is stable; an eye patient who is stable from an ophthalmic standpoint can still be an unstable patient who is at risk for falls [127–136].

13.3.5 Case Vignette 5

A 75-year-old woman with Alzheimer's disease is brought in by her pastor for "falling" and hitting her eye. Her son has the power of attorney but was unable to accompany the patient today. She has periocular ecchymoses, a hyphema, and a retinal detachment OD. She appears disheveled and unkempt and her pastor is concerned about her health. The patient tells you that "she is afraid to go home." When you call the son regarding your concerns, he tells you to "mind your own business." The son tells you that he is in charge of his mother and how he treats her is his own business. The pastor feels that she might be neglected or the victim of abuse, and he believes the son might be "taking her Social Security check."

Elder abuse is an umbrella term that includes the following forms of potential abuse: (1) physical abuse such as inflicting or threatening to inflict harm; (2) sexual abuse such as any nonconsensual sexual contact; (3) emotional or psychological abuse either verbal or nonverbal; (4) exploitation both financial or material; (5) neglect, including self-neglect, such as the refusal or failure of caregiver to provide appropriate food, shelter, health care, or protection; and (6) abandonment or desertion of a vulnerable elder in time of need.

The requirements for reporting elder abuse differ from state to state, but legislatures in all 50 states have passed some form of elder abuse prevention laws and all of these states have set up reporting systems. Much like child protective services in child abuse, adult protective services (APS) investigates reports of suspected elder abuse and clinicians should be aware of their duty to protect and duty to report such patient abuse http://www.ncea.aoa.gov/library/data/.

Elder abuse is a growing problem that has been increasingly recognized. In one study, there was a 19.7% increase in elder abuse reports from 2000 to 2004 and a 15.6% increase in substantiated cases from 2000 to 2004. In another study, two in five victims (42.8%) were>80 years http://www.ncea.aoa.gov/library/data. Ophthalmologists should be aware of the risks for their patients and alert for the possibility of exploitation and non-accidental injury in the elderly and the visually impaired.

The take-home messages for ophthalmologists encountering potential elder abuse scenarios include: (1) being aware of the problem of elder abuse and the situations which are suspicious; (2) as in child abuse cases the ophthalmologist should suspect abuse "if story doesn't match up" especially in unexplained, minor, or implausible trauma; (3) APS is the adult equivalent of Child Protective Services and the same awareness afforded to children should be given to elders; (4) physical abuse is not the only type of elder abuse and clinicians should be aware of; financial, sexual abuse, and neglect are additional forms of abuse, and sometimes the abuse is self-neglect, and should still be reported http://www.ncea.aoa.gov/library/data/.

In summary, the demographic shift in this country will disproportionately affect the specialty of ophthalmology. Geriatric patients are not just "older adults" and have unique responses to disease and special requirements for care. The ACGME competencies provide a potential model for the implementation of care guidelines that can promote recognition and treatment of geriatrics syndromes in ophthalmic populations. Ophthalmologists are not expected to be geriatricians, but should be able to recognize, triage, and refer comorbidities in the at-risk elderly patient [137–161].

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Geriatric Orthopedic Surgery

14

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14.1 Introduction

People are living longer, healthier lives and remaining very active in their later years. Musculoskeletal disorders are very common in older adults and may interfere with function and quality of life. Such conditions include arthritic joints, fragility fractures, musculoskeletal infections, torn tendons, and disorders of the spine and peripheral nerves. Many older patients seek musculoskeletal care to improve their function and quality of life. Older adults have tremendous heterogeneity in their health status and physiologic state, both of which must be carefully considered when providing musculoskeletal care. Simply stated, the older adult orthopedic patient is very different from younger adults, and this chapter will focus on specific considerations, techniques, and approaches to care required by the older adult.

14.2 The Problem

People are living longer and often healthier lives into their 90s. The number of individuals over the age of 60 is estimated to more than double and the number of individuals over 80 is expected to triple by 2050 [1]. Accompanying this aging of the population is an expectation that functional status should be maintained, which frequently requires orthopedic involvement. In some cases, orthopedic care enables older adults to continue working or participating in recreational activities into very old age. For others, orthopedic interventions permit individuals to live independently. Use of a thoughtful and detail-oriented approach to older adults enables the surgeon to address musculoskeletal issues successfully.

The older adult is now a better-educated patient, having studied their musculoskeletal condition online as well as the background and customer reviews of their surgeon. Such research has been intensified by direct-to-consumer marketing of medications, surgical implants, and surgical techniques by device manufacturers, pharmaceutical companies, health systems, and individual physicians. It is common that patients will have watched videos of a surgery they may need and studied the specific implant types and options available on the Internet. Improved education of the patient and their family leads to higher expectations for their care and outcomes. Additionally, the free availability of information, combined with health reform measures have led to a perception that orthopedic care is a commodity for purchase similar to shopping for an item online. These new expectations will continue to shape the future practice of orthopedic surgery. In fact, geriatric orthopedic surgery is regarded as a new specialty within orthopedics with dedicated fellowship training certified by the International Geriatric Fracture Society (IGFS) at some academic institutions. This distinct training marks a paradigm shift that allows surgeons to better address the unique needs of older adults, taking into account the multiple medical comorbidities, frailty, and decreased physiologic reserve in consideration of patients in operative, nonoperative, and palliative treatments [1].

14.3 Epidemiology

The population is aging worldwide and is expected to create a significant increase in the demand for orthopedic surgery. Most subspecialties within orthopedic surgery will see an increased caseload of older adults as a result. Specific procedures that will be more prominent include total joint replacement, fracture care, hand and upper extremity surgery, spine surgery, and foot and ankle surgery. Total joint surgery, for example, has been growing rapidly [2]. This increase in case volume will require surgeons to develop enhanced skills to successfully manage the special needs of older adults. Additionally, there will likely be the need for an increase in the number of surgeons to manage this

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increased volume. Hospitals and health systems are using enhanced care protocols, specialized inpatient units, and enhanced rehabilitation pathways to effectively care for their older adult patients [3].

14.4 Usual Care

In the past, usual care for the older adult orthopedic patient involved single specialty management or multidisciplinary management of the patient's medical problems.

With single specialty management, the patient goes through the care process with management of only the primary orthopedics team. The patient undergoing a joint replacement may be seen preoperatively by their primary care physician for surgical clearance. After admission, they are managed by the surgical and anesthesia teams. Medical co-management is requested if a serious complication or adverse event occurs. After an event occurs, it is sometimes too late to correct the problem. The lack of co-management often results in an adverse outcome, increase in morbidity, mortality, and hospital readmission.

With a multidisciplinary approach, various health disciplines all contribute their advice and care management in a "silo." This care paradigm creates variability in outcomes and is characterized by communication breakdown and a lack of coordination for the care, duplication of efforts and diagnostic studies. Each discipline views the patient from their specific perspective and focuses on their specific area of expertise. When that specific problem appears to be resolved, the consulting service typically "signs off the case." There is often a lack of clarity about which service will write orders. When considering orthogeriatric care, some studies have shown improved mortality at 6 months when patients are admitted to a geriatric ward with orthopedic consultation postoperatively from hip fractures compared to orthopedic admission with geriatric consultation [4].

Although multidisciplinary care has become increasingly common, it will be necessary to transition to an *interdisciplinary co-managed care model* (see Orthopedic Co-Care, below) particularly for the more complex older adult [5, 6]. This will require culture change and manpower changes to successfully implement. Interdisciplinary care requires providers to function as a cohesive team. Care coordination usually is undertaken with a nurse or advanced practice provider as care manager. Frequent communication avoids unnecessary testing, builds collegiality, and decreases adverse events. This interdisciplinary approach is especially critical for the complex older adult patient undergoing major surgery as they tend to have reduced cognition, function, and general health compared to patients that are treated under single specialty management [7].

14.5 Patient Presentation to the Orthopedic Surgeon

Older adults in a clinic setting are frequently accompanied by family members who help to advocate for them. Such visits take more time to respond to questions and opinions of those present. The perspective of the family members is valuable especially when discussing goals of care, prior interventions, cognitive status, living situation, expectations after surgery, and history of falls. Equally important are the wishes, fears, and expectations of the patient and family. Many seniors avoid such important discussions when alone with the physician. It is best to learn about such issues prior to surgery to avoid patient harm.

Institutionalized patients are especially vulnerable as they may not have family at the visit and are often accompanied by a nursing assistant unfamiliar with important care issues. In such a situation, one should involve a family member, the nursing supervisor, or the primary care provider for information to avoid problems in the consultation [8].

14.6 Patient Assessment

14.6.1 Functional Status

Functional impairments are common in older adults. One must determine the patient's baseline level of cognitive and physical function. Age, pre-injury ambulatory status, and medical comorbidities are all predictive of postoperative ambulatory capacity [9]. Patients may have multiple comorbidities and physiological losses associated with aging and these patterns are quite variable resulting in marked heterogeneity in this patient population. This situation mandates carefully planned and coordinated care to achieve high-quality outcomes [10]. Chapter 8 provides a review of the evaluation of physical function, cognitive status, frailty, and other measures.

14.6.2 Frailty

Frailty is an important predictor of surgical complications, longer lengths of stay, nursing home placement, and higher mortality and morbidity. One should identify patients who are frail, communicate this finding to the family, and plan intervention accordingly. There are several methods to evaluate a patient for frailty [11–13]. The Fried Frailty Index [11] is one such method. Recent studies have shown that the Fried Frailty Index and Edmonton Frailty Scale (EFS) are more accurate among surgical patients [14]. Chapters 8 and 1 expand on these points.

14.6.3 Nutritional Issues

Proper nutrition is fundamental for the aging patient, especially for those healing after a fracture or recovering from major surgery. Malnutrition, frequently defined as an albumin <3.5 g/dL, is common among the geriatric population with estimates as high as 46% of patients with hip fractures. Hypoalbuminemia has been linked to higher rates of sepsis, longer hospital stay, increased risk for readmission, and overall mortality. Other markers of malnutrition including BMI <22 have been associated with an increased risk of mortality of almost seven-fold at 1 year after hip fracture compared to patients with a BMI >25 [15].

Screening tools for malnutrition have not been shown to be indicative of nutritional status. Complete nutritional assessment by the team or consulting dietician in geriatric patients with major orthopedic injuries should be routine [16–18]. Oral feeding is preferred. Nasogastric feeding may precipitate delirium and lead to aspiration pneumonia. Parenteral nutrition should be avoided as it may contribute to metabolic derangement, delirium, and is associated with increased risk of sepsis.

The diet should consist of easily chewable high caloric foods, delivered in small portions. Supplementation with liquid shakes or smoothies between, or in addition to meals may also improve nutritional status. Optimal nutrition is important for health maintenance, injury recovery, and is predictive of gait status and mortality after fragility fractures [16].

14.6.4 Comorbidities

Comorbid conditions are common in the aging population and make caring for any patient more complex. The validated Charlson Comorbidity Index (CCI) is widely used to predict inpatient and 1-year mortality in hospitalized patients. The CCI is based on comorbidities and severity [19, 20]. One study of CCI scores in over 1000 patients undergoing surgical treatment for proximal femur fractures found a 12% increase in postoperative complications for every point increase in the score [21]. Other studies have suggested that other predictive scores, such as the Elixhauser comorbidity measure (ECM) have the best discriminative ability in identifying patients at risk for minor and severe adverse events, extended hospital stay, and death after hip fractures [22].

14.6.5 Social Situation and Its Impact

The social and living situation of older orthopedic patients can have an impact on their care plan, rehabilitation potential, and quality of life. It is important to determine the premorbid level of physical activity and independence to determine if a patient would even benefit from surgery. Older adults may find it difficult and overwhelming to make medical decisions and may defer to family members for insight. It is imperative to know the patients advance directives and health-care proxy. Patients without a strong support system will likely require nursing home care or skilled rehabilitation after hospitalization and a social worker and care coordinator should be involved early.

14.7 Surgical Decision-Making

14.7.1 Surgical or Nonsurgical Care

The decision to proceed with surgical intervention should always be examined at length with the patient and their support system. Goals of care, expectations, and outcomes must be discussed. The benefits of surgery must be weighed against the risks based on the factors previously discussed. Alternatives to surgical intervention such as physical therapy, injection therapy, pain management, and palliative care must be discussed for a fully informed decision.

14.8 Palliative Care

For patients who are poor surgical candidates, have poor prognosis, or are simply awaiting surgical intervention, a Palliative Care consult should be considered as a part of an interdisciplinary team. This team is skilled in managing pain, coordinating care, and maximizing quality of life utilizing a prominent palliative care focus.

14.9 Family Involvement and Communication

It is important that the patient's family be involved in medical decision-making, whether that is in the acute setting, or in the clinic. Determining if the patient has a designated power of attorney or a health-care proxy is also necessary, as family members of this patient population often take a very active role in the patient's medical care. Patient comorbidities such as dementia, delirium, and low cognitive reserve may add a layer of complexity to a treatment plan. Involving close family members early on in the course of care may change the treatment plan and recovery of a patient. Creating open and honest channels of communication between the patient, family, physician, and health-care team is essential to establishing rapport and the essential doctor-patient relationship.

A deeper understanding of a patient's support system and family dynamics is also essential in determining goals of care and likelihood of successful rehabilitation. A patient's treatment plan may also change based on the patient's health literacy, and that of their family [23, 24]. In the modern practice of medicine, shared decision-making between the physician and patient is expected. Though many older patients are able to share in the discussion of medical and surgical treatments, many will rely on their family to participate in decision-making. Care planning may also be influenced by family support. For example, if an individual has a strong family presence, they may advocate for early return to the home, visiting nursing, and home therapy with the assistance of family members. If there is a poor support network, long-term inpatient rehabilitation may be the best option. Investigation of the patient's support system is necessary in determining a patient's course of treatment.

14.10 Presurgical Medical Assessment and Care Coordination

14.10.1 Elective Surgery

Planning an elective orthopedic procedure for the geriatric patient affords the surgeon and patient certain luxuries that urgent surgeries do not allow. The patient should visit their primary care provider to optimize management of comorbidities. The primary care provider typically may ask for additional consultation to optimize the preoperative management of chronic diseases. A preoperative office visit to the anesthesiologist is helpful for the patient and increasingly a part of preoperative team assessments.

The Enhanced Recovery after Surgery approach to elective surgery has proven helpful in many settings with correction of anemia, smoking cessation, nutritional status improvement, diabetes management, and minimization of opioid medications. This approach needs to be systematically implemented into each surgeon's practice to reduce adverse events [4, 25].

14.10.2 Urgent/Emergent Surgical Care

In the emergency department (ED), a problem-focused history and physical exam, reviewed with the emergency room physician and family members by the orthopedist, is imperative to determine the best plan, initiate any needed additional workup, and arrange for prompt admission. It is important to determine the mechanism of injury. If the patient suffered a fall, contributing cardiac and neurological conditions should be explored. Stroke, myocardial infarction, arrhythmia, head injury, loss of consciousness, and syncope should be ruled out.

Assessment of the patient's current and baseline cognitive function is also important. A Mini-cog is an efficient screen, but if abnormal should be followed with an additional test such as the Montreal Cognitive Assessment or Mini-mental state examination (see Chap. 9). These cognitive measures may then be used to assess acute changes during the course of hospitalization. An acute change in mental status most often is delirium. Increasingly hospitals are screening routinely for delirium as part of general nursing practice. When delirium is detected or suspected, an underlying cause must be sought (see Chap. 2 for details).

A current and accurate list of medical problems and medications should be reviewed. A social history including place and type of residence, level of independence, and pre-injury ambulation status should be obtained, along with smoking and alcohol use history. The patient's healthcare proxy or power of attorney should be contacted early in the admission process to support medical decision-making. Advanced directives and resuscitation (code) status should be determined and discussed with the patient upon admission.

The physical examination should include inspection for other injuries and then focus on the injured extremity. A detailed musculoskeletal and neurovascular exam should be completed with special physical exam tests, if necessary. Care should be taken to immobilize an injured extremity to reduce bleeding, prevent neurological damage, and reduce pain for the patient. Pertinent imaging should be obtained for surgical planning. The use of head CT as part of the evaluation for patients with low-energy falls should be reserved for those with high clinical suspicion (e.g., trauma above the clavicles, GCS <15, and Injury Severity Score (ISS) >9). One study showed that even patients reporting head trauma or loss of consciousness are unlikely to have acute findings on head CT (0.4%) and none required neurosurgical intervention [26].

The goal of preoperative assessment is to ensure that the patient is optimized for surgical intervention [27, 28]. Surgical repair, within 24 hours of the injury, decreases initial pain, length of hospitalization, rate of complications, and influences favorable long-term outcomes [29]. A care team is ideal to avoid delay in care and to ensure patients are appropriately optimized [27, 30]. Patients with new syncopal symptoms, active chest pain, or extensive cardiac history, for instance, should undergo evaluation by a medical team and cardiology for echocardiogram and consideration of further work-up including stress-testing or cardiac catheterization. Patients with preoperative anemia should have a type, screen, and crossmatch performed with appropriate preoperative transfusion as needed and blood available intraoperatively. Coordination with the medicine and cardiology teams can also be important to discuss continuing anticoagulation in the perioperative period in patients who are high risk (e.g. history of prior VTE, recent cardiac stents) (Fig. 14.1).

14.11 Care Team Models

Organized and protocol-driven models of fracture care for seniors improve quality and decrease healthcare costs, and are highly replicable in any institution [6, 27, 31, 32]. The Rochester Model of co-managed care for fragility fractures is a comprehensive approach to the orthogeriatric patient [27]. Older orthopedic patients often have one or more medical comorbidities, which affect the outcome of surgery. Furthermore, polypharmacy is common in this aging population contributing to complicated side-effect profiles and further pharmacotherapy [33]. Involvement of a trained geriatrician is desirable in managing complex medical patients in the immediate perioperative period, thus the con-

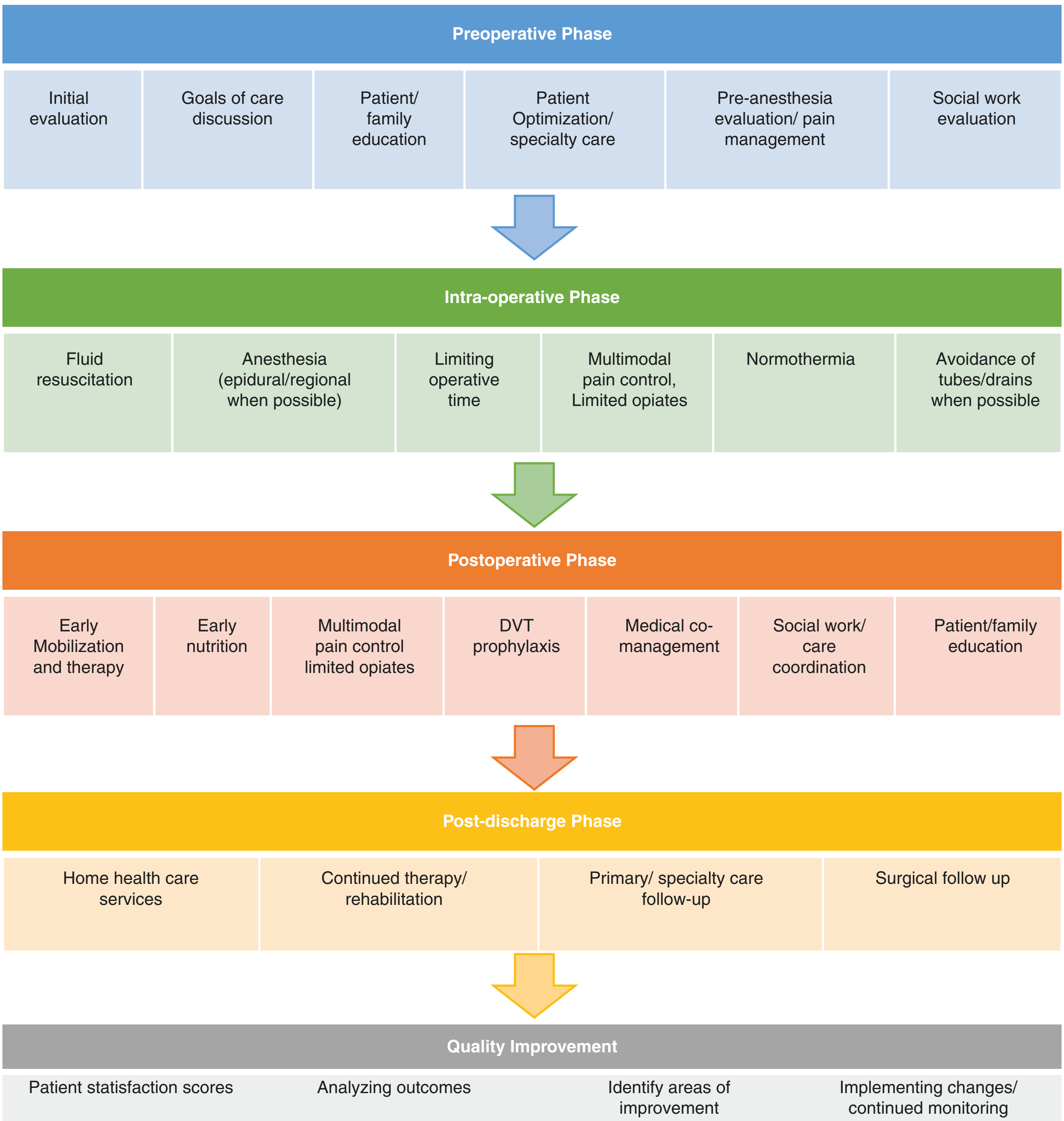

Fig. 14.1 Management of geriatric patients requires proper communication and coordination between various services to ensure prompt, efficient treatment. Whether a patient is evaluated in the outpatient setting or the emergency department, much of the workflow is the same

cept of a patient-centric, protocol-driven model of care. The orthopedics and geriatric medicine services co-manage each patient, write their own orders, see the patient daily, and share responsibility [6]. The care team consists of orthopedics, geriatrics, anesthesiologists, mid-level providers, nurses, physical and occupational therapists, dieticians, and social workers [27]. Additional input from a designated Fracture Liaison Service (FLS) is important in implementing secondary prevention strategies for future fractures including assessment of bone health and fall risk [34]. This comprehensive approach allows for streamlined care delivery from admission to discharge, decreased redundancy and medical errors, implementation of evidence-based best-practices, decreased cost of hospitalization, and fosters communication and collegial relationships [27, 28]. This model was initially implemented in select institutions across the United States. In 2018, a curriculum, toolkit, and online community was created to enable more hospitals to implement this successful model. Full information is available at ortho.agscocare.org. Some barriers to implementation of such team care are a lack of leadership, initial costs, and competing interests among colleagues and hospital administration [35]. However, the many benefits of implementing an orthogeriatric care program should overcome any barriers [28].

14.12 Anesthesia Considerations

The anesthesiologist has a variety of tools and techniques at their disposal to induce analgesia. In addition to general anesthesia, regional nerve blockade is commonly used in conjunction with orthopedic procedures.

The choice of regional versus general anesthesia is often based on the type of surgery and patient considerations. In elective surgery and arthroplasty, regional anesthesia is often preferred as part of the Enhanced Recovery After Surgery (ERAS) protocol. Some studies cite lower rates of major complications such as pulmonary complications, infection, renal injury, need for transfusion, length of stay, and 30-day mortality with regional anesthesia when compared with general anesthesia [36, 37]. One meta-analysis, however, found no statistically significant differences between the two types of anesthesia [36]. These findings are similar in patients with fragility fractures where regional anesthesia has been shown to have some minor benefits over general anesthesia in several studies [38–40]. One meta-analysis of over 2000 patients who underwent fixation of hip fractures found a lower incidence of thromboembolism and decreased 30-day mortality in patients treated with regional compared with general anesthesia, whereas general anesthesia was associated with a statistically significant decrease in operative time [41]. A similar meta-analysis found no statistically significant difference in cognitive dysfunction postoperatively [42]. Most studies have

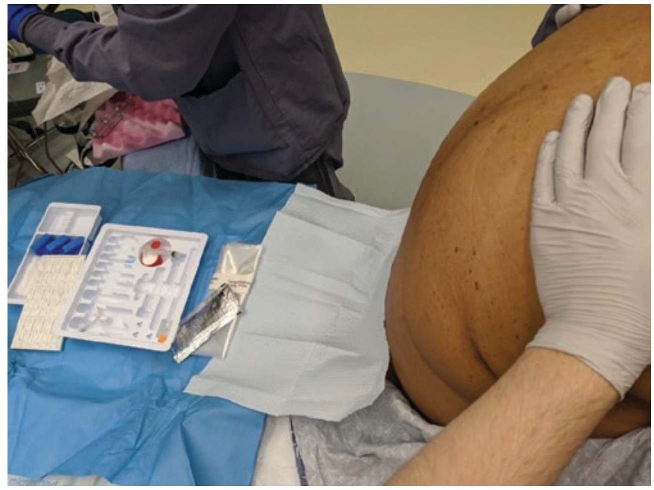

Fig. 14.2 Neuraxial anesthesia is an excellent choice for the geriatric patient that reduces the risk of pulmonary complications while allowing for reduced opiate use postoperatively

found no significant differences in long-term mortality in these patients. The choice of general versus regional anesthesia is often based on the patient's comorbidities, provider preference, and other contraindications to neuraxial anesthesia such as anticoagulants or coagulopathy. Regional anesthesia in the form of a peripheral nerve block can be helpful for acute pain relief and decreases perioperative oral and intravenous opioid use with improved pain scores [43–45]. Local infiltration of analgesia is frequently utilized in arthroplasty and is useful in total knee arthroplasty [37].

The principles of anesthesia in older patients are discussed more thoroughly in Chap. 9, Anesthesia (Fig. 14.2).

14.13 Management of Anticoagulants

Anticoagulant medications add complexity to the care of acute orthopedic patients. One must balance the urgency of fracture fixation with the risks of anticoagulant reversal and adverse effects of a delay in time to surgery. This is especially important in the management of hip fractures, as early surgery decreases the development of pressure ulcers, delirium, pneumonia, and death [46, 47].

Aspirin and clopidogrel are the most commonly used antiplatelet agents in the geriatric population. Due to the irreversible effect that these medications have on platelets, reversal is dependent on the half-life of platelets, which is roughly 7–10 days. Many studies, however, have shown that patients on aspirin or dual antiplatelet therapy with aspirin and clopidogrel had no significant differences in blood loss, transfusion requirement, perioperative complications, or mortality [48, 49]. Patients on dual antiplatelet therapy with delayed time to surgery had a significantly increased mortality [50].

The risk associated with warfarin reversal is dependent on the original indication. Those with certain prosthetic heart valves or a hypercoagulable state are high risk and have a near immediate risk of thrombosis. These patients usually require preoperative bridging therapy with heparin or low molecular-weight heparin (LMWH), such as enoxaparin. Those with a history of venous thrombosis or atrial fibrillation have a near-normal risk of thrombosis if they have taken warfarin for at least 6 months [51]. For most patients on warfarin undergoing elective surgery, most believe that an INR of 1.5 and below is safe for surgery. For patients on therapeutic warfarin, it takes about 4–5 days for the INR to reach 1.5 or below after discontinuation of the medication [52]. This delay is impractical for patients who require urgent surgery. Reversal of warfarin with Vitamin K has been extensively studied. Given intravenously, 1 mg of Vitamin K upon hospital admission significantly reduces the time to surgery and decreases INR [53]. Reversal of warfarin-associated coagulopathy in hip fracture patients with fresh frozen plasma (FFP), and Vitamin K has been shown to be safe based on retrospective studies [54, 55]. Furthermore, there is no significant difference in blood loss, transfusion rate, or hemoglobin level when reversed with FFP and vitamin K compared to patients not on warfarin. While there is no optimal dose of Vitamin K to lower INR, both oral and intravenous Vitamin K have equal and greater efficacy in lowering a high INR than subcutaneous administration [56]. Oral administration of Vitamin K may be superior to the IV route due to rare fatal anaphylaxis associated with IV administration, but is associated with lower bioavailability and slower INR reduction [57, 58]. Reversal of warfarin-associated coagulopathy with FFP, on the other hand, is rarely used for warfarin reversal in the setting of hip fracture and imparts a risk of heart failure exacerbation [58, 59]. A formula utilizing FFP for warfarin-associated coagulopathy is valuable: 1 unit of FFP = 0.57 × Pre-INR − 0.72 [59].

The use of direct oral anticoagulants (DOACs) such as apixaban, dabigatran, and rivaroxaban is also common in the geriatric population and adds an additional complexity in the perioperative period. Rivaroxaban and apixaban act through direct inhibition of activated coagulation factor 10, whereas dabigatran competitively inhibits thrombin (activated coagulation factor 2). The reversal agent andexanet alpha is approved for life-threatening bleeding from apixaban and rivaroxaban [60]. Because these agents have a prothrombotic effect they should be used only when surgery is emergent or urgent. Due to the high cost associated with these medications, however, these reversal agents may not be readily available in every practice setting. There is some evidence for the use of prothrombin complex concentrate (PCC) in the reversal of rivaroxaban [61, 62]. There is also evidence that PCC and activated factor 7 may help in the reversal of apixaban [63]. Dabigatran can be partially reversed by elimination through dialysis or with targeted antibody idarucizumab in the case of uncontrolled bleeding or in the event of emergency surgery. For elective surgeries, it is recommended to stop dabigatran for 1–3 days and apixaban and rivaroxaban 1–2 days prior to surgery. In the setting of hip fracture, however, there are no clear recommendations. Instead, common practice is to hold anticoagulation for 24–48 hours prior to surgery [58].

For patients already on therapeutic-dose anticoagulation for underlying medical comorbidities, the risk of operative site bleeding must be weighed against the risk of thromboembolic event from their underlying disease in addition to poor postoperative mobilization. Oftentimes a discussion between surgeon and the patient's primary care provider or other specialist (cardiologist, geriatrician, etc.) is needed to determine the ideal item to resume therapeutic anticoagulation. To this point, there have been no large prospective studies to address this question. Instead, the decision is often based on the type and extent of surgery undertaken.

For patients not on therapeutic-dose anticoagulation, venous thromboembolic (VTE) prophylaxis is often started the night of or morning after surgery based on the surgeon's concern for bleeding risk. While multiple studies have explored the difference in VTE incidence with bleeding risk using agents such as aspirin, factor Xa inhibitors, enoxaparin, and warfarin, there has been no clearly superior agent (#1) [64]. In fact, the PEPPER trial (Comparative Effectiveness of Pulmonary Embolism Prevention After Hip and Knee Replacement) is an ongoing prospective randomized clinical trial comparing the incidence of VTE and pulmonary embolism (PE) between aspirin, low dose warfarin, and rivaroxaban in patients undergoing elective total hip and knee arthroplasty [65]. At this time, the choice of VTE prophylaxis is largely to the surgeon's discretion in conjunction with input from the patient's primary care provider, as well as discussion of the risk-benefit profile with the patient.

14.14 Intraoperative Considerations

14.14.1 Positioning

A primary consideration when positioning an older adult for orthopedic surgery is to ensure all bony prominences are carefully padded and the patient is securely strapped to avoid skin injury or movement. Movement or even a fall is problematic when using a fracture table. The patient should be kept warm with a body temperature of 36–38 °C. Oftentimes, older adults will have stiffened joints or limited range of mobility of their spine. This should be discussed with the patient prior to getting on the table and extremity positions and spine position should reflect the limited mobility the patient had prior to surgery.

Fig. 14.3 Careful attention must be taken to ensure that all bony prominences are adequately padded during surgery. Patients should be appropriately secured in place to avoid falls

Fig. 14.4 Cemented hip hemiarthroplasty is an excellent option for patients with displaced femoral neck fractures to reduce surgical time and allow for immediate postoperative immobilization

Positioning should be done with the help of the attending physician to be certain that appropriate exposure is achieved and that the patient rests in a comfortable position during surgery. The drapes should be securely fixed to the patient, preferably with adhesive rather than staples or towel clamps. Care in removing drapes is essential to avoid injury especially to age related skin atrophy; for example, circular bandages should be unrolled to avoid injury as is more likely to occur if cut. Shorter surgical time reduces the risk of wound infection, blood loss, untoward effects of the anesthetic, and likely cognitive dysfunction (Fig. 14.3).

14.14.2 Blood and Fluid Management

Clinical assessment of the patient's volume and hemoglobin status is essential in every patient. Proper fluid management is vital to reduce complications including venous thromboembolism, pneumonia, urinary tract infection, incidence of postoperative transfusion, and mortality [66, 67]. Fluid depletion is best corrected with isotonic saline with caution to avoid over expansion. The NIH-sponsored FOCUS trial "Safety and Effectiveness of Two Blood Transfusion Strategies in Surgical Patients with Cardiovascular Disease" suggests maintaining hemoglobin levels at or above 8 g/dL for elderly patients with cardiac comorbidities [68].

14.14.3 Additional Surgical Considerations

Arthroplasty with cemented implants is a valuable option in geriatric patients because of poor bone quality. Although there is some concern that cementing may lead to increased mortality and complications from cement implantation syndrome, studies have shown no statistical difference in patients treated with cemented versus uncemented implants, but have suggested taking care in patients who are exceptionally frail [69]. While there is an increased operative time and intraoperative bleeding associated with cemented implants, there was no difference in functional outcomes, mortality, or complications at 1-year follow-up [70]. Surgery should be kept as short as possible with minimal blood loss.

Hip fracture, femur fracture, and periprosthetic fracture should be performed urgently for reasons noted earlier. Proximal humerus fracture and distal radius fracture surgery can be semi-elective. A detailed care pathway discussed early on can improve outcome quality, patient satisfaction, and lower costs [5, 6, 27, 71] (Fig. 14.4).

14.15 Postoperative Care

14.15.1 Prevention of Future Fractures

Postoperative care should be standardized and protocol-driven, ideally involving an interprofessional team. Of particular importance is the inclusion of a fracture liaison service or primary care in the management of osteoporosis for fragility fractures.

Osteoporosis is a common problem that affects 1 in 3 women and 1 in 5 men worldwide. Recognition of osteoporosis may be clinically difficult, as it is often a silent disease state until complicated by a fracture. Fragility fractures, or those that occur secondary to low-energy trauma typically from a fall from standing, are a major public health hazard, costing nearly $20 billion per year [72]. Fractures typically occur in the vertebrae, proximal femur, and distal forearm, though they may occur elsewhere in the body. Although some patients may fully recover from these injuries, many will progress to have chronic pain, disability, psychological trauma, loss of independence and some will die from their injuries. Many will be institutionalized, with 20% of hip fragility fractures requiring long-term nursing home care and 60% will never regain pre-fracture independence [73]. Hip fractures are particularly problematic and associated with up to a 33% mortality within the first year [74]. Prior fracture puts one at twice the risk for subsequent fracture. This risk is highest immediately after initial fracture. One study explored the incidence of subsequent hip fracture after initial hip fracture and found that nearly half occurred within 1 year of initial injury with a relative risk of nearly 12 at 1 month and did not normalize until after 15 years [75].

Despite the high risk of morbidity and mortality associated with fragility fractures, only 20% of patients receive treatment for osteoporosis. Fracture liaison services are a recent development aimed to identify patients with fragility fractures and coordinate long-term management of their osteoporosis in an attempt to prevent future fractures. There is a metaphorical “Bermuda Triangle of osteoporosis care” in which patients with osteoporosis are lost as there is some ambiguity of who is responsible for the long-term management of osteoporosis between orthopedic surgeons, primary care, and osteoporosis experts (e.g., endocrinology or rheu-

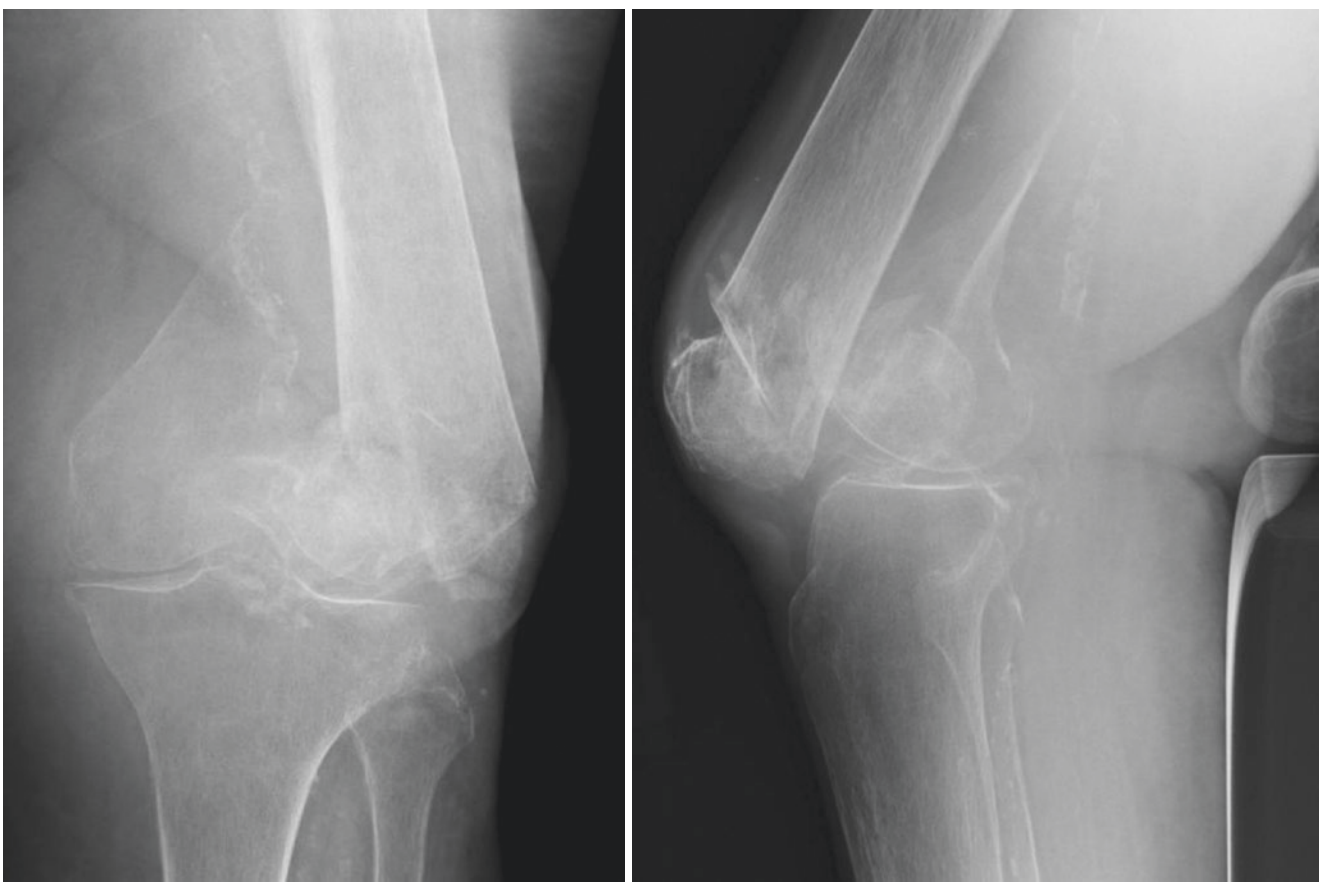

Fig. 14.5 Geriatric patients are at increased risk of fragility fractures from low-energy trauma due to underlying metabolic bone disease. This patient and her family elected for nonoperative management due to her nonambulatory status from a prior cerebrovascular accident, highlighting the importance of goals of care discussions early on in evaluation

matology). The fracture liaison takes a multidisciplinary approach including input from the providers listed above, in addition to physical therapy and dieticians, to identify these patients and ensure they are properly assessed and managed. They also coordinate the completion of further work-up (e.g., DEXA imaging), initiation of pharmacologic therapies (calcium/vitamin D, bisphosphonates, etc.), and ensure patients have long-term follow-up with a provider for their osteoporosis. Studies have shown that the use of a fracture liaison service increases the rate of osteoporosis diagnosis from 5–30% up to 80% and results in a 30–40% reduction in the risk of subsequent fragility fracture [72] (Fig. 14.5).

14.15.2 Pain Management

Pain management is complex, as pain is often under-reported, especially in those with cognitive impairment. Furthermore, analgesics have an increased side effect profile in older people. Multimodal analgesia using narcotics, non-narcotic analgesics, and local nerve blocks is effective [76–79]. The combination of NSAIDs/acetaminophen with opiates produces synergistic pain relief and decreases the need for opioid medications. Duration of NSAID use should be limited to about 2 weeks due to renal, cardiovascular, and gastrointestinal toxicity. Intravenous, oral, and subcutaneous Morphine, fentanyl, and hydromorphone have no difference in the deterioration of cognitive function or incident delirium [77]. Meperidine causes delirium and should be avoided [78]. Knowledge of delirium risk from narcotics must be balanced with the knowledge that uncontrolled pain also contributes to delirium. Meta-analyses found that local nerve blocks are effective and reduce complications in femur fracture [80, 81]. Intravenous patient-controlled analgesia (PCA) provides superior postoperative pain relief compared to nurse administered boluses but because of comorbidities, particularly cognitive impairment and hand arthritis, may not be effective in some seniors.

14.15.3 Mobility and Weight Bearing

In most situations, the primary goal of orthopedic surgical intervention is to restore the patient to their prior level of activity and independence, or to an increased level of independence. A secondary goal of surgery is to prevent the complications of immobility and its sequelae—pressure injury, stiff joints, deconditioning, pneumonia, and delirium. In almost all cases, rehabilitation should begin soon after surgery. Every surgeon has his or her own preference in the initiation of mobility and physical therapy and these differences depend on the surgery performed (a patient with total knee arthroplasty may immediately bear weight as tolerated while one with a tibial plateau fracture may be non-weight bearing for some time). The surgeon must decide on this status and engaging early physical and occupational therapists is most valuable to achieve the best outcomes, avoid complications, and achieve ideal analgesia [82–84] (Fig. 14.6).

Fig. 14.6 Stairs can be a major hazard for the geriatric patient. Steep landings, narrow steps, and other items on the steps, such as shoes, increase the risk of falls. Proper evaluation and education by a physical therapist can help prevent falls in patients as they mobilize after surgery

14.15.4 Braces

Braces are best avoided but occasionally one is essential: tibial plateau fracture, some ankle fractures and minor wrist fractures management. Complications of braces include delirium, pressure pain, tendon injury, and skin breakdown [85].

14.15.5 Skin Considerations

Orthopedic patients are especially vulnerable to skin injury. Pressure injuries are serious complications and can lead to hospital readmission, infection, sepsis, surgery, and death.

Fig. 14.7 Geriatric patients are at risk for skin injury, particularly those with decreased mobility. (**a**) A heel ulcer developed on this patient from a poorly padded walking boot. (**b**) If a splint is needed, extra padding should be applied to bony prominences such as the metatarsal heads and calcaneus to avoid skin injury. (**c**) This patient sustained a full thickness skin injury to the proximal thigh from a knee immobilizer during a prolonged hospitalization

With high quality care, they are largely preventable with careful bedside care [85]. Skin must be checked several times a day for proper positioning, padding, redness, blisters, and ulcers. Sores most commonly are found at the hips, sacral region, heels, and elbows. Routine and frequent skin assessment and care by members of the multi- or interdisciplinary team is most valuable in avoiding or managing skin pressure problems. Such an approach is better than the common practice of the past, which included routine repositioning, an activity that can cause a shear injury, a precursor to an ulcer, or pressure relieving mattresses. Interdisciplinary team care and early mobilization are effective strategies in reducing skin injury [85–88]. Evaluation tools for assessing risk of pressure ulcers include the Braden [89] and Norton [90] scales. The Norton scale may be better at identifying high-risk patients. Grip strength (possibly as a surrogate for sarcopenia) predicts inpatient and 30-day risk of pressure ulcers [91] (Fig. 14.7).

14.15.6 Delirium

Delirium is a common and serious complication in the postoperative period affecting about half of patients after hip fracture and increasing mortality and length of stay [28, 92–95]. Certain medications (anticholinergics, H2 blockers, antihistamines, benzodiazepines, skeletal muscle relaxants, and NSAIDs) are important precipitants and are best avoided. Other risk factors and strategies to minimize this complication are discussed in depth in Chap. 2.

The risk of complications, poor outcomes, and mortality in older orthopedic patients requiring surgery is high, a result of many comorbidities, losses of physiological function and remarkable heterogeneity. Such patients are simply more vulnerable, and the perioperative care requires a highly orchestrated interdisciplinary team to achieve the best outcomes [27, 85, 92, 93, 96–98].

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15 Rehabilitation

Dale C. Strasser

15.1 Introduction

Rehabilitation consists of a broad set of practical interventions and targeted medical management to promote function and quality of life particularly in context of disabilities. Common rehabilitation approaches include therapeutic exercises, assistive technologies, compensatory strategies, orthotic devices, and environmental modifications—all delivered by a team of rehabilitation providers with complementary skill sets and tailored to the specific needs of a given individual. Physicians provide medical direction and manage health-care issues that directly impact function like pain, spasticity, cognitive impairment, and neurogenic bladders. For elderly individuals, this approach is modified on principles pioneered in Geriatric Medicine including the recognition and management of frailty and geriatric syndromes. The medical specialty of Physical Medicine and Rehabilitation (PM&R) and Geriatric Medicine share practical, patient-centered orientations to promote function and quality of life, which reflect a synergy between PM&R and Geriatric Medicine. Physicians collaborate closely with other health professionals, such as Physical Therapists and Social Workers, and the effectiveness of their work is influenced by the quality of communication, care coordination, and patient-caregiver goal setting. In this chapter, the context of Geriatric Rehabilitation is presented along with practical suggestions on keeping this service delivery model active and relevant in an era of financial constraints and fragmentation of services along with newer material on prehabilitation and rehabilitation for COVID-19 patients. Summary comments reflect on potential gains gained through more research and cross-disciplinary collaborations along with potential threats to optimal services.

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15.2 Geriatric Rehabilitation: How Is It Different and Why Is It Effective

With a bit of respectful exasperation, the elderly woman looked up at the Occupational Therapist (OT) and stated “honey, I have been peeling potatoes since I was twelve years old and I am tired of it.” Even though the stroke had impaired her ability to do the task, the 84-year-old woman did not see much use for a one-handed potato-pealing technique despite the sincere encouragement of her young therapist. I learned something profound in this exchange in my second year of residency. The patient desired some independence on her own terms, and she wanted to go home with her family. She worked hard to achieve these goals and her actions engaged her family to be effective care-givers. The lesson learned—rehabilitation activities should be personally meaningful to achieve patient participation and positive outcomes. Each patient is unique and the marked heterogeneity among seniors demands that clinicians identify the specific goals and aspirations of their recovery after any disabling perturbation.

Over the last 30 years increasing evidence has emerged that geriatric patients who receive rehabilitation services targeted to their particular circumstances have improved outcomes. In a systematic review and meta-analysis of 17 randomized controlled clinical trials with nearly 5000 patients, Bachman concluded that rehabilitation programs designed specifically for geriatric patients have the potential to improve functional outcomes, decrease nursing home admissions, and improve life expectancy in this population compared with general rehabilitation services [1]. In 88% of the geriatric rehabilitation units a comprehensive multidisciplinary geriatric assessment was performed while none were performed in the general rehabilitation groups, lending support to a geriatric evaluation to guide the interventions the needs of this group and to incorporate issues of frailty, and geriatric syndromes.

Observations that general rehabilitation services are not optimally attuned to the needs of older patients preceded

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these clinical trials. The mismatch of acute inpatient rehabilitation and the dynamics of effective services for the frail and elderly patients was a source of frustration and made more poignant as geriatric medicine emerged in the 1980s and 1990s in the United States. This mismatch continues today. Spurred by the identification of functional impairments through the comprehensive geriatric assessment units, concerned professionals sought interventions including rehabilitation. Even though the field of PM&R had pioneered medical rehabilitation (primarily for a younger population), issues of pacing, goal setting, and rehabilitation therapies in context of frailty and common geriatric syndromes were unfamiliar to many in general rehabilitation. And perhaps even more frustrating, individual rehabilitation practitioners did not appreciate the inadequacies of the current delivery model. Financial constraints and regulatory guidelines also impeded the incorporation of frail elderly patients into acute rehabilitation services.

15.3 Promoting Function Through Rehabilitation

Goal Setting
Assessment
Targeted Interventions
Program Evaluation and Quality Improvement

As shown in the stroke survivor's disinterest in peeling potatoes, well-intentioned rehabilitation efforts have limited chances of success without an essential buy-in. Meaningful goals anchor geriatric rehabilitation efforts and such goals commonly emerge from a shared, collaborative process among providers, patients, and their families. The process of goal setting is arguably more important than any specific objective and the skilled rehabilitation professional facilitates the framing of the goals within the realm of the possible. For example, an initial goal of "I want to walk by myself" may translate into "I want to get around" or "I want to go to my grandchild's graduation." An effective starting point revolves around the patient's preferences with input from their families and social network.

A comprehensive geriatric assessment frames the development of goals and consists of Medical, Mental, Physical, and Environmental Domains. For the rehabilitation specialist, the principles of geriatric medicine and common geriatric syndromes represent a key starting point, and these topics are covered elsewhere in this book including the Chap. 13. Rehabilitation specialists targets the specifics of function with common domains of functional assessment including physical (e.g., activities of daily living (ADLs), mobility, swallowing), cognitive (e.g., memory, judgment, language, and communication), and socio-environmental (housing, barriers social support, and resources). Only by evaluating all these factors can one gain a comprehensive sense of what is needed. For example, an individual's capabilities and potential with ADLs, gait, coping, and cognition within a particular social and physical environment can be pivotal in the individual's ability to live alone, navigate stairs, drive, and manage finances.

An interdisciplinary team of rehabilitation professionals address interrelated determinants of function—physical therapist or PT (mobility), occupational therapist or OT (self-care), speech language pathologist or SLP (swallowing, aspiration risks, and practical cognition), nurses (skin, bowel, bladder management), and physicians (medical management and direction) [2, 3]. Furthermore, higher functioning teams impact patient outcomes. More cohesive teams have better outcomes and team functioning can be improved through staff training [3]. Process of care measures which capture meaningful interactions between staff and patients hold tremendous potential in the evaluation and improvement of treatment effectiveness, particularly in the relationship-oriented areas of rehabilitation and geriatrics [4].

15.4 The Byzantine World of Accessing Rehabilitation Services

While the principles of geriatrics and rehabilitation are straightforward, challenges emerge when figuring out how to get the services in an era of increasing financial constraints and the associated red tape. Much has been written about the ballooning health-care costs in the United States. The fastest growing expenses for the Center for Medicare and Medicaid Services (CMS) are the Post-Acute Care (PAC) costs, which include services delivered in acute Inpatient Rehabilitation Facilities (IRFs), Skilled Nursing Facilities (SNFs) also known as subacute rehab, Home Health (HH), Outpatient Therapies, and Durable Medical Equipment (DME). CMS outlays for PAC have doubled in the past 14 years. Forty percent of the growth of CMS expenses comes from increased PAC costs. Understandably, this situation has resulted in close scrutiny of all PACs with subsequent more financial and administrative constraints. Ideas under consideration to address this situation include bundling of services and payment neutrality across sites. Under bundling a health-care system is paid a lump sum per episode (e.g., hip fracture, stroke, or pneumonia) and has the flexibility to utilize the resources as they deem best. Payment neutrality refers to comparable payments across settings (e.g., subacute versus acute rehabilitation).

Many rehabilitation professionals are concerned about the potential deleterious effects of either of these changes primarily through a shift from acute IRF-based rehabilitation to SNF-based rehabilitation along with more restrictive payment structures in both settings. Patients treated in subacute rehabilitation settings (SNF) have longer lengths of stay, lower intensity of services, less physician involvement, and lower per diem costs than patients treated in acute rehabilitation (IRF). Physicians with documented rehabilitation expertise, usually in PM&R, manage care in acute settings including daily physician visits and weekly team conferences, while geriatricians or other generalists provide medical oversight in most subacute settings with a minimum of a monthly visit. Comparisons of outcomes are challenging because of the different, but overlapping patients served and the lack of common functional outcome measures across the two settings.

In principle, these settings serve different populations with distinct services. The primary criterion for admission to subacute rehabilitation is a need for skilled level of services, which can be provided by either nursing, PT, or OT. Admission criterion for acute rehabilitation includes the patient's ability to participate in a minimum of 3 hours of therapy services a day, justification for two of three rehabilitation therapies (i.e., PT, OT, SLP), and the need for ongoing medical and nursing services. In addition, CMS stipulates that a minimum of 60% of the patients fall into 1 of 13 diagnostic categories (such as stroke, Parkinson's disease, or brain injury). Of note, severe debility from a protracted hospitalization and elective joint replacements are not included in one of these categories even though these patients can be admitted under the remaining 40% if they meet the other requirements. Hence acute rehabilitation provides more intensive services with greater physician involvement, more effort devoted to care coordination, and shorter lengths of stay at significantly higher per diem costs and total costs.

Practically speaking these arrangements can be problematic in several ways. Wide variations in the actual services delivered and outcomes achieved vary within each category, IRF and SNF. A patient may not fit well into either PAC category. For example, a medically complex patient may benefit from daily physician monitoring and proximity to medical specialists found in acute rehabilitation, but not have the physical endurance to tolerate the required intensity of rehabilitation therapies. A medically tenuous patient may not be accepted in acute or subacute rehabilitation, and still not meet the criteria for long-term acute care (LTAC). The wide variations in both acute and subacute facilities complicate post-acute care discharge planning along with geographic differences in availability. Furthermore, the interpretations of CMS regulations vary by location where a particular clinical picture may be acceptable for acute rehab in one location, but not another.

It seems that the better the subacute facility, the lower chance of a bed availability! These circumstances put the acute hospital discharge planner in an awkward situation as he or she is pressured to take the first available bed. Likewise acute rehabilitation facilities vary in their knowledge and skills in managing the frail, elderly patient. Also, there are patients who would benefit more from the intensity of acute rehabilitation after a period of recuperation and an initial lower intensity of exercise such as acute trauma with activity restrictions or profound debility. However, planned transitions from subacute to acute rehabilitation are uncommon and likely due, in part, to financial disincentives to collaborate in this manner.

An ideal SNF patient could be someone who may not have the endurance to participate in the 3 hours a day of therapy, and for whom an extended, slower pace rehabilitation course would likely prove more beneficial. LOS restrictions are more flexible and can extend up to 100 days, provided clinical improvement can be documented under CMS guidelines (though full coverage ends at 3 weeks). An IRF patient would be expected to benefit from a more intense and focused medical, nursing, and rehabilitation therapies, and would be able to achieve desirable goals in a relatively short period of time, such as 2–3 weeks. In general, payors are attracted to the SNF services because of the costs.

An ongoing debate exists in comparing acute versus subacute facilities. Discussions on this topic get convoluted as CMS places SNFs, IRFs, LTACs, and Home Health Services (HH) are grouped in the category of post-acute care (PAC). For Medicare beneficiaries, services provided in PAC settings are the fastest growing segment of health care in the United States. For example, Medicare payments to PAC providers reached $59 billion in 2013, more than doubling the costs since 2001. Faced with concerns on health-care costs, CMS has pursued actions under Federal mandates to contain the costs of PACs [5]. For example, IRFs have seen stricter admission criteria, payment cuts, and audit processes to monitor and recoup costs deemed unnecessary or not covered. Concurrent with these constraints has been a steady decline in the number of IRFs. The crux of the discussion is whether and to what extent rehabilitation services can be shifted to less expensive SNF settings.

Comparisons of patient outcomes between acute and subacute settings are complicated for a variety of reasons. While the two settings share some similar patients, the populations between the two differ as does the intensity of services, nursing staffing levels, and physician involvement and there is tremendous variability among rehabilitation facility types (SNF vs IRF) and within site variations. The Improving Medicare Post-Acute Care Transformation Act (IMPACT) of 2014 established a set of outcomes applied across all PACs, including SNFs and IRFs to promote more meaningful [6]. These changes have the potential to make meaningful comparisons across PACs and allow for more data-based decisions on policies and payments. The per diem cost of subacute rehabilitation is approximately 1/3 to 1/2 of acute rehabilitation, a fact that demands an analysis of clinical quality outcomes in both settings.

With these caveats, there is reasonable evidence that for comparable patients outcomes are superior in acute settings particularly for the diagnoses of stroke and hip fracture. A recent meta-analysis on stroke rehabilitation found that IRFs produced better outcomes though at higher costs than SNFs [7]. This review supports the findings of a study commissioned by the ARA Research Institute, an affiliate of the American Medical Rehabilitation Providers Association (AMRPA), Dobson DaVanzo & Associates, LLC., which examined over 100,000 matched pairs of patients with the same condition treated between 2005 and 2009 [8]. Compared to the SNF patients, IRF patients had better clinical outcomes on five of six measures in the longitudinal analysis. The sixth measure was hospital readmission and IRF patients had fewer hospital readmissions than SNF patients for amputation, brain injury, hip fracture, major medical complexity, and pain syndrome. As an industry-sponsored study which has not been published in peer-review journals, readers are advised to examine the methods closely. With this caveat, the study merits a discussion given its apparent methodological rigor and consistency with findings from other published work.

15.5 The Convergence of PM&R and Geriatric Medicine

Rehabilitation is an attitude and an orientation toward the maintenance and promotion of function. In the early to mid-twentieth century, rehabilitation techniques emerged as concerned health-care providers addressed functional loss and disability with exercise, wheelchairs, prosthetics, compensatory strategies, and specific medical interventions for disable groups. In the process, a function-oriented service delivery model incorporating multidisciplinary interventions within a biopsychosocial framework emerged to optimize a disabled individual's function. This approach contrasted radically with the traditional medical model at that time of physician dominated authoritative director of health care. This new approach emphasized the interactive role of patients, physicians, and other providers and represented a precursor to the contemporary emphasis on patient-centered care. Like students in school, success is viewed in terms of a skill performance. Can the disabled individual safely bathe, toilet, dress, climb stairs, live alone, or return to work?

Physical Medicine and Rehabilitation (PM&R) coalesced as a medical specialty in the United States and other countries in response to large numbers of surviving injured soldiers associated with twentieth-century armed conflicts. During World War I, specialty hospitals were developed for disabled soldiers, including for the treatment of spinal cord injuries. Taking advantage of recent advancements in engineering and manufacturing, concerned individuals, including friends and relatives of injured soldiers developed more useful canes, crutches, orthotics, and wheelchairs for the disabled. In the 1920s and 1930s, "physical therapy" physicians and other health professionals expanded on the therapeutic use of physical agents such as light, diathermy, hydrotherapy, electricity, and magnetism. In World War II, Howard Rusk in the United States and others developed effective models of service delivery for disabled soldiers [9]. The team-based models of service delivery and the use of physical agents in medical care were precursors to the formal recognition of PM&R as a medical specialty in the United States.

Around the same time period in the UK, another young physician, Marjorie Warren, confronted a hospital full of patients with chronic conditions and disabilities where the expectation was long-term institutionalization. Dr. Warren discarded this warehouse attitude and pioneered a practical, patient-centered approach to address functional disabilities. She recruited diverse health-care providers (e.g., aids, nurses, physiotherapists) and coordinated their efforts to train and mobilize her patients. Along the way, she developed new approaches such as the "shuffle board transfer" which is known in the United States as the "sliding board transfer." Between 1935 and 1939, 80% of the patients in the "Hospital of the Incurables" were successfully transitioned to the community. Dr. Warren played a pivotal role in the development of the medical specialty of Geriatric Medicine and was instrumental in the incorporation of Geriatric principles into the UK National Health Service (NHS) in the late 1940s [10].

With advances in health care, the establishment of Medicare, and an aging population of baby boomers and their parents, the common interests of the medical specialties of PM&R and Geriatric Medicine became increasingly obvious. Beginning in the 1980s, seminal work on Geriatric Assessment Units documented the benefits of a comprehensive, functionally oriented geriatric assessments and multidisciplinary team interventions. The commonalities between the medical specialties were obvious to anyone who looked. With support of the John A. Hartford Foundation, the American Geriatrics Society spearheaded an exhaustive effort to articulate and support geriatrics principles among ten surgical and related medical specialties. Representatives of the American Academy of PM&R were active participants in this process which is reflected in a 2002 editorial entitled "Geriatrics and Physical Medicine and Rehabilitation: Common Principles, Complementary Approaches, and 21st Century Demographics" [11].

The confluence of PM&R and Geriatrics reveals a basic insight—the value of a patient-centered approach with an emphasis on function and practical interventions delivered by multidisciplinary teams. In PM&R and Geriatrics, the service delivery model is a dynamic interaction of providers and patients to promote function, in contrast to a traditional and more passive model of a physician, a patient, and a prescribed intervention. Even though this dynamic patient-centered and team approach has proven highly effective, the maintenance of such an approach remains challenging and must adapt to changing circumstances and financial pressures of contemporary health care.

15.6 Frailty, Geriatric Syndromes, Rehabilitation, and Prehabilitation

Frailty can be thought of as increased vulnerability or decreased functional reserves which manifest in physical, psychological, and socioeconomic dimensions. Older and at-risk adults are susceptible to major health and functional status changes triggered by relatively minor perturbations. In fact, frailty is a powerful predictor of increased risk of adverse outcomes and mortality from nearly any significant change in medical status such as a major surgical procedure, stroke, fall or fracture, or decline in social support such as with social engagements, death of a spouse, or loss of financial support. It now can be easily recognized by any clinician using simple tools of assessment. Chapter 1 provides a thorough discussion of this frailty and geriatric syndromes.

Geriatric and rehabilitation frameworks are useful tools in the diagnosis and management of geriatric syndromes. Falls, delirium, dementia, incontinence, polypharmacy, and pressure sores present as symptom complexes with multifactorial and overlapping causes and are usually associated with functional impairments. The presenting symptoms and associated risk factors are targeted with broad-based biopsychosocial interventions to mitigate the symptom complexes. Not only does the interface of rehabilitation and geriatric syndromes reveal similarities in content and approach, a synergy emerges where insights from one informs the other.

A rehabilitation team can provide comprehensive input into the management of geriatric syndromes. Typically, the physician spends 5–15 minutes a day with a patient while various rehabilitation team members interact with patients 24 hours a day across the spectrum of human activities. Nurses care for patients 24 hours a day/7 days a week. They play a major role in setting the tone of the treatment environment that represents a transition from a dependent and passive role of acute care to a self-determining and active participation in rehabilitation. The PT works on gait, mobility, and balance; the OT addresses self-care, personal hygiene, and activities of daily living (ADLs), and the SLP treats disorders of swallowing, attention, and practical cognitive functioning. The impact of geriatric syndromes occurs in the practical world of daily living and members of the rehabilitation have the skills to intervene comprehensively in a coordinated manner.

Falls represent the quintessential geriatric syndrome. They occur with increasing frequency such that an 80-year-old has an eight times greater risk of falls compared with a 65-year-old. A history of falls predicts increases in morbidity, mortality, disability, and early institutionalization. Falls have multifactorial risk factors which are categorized as intrinsic (e.g., polypharmacy, dementia, gait abnormalities), environmental (e.g., stairs, lighting, furniture), and situational (e.g., inattention, poor safety awareness, unfamiliar setting). The recognition of falls as a geriatric syndrome is paramount in rehabilitation. Effective interventions arise from a comprehensive biopsychosocial framework to address risk factors, promote healthy behaviors, and to develop interventions for identified issues of mobility (e.g., gait, balance, endurance), ADLs (e.g., toileting, dressing, meal preparation), neurocognition (e.g., attention, judgment, and safety awareness), and the social and physical environment (e.g., social support and physical barriers). A review of fall risk assessment tools in rehabilitation can be a helpful resource in the evaluation and treatment of falls [12].

Incontinence. For the elderly patient, successful interventions for bladder and bowel management commonly have a behavioral component. The acts of micturition and defecation are complex tasks involving the autonomic and conscious nervous systems—gross and fine motor skills are needed for toileting, while neurocognitive skills such as attention, communication, and visual spatial perceptions are utilized to ready the individual for continence. An interdisciplinary rehabilitation team can play an important role in bladder and bowel assessment and treatment by targeting the specific functional activities to promote continence, such as toilet transfers, clothing management, caregiver communication, and problem-solving. In one clinical trial in an acute rehabilitation setting, a staff awareness and skills training intervention on bladder management was associated with improved bladder continence and overall functional improvement [13]. Furthermore, measures of rehabilitation team functioning correlate with bladder management. Rehabilitation patients treated by higher functioning teams are associated with greater levels of bladder continence [14]. Bladder and bowel management are enhanced by an interdisciplinary rehabilitation team which targets specific deficits associated with the problem. *Other sections of this book describe in detail medical and surgical interventions to promote bladder and bowel continence (Chaps. 19 and 21).*

Dementia. Neurocognitive decline in elderly individuals often is first noted by their children and others following relatively minor medical events like a frozen shoulder or an Emergency Department visit following fall. In the rehabilitation setting, clinicians must be attuned to these comments and observations as underlying cognitive impairment in a senior profoundly influences risk for adverse outcomes and care planning. For example, major medical or surgical events like a stroke, hip fracture, coronary artery bypass procedure, or hospitalization for pneumonia can unmask cognitive decline, which in turn has implications for an individual's independence, living situation, and quality of life. Such patients are frequently referred for rehabilitation therapies and too often the cognitive impairment has not been recognized by clinicians in the acute care setting whose focus was on the acute illness. Recognizing subtle cognitive impairment is critical in the assessment and management of specific deficits (e.g., money management, safety in the home and community, and learning new skills such as the use of a specialized wheelchair). For an elderly individual with recently apparent cognitive impairment, questions to be addressed during rehabilitation include hygiene, independent living, and safety with meal preparation, community activities, or driving. *Details on the diagnosis and management of dementia are available in Chap. 4 "Psychiatry*." A rehabilitation clinician must be expert in recognizing patients with even mild dementia and doing so helps greatly in their providing a practical, real-world plan to rehabilitation goals. Even for the patient not in a rehabilitation unit, the rehabilitation consulting team can add greatly to the management of patients with dementia by implementing interventions to optimize functional outcomes.

Delirium. A robust literature documents the extent of delirium in elder patients in acute hospitals and most other inpatient venues and that delirium is commonly not diagnosed especially in seniors where the common presentation is hypoactive as opposed to the typical hyperactive state of younger individuals. While the literature is not as robust as it is in the general hospital setting (where delirium is missed in up to 40% of cases), the clinical impression in rehabilitation settings is that delirium is more common than generally thought. The recognition of delirium should refocus the efforts of medical and rehabilitation professionals toward risk reduction including the potential contributions of medications, sleep hygiene, and environmental factors. A patient with a reversible delirium may be inappropriately denied intensive services based on an erroneous interpretation of current symptoms. All rehabilitation clinicians should be expert in preventing, recognizing, and treating delirium in their patients. Chapter 2 provides a detailed account of this common problem.

Polypharmacy. Common conditions impacting rehabilitation include pain, affect, agitation, neuropathy, spasticity, impairments of attention and memory, orthostasis, and bladder and bowel incontinence. Medications used for these conditions have disturbing side effect profiles, including especially those with anticholinergic properties. There are many non-pharmacological interventions that are effective for these problems. Rehabilitation professionals must be vigilant to medication side effects (including those from effectively agents used in younger patients) in the highly vulnerable senior population, and choose drugs wisely. A high-functioning team can assist in identifying non-pharmacological treatments for many of these conditions such as pain, agitation, and spasticity. In addition, the interdisciplinary team can assist in assessing the impact of certain trials of medication for a spectrum of common rehabilitation issues cited above while at once monitoring for side effects. In a comprehensive review on the topic in PM&R, Geller et al. identified strategies modified from geriatric medicine and public health such as physician engagement, accurate assessment of medication lists, patient-centered process, using explicit and implicit criteria for guidance, practicing medication debridement when appropriate, and using technology and computer-assisted tools to identify problem areas and offer practical solutions [15]. In a more recent review, Yoon [16] delved into complementary and alternative strategies for pain management and other common issues in the geriatric rehabilitation population. Chapter 5 provides a thorough review of this subject and detailed information of the popular Beer's list of drugs best avoided in seniors.

15.7 Prehabilitation

Prehabilitation refers to presurgical programs to improve outcomes particularly for at-risk, frail older adults through a structured program of mobilization and exercise along with addressing nutritional and psychosocial determinants. Prehabilitation arose from the well-established relationship between frailty and surgical outcomes—the greater the frailty the poorer the outcomes. The potential benefits and supporting rationale of prehabilitation are well-acknowledged in the literature both in the United States and internationally [17, 18]. Hanna, Ditillo, and Bellal [18] support the use of frailty measures for preoperative risk stratification as such measures are highly predictive of adverse perioperative events. They assert that the identification of frail individuals facilitates targeted interventions to optimize surgical outcomes. They further advocate for broad implementation in the United States of multimodal interventions to improve the quality of geriatric surgery health care.

In the UK, Durrand, Singh, and Danjoux [17] propose a tiered approach to prehabilitation interventions. They place risk factors into the categories of physical activity, inspiratory muscle training smoking, alcohol, nutrition, and psychological factors and then describe screening principles, assessment for at risk patients, intervention principles, and targeted prehabilitation goals.

In a systematic review of prehabilitation covering 1996 through March 2013, Cabilan, Hines, and Munday [19] did not find any evidence to support prehabilitation for hip or knee arthroplasty in objective and self-reported function postoperatively though there was evidence that prehabilitation of greater than 500 minutes may reduce admission to rehabilitation for these patients. They acknowledged this evidence is preliminary and there was insufficient data in cardiac, colorectal, spinal, or upper gastrointestinal/hepatobiliary surgical populations to make conclusions on the impact of prehabilitation.

More recently, Hijazi, Gondal, and Aziz [20] reviewed nine prehabilitation programs in abdominal cancer surgery published between 2009 and 2015. Assessment tools included the 6-min walk test, anaerobic threshold, VO_2max, and a measure of health-related quality of life (SF-36). Given the heterogeneity of the studies, definitive conclusions on the efficacy of prerehabilitation interventions could not be determined. They recommended standardization of interventions and advocated for tri-modal interventions with exercise, nutritional, and psychosocial components. The authors support programs customized to the specific needs of a patient which take into account the social resources along with the patient's goals, interests, and capabilities. And finally, there may be further benefits to prehabilitation to set the stage for a post-op mindset of function, mobilization, and social engagement.

Further refinements in the dosing and implementation of prehabilitation interventions are needed. The work of Bean and others [21] demonstrated the potential utility of a structured, innovative program with combined outpatient and home physical therapy (PT) boosted with a commercially available app and computer table in the REACH project (Rehabilitation Enhancing Aging through Connect Health). Of particular note, such a program may be more effective and less expensive than one conducted exclusively in a traditional outpatient setting.

Prehabilitation makes sense to health professionals cognizant of frailty and function in the elderly. It is so "intuitive" that one may be tempted to take it for granted. However, as limited economic and social resources impede the implementation of such programs, further work is needed to refine the intervention, optimize its use, and justify the costs. Many leaders in surgical and related medical specialities endorse and promote the value of Prehabilitation to optimize surgical outcomes in the frail, older adult patient [18, 20].

15.8 Rehabilitation and COVID-19: Acute, Subacute, and Longer-Term Issues

The elderly population has been impacted by the COVID-19 (SARS-CoV-2) pandemic more than any other age groups. This group accounts for the highest number of serious illnesses, deaths, and protracted symptoms [22]. The virus affects multiple organ systems with a widely varying spectrum of severity. The protean manifestations of the disease extends beyond the lungs to every major organ system and physiological processes including cardiac, gastrointestinal, neurological, circulatory, musculoskeletal, and immune systems [23]. Despite the extensive research and rapidly expanding literature on COVID-19, uncertainty remains on the mechanisms, treatments, and even duration of symptoms. In this section, we offer current insights on the role of rehabilitation as both a medical specialty (PM&R) and as a group of strategies and interventions to promote function and recovery through the stages of the disease process—acute, subacute, and longer-term and chronic issues.

Rehabilitation efforts in the acute phase build on the value of mobilization and environmental awareness (such as natural light and noise level) in critical care settings. Prepandemic work shows that a majority of ICU patients suffer from "post intensive care syndrome" with a spectrum of sequelae and functional decline [24, 25]. Concerted, coordinated rehabilitation efforts with support from hospital administration and medical colleagues improve patient outcomes and reduce costs in the ICU setting [26, 27]. Specifically relevant to acute COVID-19, early rehabilitation interventions had a positive impact on patients with ARDS patients in the ICU [26]. As reviewed by Kim et al. [28], COVID-19 patients with ARDS commonly require high positive end-expiratory pressure and likely deeper sedations and these variables are associated with further declines in cognition, weakness, and overall functioning which should be factored in when designing rehabilitation interventions.

Rehabilitation interventions post-acute COVID-19 typically place emphasis on pulmonary function [29, 30], functional loss from debility, and to address other organ specific areas such as neurological and cardiac to optimize function and health [28]. Interventions target patient-centered goals in ADLs (activities of daily living) and self-care, mobility and transfers, swallowing and aspiration risk and are provided by a spectrum of rehabilitation professionals which expands beyond nursing and medicine to include rehabilitation therapies (OT, PT, SLP), social services, and neuropsychology. Following an acute hospitalization for active COVID-19 ongoing functional issues can benefit from directed inpatient treatments which can occur in skilled nursing facilities (SNFs) and acute inpatient rehabilitation (IRFs). The differences and relative advantages of each setting are discussed earlier in this chapter, and when patients meet the CMS admissions criterion, IRF-based rehabilitation are preferred and likely produced improve outcomes based on the experiences following strokes and hip fractures.

COVID survivors are returning to their health-care providers with new or re-occurring symptoms many weeks and months after the virus has cleared. The terms "Long Haulers" and "Long COVID" emerged from post-COVID support groups and refer to a constellation of symptoms (Long COVID) including fatigue, exhaustion, and "brain fog" along with a re-emergence of the original organ issues such as those with lungs, hearts, clotting irregularities, and the nervous system involvement. Long Haulers are those who suffer from these post-acute COVID symptoms. More recently, the National Institutes of Health (NIH) has endorsed the term "PASC" for Post- Acute Sequelae of SARS-CoV-2 Infection. Post-viral symptoms are increasingly recognized in the scientific circles [31–33] and national publications. A recent *New York Times Magazine* article [34] highlighted the Mount Sinai Hospital—Center for Post-Covid Care where most of patients are predominately female in the late 20s through 50s, and many of these with mild to moderate symptoms.

The complaints and experiences of these Long Haulers remind this author (DCS) of post-polio syndrome (PPS). Following another devastating and frightening pandemic, polio survivors showed up in clinics with vague and disabling complaints of pain, fatigue, "brain fog," and functional loss many years after the original infection. Many of these survivors felt shunned by the medical establishment likely due to the diffuse complaints, limited understanding of the underlying mechanisms, and the absence of effective treatments. These polio survivors benefit from a rehabilitative approach which validates their condition and promotes pacing, adaptations, non-fatiguing exercises, realistic goal setting, and the value of support groups. Validation from clinical providers along with patient and family education and support helps many of those with PPS and these themes sound relevant to Long Haulers.

Many have noted the similarities of Long COVID to Myalgic Encephdalomyelitis/Chronic Fatigue Syndrome or ME/CFS [33]. Dr. Anthony Fauci, Director of the National Institute of Allergy and Infectious Diseases said, "it's extraordinary how many people have a postviral syndrome that's strikingly similar to ME/CFS. They just don't get back to normal energy or normal feeling of good health" ([34]; p 33). Similar post-viral syndromes have been associated with the viral pandemics of the 1889–1892 ("Russian Flu") and of the 1918–1919 ("Spanish Flu") with complaints of pain, numbness, and fatigue.

Physiatrists and other rehabilitation professionals such as therapists and psychologists have experience in symptom management and functional loss in conditions where fatigue, pain, and functional loss dominate and the underlying mechanisms are poorly understood and with few if any specific treatments such as polio, brain injury, and most of the muscular dystrophies. In many of these cases, linking the known pathology with current symptoms is based primarily on reasonable conjecture as the scientific base remains uncertain. Rehabilitation and mental health professionals have a higher ambiguity tolerance than many health professionals. A good faith effort is made to diagnose, then we move forward with patient-centered goals and practical interventions which may include counseling and patient education, pacing and non-fatiguing exercises, equipment and assistive aides, and judicious use of medications targeting symptoms such pain, affect, and fatigue. This rehabilitation approach commonly utilizes an interdisciplinary approach such as coordination with OT and PT to address issues of decline in ADLs and mobility, and encourages the patient to participate in disease or condition support groups.

An interdisciplinary team response to post-COVID symptoms does present specific challenges. In contrast to post-polio where loss of muscle strength is a dominant feature, post-COVID symptoms are commonly associated with pulmonary, cardiac, and other organ symptoms. The commonality with post-polio is the fatigue, diffuse myalgias, and a sense of not being taken seriously. It is in these broader and less specific symptoms that a rehabilitation team approach seems particularly relevant.

A paradox arises when examining individuals with Long COVID. Older people [22] report longer duration of symptoms than younger age groups. While 47% of those over 50 years of age report protracted symptoms, the percentage reduces with younger groups such that 32% of 35–49 years and 26% of the 18–34 years of age have such complaints. Overall, it has been estimated that 10% of those who have the COVID-19 infection develop symptoms which last for months and months [33, 34]. Differences in immune systems responses may explain the demographics of those who seek services at a Long COVID Clinic [34]. Women and younger adults tend to have more robust immune systems than the elderly and a higher incidence of autoimmune conditions.

Long COVID may present differently in elderly individuals and could be missed in the context of multiple chronic conditions associated with aging. The geriatric patient may have atypical or muted presentations compared with younger adults as is the case with many diagnoses and conditions such as sepsis, heart disease, and depressions. It is reasonable to assume that Long COVID may be more challenging to discern in the older versus younger patient. Concerned physicians and other health-care providers who interact with the geriatric patients should be aware of this potential and act accordingly.

Three themes emerge when considering Long COVID in an older adult. Organ-specific issues need to be dealt with primarily at the organ level, that is, pulmonary, cardiac, neurological, clotting dysfunctions, and so on. One must look more closely to recognize such symptoms as fatigue, "brain fog," new loss of smell and taste, and then design interventions to help. The importance of goal setting and integrating the principles of geriatric medicine and frailty syndromes applies.

In their "Living with COVID," the UK-based National Institute of Health Research compiled a framework to understand individuals with Long COVID [35]. Key points include the recognition of the protean manifestations of the condition, the lack of consensus on diagnostic criteria, the disproportionate effect on certain groups including those in nursing homes and those in Black and other minority communities, socially disadvantaged groups, and the social and psychological impact associated Long COVID. Given the multiple dimensions Long COVID, broad-based coordinated efforts are needed to better understand Long COVID and to help the Long Haulers.

Mendelson et al. [31] recently published an informative clinical update on Long COVID. Rehabilitation interventions reviewed here and elsewhere offer useful suggestions to manage Long COVID. They recommend a holistic team approach which includes input form rehabilitation medicine, occupational therapy, physical therapy, and behavioral health with medical specialist input as needed for areas such as pulmonology, cardiology, and neurology.

Similar to fatigue in PPS, careful pacing of activities and goal setting are recommended. Unique to COVID is olfactory dysfunction and the likelihood of the need to address pulmonary issues. The loss of the sense of smell and taste is quite bothersome to patients and could conceivably impact nutritional status. When this symptom persists, olfactory training with repeat and deliberate sniffing a set of odorants may be beneficial [36]. Common substances are lemon, rose, cloves, and eucalyptus.

15.9 Heading to the Future

Substantive progress has been made in addressing the needs of our aging population through education, training, service delivery, and critical inquiry over the last 30 years. Support from private foundations (i.e., John A Hartford Foundation and Atlantic Philanthropies), professional organizations (i.e., AGS and AAPMR), and Federal agencies (i.e., NIA/NIH, AHRQ, and CMS) to name a few will continue to play pivotal roles. The Geriatrics for the Specialist Initiative (GSI) of the AGS typifies the impact of a targeted program to support the principles of geriatric medicine across medical and surgical specialties. Information on this 20-year effort of the GSI is available on the website of the American Geriatric Society. Insights gained through the pioneering work of Marjorie Warren in Geriatric Medicine and Howard Rusk in PM&R still resonate in the twenty-first century—an emphasis on function through comprehensive evaluations, interdisciplinary team treatments, and practical interventions directed at patient-centered goals. Ongoing broad-based efforts across medical specialties and health-care professionals will continue to address intertwined health and rehabilitative needs of our aging population.

Opportunities and challenges characterize the future of Geriatric Rehabilitation. Current research across a range of areas such as sarcopenia, neuroplasticity, bone metabolism, gait and balance, health services research, and implementation science portend further progress. While the need for truly cost-effective services is unassailable, clinicians remain understandably leery of changes driven primarily by administrative and regulatory without key input from providers and the direct stakeholders. For years, rehabilitation researchers and policy analyst describe the "black box" of rehabilitation. Rehabilitation works, but we have limited understanding of how the goals are achieved. More recent work on the active ingredients of rehabilitation services, rehabilitation team functioning, and the role of medical leadership in rehabilitation team effectiveness are promising avenues [2].

Gazing into a crystal ball, this author offers an optimistic perspective and envisions an evolution of rehabilitation akin to geriatrics and the relationship Geriatric Medicine to primary care and other medical specialties. The need for rehabilitation services for this population exceeds the capacity of one or even a few medical specialties. From a foundation in the diagnosis and management of geriatric syndromes and frailty, rehabilitation providers develop and implement individualized interventions to optimized function. Further cross-fertilization among PM&R, Geriatric Medicine, and other medical and surgical specialties brings important knowledge and skills to achieve the goals. Recent trends with the increased presence of PM&R physicians in subacute settings are encouraging.

A basic behavioral science of rehabilitation effectiveness reveals inside the "black box" of rehabilitation. Knowledge on the active ingredients of services, rehabilitation team effectiveness, and the optimal role of physician engagement leads to the development of valid and reliable measures suitable of evaluation and monitoring service delivery. As the values and perspectives of patients, families, and caregivers are incorporated into geriatric rehabilitation services and measured through standardized techniques, the spectra of unintended consequences of changes in service delivery lessens. PM&R physicians and other rehabilitation professionals are now seen as experts in team medicine, exercise medicine, and the optimization of function, and they work collaboratively across a range of medical, surgical, and health-care professionals to achieve the common goals. While this rosy future is not preordained, it does offer goals and a framework to progress. With the passion and commitment of our forbearers such as Marjorie Warren and Howard Rusk, real progress will continue.

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16 Urology

Tomas L. Griebling

Geriatric care forms a large portion of most general urologic practice. Indeed, many of the most common urologic conditions occur with increasing incidence and prevalence among older adults. However, these should not necessarily be considered an inevitable or normal part of aging. Examples include urinary tract infections, urinary incontinence, pelvic organ prolapse, sexual dysfunction in both men and women, benign prostatic hyperplasia, and various genitourinary malignancies. In addition, urologic conditions frequently influence development of other geriatric syndromes including falls, pressure ulcers, and polypharmacy. Many urologic conditions can be treated both medically and surgically, and decisions for care must be made within the framework of overall health including consideration of comorbidities, frailty, potential for clinical improvement, and goals of care. Some urologic conditions require acute care and can be resolved completely with active treatment. However, many of the more common urologic conditions affecting older adults are chronic in nature and may require ongoing therapy. Decisions about the need for treatment are often based on development of symptoms that influence functional status or quality of life. Continued population growth among older adults will lead to future increases in urologic health needs in the geriatric age group. This will likely translate into an increased rate of the need for surgical care among older adults [1].

Translational research has identified several anatomic and physiological changes in the genitourinary system that predispose to development of urologic disorders. For example, the ratio of smooth muscle to collagen and supportive tissue in the bladder decreases with advancing age. These structural changes can lead to alterations in contraction strength and bladder compliance [2]. These changes can be associated with increased urinary frequency and urgency, nocturia, and a decreased ability to efficiently empty the bladder. Involuntary detrusor contractions can cause urinary urgency and frequency, and decreased voluntary bladder contraction strength and velocity may lead to impaired emptying ability. Functional innervation to the bladder may decrease over time in response to chronic outlet obstruction and detrusor overactivity [3]. This may eventually lead to loss of compliance and muscle elasticity which can manifest as decreased urinary storage and impaired bladder emptying. With advancing age, bladder capacity tends to remain relatively stable or may decrease slightly [4]. Also, alterations in neurotransmitters or epithelium may cause sensory changes with bladder filling, so the appreciation of bladder fullness is altered. Oxidative stress may damage tissues in the urothelium and detrusor and lead to symptomatic bladder dysfunction [5].

With aging, there are also progressive anatomic changes that tend to decrease pelvic floor muscle strength and soft tissue support which can lead to increased rates of pelvic organ prolapse in elderly women. Cadaveric studies using tissue biopsies have shown a generalized decrease in striated muscle relative to connective tissue in the pelvic floor [6]. Other risk factors include increased parity and prior vaginal delivery. Bony support of the pelvis may influence these changes and could be altered by some skeletal disorders including osteopenia or osteoporosis [7, 8]. Apoptotic cellular changes may lead to changes in soft tissue support in the pelvic floor structures [9]. Similarly, apoptosis of the rhabdosphincter can lead to an increased risk for development of stress urinary incontinence [10]. This can be associated with loss of normal circumferential anatomy and decreased urethral resistance and closure pressures which in turn lead to worsening incontinence [11]. Although pelvic muscle exercise may be clinically useful for a variety of conditions, many older women may not be able to generate adequate voluntary muscle contraction on initial physical examination [12]. Working with a physical therapist or other clinician on targeted muscle training can be helpful.

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16.1 Urinary Incontinence

Urinary incontinence (UI) is defined as the involuntary loss of urine [13]. UI can be classified as both a specific clinical diagnosis and also a geriatric syndrome. Both incidence and prevalence of UI increase with advancing age, but UI should not be considered a normal or inevitable part of aging. UI can be transient or established, and various types have been recognized. It is important to diagnose the specific type of UI a patient experiences because this will guide therapeutic options.

16.1.1 Transient Urinary Incontinence

The term "transient urinary incontinence" refers to UI that is generally caused by factors other than the bladder itself and is typically reversible if the underlying etiology is addressed. In most cases, transient UI occurs relatively suddenly in someone who has previously been continent of urine or as sudden worsening of mild UI. It is estimated about 30% of new cases of UI in community-dwelling older adults may be caused by a transient condition [14]. A wide variety of different clinical conditions have been linked to development of transient UI. Urinary tract infections are associated with urinary urgency, frequency, and urgency incontinence and may require antibiotic therapy. Atrophic vaginitis and urethritis may occur in elderly women and can often be effectively treated with vaginal estrogen preparations [15]. Severe constipation can slow transit time and lead to increased water reuptake with subsequent development of polyuria, while low fecal impaction may cause bladder outlet obstruction.

Many medications can cause transient incontinence. The most common include diuretics, antipsychotics, benzodiazepines, calcium channel blockers, and medications with strong anticholinergic properties. Polypharmacy itself can also be associated with increased risk of UI [16]. Alcohol and other substance abuse may contribute to UI in some older adults. Polydipsia, peripheral edema, and congestive heart failure may produce polyuria or nocturia leading to transient UI. Psychological and behavioral disorders, delirium, and mobility impairment may also be linked to increased risk of UI. Normal pressure hydrocephalus (NPH) is associated with a classic triad of symptoms including UI, gait ataxia, and cognitive dysfunction. Sleep apnea can cause alterations in antidiuretic hormone secretion leading to nocturia and nocturnal polyuria.

16.1.2 Established Urinary Incontinence

Established or chronic UI is quite commonly seen in geriatric patients. Population studies show that up to 44% of all people over 65 year of age report some history of urinary leakage and about 12% of community-dwelling older women reported severe or very severe UI [17]. Rates in those living in nursing homes and those receiving home care services were much higher at about 37% and 40%, respectively. Several different types of established or chronic UI are recognized.

Urgency UI is the most common form of established incontinence in the geriatric population. Symptoms include urinary urgency and frequency, and some people are unable to reach toilet facilities before they experience loss of urine. This is often caused by detrusor overactivity with associated sensory and motor changes in the bladder. The etiology is complex and often multifactorial. The term "overactive bladder" has been used clinically to describe this condition. Many neurological disorders including stroke, Parkinson disease, multiple sclerosis, and spinal injury are associated with detrusor overactivity and urgency UI. Increased white matter hyperintensities on brain MRI have been identified as a correlate of increased detrusor overactivity and associated urgency UI in older adults [18]. Some patients with urgency UI may also experience fecal incontinence due to an overlap in neural control mechanisms. Detrusor hyperactivity with impaired contractility (DHIC) is a unique form of bladder dysfunction that is seen more commonly in geriatric patients. In this condition, patients experience urinary urgency due to the detrusor overactivity; however, they do not completely empty the bladder when they urinate due to impaired bladder contractility during the voiding effort. Effective treatment must address both components of storage and voiding dysfunction.

Stress UI is also very common in older adults including both men and women. In men, it is often associated with prior treatment for prostate disease including radical prostatectomy for prostate cancer or transurethral resection for benign prostatic hyperplasia (BPH). In women, stress UI is most commonly caused by either urethral hypermobility or intrinsic sphincter deficiency. In all cases, the pressure in the bladder exceeds the urethral outlet resistance and leakage occurs with activities that increase intraabdominal pressure such as coughing, laughing, lifting, or sneezing.

Overflow incontinence is associated with incomplete emptying of the bladder due to either outlet obstruction or detrusor underactivity with poor contractility. There has recently been an increased interest in the concept of "underactive bladder" including analysis of potential causes and treatments [19, 20]. Various neurogenic and myogenic factors associated with the development of underactive bladder include poorly controlled diabetes, bladder ischemia from vascular disease, and chronic bladder obstruction from prostate enlargement in men or severe pelvic organ prolapse in women.

"Functional incontinence" is a term used to describe UI that is caused by factors other than the bladder itself. The most common associated causes include impairments in cognition or mobility. If the underlying problem can be corrected or improved, the functional UI may also resolve or improve. Mixed incontinence refers to a condition in which a patient experiences more than one type of UI. The most common combination is urgency and stress UI, although other combinations are also possible. This can make successful treatment of UI more challenging in affected patients.

Clinical evaluation requires careful history and physical examination to guide therapy. Evaluation should include assessment of the level of independence for performing activities of daily living as well as baseline cognitive status and mobility. Alterations in functional status, including increased dependence on others for ADLs, have been linked to increased prevalence of UI [21]. Impaired mobility with reduced walking speed and poor balance contributes to increased risk of ADL decline and UI [22].

A pelvic examination in women and genitourinary examination in men should be part of this routine evaluation. Assessment of prior therapies tried and level of success is important. In addition, evaluation of caregiver support and environmental factors including the living environment are useful. In addition, several other tests can be included in the assessment which may be useful, particularly in elderly patients. Urinalysis is used to evaluate for hematuria, UTI, proteinuria, or glucosuria that could indicate renal disease or diabetes. Voiding diaries help to identify voiding patterns and factors that may trigger UI. They can be particularly helpful in cases of nocturia to differentiate between nocturnal polyuria and other causative factors [23].

Assessment of post-void residual volume either by bladder ultrasound or simple catheterization is helpful to check for incomplete bladder emptying associated with overflow incontinence, bladder outlet obstruction, or underactive bladder [24].

Urodynamic testing is useful in evaluation of UI for select geriatric patients. The main indications include underlying neurological or other comorbid conditions, failed prior therapy for UI, or planned genitourinary surgery [25]. The test is designed to reproduce symptoms if possible in order to help differentiate clinical issues and guide therapy. For example, it is helpful to distinguish between patients who do not empty the bladder due to outlet obstruction versus those with an underactive and poorly contractile bladder.

16.1.3 Negative Impacts of Urinary Incontinence

UI is associated with negative outcomes on overall and health-related quality of life for many older adults. People with chronic UI often experience increased rates of depression, social isolation, and stigmatization and embarrassment [26, 27]. It tends to limit the ability to participate in social activities and interact with others outside of the home. Health problems include increased skin irritation or infection, pressure ulcers, UTI, and falls.

Urinary incontinence is common in residents of nursing homes and other long-term care settings. Reported prevalence ranges from about 46% in short-term nursing home resident to over 75% among long-term residents [17]. UI in nursing home residents has been linked to decreased sense of dignity, autonomy, and blunted mood [28]. Organizational and staffing factors are important variables that contribute to rates of UI in nursing homes [29]. Targeted treatment and organizational process change can reduce rates of UI in these settings [30]. Prompted and assisted toileting programs, sometimes combined with assessment of bladder volumes using diaries or ultrasound, can be quite useful to help individual resident improve their continence status [31].

16.1.4 Treatments for Urinary Incontinence

Treatments for UI should be tailored to individual patient goals and needs. Different types of UI require different treatments, and therapy should be based on overall goals of care, functional status, and comorbidities. The role and needs of caregivers must also be considered. Treatment often requires multiple components or approaches. The options include behavioral therapies, devices, medications, and surgeries (Table 16.1).

16.1.4.1 Behavioral Therapies

Behavioral therapies form the mainstay of treatment for UI in most patients. Avoiding dietary components that increase bladder irritation and urinary urgency and frequency can be useful. This includes caffeine, alcohol, highly acidic foods, and carbonated beverages [32]. Fluid restriction is generally not helpful, and can worsen urinary urgency and frequency in some patients due to increased urinary concentration; however, limiting fluids after dinner can reduce nocturia.

Table 16.1 Treatments for urinary incontinence

Behavioral therapies	
Timed voiding	
Prompted toileting	
Assisted toileting	
Diet modification (avoid caffeine, alcohol, carbonation, etc.)	
Pelvic floor muscle exercises	
Urge suppression strategies	
Device therapies	
Condom catheters (penile sheaths)	
Pessaries (intravaginal support devices)	
Indwelling catheters (urethral or suprapubic)	
Absorbent pads and other products	
Pharmacotherapies	
Antimuscarinic agents	
Darifenacin (time released)	7.5 mg or 15 mg orally once daily
Fesoterodine (time released)	4 mg or 8 mg orally once daily
Oxybutynin	5 mg two or three times orally daily (maximum daily dose 30 mg)
Oxybutynin (time released)	5 mg, 10 mg, or 15 mg orally once daily
Oxybutynin (transdermal patch)	One patch (3.9 mg daily) topically, changed every 3 days
Oxybutynin (transdermal gel)	One packet topically once daily
Tolterodine	1 mg or 2 mg orally twice daily
Tolterodine (time released)	4 mg orally once daily
*Main side effects of antimuscarinic agents: dry mouth, dry eyes, constipation, confusion, headache, blurred vision, tachycardia, QT interval prolongation on electrocardiogram, bradycardia, and urinary retention	
β-3 agonist agents	
Mirabegron (time released)	25 mg or 50 mg orally once daily
*Main side effects of β-3 agonist agents: hypertension, headache, nausea, dizziness, and tachycardia	
Surgical therapies	
Stress urinary incontinence	
Sling cystourethropexy (bladder neck)	
Mid-urethral sling	
Bladder neck suspensions	
Bulking agent injection (bladder neck)	
Urgency urinary incontinence	
Chemodenervation (botulinum toxin injection)	
Neuromodulation	
Augmentation cystoplasty	
Urinary diversion	

Timed or scheduled urination can be useful, particularly among those with urinary urgency and urgency UI. Timed voiding is often combined with learning to delay voiding by controlling urge symptoms; this behavioral technique is called “urge control” [33].

Pelvic floor muscle exercises are useful for many patients with stress UI and urgency UI. Patients generally need targeted instruction and may benefit from working with a physical therapist or nurse for individualized coaching. Such behavioral treatments typically require 3–4 visits to gain confidence in proper techniques and then a periodic review for reinforcement. Older adults using this type of behavioral therapy must be motivated to continue pelvic floor exercise and understand how to use them at appropriate times. Pelvic floor muscle exercise has been shown to work well in both men and women and can improve UI more than simple bladder training and timed voiding alone [34, 35].

16.1.4.2 Pharmacotherapies

Medications are widely used for treatment of UI in both younger and older patients but should be initiated only after a trial of behavioral therapy. Most medications are targeted at overactive bladder and are used to treat urinary urgency, frequency, and urgency UI. Antimuscarinic, anticholinergic agents which block muscarinic receptors in the bladder reduce involuntary detrusor contractions. Side effects of this class of medications include dry mouth, dry eyes, constipation, headache, confusion, and possible urinary retention [36]. Recent epidemiological studies have suggested a potential risk of use of these agents and future development of dementia [37]. Newer agents include beta-3 agonists that also work to reduce bladder overactivity but avoid the typical anticholinergic effects. Potential adverse effects for this class of agents includes hypertension, headache, nausea, dizziness, and tachycardia (including possible atrial fibrillation). The route of administration may be an important consideration, particularly in geriatric patients. Transdermal preparations applied as either a skin patch or gel may be useful in those with swallowing problems. Time-released medications may improve adherence and efficacy. However, it is important to remember that time-released medications much be swallowed whole and cannot be cut, split, or crushed. Liquid preparations may be useful in patients with swallowing difficulties or in those who require use of a feeding tube.

Using the lowest effective drug dose is recommended, and patients should be monitored carefully and continuously for possible drug interactions or other adverse effects. Discontinuation of medication due to side effects or limited perceived efficacy is common, and several different medications may need to be tried to find one that works best for an individual patient [38, 39]. Cost is also a factor when considering medication therapy for elderly patients [40]. Insurance coverage is variable and may differ substantially between medications for a given payment plan.

16.1.4.3 Surgical Therapies

Surgical therapy can be useful for treatment of UI in older adults, particularly if more conservative therapies such as behavioral options or medications have not been successful. In carefully selected patients, surgery can improve outcomes for UI. Decisions for surgery should not be based on patient age alone. Instead, overall health, comorbidity, and goals of care should be the guiding variables [41]. Development of minimally invasive surgical options have made these potentially feasible treatments for many older adults with UI and other lower urinary tract conditions [42].

Injection of bulking agents at the bladder neck to increase urethral outlet resistance is minimally invasive and may be effective in elderly women with stress urinary incontinence [43]. A variety of materials have been used for this purpose. Results are generally good, and the procedure offers the advantage of being easily repeatable if needed. This type of therapy may be particularly useful in elderly women with stress UI who may not be good surgical candidates for more involved procedures. This can often be performed with minimal sedation and local anesthesia rather than a general anesthetic.

Sling procedures place some type of supportive graft either under the mid-urethra or the bladder neck. Various graft materials are available including autologous fascia, other biological grafts either from cadaver tissue donors or animal xenografts, or synthetic mesh. Outcomes in carefully selected elderly women are generally good with complication rates similar to those in younger patients [44]. However, other reports suggest older women may have less overall clinical success with slings and are at higher risk of complications [45, 46]. Sling procedures for treatment of male stress UI have also been developed, although outcome data specific to elderly men are limited. In men with stress UI, implantation of an artificial urinary sphincter is also an option. Good cognitive status and hand dexterity are required to correctly operate the device after implantation. In select patients, this therapy can be quite effective [47].

For patients with urinary urgency, frequency, or urgency UI, neuromodulation and chemodenervation are minimally invasive surgical therapies that can treat symptoms. Neuromodulation uses electrical stimulation of the nerves that control bladder contractility. Sacral neuromodulation is performed by implanting an electrode in the third sacral foramen (S3). This is connected to a programmable generator that provides impulses to the nerve. Success rates up to 83.3% have been reported in selected elderly patients who underwent stimulator placement [48]. Although uncommon, device infection or erosion may require surgical explantation. Overall complication rates are similar in older and younger patients, and age alone should not influence decisions for treatment with this therapy [49, 50]. Percutaneous tibial nerve stimulation is a nonsurgical option for neuromodulation therapy. A tiny needle similar to those used in acupuncture is placed near the ankle and electrical stimulation is applied to the posterior tibial nerve. Sessions are conducted every 1–2 weeks for 10–12 sessions. In patients with good response, maintenance therapy is then performed monthly. Chemodenervation of the bladder detrusor muscle is also used for treatment of urgency UI and symptomatic urinary urgency and frequency. Onabotulinum toxin A is the most commonly used agent. Studies have demonstrated clinical efficacy and safety in both younger and older adults [51]. The main potential risk is urinary retention which could require clean intermittent catheterization at least temporarily in order to drain the bladder.

In highly select patients, urinary diversion may be considered for treatment of intractable UI. This could include reconstructive procedures with either creation of a urinary stoma such as an ileal conduit, or a continent catheterizable pouch. In some patients, management of a stomal device may be preferable to UI. However, these are major surgical procedures, and care must be taken to weigh risks and benefits for a given patient and their caregivers before selecting this type of therapy [52, 53].

16.2 Urinary Catheters

Urinary catheters are sometimes used for management of urological and non-urological conditions. For example, patients with perineal skin breakdown or sacral pressure ulcers may require temporary indwelling catheter drainage to keep the affected area dry and allow for tissue healing. Temporary urinary catheter drainage is also used after reconstructive surgery with flap placement in order to keep the surgical site dry during healing.

However, in older adults, chronic indwelling catheters should be avoided if possible [54]. Indwelling catheters are associated with substantial potential complications including urinary tract infections, bacterial colonization, urosepsis, and stone formation [55]. Catheters should be removed when feasible, and patients should be monitored for signs or symptoms of infection. Tissue irritation from chronic catheterization can lead to squamous metaplasia of the bladder epithelium and development of squamous cell carcinoma. If chronic catheter use is needed, suprapubic tube drainage is generally preferred over urethral catheterization. This reduces the risk for urethral and bladder neck erosion. In addition, it is often more comfortable for patients. It may be easier for caregivers to change compared to urethral catheterization, particularly in men, and also get the catheter away from the genital tract which is beneficial for older adults who remain sexually active.

Persistent urinary leakage around an indwelling catheter is typically due to either catheter blockage or bladder spasms. Catheter irrigation with sterile saline can help relieve obstruction from urinary sediment. Clinicians should avoid placing larger caliber catheters, which will only serve to dilate the tract and will not solve the underlying problem of detrusor overactivity. If used in the urethra, larger catheters increase the risk of tissue erosion which can lead to severe urinary incontinence and can require advanced surgical reconstruction or even bladder removal. Use of antimuscarinic medications to reduce bladder contractions can be quite useful in patients who experience urinary incontinence associated with indwelling catheters.

A variety of devices are available to manage urinary leakage including absorbent pads and condom catheters. These are useful for select patients. For example, they can be used when someone wants to participate in social activities or exercise that they might otherwise avoid due to UI. Numerous designs are available, and recent improvements have helped enhance odor control, fluid absorbency, and other associated factors [56–58]. Condom catheters are useful for men with UI. These disposable devices are designed to surround the penis and are connected to a urinary collection device. They can be particularly helpful for management of bothersome nocturia or if UI prevents men from participating in activities outside their home. Proper sizing and skin hygiene are important to prevent skin irritation or erosion.

16.3 Urinary Tract Infections and Asymptomatic Bacteriuria

Urinary tract infection (UTI) is one of the most common urologic conditions that occur in older adults. UTI tends to be more common in older women than men. It can sometimes be challenging to differentiate symptomatic UTIs, which require antibiotic treatment and asymptomatic bacteriuria that does not. Urine cultures are strongly recommended to confirm infection, help identify the associated bacterial organisms, and guide therapy. Antibiotic susceptibility patterns are in constant flux, and it is crucial to identify drug resistance and select appropriate treatment. Although empiric antibiotic therapy may be started based on clinical symptoms and dipstick urine results, antibiotics may need to be changed depending on results of antibiotic susceptibility tests. Catheterized urine samples may be needed if older adult patients have difficulty producing an adequate clean-catch specimen [59]. This can reduce contamination of the sample with periurethral or vaginal flora.

The most common symptoms of UTI include urinary urgency and frequency, dysuria, bladder pain, and fever. Cloudy and foul-smelling urine are common but can be caused by multiple other factors and are not themselves good indicators of infection. Many older adults may not exhibit these typical symptoms [60]. Instead, they may have "atypical symptoms" including confusion, lethargy, anorexia, agitation, UI, and behavioral changes [61]. Delirium may occur in some patients with UTIs [62]. Pyelonephritis or other complex UTIs are often associated with comorbidity such as stone disease, diabetes, or anemia. Urosepsis in elderly patients may be serious and is associated with increased risk of mortality due to decreased physiological reserve. Factors that increase the risk of mortality in older adults with urosepsis include advanced age (≥85 years), hypothermia, severe cognitive impairment, and chronic renal disease [63]. Hospital-acquired UTIs are also associated with an increased risk of mortality compare to community-acquired infections [64]. Management with fluid resuscitation and appropriate antibiotic therapy is crucial. Fungal UTIs are less common and tend to occur with advanced age in patients with reduced immune status including those with a prior history of organ transplant on immunosuppressive therapy, those with HIV disease or AIDS, and in those with poorly controlled diabetes. Treatment may require antifungal agents such as fluconazole [65].

In contrast, asymptomatic bacteriuria with or without pyuria is a very common condition in older adults and should not be treated with antibiotics unless there are special considerations such as planned genitourinary surgery. In community-dwelling older adults, asymptomatic bacteriuria occurs in about 10% of men and 10–20% of elderly women [66]. Extensive data support that asymptomatic bacteriuria does not require antibiotic therapy [67, 68].

A number of clinical factors increase risk of UTIs among older adults. Catheter-associated UTIs are highly prevalent in acute care hospitals and other inpatient settings [55]. Clean intermittent catheterization can reduce infection rates in patients with retention, and risk is lower compared to chronic indwelling catheter use. Obesity and significant underweight body mass index have both been linked to higher rates of UTI in older patients [69].

Several different therapies have been used to prevent UTIs in older adults. Administration of vaginal estrogens can reduce symptomatic UTI rates in elderly women by causing reacidification of the vaginal fluid milieu [15]. This permits growth of *Lactobacillus* sp., the normal vaginal flora. These bacteria act as an important host defense mechanism and kill pathogenic bacteria associated with UTIs. Contraindications to vaginal estrogen use includes a personal history of breast or uterine cancer. Ingestion of cranberry juice or cranberry supplements is popular for UTI prevention. Proanthocyandidins in cranberry interact with fructose in bacterial cell walls and prevent adherence of bacteria to the urothelium. However, data on clinical efficacy have been mixed [70, 71]. In general, chronic antibiotic use for prophylaxis should be avoided unless no other options are available. Although it can be useful in select patients, it is also associated with an increased risk of drug-resistant bacterial infections which can make treatment more challenging.

Evaluation and treatment of UTIs in nursing homes and other chronic care settings requires special consideration. Differentiation between symptomatic UTIs and asymptomatic bacteriuria can be particularly challenging in this setting, and overuse of antibiotic is common [72, 73]. Drug selection should be guided if possible by local antibiogram data based on local prevalence of specific organisms and resistance patterns. Environmental contamination in nursing home and other chronic care settings may be associated with certain types of infection including methicillin-resistant *Staphylococcus aureus (MRSA)* [74]. Strict handwashing and other infection prevention protocols can help reduce this risk.

The overall costs associated with the evaluation and treatment of UTIs is staggering, and in the United States, it surpasses the cost of almost all other major genitourinary disorders [75, 76]. The high incidence of UTI certainly contributes, but overtreatment of asymptomatic bacteriuria and care provided in emergency rooms and urgent care centers are also important factors.

16.4 Hematuria

Hematuria is defined as the presence of blood in the urine. This is almost always abnormal, and clinical evaluation is generally indicated to identify potentially serious underlying causes [77]. Common etiologies include urolithiasis, malignancies such as kidney cancer or urothelial tumors in the bladder, ureter or kidney, or trauma. Men with severe benign prostatic hyperplasia (BPH) may have bleeding from engorged prostatic capillaries. The use of anticoagulation is common in geriatric patients for treatment of cardiac arrhythmias for stroke prevention. Both normal and supratherapeutic levels of anticoagulation can cause hematuria associated with other genitourinary pathology. All patients with hematuria, including those who develop hematuria after the initiation of anticoagulation, should undergo appropriate clinical evaluation. This includes both cystoscopy and some type of contrast-based imaging such as CT urogram or retrograde pyelography [78].

16.5 Sexual Health

Sexuality and sexual health remain an important part of life for many older adults who wish to remain sexually active if possible [79]. Survey data demonstrate that up to 20–30% of all older adult men and women remain sexually active well into their 80s [80]. Urologic clinicians can help to evaluate and treat sexual health issues in this population. Many common comorbid conditions including diabetes, hypertension, heart disease, and peripheral vascular disease can negatively impact sexual health in geriatric patients. Urinary incontinence and treatments for prostate cancer or other malignancies can substantially reduce sexual health in this population [81, 82]. Those with better overall health and less comorbidity tend to remain more sexually active with advancing age [83, 84]. Sexual health changes may also be signs or symptoms of underlying comorbid disease. For example, new onset erectile dysfunction can be an early warning sign of heart disease. Frailty has been shown to negatively affect sexual health status and is associated with multiple changes in both physical and psychosocial domains [85]. Other gynecological disorders including atrophic vaginitis, vaginal dryness, and pelvic organ prolapse can diminish sexual function in elderly women [86]. Impaired sexual health is also associated with higher rates of depression and other mental health issues in older adults [87, 88].

Partner availability may limit sexual activity, and masturbation may become a primary form of sexual expression for some older people. Other forms of sexual activity may change with aging including a reduction in the emphasis on penetrative sexual activity and increased attention to intimacy with close physical and emotional contact [89]. The living environment plays an important role, particularly for those living with extended family caregivers or in nursing homes or assisted living facilities. Increased awareness of sexual health needs has led many nursing homes to work to better accommodate these residents [90]. Inappropriate sexual behavior can be problematic for older adults with cognitive impairment or dementia and may be particularly challenging for caregivers [91]. Screening and treatment for sexually transmitted diseases may be indicated if signs or symptoms of infection are present [92, 93].

Recently there has been an increased awareness of the unique sexual healthcare concerns and needs of lesbian, gay, bisexual, transgender (LGBT) older adults. This can impact multiple aspects of both general and health related quality of life [94]. For example, cancer care may lead to changes in sexual function and health, and LGBT patients may have unique clinical needs in this regard [95]. Additional research and clinical work related to sexual minority health will help to expand understanding and improve outcomes for these patients and their loved ones.

A wide variety of therapies are available for sexual health problems in older adults. These range from sexual therapy and counseling to medications or surgeries. Treatments should be targeted to each patient's specific goals and outcomes and should be selected within the scope of overall health and comorbidity.

16.6 Urolithiasis and Stone Disease

Stone disease affects about 20% of all adults at some point in their lives. Rates of stone formation are similar among older and younger adults, and those with a prior history are at risk for recurrence. Poor hydration status is one of the strongest risk factors for stone formation. Older adults often have a reduced sensation of thirst or may have difficulty swallowing which can lead to inadequate fluid intake. Compared to younger adults, older patients have a 2.5- to 3-fold increased rate of inpatient hospitalization for stone disease [96].

Stone composition can change with age, and uric acid stones are more common in older adults. This may particularly affect older patients with diabetes who may have impairments in urinary ammoniagenesis and produce abnormally high levels of uric acid with a low urinary pH [97]. Age-related alterations in vitamin D and calcium metabolism may also affect urolithiasis risk. Hyperuricosuria and hypercalciuria appear to be common in older patients with recurrent stone disease.

Small stones (<5 mm) often pass spontaneously with hydration and oral analgesics. Oral selective alpha-blockers such as tamsulosin may be helpful to enhance ureteral relaxation and stone passage. Cystoscopy with ureteral stent placement is indicated to bypass obstruction in cases of larger stones, particularly if the patient experiences intractable nausea, vomiting, or pain. Other indications for urgent ureteral stent insertion include baseline renal insufficiency, a solitary functioning kidney, or significant urinary infection or bacteriuria. Surgical therapy with ureteroscopic stone fragmentation and extraction, extracorporeal shock wave lithotripsy, or percutaneous nephrostolithotomy may be required. Overall success rates for these procedures are similar in geriatric and younger patients [98, 99].

16.7 Benign Prostate Diseases

16.7.1 Benign Prostatic Hyperplasia (BPH)

One of the most common urologic disorders in aging men is benign prostatic hyperplasia (BPH). Symptoms typically begin around 40–50 years of age [100]. Proliferation of epithelial and stromal elements occurs in response to serum testosterone. The effect of prostate enlargement is variable, and some men have no symptoms while others develop substantial voiding difficulty. Typical symptoms include decreased force of urinary stream with urgency, frequency, and nocturia. Severe cases may be associated with acute or chronic urinary retention [101]. Prostate size does not necessarily correlate with the degree of symptoms. The voiding symptoms associated with BPH can have a negative impact on overall and health-related quality of life for many men [102].

Table 16.2 Medications for treatment of benign prostatic hyperplasia (BPH)

α-Adrenergic antagonist agents	
Nonselective agents	
Doxazosin (Cardura)	1–8 mg orally once daily at bedtime (must titrate dose)
Terazosin (Hytrin)	1–10 mg orally once daily at bedtime (must titrate dose)
Selective agents	
Alfuzosin (Uroxatral)	10 mg orally once daily at bedtime
Tamsulosin (Flomax)	0.4 mg or 0.8 mg orally 30 min after the same meal once daily
*Main potential side effects of α-adrenergic antagonist agents: orthostatic hypotension and dizziness (these tend to be more pronounced with the nonselective agents)	
5-Alpha reductase inhibitor agents	
Dutasteride (Avodart)	0.5 mg orally once daily
Finasteride (Proscar)	5 mg orally once daily
*Main side effects of 5-alpha reductase inhibitor agents: decreased libido and erectile dysfunction	

There are a variety of treatments available for BPH including both medical and surgical therapies [103]. The most commonly used classes of medications include α-adrenergic antagonists and 5-α-reductase inhibitors (Table 16.2). The α-adrenergic antagonists include terazosin (Hytrin), doxazosin (Cardura), tamsulosin (Flomax), and alfuzosin (Uroxatral). These drugs block α-adrenergic receptors in the prostatic urethra and bladder neck. This causes smooth muscle relaxation which in turn reduces outlet resistance. These medications have good overall efficacy [104]. The main adverse effect is orthostatic hypotension, which is more common with the older, less selective agents (terazosin, doxazosin). Tamsulosin specifically can cause the intraoperative "floppy iris syndrome," leading to potential intraocular surgical complications particularly during cataract extraction and intraocular lens placement [105]. Preoperative temporary discontinuation of this medication is often indicated to help prevent this potential complication.

The 5-α-reductase inhibitors act by blocking the enzymatic conversion of testosterone into dihydrotestosterone (DHT). Reductions in circulating DHT lead to shrinkage of the prostate gland and improvement in urinary outflow. It can take several months for these medications to reach full effect. The two main drugs in this group are finasteride (Proscar) and dutasteride (Avodart). These medications are generally more effective in men with larger volume prostates. Potential side effects include decreased libido and development of gynecomastia or breast tenderness. The drugs also cause an approximately 50% reduction in circulating serum PSA. After initiating a 5-α-reductase inhibitor, measured serum PSA levels should be doubled to estimate the actual PSA level. Several studies suggest combination therapy with both an α-adrenergic antagonist and a 5-α-reductase inhibitor has better efficacy compared to monotherapy, particularly in men with more severe voiding symptoms or larger prostates [106]. However, increased cost and potential side effects need to be carefully considered. Although phytotherapies are popular among older patients with BPH, to date there has been relatively limited research on their efficacy [107, 108].

Surgical therapy for BPH may be required if medical treatment fails [109]. Options include both open and endoscopic procedures. Open suprapubic prostatectomy is typically reserved for patients with very large prostate gland volumes (>100 g). For the majority of men, transurethral surgeries have replaced open surgery and are associated with improved morbidity and good clinical outcomes. Transurethral resection of the prostate (TURP) remains the gold standard to which other forms of surgery are compared. Newer treatments use laser energy to vaporize, resect, or enucleate prostate tissue [110–112]. Other ablative therapies include microwave thermotherapy or hydroablation. These cause tissue necrosis and sloughing. Intraurethral prostatic stents have also been used to treat BPH, particularly in men with severe comorbidity who may be poor surgical candidates for even minimally invasive options [113, 114].

Many of the current minimally invasive options for treatment of BPH offer potential advantages for elderly patients. In some cases, these can be done in an outpatient office setting under local anesthetic or sedation which obviates some of the potential risks associated with more involved regional or general anesthesia. Most have minimal risk of bleeding which can be advantageous for men on anticoagulation therapy.

16.7.2 Prostatitis

The overall prevalence of prostatitis among adult men ranges from 2% to10% [115]. Prostate infections are either acute or chronic. The condition tends to occur more commonly in older men, and rates of hospitalization are 2–2.5 times higher in this population compared to younger men [116]. Acute bacterial prostatitis is characterized by rapid onset of symptoms with fever, chills, urinary frequency and urgency, dysuria, and pelvic or perineal pain. Findings can be subtle in older men due to a reduction in overall immune response associated with aging. Physical examination may reveal an enlarged and tender prostate. Care should be taken to avoid vigorous prostate massage as this could lead to vascular seeding of bacteria and urosepsis. Urine cultures are useful to pinpoint specific organisms and guide antibiotic selection. Inpatient care with intravenous antibiotics may be necessary if the patient is severely ill. If a prostate abscess is identified on CT imaging, surgical drainage is usually indicated. Acute urinary retention often occurs in cases of acute prostatitis and may require suprapubic tube placement for bladder drainage. Urethral catheterization should be avoided to prevent bacterial seeding and urosepsis. Extended antibiotic therapy (>4 weeks) with an agent which achieves good tissue penetration such as doxycycline or a fluoroquinolone is often required.

Chronic prostatitis is more common than acute prostatitis in elderly men and is usually associated with urinary urgency, frequency, nocturia, scrotal or perineal pain, or referred pain in the low back and suprapubic region [117]. Physical findings are variable and the prostate may or may not be abnormal on digital rectal examination. Expressed prostatic secretions and urine cultures are helpful to confirm diagnosis and guide therapy. Treatments include targeted antibiotic treatment and dietary modification to avoid urinary irritants such as alcohol, caffeine, or carbonated beverages.

16.8 Genitourinary Cancers

Cancers of the genitourinary tract increase in incidence and prevalence with advancing age. Depending on the type of cancer and the grade and stage, treatment ranges from surgical excision to chemotherapy, radiation therapy, or immunotherapy. Consideration of overall health, quality of life, and goals of care are important, and treatment choices must be made in the context of associated comorbidities. This section reviews selected relevant issues associated with genitourinary cancer diagnosis and treatment in the older adult population.

16.8.1 Kidney Cancer

Kidney cancers are frequently diagnosed incidentally in geriatric patients who have undergone abdominal imaging for other symptoms or conditions. Age over 75 is a risk factor for more advanced disease, although in older adults with very small tumors, active surveillance is a feasible option, which may obviate the need for invasive surgical therapy [118]. Assessment of underlying comorbidity may be particularly useful to guide therapeutic options for small kidney cancers in elderly patients [119].

In those who do require surgery, comorbidity is more important than chronological age in overall outcomes from either radical or partial nephrectomy. Outcomes and complications from laparoscopic and robotic partial nephrectomy appear similar to those observed in younger patients [120]. Despite this, overall rates of partial nephrectomy in geriatric patients still lag behind use in younger people [121]. The exact reasons for this are unclear but may reflect clinician bias against using these techniques in older or frail individuals. Cytoreductive surgery may be considered in some patients with more advanced disease, although complication rates including need for blood transfusion are higher among older adults [122]. Immunotherapy may be considered but can be difficult for some older adults to tolerate, particularly if they have associated functional impairments or worse overall performance status. In patients with upper tract urothelial cancers, radical nephroureterectomy may be considered, although the cancer-specific survival in this population (>80 years of age) is lower than in younger patients [123].

16.8.2 Bladder Cancer

Bladder cancer is one of the most common urologic malignancies and occurs predominantly in older adults. Prevalence and incidence both increase substantially with advancing age. The primary risk factor is cigarette smoking, although exposure to certain chemicals such as aniline dyes also increases risk. Due to the long latency of carcinogen exposure, the median age at diagnosis is >70 years [124]. Hematuria is the most common associated symptom. Diagnosis is typically made through a combination of imaging and direct visualization with cystoscopy. New technologies such as blue light cystoscopy can enhance diagnostic accuracy in some patients [125]. Tumor resection is required for tissue diagnosis and to determine the grade and stage of disease. It is important to clearly identify whether the tumor is superficial or invades the muscle of the wall of the bladder because this influences subsequent therapy. Tumor restaging with repeat resection, especially in cases of incomplete initial resection or where there is a lack of muscularis propria in the sample, can be extremely useful. Adjuvant therapy with intravesical administration of mitomycin C or bacillus-Calmette-Guerin (BCG) may be considered in patients with superficial bladder cancer. However, it has been shown that BCG therapy has a somewhat decreased efficacy in older compared to younger adults [126]. This may be due to diminished immune response with aging.

The standard therapy for muscle invasive bladder cancer has been surgical treatment with radical cystectomy and urinary diversion. This is one of the most invasive and complex surgical procedures performed in urology. Risk of morbidity and mortality is compounded by the fact that many of these patients have substantial underlying comorbidity and chronic health problems. For example, bladder cancer is frequently linked to a history of cigarette smoking, and patients may have lung disorders such as chronic obstructive pulmonary disease (COPD) or restrictive airway disease that puts them at increased anesthetic risk. Despite this fact, multiple studies have demonstrated that with appropriate preoperative planning, intraoperative and postoperative care, radical cystectomy and urinary diversion is safe even in elderly patients [127, 128]. Survival benefits have been demonstrated but must be considered within the overall context of comorbidity and other health issues. Reduced performance status, frailty, and sarcopenia predict complications in patients undergoing radical cystectomy [129, 130].

Bladder sparing surgery in some elderly patients with muscle-invasive cancer using endoscopic resection followed by adjuvant radiation and/or chemotherapy shows similar overall survival to radical surgery in some studies [131]. However, other studies show worse overall performance status and comorbidity, and those who are very elderly tend to have worse outcomes in terms of both overall and cancer-specific survival [132, 133]. Radiation therapy can be useful in bladder cancer patients with intractable bleeding who are not candidates for other surgical interventions [134].

16.8.3 Prostate Cancer

Prostate cancer is one of the most common solid tumor malignancies seen in adult men [135, 136]. This section selectively focusses on issues specific to geriatrics and elderly men. Routine prostate cancer screening is controversial, but most agree that when it is used, screening should generally be discontinued once men have reached 70–75 years of age. This is because use of definitive therapy for prostate cancer with either radical prostatectomy or radiation therapy is typically reserved for men with at least 10 or more years of estimated remaining life expectancy [137]. Mean life expectancy for men in the United States is approximately 82–84 years. In contrast to screening, targeted diagnostic assessment in selected patients at risk for development of prostate cancer may be useful to guide therapy in light of their overall health status. This may be true even if it is not done with curative intent.

Treatment decisions for elderly men with prostate cancer must be made with consideration of overall health and other comorbid conditions. Evaluation of functional status using activities of daily living (ADLs) and instrumental activities of daily living (IADLs) may be useful [138]. In addition to functional status, information on disease burden and estimated remaining life expectancy can be useful in making clinical decisions in this population. In many cases, prostate cancer is a relatively slow growing and indolent tumor, and many elderly men will die from other conditions such as cardiovascular or pulmonary disease [139]. However, some cases of prostate cancer may be more aggressive and develop into metastatic disease [140].

Treatment of organ-confined prostate cancer includes radical prostatectomy or radiation with either external beam treatment or brachytherapy. Some clinicians recommend radiation therapy in geriatric patients to avoid the risks associated with radical surgery. However, radiation therapy can be associated with complications including sexual dysfunction, radiation injury to other pelvic organs, or urinary incontinence [141]. Urinary incontinence following radical prostatectomy can have negative effects on quality of life including physical and social activities and mood in elderly men [142].

Treatment of metastatic prostate cancer often involves use of hormonal therapy or chemotherapy to reduce disease and symptom progression, although they are not used with curative intent. The chemotherapeutic agent docetaxel has increased overall survival in early clinical trials [143]. Androgen deprivation therapy is more commonly used and is beneficial in many patients although there are potential risks including cardiovascular disease and diabetes [144]. Because it blocks testosterone production, hormonal therapy is associated with gynecomastia, hot flashes, loss of libido, reduced sexual function, and sarcopenia which is part of the frailty phenotype. Because this therapy can also be associated with bone loss, men treated with hormonal therapy should be evaluated with imaging for osteopenia or osteoporosis before and during treatment [145]. Bisphosphonates including alendronate and zoledronic acid slow bone resorption during antiandrogen therapy [146, 147]. The high cost of hormonal treatment may be a barrier for some patients and must be considered when making treatment decisions.

16.8.4 Testis Cancer

Primary germ cell tumors are relatively rare in elderly men and occur most commonly between 15 and 35 years of age. Lymphoma is the most common testicular malignancy seen elderly patients [148, 149]. In most cases, this represents a manifestation of systemic disease and should be evaluated and treated in this context. If geriatric patients do present with a primary germ cell tumor, evaluation and treatment should follow accepted guidelines typically used in younger men. It may be necessary to adjust chemotherapy regimens based on age-related changes in renal hepatic or pulmonary function, or due to other underlying comorbidity. Overall life expectancy following successful treatment approaches that of other elderly men without a history of testis cancer [150].

16.9 Influence of Urologic Conditions on Geriatric Syndromes

The “geriatric syndromes” are conditions that occur more commonly among older adults, are complex and typically multifactorial, and often have a substantial negative impact on outcomes for affected patients. Prevention is a key consideration, and urologic conditions may be associated with a number of these conditions. There is often overlap between conditions such as the association between urinary incontinence, falls, and frailty. These conditions can have both direct and indirect effects on urologic health in older adults [151]. The Health and Retirement Study involved 11,000 older adults living either in the community or in nursing homes and found that 49.9% had at least one geriatric syndrome and many had more than one [152]. The presence of one or more geriatric syndromes led to an increased need for assistance with activities of daily living (ADLs), even after controlling for other demographic factors and chronic diseases. Presence of one geriatric syndrome led to an adjusted risk ratio of 2.1 (95% CI, 1.9–2.4). For two syndromes, this increased to 3.6 (95% CI, 3.1–4.1), and for three or more syndromes 5.6 (95% CI, 56–7.6).

16.9.1 Falls

Falls are one of the most common conditions seen in elderly people and are often associated with substantial injury including hip or long bone fractures and diminished mobility. Both indwelling urinary catheters and urinary incontinence are risk factors for injurious falls [153]. Overactive bladder and other lower urinary tract symptoms may also contribute to this risk [154]. Nocturia is particularly problematic and has been linked to an increased risk of falls in the older population [155]. This can be due to a number of factors including postural hypotension, gait and balance problems, poor lighting, visual and other sensory impairments, and environmental trip hazards between the bed and bathroom. Nocturia is also often associated with urinary urgency, and older adults may fall when trying to rush to the toilet. Delirium and dementia have also been associated with an increased risk of falls in those with incontinence. Targeted interventions in long-term care settings decrease the rate of falls and injuries among older adults with urinary incontinence. Urinary catheters are physical restraints and should be avoided if possible.

Androgen deprivation therapy for metastatic prostate cancer in elderly men is associated with diminished bone mineral density and increased risk of fractures and other injuries due to falls. Careful attention to bone health is important in this population. Older men with BPH and other conditions causing lower urinary tract symptoms have higher rates of falls and fractures compared to men without these urinary symptoms [156].

16.9.2 Pressure Ulcers

A pressure ulcer is an area of localized skin and tissue necrosis which most typically occurs over bony prominences. This is caused by prolonged pressure of the tissues against a hard surface, or from shearing forces with movement and transfers. Older adults are at increased risk for pressure ulcers due to several anatomic and physiological changes in the skin including decreased elastic tissue and changes in collagen and other connective tissue structures. Alterations in immune function and skin integrity also increase the risk of superficial skin infections. Urinary incontinence is a common factor that can lead to increased risk of pressure ulcer formation in elderly people. Tissue maceration due to chronic moisture from urinary leakage can exacerbate these issues, particularly for the development of perineal and sacral ulcers. Careful positioning and transfer of older adults is especially important. This includes transfers of patients on and off operating tables during surgery. Adequate padding is essential to reduce risk of developing pressure ulcers during surgical care. Early physical mobilization and activity after surgery are also important. Prolonged bed rest increases the risk for pressure ulcers and many other serious conditions including deep vein thrombosis, pneumonia, pulmonary embolus, and deconditioning [157]. Frequent turning and repositioning of patients or use of specialized equipment such as air mattresses or other pressure reduction methods can be very useful to prevent injury. Overall prevalence of pressure ulcers among hospitalized older adults has been reported to be as high as 8.9% [158]. Urinary, fecal, and dual incontinence are among the strongest risk factors for the development of pressure ulcers in the geriatric population. Careful physical examination should be part of routine care for elderly patients with urinary and/or bowel incontinence.

16.9.3 Elder Mistreatment

Screening for elder mistreatment is a responsibility of all healthcare professionals and is subject to mandatory reporting in the United States and many other countries. Professionals who report suspected abuse are protected from liability or retaliation. Urologic care providers are in a unique position because they often see older adults on an ongoing basis for care of chronic healthcare conditions. They may be particularly able to identify cases of neglect or sexual abuse because of the nature of the conditions they treat such as urinary incontinence and pelvic floor disorders. Warning signs for abuse and neglect include poor hygiene, nervous interactions with accompanying caregivers, social withdrawal, or physical signs such as lacerations, abrasions, or bruises. Physical findings out of proportion to a reported mechanism of injury are also indications of potential abuse.

Urinary incontinence and associated depression and social isolation are risk factors for psychosocial abuse toward older adults by their caregivers [159]. Neglect by caregivers and self-neglect have been associated with urinary incontinence among older adults. Greater physical disability is also associated with self-neglect among elderly people [160]. Future research will help identify if successful treatment of urinary incontinence may reduce rates of abuse and neglect for affected older adults.

Identification of sexual abuse or mistreatment among older adults is within the realm of urologic care. The National Center on Elder Abuse defines this as “nonconsensual sexual contact of any kind.” Evaluation should include detailed history and examination, including pelvic examination. Screening for sexually transmitted diseases should also be considered in appropriate situations of increased risk derived from the sexual history.

16.10 End-of-Life Care and Urology

Urologic care of geriatric patients may include aspects of palliative and end-of-life care. This includes direct care for urologic conditions associated with terminal illness such as metastatic cancers of the genitourinary system or severe urosepsis. It may also include provision of urologic care for conditions seen more commonly near the end of life including urinary incontinence or urinary tract infection [161]. Symptom management and high-quality treatment within the overall goals of care for the patient and their loved ones are the main focus of palliative care. This includes pain and symptom relief and coordination of care. Surgical therapy may be indicated in select cases where cytoreductive treatment for a large tumor burden or treatment for intractable bleeding or pain may be of benefit. Integrated care delivery with providers from multiple specialties and disciplines is particularly useful in palliative care settings [162].

16.11 Conclusion

Care of older adults forms a large portion of most general urologic practice. The incidence and prevalence of many of the most common urologic conditions increase with advancing age. Urinary incontinence is considered both a clinical diagnosis in older adults and a common geriatric syndrome. It contributes to other geriatric syndromes including pressure ulcers and falls. Most genitourinary malignancies also occur predominantly in an older adult population. Increased understanding of general principles of geriatrics and how these influence urologic care in this population will help urologists provide enhanced care to older adult patients and may lead to better overall clinical outcomes.

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Vascular Surgery

17

Jonathan R. Thompson and Jason Johanning

Man is as old as his arteries – Sir William Osler

Vascular surgery involves surgical and nonsurgical interventions related to arterial, venous, and lymphatic pathophysiology throughout all ages, but the average age of a vascular surgeon's patient is that of the Medicare population and thus dominantly an elderly population. With the expected increase in our elderly population, the diagnosis and treatment of arterial disease will become must-have-knowledge for the vascular surgeon and generalists alike. Therefore, vascular surgeons will be disproportionately impacted by the upcoming population shift and must not only know the treatment of vascular disease but must also incorporate a knowledge of the role aging plays in relation to surgical treatment and outcome. Although a working knowledge of the most common sites of disease, the initial diagnostic tests, treatment options, and outcomes are necessary to provide optimal guidance for vascular patients. The goals of care in these patients must be focused on insuring the maximum possible ambulation distance, independence in old age, and quality of life.

The vascular surgeon is tasked with establishing a diagnosis using primarily noninvasive tests, initially treating the patient noninvasively with, for example, medications focused on stabilizing and inhibiting atherosclerosis . If indicated, the surgeon may consider a therapeutic plan to include both minimally invasive and open surgical treatment. As vascular patients often have multiple comorbidities associated with advanced age, it is clear that vascular surgeons must be adept at recognizing and caring for the associated changes which occur in the aging patient and determining the best course of action: medical management and/or surgical intervention. The ultimate question becomes which of these actions will lead to the best outcome including providing optimal quality and quantity of life.

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17.1 Biology of Aging

Repetitive pulsation of the arterial system leads to fracture of the elastic lamella of the larger arteries, specifically the aorta and its proximal branches, leading to stiffening of the arterial tree and tendency toward dilation. This decreased capacitance of the arterial system is reflected by the fact that aortas in young patients will dilate by approximately 10% with pulsatile flow in comparison with the aged aorta which dilates only 2–3%. This arterial stiffening results in a rise of aortic systolic pressure and a lowering of diastolic pressure and subsequent widening of the pulse pressure. This widened pulse pressure leads to increased pulse wave velocity in the smaller vasodilated vessels creating increased stress in distal organs. Although there can be age-related structural changes in the microcirculation, they are usually attributed to diseases such as diabetes, renal dysfunction, and atherosclerotic changes. However, one must consider the relative breakdown of larger artery function and subsequent increased pulsatile flow. Pulsatile flow has been shown over time to result in damage to downstream tissues with pathologic features including thrombosis, edema, and inflammation. Thus, one should consider that treatment aimed at reducing arterial stiffness and limiting aortic pressure fluctuations will likely improve end organ function in the elderly. Treatment of the aging patient should focus on the stiffened central and remaining nonpathologic arteries. Antihypertensive medications including ACE inhibitors, ARBs, and calcium channel blockers have been shown to reduce the pulse wave and demonstrate survival benefits in major trials including REASON and CAFÉ. The mechanism behind the beneficial effect of these medications in the older patient is understandable when the reduction in muscular effects of the small- and medium-sized arteries is blunted allowing the elastin within the artery to absorb the pulse wave, thus transferring the role of dissipating the pulsatility from the large- to small- and medium-sized arteries [1].

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17.2 Vascular Surgery and Frailty

Vascular surgeons are well aware that advanced chronologic age and the ability to perform a successful vascular operation are not mutually exclusive. The literature is replete with case series from individual institutions documenting the ability to take octogenarians and nonagenarians through complex vascular operations, including carotid endarterectomies, open abdominal aortic aneurysm repairs, and femoral to pedal bypasses. However, the literature is also clear that age in and of itself is an independent predictor of mortality and adverse outcomes after vascular surgical procedures. The research challenge remaining is to identify what factors can best be utilized preoperatively to predict a successful or unsuccessful outcome in vascular surgery patients with advanced age. Frailty is a syndrome that appears to be a powerful predictor of a markedly elevated risk for postoperative mortality and morbidity. Ongoing investigations are possible since there are now reliable measures of frailty, and these tools are being increasingly used preoperatively to establish risk. Chapter 1—Frailty provides an in-depth discussion of this syndrome and strategies to assess its presence. The concept of frailty applied to vascular surgery has begun to populate the literature, and the data are compelling with frailty being one of the most prominent predictors of outcomes after vascular procedures. A recent review of frailty studies in the literature for vascular patients demonstrated that frail status was associated with increased comorbid status, prolonged length of stay, discharge to assisted living facility, loss of independence, postoperative morbidity, and all-cause mortality. Retrospective frailty assessments suggest that geriatric measures may be ideal tools to assess the vascular surgical patient preoperatively. Arya et al. assessed patients undergoing both endovascular and open elective aortic aneurysm operations in the NSQIP database utilizing the modified frailty index (mFI) [2]. They noted that frail patients were more likely to suffer severe complications after both open and endovascular aortic repair. Importantly, frail patients experiencing complications were also noted to have a higher rate of failure to rescue [2]. Utilizing the same mFI assessment tool, Karam et al. demonstrated that an elevated mFI carried an odds ratio of 2.14 for 30-day mortality in vascular surgery patients [3]. Lee et al. have assessed the psoas muscle dimensions on CT scans as an indicator of frailty. They demonstrated that muscle area correlated significantly with postoperative mortality through all time points up to 90 days after elective aortic aneurysm repair [4]. Srinivasan et al. assessed patients with ruptured abdominal aortic aneurysms and utilized geriatric tools including the Katz functional independence score, Charlson score, number of admission medicines, visual impairment, hearing impairment, hemoglobin, and statin use as predictors [5]. They found that the geriatric variables were highly predictive of outcome compared to standard comorbidities. They were able to construct a receiver operating characteristic curve to assess the ability of geriatric variables to assist in predicting outcomes. An ideal test is that with a value of 1.00 with the current study having a very good level of 0.84. They determined geriatric variables have significant predictive ability for poor outcomes compared to traditional comorbidity focused tools [5]. For carotid surgery, Melin et al. assessed the utility of a deficit accumulation index tool called the Risk Analysis Index to assess frailty of patients undergoing carotid artery operations in the American College of Surgeons National Surgical Quality Improvement Program (NSQIP) database. It was noted that patients who scored frail had a markedly increased risk of stroke, myocardial infarction, death, and length of stay after carotid endarterectomy [6]. Clearly the early literature suggests that preoperative assessment using frailty can provide significant prognostic value to patients aside from classic medical comorbidities. Chapter 8—Tools of Assessment provides information on many tools (including a frailty score) valuable in assessing seniors for geriatric focused comorbidities that could put a patient at increased risk of poor outcomes after a surgical procedure.

Frailty, functional impairment, and multiple comorbidities have been shown to be predictors of poor outcomes in several recent trials confirming the results of previous retrospective studies' conclusions that frailty and geriatric variables will play a large role in risk stratification of vascular patients. Partridge et al. used the Edmonton frail scale, MoCA, functional status including gait speed, timed up and go, and hand grip strength to assess 125 vascular surgery patients. They noted a high incidence of impaired physical functional and cognitive status. This combination of impairments was associated with a significantly increased hospital length of stay as well as adverse postoperative outcomes [7]. Ambler et al. used a deficit accumulation index model of frailty to follow 413 patients (median age 77) for a median of 18 months. They demonstrated, respectively, a receiver operating curve of 0.83, 0.78, and 0.74 for 1 year mortality, discharge to a care institution, and prolonged length of stay, respectively [8]. Both studies clearly attest to the strength and potential of using geriatric variables and assessment to risk stratify patients and convey operative risk in the preoperative setting.

The current data suggest that identifying frailty has the ability to assist in preoperative decision-making, especially in complex and elderly patients. Both retrospective and prospective studies confirm frail patients, and those with other functional impairments are at an increased risk of immediate postoperative mortality and morbidity as well as long-term mortality. Future studies need to confirm these findings in larger cohorts of vascular patients. Until more risk assessment studies are available, vascular surgeons will need to use available preoperative risk assessment tools to be fully informed when counseling patients and their families about perioperative risk and goals of care.

17.3 Specific Vascular Surgical Considerations for Elderly Patients

History and physical examination for vascular disease is based on standard findings known to all clinicians caring for seniors. Briefly, symptoms of carotid embolization, the presence of an asymptomatic pulsatile abdominal mass at the umbilicus, symptoms of claudication with loss of hair and decreased or absent pulses, and varicose veins or venous stasis changes satisfy the bulk of assessing for the presence or absence of significant vascular pathology. Given the high prevalence of vascular disease in the geriatric population, a high index of suspicion should be present and lead all clinicians to perform a thorough vascular specific history and physical examination.

The majority of conditions of arterial pathology in the carotid, infrarenal aorta, and lower extremities can be assessed using standard measures available in the vascular laboratory. The majority of vascular disease including retroperitoneal and supraclavicular structures can be accurately imaged with ultrasonography. With the proximity of the arteries to the skin surface, the lack of exposure to radiation or need for potentially nephrotoxic dye, ultrasonography in conjunction with physiological pressure studies (ankle brachial index, ABI) is now considered the primary assessment tool for most vascular surgeons for the initial and subsequent assessments of patients with peripheral arterial disease. Using this approach, the vascular laboratory is able to reliably document the presence and extent of carotid, upper extremity, mesenteric, renal, infrarenal aortic, and lower extremity disease and differentiate the presence of atherosclerosis and conditions such as thrombosis and embolization both at a macro and micro level.

Recently, with advancements in radiologic imaging, noninvasive head to toe assessment of the larger and medium arterial tree has become commonplace. Rather than supplanting the vascular laboratory, the use of advanced imaging serves to confirm or refute findings of the vascular laboratory and provides detailed assessment for the surgeon prior to intervention. CT scanning of the arterial tree has become so detailed that it has nearly eliminated traditional angiography for diagnostic purposes to highly selected situations such as determining the patency of tibial artery stenosis or assessment of challenging cervicocerebral anatomy. Additionally, the presence of calcium, which previously limited the ability of CT scans to provide diagnosis, has now been overcome, and assessment of calcium and plaque characteristics is now easily assessed with detailed CT scanning. Magnetic resonance imaging (MRI) has become less popular than CT scanning due to cost, imaging time constraints, patient reluctance, and the potential for nephrogenic systemic dermatopathy in renal failure patients. However, MRI is still important in instances of markedly reduced flow in the carotid circulation. In that situation it may help determine the presence of a patent internal carotid artery. Each imaging modality has its pros and cons. For the non-surgeon, it is important to understand they cannot always be used interchangeably. Ultrasound, CT, and MRI should be ordered based upon indications and local practice patterns.

Similar to noninvasive imaging, there has been a marked focus on providing vascular disease treatment with minimally invasive interventions. In general, all vascular patients have four specific options in order of increasing invasiveness. First is medical management, which all patients should receive and for some is all that is warranted. Second is a purely endovascular percutaneous catheter-based approach performed under local, monitored, or general anesthesia to treat arterial disease using balloons, stents, and devices designed to improve arterial flow. Third is a combination of open and endovascular procedures with the open component of the procedure usually limited to a small incision with the endovascular component serving to improve outflow or inflow and thus reduce the total magnitude of the operation. Fourth is a purely open operative approach that consists of a standard incisional approach and intervention employing common surgical techniques without the need for advanced radiologic imaging. It is important to remember that there are usually two or three treatment options for patients with complex arterial pathology especially in the lower extremity. Thus, one should consider for the elderly patient his or her goals of care, life expectancy, and the surgeon should then guide the patient using judgment that balances the expected long-term outcome of the intervention against the potential morbidity and loss of quality of life that may be incurred [9].

17.4 Carotid Artery Occlusive Disease

Stroke is the third leading cause of death in the USA and results in significant disability. Approximately 80% of strokes are ischemic and 20% hemorrhagic. And of those 80% of ischemic strokes, 20–30% are attributed to atheroembolic disease due to stenosis of over 50% of a carotid artery [10]. Proper diagnosis, management, and treatment of carotid stenosis are important for reducing risk of ischemic stroke in elderly patients (75% of strokes occur in patients older than 65 years of age). With the recent advent of carotid stenting and ability to treat formerly considered nonoperable patients, a renewed focus had been placed on risk stratification for proper selection of appropriate treatment. Especially in the asymptomatic senior, treatment decisions must include considerations of vascular variables such as the degree of stenosis, presence of subtle symptoms, medical comorbid conditions, and patient goals of care with a careful assessment of life expectancy and potential risk reduction in the asymptomatic patient.

A focused history is important to identify those patients at increased risk for carotid disease and perioperative stroke especially in the asymptomatic patient. Risk factors for carotid disease are similar to those of atherosclerosis in other peripheral arteries: smoking history, advanced age, male gender, and positive family history. Risk factors for stroke are multifactorial, but for patients with carotid disease, the most important are a history of neurologic symptoms, the degree of carotid stenosis, and the plaque characteristics. Patients with prior or current cardiovascular disease are at increased risk for concurrent carotid disease, and given that myocardial infarction is the most common complication leading to death after a carotid intervention, it is imperative to know a patient's cardiac history. Neurologic symptoms such as unilateral weakness, numbness or paresthesias, aphasia or dysarthria, history of transient ischemic attack (TIA), prior stroke, and amaurosis fugax are all significant historical findings that, if present in the last 6 months, define a symptomatic state. Symptoms not usually associated with carotid disease are vertigo, ataxia, diplopia, nausea, vomiting, decreased consciousness, and generalized weakness. The importance of identifying symptoms cannot be overemphasized. Patients with truly symptomatic carotid disease often benefit from an intervention, but this is not always the case for patients with asymptomatic lesions. Surgeons often must evaluate patients who have had a carotid scan (ultrasound and/or CTA) performed in a patient with vague symptoms that reveals an underlying lesion. Very careful assessment of such patients is critical to avoid an operative or endovascular intervention for an incidental and clinically nonsignificant finding. It may be helpful to involve other specialists, including stroke neurologists, in the patients' care to help determine the cause of these vague symptoms.

A physical examination is important to document any pre-intervention deficits that have incurred from a remote stroke and in a patient with a history of a TIA to ensure full recovery of neurological function or identify subtle residual deficits. If assessing the patient for a bruit, one must recognize that a carotid bruit is typically present when the stenosis is 50–70%, and it is often absent in patients truly at risk with a >70% stenosis. Additionally, the examination should focus on (a) the heart assessing for irregular rhythm or murmur, which could portend an embolic stroke, (b) palpation of distal pulses to assess systemic nature of the disease, and (c) the cranial nerve examination to establish the baseline. A formal ophthalmologic examination should be obtained in the setting of amaurosis fugax or any associated visual symptoms to identify Hollenhorst plaques and/or cholesterol emboli from the offending plaque.

The initial diagnostic study of choice for the vascular surgeon is duplex ultrasonography performed in an Intersocietal Accreditation Society (IAC) accredited laboratory. The degree of stenosis is determined by peak systolic and diastolic velocities through a narrowed lumen. Ultrasound is also useful for determining plaque morphology in the hands of a trained technician. This procedure requires substantial operator experience. Unfortunately, this modality can only assess the extra cranial carotid arteries. An accredited laboratory will be able to correlate their ultrasound findings with more detailed and advanced imaging such as angiography, CTA, and MRA. In the emergency department or any urgent care venue, typically a CT or CT angiogram is done (except in patients with contrast allergy or renal failure) in the evaluation of a patient with symptoms suggestive of a stroke. Both the carotid vessels and the brain are imaged satisfactorily with this technique such that many surgeons now forego duplex examination in the urgent setting. Modern scanners have impressive resolution and allow full examination of neck cervicocerebral and intracranial arteries. High calcium content in plaque previously obscuring arterial flow has been essentially obviated with the current increase in CTA imaging capability. CTA, while noninvasive, does expose the patient to ionizing radiation and can be expensive. MRA is an option for noninvasive vessel imaging but is less often utilized because of time constraints, potential patient anxiety, and the known problem of overdiagnosing the degree of stenosis because of interference from calcific lesions. In contrast, the MRI of the brain is ideal in assessing ischemic damage, and in this regard, it is more sensitive than CT. The effectiveness of the noninvasive imaging options has limited diagnostic angiography to situations where there is marked discrepancy between noninvasive images. The importance of this cannot be overstated: the patient avoids an invasive procedure for diagnosis only and foregoes the 1.0–1.5% risk of stroke from a diagnostic angiography.

Once a patient is determined to have a lesion, the surgeon must determine the critical issue of whether the patient is symptomatic from the lesion or asymptomatic. The data have clarified that patients with a significant stenosis (>50% narrowing) in the carotid artery ipsilateral to the symptomatic hemisphere benefit from carotid intervention performed by experienced surgeons or interventionists using open or endovascular techniques, respectively. Ideally all patients should have outcomes entered into an appropriate quality registry to confirm benefit to the patient and institution providing care. Randomized trials, specifically NASCET and CREST, have documented an acceptable rate of perioperative stroke and death for patients undergoing intervention for stroke risk reduction that far outweighs treating the symptomatic patient with medical management alone [11, 12]. The options for management are endovascular, open procedure, or a combination of both. Carotid artery endovascular stenting is usually reserved for patients who are thought to be high risk surgical candidates from either a physiologic or anatomic standpoint. Such physiologic risks include age greater than 75, congestive heart failure, ejection fraction <35%, unstable angina, and severe pulmonary disease among others. Anatomic risks include those with cranial nerve deficits, prior head neck radiotherapy, difficult-to-access carotid lesions, spinal immobility, and contralateral occlusion. Additionally, carotid artery stenting has been shown to reduce the perioperative myocardial infarction rate by half and thus may be the best choice for those patients with known severe cardiac disease. However, open endarterectomy remains the gold standard for intervention. It has the lowest rate of perioperative stroke in acceptable operative candidates. Complications associated with both interventions include stroke, myocardial infarction, and death. The risk of myocardial infarction is higher with endarterectomy as are the rates of cranial nerve injury. Thirty-day stroke and death rates for endarterectomy by a highly experienced surgeon in symptomatic patients should be less than 6%. Indeed, the majority of single centers and Vascular Quality Initiative registry report 30-day stroke and death on the order of 2–3% [11]. Surprisingly, several randomized trials confirmed the risk of an adverse event is higher with carotid artery stenting (CAS) than carotid endarterectomy (CEA) in older patients. A new hybrid procedure, transcarotid artery revascularization (TCAR), involves stenting through direct access to the carotid artery. Perioperative stroke rate with the procedure is lower than any modality but remains to be seen if the procedure will result in similar outcomes for older patients.

The more contentious issue currently in the area of carotid artery stenosis is what to do with the patient with positive imaging who is thought to be asymptomatic from the lesion. Some believe these patients would benefit from intervention based upon randomized studies such as the ACAS trial. However, there are several caveats that must be considered as a surgeon evaluates such asymptomatic patients: (1) screening for asymptomatic carotid artery disease has not shown any benefit in stroke risk reduction (the United States Preventative Task Force has concluded that the harms of screening for asymptomatic carotid artery stenosis outweigh the benefits even in the setting of coexistent atherosclerotic disease, a carotid bruit, or prior head and neck radiotherapy); (2) the initial ACAS trial included only patients with an estimated life expectancy of over 5 years; (3) the trial demonstrated that the beneficial effect of endarterectomy is conferred only after approximately 4 years and if the perioperative stroke and death rate is less than 3%; (4) current data suggest in Medicare recipients that asymptomatic carotid intervention is not acceptable with approximately 30% of patients dying within 3 years after undergoing asymptomatic carotid artery intervention; and (5) elderly females are the least likely to benefit from asymptomatic carotid artery intervention based on a post hoc analysis of the ACAS trial [13–16]. More recent studies have suggested in the veteran population that treatment of asymptomatic patients with medical therapy. To fully understand and clarify the role of asymptomatic carotid artery intervention, the currently active CREST II trial will investigate the role of intervening on asymptomatic carotid artery disease utilizing either carotid endarterectomy or carotid artery stenting with medical management versus best medical management alone utilizing a two parallel randomized trial design.

The most important concern in considering a procedural intervention in a patient with asymptomatic carotid artery stenosis is that the surgeon must understand and fully explain the risk and benefit of an intervention so the patient can make a fully informed decision. In communications with patients, a surgeon must fully understand the patient's goals of care and then, and only then, can a judgment concerning an intervention be wisely made. The surgeon can only advise a patient fully after an assessment of risk factors known to negatively impact short- and long-term outcomes of an intervention. Strong arguments can be made for withholding CEA in the setting of dialysis and life-limiting conditions where the data clearly show both short- and long-term mortality do not reduce the risk of future stroke. More importantly, long-term survival studies have demonstrated that performance of CEA on asymptomatic patients may have acceptable perioperative stroke and death rates but does not achieve acceptable long-term survival. To emphasize this point, Wallaert et al. demonstrated an overall 5-year survival of 80% in patients with asymptomatic disease; however, those with high risk, for example, age >80, dialysis dependence, insulin-dependent diabetes, or severe contralateral disease, are unlikely to survive long enough to benefit from CEA [17]. This study is supported by a recent study in the veteran population suggesting patients with comorbidites including cancer, congestive heart failure, renal failure, and COPD do not benefit from intervention. Graphical evidence of long-term survival for patients with both symptomatic and asymptomatic carotid disease and those at the extreme of age is noted in Table 17.1. Identifying frailty preoperatively helps stratify patients in the older age groups who will likely have poorer surgical outcomes (Fig. 17.1).

17.5 Abdominal Aortic Aneurysm

Abdominal aortic aneurysm (AAA) is a disease of the elderly most commonly in men who have smoked. AAA is an inflammatory disease of the aorta in which progressive remodeling of arterial wall initiated by smoking with a strong genetic component. The destruction of the aortic wall is

Table 17.1 Poor survival of patients in "real-world" populations undergoing both symptomatic and asymptomatic CEA[a]

Time	Cumulative mortality risk %	
	Symptomatic	Asymptomatic
1 year	10	6.2
2 year	18.8	13.1
3 year	27.1	19.8
4 year	36.3	27.9

Data from Jalbert et al. [14]

[a]A survival of a minimum of 5 years for asymptomatic patients based on the ACAS trial is needed for patients to benefit from asymptomatic endarterectomy

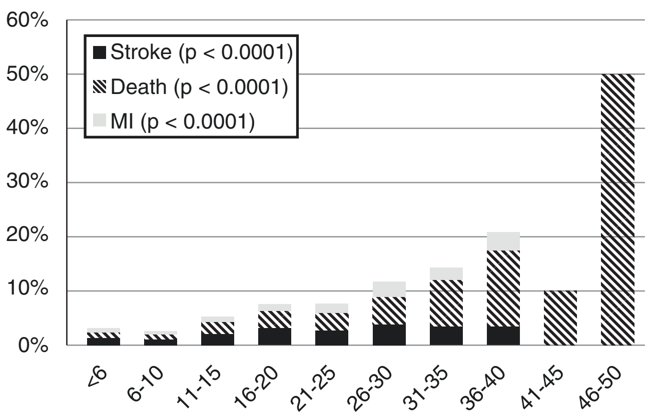


Fig. 17.1 Frailty has the potential to significantly improve patient selection in the preoperative period for patients undergoing carotid endarterectomy. Applying frailty analysis to patients in the National Surgical Quality Improvement Project, increasing frailty scores correlated with a marked increase risk of 30-day complications in patients undergoing both symptomatic and asymptomatic CEA. (Reprinted from Melin et al. [6], Copyright 2015, with permission from Elsevier)

caused by the end effector matrix metalloproteinase, which leads to loss of the elastin within the aorta and subsequent dilation of the wall. The presence of an aneurysm is defined by increase in vessel diameter by more than 50% (usually a diameter over 3.0 cm). Over 95% of aortic aneurysms are located in the infrarenal location. Once present, aneurysms do not grow longitudinally but rather dilate over time. AAAs typically grow between 1 and 4 mm per year and tend to follow a linear growth regardless of size. Once identified, an aneurysm warrants careful surveillance. Guidelines, summarized below, exist to guide practitioners on how often to image an AAA. Physical activity, in spite of a common perception, does not cause rupture. Rather the size of the aneurysm is the most predictive factor for rupture of the aneurysm. Presence of COPD, uncontrolled hypertension, and female gender also increase the risk of rupture. The presence of diabetes is actually protective.

Most aneurysms are identified during the time of radiographic scanning either for unrelated reasons or by clinicians following the current USPSTF recommendations for a one time screen using ultrasound of men ages 65–75 who ever smoked [18]. Physical examination of the aorta is very difficult and especially unreliable in those with an elevated BMI.

Abdominal aortic aneurysms can be assessed utilizing multiple diagnostic imaging techniques. From a screening perspective, ultrasound is able to assess the infrarenal aorta diameter with a sensitivity and specificity nearing 100%. Because ultrasound has no known risk and is reliable, it should be performed in patients for both a screening study and those suspected of having an aneurysm. Ultrasound is unable to assess the perivisceral and thoracic vasculature. Therefore, once an abdominal aortic aneurysm is identified, a computed tomography angiogram (CTA) is the most commonly obtained study to fully delineate the concomitant arterial circulation and assess its potential for future repair. The use of magnetic resonance imaging can also document the presence of an aneurysm and help define its morphology. However, its use is limited both in routine diagnostic and emergent situations due to the typical delay often experienced in obtaining the study as well as the anxiety many patients experience. Once an aneurysm has been identified, it should be followed at regular intervals if it does not meet size criteria for repair. Currently in the USA, aneurysms are routinely repaired once they reach the size of 5 cm for females and 5.5 cm for males. This recommendation is based upon multiple trials showing acceptable mortality and morbidity at this aneurysm size. If an aneurysm measures 3.0–3.9 cm, recommendations are for following the aneurysm every 3 years, often with ultrasound. In our practice, a new diagnosis of a AAA warrants short interval imaging (6–12 months) with a clinic visit to ensure the aneurysm is not rapidly expanding. At this point, standard surveillance protocol can be followed. Once the aneurysm reaches 4–4.9 cm, a vascular surgeon will likely reassess the patient at no longer than 1 year intervals. At this point, it is reasonable to involve a vascular surgeon for surveillance and ultimate management based on the varying surveillance strategies in the Society for Vascular Surgery guidelines.

Treatment for an AAA is specifically aimed at reducing a patient's risk of rupture as once rupture occurs, the mortality with or without surgery is very high. Currently, no medical treatment exists for an abdominal aortic aneurysm. Propranolol beta blockade has been shown to be ineffective. The most rigorous and anticipated study of medical management for AAA utilizing doxycycline has now been complete with initial results published. The Non-Invasive Treatment of Abdominal Aortic Aneurysm Clinical Trial (N-TA^{3}CT) trial showed no benefit in growth rate reduction with doxycycline treatment in patients with small aneurysms [19]. For now, surgery remains the only form of treatment that will reduce the mortality risk associated with aneurysm rupture. The risk of the operation must be lower than the risk of aortic rupture. Mortality from rupture in males at 5.5 cm is approximately

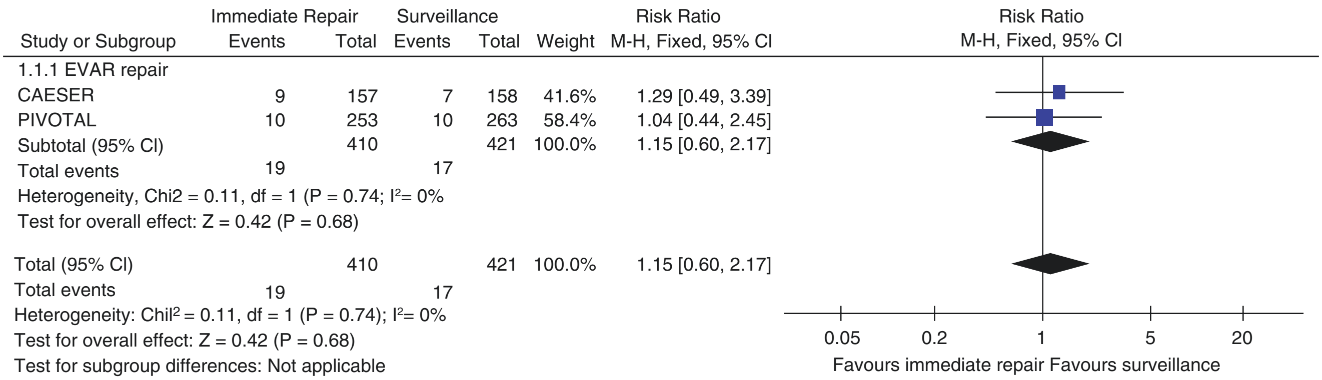


Fig. 17.2 Currently there is no indication for either open or endovascular intervention for patients with aneurysms less than 5 cm based on four well-performed randomized trials demonstrating no benefit to early intervention. (From Filardo et al. [20])

1–2% per year and likely to begin to be greater than the operative mortality. For patients with multiple comorbidities, risk of perioperative mortality may actually be higher than the risk of rupture especially in the frail patient. In these cases the repair threshold may actually be raised. Most importantly, intervening on small aneurysms (<5 cm) has not been shown to be beneficial. Meta-analysis of the four randomized trials of early AAA repair has not shown a survival benefit, and there is a definite burden for the patient with operative repair (Fig. 17.2) [20]. Patients are occasionally told they have a "ticking time bomb" in their abdomen which must be fixed. At small sizes this expectation and statement is not supported by data.

Surgical intervention can be open or endovascular. Standard open operations are performed through either a midline laparotomy or retroperitoneal approach with clamping of the aorta and sewing in a bypass graft. This technique has the advantage of eliminating the aneurysm but is associated with hernia formation and potential for postoperative bowel obstructions and aorto-duodenal fistula. Endovascular treatment has been popularized with placement of endografts through the femoral arterial circulation and exclusion of flow into the aortic sac. This form of treatment typically is associated with a shorter hospital length of stay and recovery time but leaves the aneurysm in situ. Leaving the aneurysm in situ requires close follow-up (generally annually) using CTA with the risk of excessive radiation and inconvenience to the patient. Endovascular repair may need revision because of graft movement and/or re-pressurization of the aortic sac. Nonetheless, with appropriate exclusion of the aneurysm, endovascular repair has been found to have similar mortality rates to open repair over time. In the elderly patient, the gain in the immediate perioperative period must be balanced with the burden of repeat imaging to insure a stable aortic repair. Accordingly, the surgeon in discussions with the patient will need to explain carefully the immediate and long-term benefits and burdens of an open or endovascular procedure (Table 17.2).

Table 17.2 The poor long-term survival of octo- and nonagenarians undergoing endarterectomy in long-term follow-up

	Cumulative mortality risk %	
Time	Octogenarian	Nonagenarian
1 year	10.7	16.5
2 year	20	28.3
3 year	27.6	38.3
4 year	35.6	47.3
5 year	43.3	56.2

Data from Lichtman et al. [15]

17.6 Lower Extremity Arterial Disease

Peripheral arterial disease (PAD) is a disease of the elderly. Approximately 20–25% of patients over age 75 have disease based on an ankle brachial index of less than 0.90. Approximately 50% of the population with reduced ABIs will be asymptomatic. Of the remaining patients with reduced ABIs, 40% will present with intermittent claudication and 10% will present with critical limb ischemia. Regardless of their presentation, the PAD population is most notable for systemic atherosclerotic disease, which predisposes the patient to a high risk of cardiovascular disease and death. Therefore, any patient with a reduced ABI should be counseled regarding risk reduction activities (smoking cessation and exercise) and treated appropriately for cardiac and cerebrovascular disease, if identified. The impact of the systematic nature of atherosclerotic disease is emphasized when examining the survival curve of patients with asymptomatic disease compared to normal patients (Fig. 17.3). Once a patient with PVD becomes symptomatic with either intermittent claudication (IC) or critical limb ischemia (CLI) the survival of the patient worsens [22].

When selecting patients for intervention with reduced ABIs, foremost a detailed history focusing on the patient's lower extremity complaints should be obtained. The classic presentation of patients with peripheral arterial disease is that of classical claudication which is described as pain or

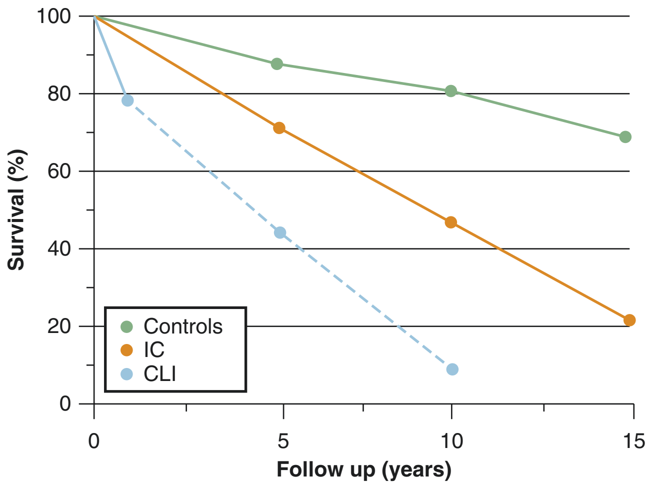


Fig. 17.3 Survival of patients with peripheral arterial disease is markedly decreased in comparison with patients with no evidence of disease. The presence of symptomatic status of a patients PAD markedly worsens long-term survival. (Reprinted from Norgren et al. [21], Copyright 2007, with permission from Elsevier)

discomfort of calf or buttock muscles with a defined time of exertion and that subsides with 5–10 min of rest. Unfortunately, not all patients present with classic claudication and many remain asymptomatic or have atypical symptoms. Often elderly patients have minimal complaints as their associated comorbidities limit ambulatory function either due to cardiopulmonary disease, arthritis, or spinal stenosis. The presence of significant coexistent disease in the PAD patient is 50–75%. Thus it is imperative to assess whether the PAD is the primary cause of complaints. Testing in the form of exercise treadmill or reactive hyperemia is indicated in this situation to determine if vascular disease is truly the cause of the patient's symptoms. In the elderly patient, neurogenic claudication secondary to spinal stenosis and osteoarthritis of the hip or knee must be differentiated from vasculogenic claudication. Osteoarthritis is differentiated from claudication as the pain generally localizes to the joint, improves with pain medications, and is commonly brought on with movement of the involved joint. Neurogenic claudication, in contrast, is more difficult to differentiate from vasculogenic disease. Neurogenic claudication most commonly presents with pain in the calves and posterior thigh and buttocks. In contrast to vasculogenic disease, neurogenic claudication has variable distance to onset and variable recovery time often worsening with repeated episodes of activity. Neurogenic claudication can often be diagnosed through use of assistive devices such as having the patient evaluate the pain walking with a shopping cart and other measures that decompress the spinal canal. It is not unusual for osteoarthritis, neurogenic claudication, and vasculogenic claudication to coexist in the elderly patient. The surgeon will need to carefully consider the patients most dominate symptoms in order to determine which treatment options to pursue for optimal outcome and the maintenance of ambulation and function. Similar to both carotid and aortic diagnoses, the use of the noninvasive ABIs and ultrasound can document the extent and location of the disease in the majority of patients. Similarly, CTA has proven to be invaluable in providing a roadmap for surgical planning and with modern scanners. Traditional angiography is reserved to assessing tibial arteries not clearly seen on CTA and is usually performed with intervention in mind.

The paradigm for treating the patient with PAD should focus initially on lifestyle issues and medical management. Based on the natural history of PAD many patients remain stable with regard to their disease at presentation or improve regardless of treatment. Institution of medical management with antiplatelet and cholesterol lowering therapy in conjunction with smoking cessation are the mainstays of medical therapy. In addition to medical therapy, an initial trial of exercise therapy should be attempted. Data are robust that exercise therapy will improve maximal walking time and ability. These outcomes are independent of increased ABI. Indeed, typically no significant change is expected in ABI. Importantly when comparing trials of exercise therapy with endovascular intervention, data demonstrate that supervised exercise therapy offers equivalent results over time (usually 1–2 years) with no complication rate and equivalent progression to limb loss. The combination of supervised exercise therapy and endovascular intervention likely offers the best option for the claudication patient in need of treatment. Trials examining dual therapy show a clear improvement in walking distances compared to endovascular intervention alone [23].The Centers for Medicare & Medicaid Services now offers reimbursement for supervised exercise therapy. Unfortunately, this is not available at many institutions. Providers need to assess their local environment for access to this option. Unlike cardiac rehab, which is performed after a cardiac event, exercise therapy for PAD is prescribed as a treatment. This treatment is intensive, often 3 days per week for 1 h each session. Therapy typically lasts for 12 weeks but can be extended another 12 weeks if a physician recommends continuing therapy.

If medical management and supervised exercise therapy have failed to give the desired result for the patient and they are willing to undergo intervention, it is reasonable to offer patients with lifestyle-limiting claudication options for intervention including stenting of the aorto-iliac and femoral segments or surgical bypass when long segment stenosis or occlusion is present in a patient with an acceptable risk. For the patient with claudication, it should be emphasized that the intervention is for lifestyle improvement and not for limb salvage. This is so despite the occasionally expressed notion that limb salvage is improved. The risk of amputation is quite low for the patient with severe claudication (Fig. 17.4).

Patients should not be counseled that due to reduced ABIs they are at a high risk of amputation without surgical treatment: that is blatantly false. This is in contrast to patients with critical leg ischemia (tissue loss or pain at rest) where all efforts to revascularize lower extremity should proceed promptly due to the high rate of amputation without revascularization. This can be accomplished with either endovascular or open surgical approach. The open surgical approach is usually reserved for patients in whom inline endovascular flow cannot be restored or in patients with a significant amount of tissue necrosis. This endovascular first approach is commonly utilized as first-line therapy regardless of lesion length given the perceived lack of morbidity and mortality. This concept is based on the BASIL trial where 30-day morbidity, and all-cause mortality at 6 months was higher in open than endovascular intervention. Yet patients undergoing open surgery had a better amputation free survival and lower all-cause mortality at 2 years [25]. Currently the BEST-CLI trial is hoping to answer the surgery vs. endovascular conundrum utilizing an innovative pragmatic randomized design focusing on outcomes such as amputation rate, repeat intervention, and mortality [26].

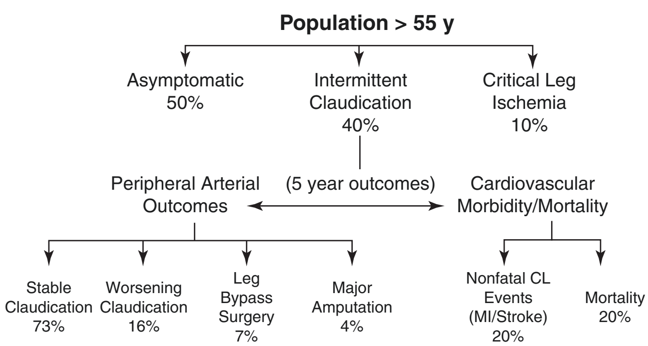
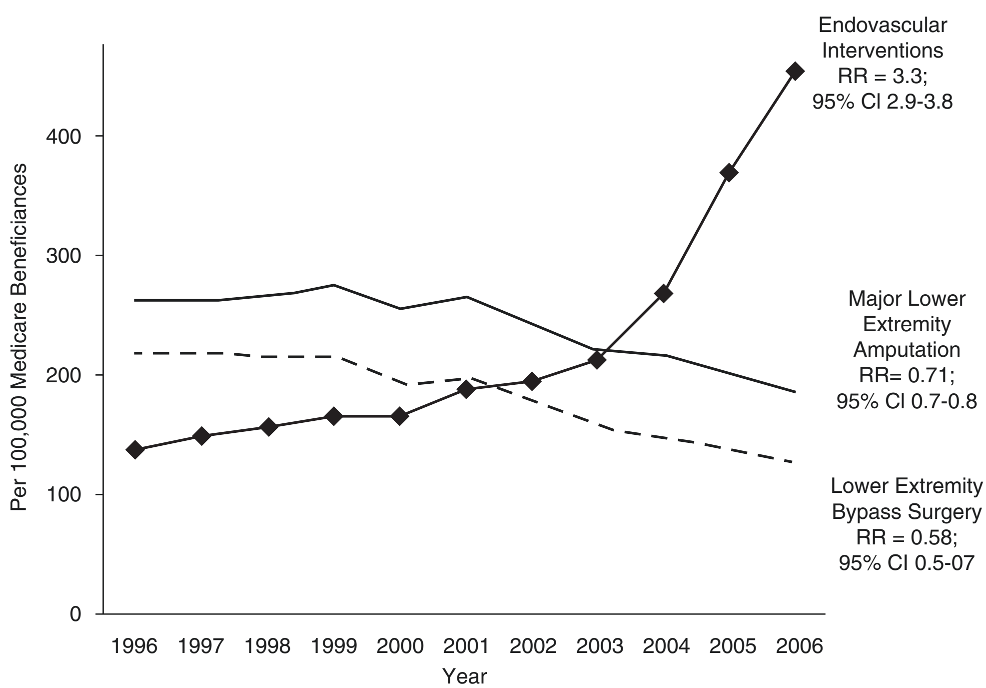


Fig. 17.4 The benign nature of PAD in the lower extremities is noted in the flow chart with 90% of patients presenting with no or minimal symptoms. Of patients with intermittent claudication, the risk of amputation is approximately 4%, with less than 10% of patients needing intervention alluding to the lifestyle nature of intervention for claudication. (From Weitz et al. [24])

Given the ease of endovascular intervention , the relative lack of complications, and the rapid advances in devices to treat peripheral arterial disease, it is not surprising to see the marked rise in this procedure in the USA. There is a tradeoff however that needs to be acknowledged that many endovascular procedures need to be repeated given the poor durability. Additionally, it should be recognized that interventions do come with risk which includes a low but real risk of amputation often at a level higher than expected. This increase in endovascular procedures is associated with a corresponding reduction in surgical bypass and amputations (see Fig. 17.5). The causal relation between alterations in revascularization procedures and improvement in amputation rates has yet to be precisely determined [27]. One must keep in mind that the goal of intervention is to maintain an ambulatory and functional patient. When nursing home residents undergo lower extremity revascularization, few survive to be alive and ambulatory at 1 year and regain little to no function [28, 29]. Thus in these nonambulatory patients, the choice between limb salvage and palliative amputation must be contemplated, considering carefully the patient's goals of care and preferences. The best choice is the least invasive treatment with the lowest morbidity and mortality while achieving the patient's goals.

Fig. 17.5 A marked rise in endovascular interventions is noted with a concomitant decrease in open surgical bypass and amputations in the USA. A causal relationship between alterations in revascularization procedures and improvement in amputation rates has yet to be formally determined. (Reprinted from Goodney et al. [27], Copyright 2009, with permission from Elsevier)



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Rheumatology

18

Rebecca L. Manno and Jason E. Liebowitz

18.1 Introduction

Many rheumatic diseases disproportionately affect older individuals. Osteoarthritis is almost universally present among octogenarians. Giant cell arteritis, the most common systemic vasculitis in North America, occurs exclusively in individuals over the age of 50 with a mean age of onset between 70 and 80 years. Rheumatoid arthritis has a prevalence of 2% in the USA among individuals over the age of 60 [1]. In fact, the earliest recorded description of rheumatoid arthritis was among older individuals in the year 1800 when Dr. A.J. Landre-Beauvais described a severe illness with involvement of the joints, female predominance, a chronic course, and precipitous decline in general health among three patients over the age of 70 [2]. Rheumatic, autoimmune, and musculoskeletal diseases may be common among older individuals, but the care of these patients is far from routine.

Rheumatic diseases, and the medications used to treat them, often affect muscles and joints. This has a profound and unique impact on older individuals who are often already dealing with aging-related musculoskeletal issues that are the consequence of multiple comorbidities, poor functional status, malnutrition, sarcopenia, and cognitive impairment. Fixed incomes and complicated medication regimens with biologic agents that have rarely been studied in older individuals add layers of complexity to management for both patients and providers. Many of these important issues are not being adequately addressed in our current healthcare system.

The objective of this chapter is to review the current epidemiologic, diagnostic, and therapeutic data for some of the most common rheumatic conditions among older individuals in the realms of arthritis, myositis, vasculitis, and connective tissue disorders. By highlighting some of the important unanswered questions in the multifaceted care of older patients with rheumatic disease, we hope to generate future investigation in these areas. Research in geriatric rheumatology has the potential to generate comprehensive, individualized, and data-driven management strategies that will improve quality of life and quality of care for older patients suffering with these conditions.

18.2 Arthritis and the Older Patient

18.2.1 Osteoarthritis

18.2.1.1 Epidemiology

Osteoarthritis (OA) is the most prevalent joint disease in the USA, with a prevalence of up to 30% and incidence rates rising sharply after age 50 [3]. Risk factors for OA include female gender, obesity, joint injury, repetitive use of joints, and family history, but the most important risk factor is advanced age. With a predicted 88.5 million Americans reaching the age of 65 or older by 2050, nearly 30 million individuals in the USA will have OA in the future [4].

Studies evaluating the annual healthcare costs of OA per individual in the USA have provided a wide range of estimates from $989 to 10,313 per year [5, 6]. Although substantial variation exists across studies, it is universally accepted that this is an expensive problem with the cost of knee OA-related healthcare estimated to account for approximately 10% of direct medical costs per individual over their lifetime [5]. OA is undoubtedly a prevalent and costly medical condition which targets older individuals.

18.2.1.2 Diagnosis of OA in Older Individuals

Much like everything else when caring for older patients, there can be a unique level of complexity in diagnosis even for the most routine and common medical conditions, such as OA. Classification criteria for knee OA endorsed by the

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American College of Rheumatology based on clinical features alone (age, stiffness <30 min, crepitus, bony tenderness, bony enlargement, absence of warmth) has a 95% sensitivity but only 69% specificity [7]. Specificity increases to 75% with the addition of laboratory features (negative autoantibodies, normal ESR, synovial fluid consistent with OA) and to up to 86% with confirmatory X-ray data [7].

It is the opinion of these authors that clinical features are generally sufficient to diagnose OA in older patients. However, red flags which should prompt further diagnostic investigation with laboratory studies, imaging, and/or arthrocentesis include: joint warmth, joint effusions, or dominant involvement of the metacarpophalangeal (MCP) or metatarsophalangeal joints. Particularly in the multimorbid older adult, a diagnosis of OA (versus other forms of arthritis) may be challenging because of pain and functional impairment from other sources such as neuropathy, myelopathy, or depression. This is an area where additional research and investigation to develop diagnostic arthritis algorithms, specific for older individuals, would be extremely valuable to streamline joint assessments so that management can begin swiftly.

18.2.1.3 Management of OA in Older Individuals

There are multiple guidelines that have been published by highly reputable professional organizations [American College of Rheumatology (ACR); European League Against Rheumatism (EULAR); Osteoarthritis Research Society International (OARSI); European Society for Clinical and Economic Aspects of Osteoporosis and Osteoarthritis (ESCEO)] with regard to the treatment of OA (specifically knee OA). There is agreement among these guidelines that OA management requires a combination of nonpharmacologic and pharmacologic (oral, topical, intra-articular) treatments [8, 9].

Patient education, weight loss, and exercise programs are universally recommended, although the effects of these interventions on early symptoms and long-term disease modification remain controversial [8]. Even a modest 5% reduction in weight among patients with BMI ≥25 and knee OA has been shown to produce small, but significant, improvements in physical function [10]. Exercise is a critical component of any weight loss program, but often weight loss is not an appropriate goal for older individuals with OA because of comorbid conditions such as sarcopenia and frailty. Thankfully the benefits of exercise extend well beyond weight loss for OA management.

Exercise is one of the few OA treatments that has consistently demonstrated efficacy in reducing pain, disability, and improving joint function. For these reasons, it is universally accepted that it should be an integral part of any OA treatment plan for older adults [8]. A recent systematic review and meta-analysis of 48 exercise trials concluded that the optimal exercise program for individuals with knee OA entails supervised sessions three times per week with fitness goals of improving aerobic capacity, quadriceps strength, and lower extremity performance [11]. However, barriers are often encountered when trying to implement an exercise program for older adults with OA. Advanced, symptomatic OA may prevent moderate to strenuous exercise, and comorbidities such as heart disease or neuropathy can make conventional exercise programs challenging [12]. In our opinion, the solution is to create a customized and creative OA exercise program based on the individual needs of the older patient. For some older patients, this may include aquatic therapy, tai chi, or yoga. All exercise programs should include a resistance exercise component.

Perhaps one of the biggest barriers to implementing an exercise program for older individuals with OA is physicians themselves. In a survey of primary care physicians, geriatricians were among the medical specialties that counseled patients the least (22%) on aerobic exercise [13]. Recommendations for strength training were low among all physician groups, although doctors who exercise are more likely to counsel their patients to exercise [13]. In a balanced factorial experiment among primary care physicians in the USA who were presented with a case of diagnosed knee OA, only 30% made recommendations to the patient for exercise [14]. Physician education on how to prescribe exercise for the management of OA is a large unmet need which should be improved upon to optimize care for older arthritis patients.

The objective of pharmacologic treatment for OA is to manage symptoms, because there is not a single disease-modifying OA agent on the market. Acetaminophen (≤3 g per day) remains the first-line therapy for OA [8, 15]. However, when acetaminophen is not sufficient to control OA symptoms, then nonsteroidal anti-inflammatory drugs (NSAIDs) may be recommended. Topical NSAIDs have minimal systemic side effects and are a very good option for older individuals with OA. Prescribing oral NSAIDs becomes much more complex. Oral NSAIDs have a greater impact on pain, stiffness, and physical function compared to acetaminophen, but worrisome side effects such as gastrointestinal bleeding and renal and cardiovascular toxicity often limit their use in the geriatric population [16]. The long-term use of NSAIDs for a chronic medical condition, such as OA, is generally not recommended for older patients (>75 years) because of these adverse effects [17]. However, if NSAIDs are to be used for the management of OA in an older patient, then using the lowest dose possible for the shortest amount of time possible is prudent. Data from a meta-analysis suggest a two- to threefold increase in relative risk of gastrointestinal complications with daily high-dose NSAIDs compared to low or medium doses, except for celecoxib [18]. The use of concomitant gastroprotective agents, such as proton pump inhibitors, may decrease the GI risk but does not negate it. ESCEO recommends cycles of NSAIDs instead of "chronic" use which is a feasible approach for older patients although there are no specific recommendations on duration or dose cutoffs [19]. Some NSAIDs are considered higher risk or less cost-effective than others for older individuals. Indomethacin, in particular, is more likely than other NSAIDs to have adverse CNS effects and should be avoided in elderly patients [17]. Using an Osteoarthritis Policy Model, naproxen and ibuprofen were found to be more cost-effective than opioids or celecoxib for the treatment of OA among multimorbid older adults [20]. Other oral analgesic agents such as opioids, duloxetine, and tramadol may have a role for the management of OA in carefully selected older patients, although thoughtful consideration should be given to dosage and side effect monitoring because of the potential for these agents to cause dizziness, lower the seizure threshold, and cause severe constipation [8, 15, 17, 19].

Currently, to date, there is no conclusive evidence that standard treatments for rheumatoid arthritis are effective in the treatment of osteoarthritis. This has been an interesting area of investigation for specifically for erosive OA. Erosive OA, also referred to as "inflammatory osteoarthritis," affects the small joints of the hands and is typified on imaging by central erosions with marginal proliferation. These classic findings are referred to as "gull-wing deformities" and can be seen at both the distal interphalangeal (DIP) and proximal interphalangeal (PIP) joints [21]. Neither TNF-alpha inhibitors, such as adalimumab and infliximab, nor hydroxychloroquine have proved to be more effective than placebo in reducing pain or changing disease progression in erosive OA [22–26]. For these reasons, the 2019 American College of Rheumatology/Arthritis Foundation Guidelines for the Management of Osteoarthritis of the Hand, Hip, and Knee recommends against treatment of osteoarthritis with hydroxychloroquine, methotrexate, or anti-TNF-α therapies [9].

The US Food and Drug Administration has recently accepted for review a Biologics License Application for tanezumab. Tanezumab is a monoclonal antibody that is part of an investigational class of nonopioid chronic pain medications known as nerve growth factor (NGF) inhibitors. NGFs are being tested for analgesic (not disease modifying) effects for OA pain. In a randomized clinical trial of nearly 700 patients with moderate to severe OA, patients treated with subcutaneous tanezumab (either with fixed doses at 8-week intervals or with a forced titration at week 8) showed statistically significant improvements in joint pain, physical function, and patient global assessment of osteoarthritis over 16 weeks compared to those given placebo [27]. This medication, if approved, is of particular significance in the care of older adults given the contraindications that many of these patients have to nonopioid and opioid medications in the treatment of their osteoarthritis. However, further study is needed to fully understand the potential adverse effects of this medication, including arthralgia and paresthesia. Cost, both to individual patients and the healthcare system, are also important considerations given the high price likely to be associated with this medication and the high prevalence of OA in general.

Chondroitin sulfate (CS) and glucosamine sulfate (GS) are natural compounds containing glycosaminoglycans that have demonstrated some symptom amelioration in OA [28]. There is a wide heterogeneity in the regulatory status and labeling of commercial forms of these compounds in the USA compared to Europe, which may be why the pooled results from several high-quality studies have failed to demonstrate significant effects on pain [29]. The 2019 ACR guidelines do not universally recommend CS or GS for knee OA [9], but the 2003 EULAR guidelines do endorse their use [30]. More research is needed before these compounds can be universally recommended for older adults with OA, although the general safety of CS and GS makes them an attractive therapeutic option in this high risk population.

Intra-articular injections, either with corticosteroids or hyaluronic acid, may be a therapeutic strategy for older individuals with OA, particularly of the knee. The frequency with which intra-articular steroid injections are administered is generally determined by symptom severity. In an important OA study, patients with knee OA were randomized to receive intra-articular injections every 3 months with either 40 mg triamcinolone or saline [31]. No detrimental effects were observed to the knee structure or joint space at this dosing interval [31]. Further, the group that received intra-articular corticosteroid injections had significant improvements in pain and stiffness compared to saline injections [31]. A dosing interval of every 3–6 months for corticosteroid injections to manage OA is generally considered safe, although recent studies have debated the possible increased risk of osteoarthritis progression associated with corticosteroid injections [32, 33].

The routine use of hyaluronic acid for OA management is controversial as evidenced by the varied recommendations from key professional societies [8]. In a systematic review and meta-analysis of 137 randomized controlled trials of adults with knee OA, all intra-articular therapies (corticosteroid, hyaluronic acid, or placebo) were superior in improving pain, stiffness, and function compared to oral agents (acetaminophen, diclofenac, ibuprofen, naproxen, celecoxib, oral placebo) [34]. Of note, in this evaluation, even intra-articular placebo was comparable to oral therapies which raises interesting questions about the placebo effect in OA trials and other pain pathways involved in OA [34]. In general, intra-articular therapies are a great therapeutic option for older individuals with OA because of their effectiveness and relative safety, although, for multi-joint OA, this is not a practical approach.

In recent years, mesenchymal stem cell (MSC) therapy for articular cartilage defects has emerged as a potential OA treatment modality. There is theoretical biologic plausibility in the use of MSC therapy to focally or diffusely restore cartilage in areas of the joint where regenerative potential is limited. To date, in vitro and animal studies of MSC therapy, either used alone or as an adjuvant to surgery, have indicated promise, and randomized controlled trials have demonstrated reasonable degrees of efficacy and safety, though these studies are of limited quality [35].

Platelet-rich plasma (PRP), an autologous blood product produced by centrifuged whole blood that yields a concentration of platelets above the baseline value, is a treatment that has been used as a local injection in animal models to improve the biomechanical behavior of cartilage and chondrocyte proliferation and to repair cartilage injury [36–38]. This work in animal models has prompted use in human patients, including among professional athletes. However, PRP lacks proper standardization, and thus it has been difficult to evaluate safety and efficacy in a methodical fashion.

The 2019 American College of Rheumatology/Arthritis Foundation Guideline for the Management of Osteoarthritis of the Hand, Hip, and Knee strongly recommend against the use of stem cell injections or PRP treatment in patients with knee and/or hip osteoarthritis [9]. The efficacy data for either intervention are simply lacking at this time. Further, neither stem cell injections nor PRP are covered by insurance (or Medicare) and convey high out-of-pocket cost to older patients.

18.2.1.4 Surgical Management of OA

Surgical management for OA becomes an option once medical therapies have been exhausted. It is estimated that, by 2040, there will be 1.43 million total hip replacements and 3.42 million total knee replacement surgeries per year [39]. Treatment with total knee replacement can alleviate pain and improve function. Ninety-five patients with knee OA were randomized to receive total knee replacement (mean age 65.8 ± 8.7 years) or nonsurgical treatment (mean age 67.0 ± 8.7 years) which consisted of five interventions: exercise, education, dietary advice, use of insoles, and pain medication. The surgical intervention group demonstrated superior pain relief and functional improvement after 12 months compared to nonsurgical treatment. Interestingly, the nonsurgical intervention group still had significant improvement in pain and function with only 26% progressing to total knee replacement the following year [40]. As expected, the serious adverse events in the surgical group were higher [40]. The data for arthroscopic debridement of OA affected joints or meniscectomy are more controversial with randomized controlled trials showing similar benefit to sham control or optimized physical and medical therapies [41, 42].

Ultimately, the decision regarding surgery for OA management requires careful consideration of surgical risk versus quality of life and functional benefits. For older individuals who often have multiple joints affected by OA, the implication of postoperative immobility, pain, and rehabilitation on other arthritic joints should also be considered. Importantly, OA nonsurgical management should be continued postoperatively in order to maintain the health of all joints affected with OA.

18.2.2 Rheumatoid Arthritis

18.2.2.1 Epidemiology

An estimated 0.5–1% of the population in the USA has rheumatoid arthritis (RA), and the largest proportion of these patients are older adults [43]. The Rochester Epidemiology Project of Olmsted County suggests there has been an increase in the overall incidence of RA among adult women from 1995 to 2007 compared to the previous four decades with a peak annual incidence of RA among individuals aged 65–74 years (89 per 100,000) [44]. Although late-age onset RA remains less common, the estimated annual incidence in the USA among those aged ≥85 years is 54 per 100,000 people is still markedly higher than the youngest age group (18–34 years) with an incidence of 8.7 per 100,000 [44].

18.2.2.2 Clinical Features and Differential Diagnosis in Older Individuals

The hallmark clinical feature of RA is a symmetric inflammatory polyarthritis which involves the small joints of the hands, wrists, and feet. Patients typically recount a history of morning stiffness, joint swelling, and systemic constitutional symptoms. This may occur with an indolent course over several months or with sudden onset. There have been conflicting reports of the elderly or late-age onset RA phenotype in the literature, but the full spectrum of clinical manifestations of RA can present in older individuals [45–48]. Most importantly, RA can be equally as severe in the old as in the young with erosions, joint destruction, and profound disability occurring within just 3 years after diagnosis [49].

The 2010 ACR/EULAR classification criteria for rheumatoid arthritis apply to all age groups and provide a scoring system to diagnose definite RA based on synovitis, autoantibodies, evidence of systemic inflammation, and duration of symptoms [50]. Importantly, other causes of arthritis must be ruled out before applying these RA classification criteria, and thus the differential diagnosis for polyarthritis in an older individual should be considered carefully. OA and RA often occur concomitantly in older individuals. Bony hypertrophy from Heberden and Bouchard nodes can make clinical assessment of synovitis challenging, so evaluation for other features of RA becomes critical.

The presence of prolonged morning stiffness, MCP and wrist arthritis, autoantibodies, and inflammatory synovial fluid are important clues to the presence of RA even in a patient with multi-joint OA. Crystalline arthropathies (gout, pseudogout) are common RA mimics in older individuals, especially in their more advanced phases when multiple joints are involved. Tophaceous deposits may be mistaken for rheumatoid nodules or Heberden's and Bouchard's nodes. In such cases, joint aspiration and synovial fluid analysis for the presence or absence of monosodium urate and/or calcium pyrophosphate crystals are necessary to make the correct diagnosis. Remitting seronegative symmetrical synovitis with pitting edema syndrome (RS3PE) is a rare inflammatory arthritis which occurs almost exclusively in individuals over the age of 60. RS3PE is an RA mimic that does not progress to joint erosions or deformities. Patients with RS3PE respond very well to therapy with corticosteroids, but the association between RS3PE and malignancy obligates evaluation for an occult cancer [51]. Finally, other autoimmune conditions which have arthritis as a key component and occur with frequency in older individuals, namely, dermatomyositis, scleroderma, and Sjogren's syndrome, should be considered if additional rheumatic features such as skin rash, sicca, muscle weakness, or Raynaud phenomenon are also present.

18.2.2.3 Laboratory Features in Older Individuals with RA

RA is a chronic autoimmune condition, and generally laboratory studies will reflect systemic inflammation. An unexplained anemia of chronic disease, thrombocytosis, and hypoalbuminemia in an older individual with articular symptoms should prompt consideration of RA. Rheumatoid factor (RF) is present in 50–90% of patients with RA. However, it is also one of the most common autoantibodies found in the healthy elderly population without RA. The prevalence of RF in the general older population (≥60 years) ranges from 10% to 48% [52–54]. RF lacks specificity for RA as it is found in a multitude of other common conditions. When presented with an older patient who has a positive RF and arthralgias, the following conditions should be considered in addition to RA: subacute bacterial endocarditis, paraproteinemias (monoclonal gammopathy of unknown significance, multiple myeloma), hepatitis C infection, cryoglobulinemia, and Sjogren's syndrome [55–57]. Anti-citrullinated peptide antibodies (ACPAs), which include anti-cyclic citrullinated antibodies (anti-CCP), are much more specific for RA (up to 98%) compared to RF [56, 58]. Therefore, ACPA may be more useful diagnostically for older patients. In addition to being specific for RA, ACPAs are prognostic for aggressive erosive disease, even among older individuals [59–61].

In a study using data from the Department of Defense Serum Repository, it was found that the preclinical period for RA, defined as the time during which RF and/or ACPA are positive but clinical symptoms are not present, lengthens as the age at RA diagnosis increases [62]. The clinical significance of this is not clear. However, it opens the door to interesting areas for future investigation regarding the interactions between an aging immune system, genetic and environmental exposures on the emergence of a clinical phenotype and autoantibodies in RA.

18.2.2.4 Cardiovascular Disease and RA

Cardiovascular disease (CVD) is common among older individuals, and it is the leading cause of death in RA [63]. Hence, this is an extremely important comorbidity to be aware of while managing the care of an older RA patient. CVD can be subtle in RA. Individuals with RA are less likely to report angina and more likely to have unrecognized myocardial infarction and sudden cardiac death compared to age-matched individuals without RA [64]. Traditional cardiovascular risk factors should be carefully monitored in older RA patients and medications with associated cardiovascular risk (such as NSAIDs) used with extreme caution. Finally, there is an association between RA disease activity (joint pain severity and systemic inflammation) and CVD risk [65].

18.2.2.5 RA Management for the Older Patient

The treatment of RA has been revolutionized over the past 15 years. Early and appropriate treatment with disease-modifying anti-rheumatic drugs (DMARDs) in order to achieve a goal of low disease activity or remission (treat to target) is now the standard of care for RA management. This approach is outlined in the 2015 ACR Guidelines for the Treatment of Rheumatoid Arthritis, which note that DMARDs should be selected based on disease severity, disease activity, and important comorbidities [66]; new guidelines will be available in 2020 from the ACR and will likely echo these recommendations. There are no absolute contraindications to any DMARDs in older individuals, and the approach to RA management should never be adjusted based on advanced chronologic age alone. Yet older patients are significantly less likely to receive DMARDs compared to their younger counterparts despite data which support comparable disease severity and duration [67–70]. Older individuals (≥65 years) with RA who are not seen by a rheumatologist are more likely to be treated with glucocorticoids alone and not prescribed DMARDs [71].

The observation of decreased use of DMARDs in the elderly has multiple etiologies; however, lack of DMARD efficacy in older RA patients is not among them. In a study of 151 methotrexate naïve older RA patients (mean age 75 years) in whom an aggressive treat-to-target approach using methotrexate, TNFα-inhibitors (TNFi), and/or tocilizumab was utilized, there was a high treatment adherence rate (76%), and 50% achieved structural remission (change in van der Hejde-modified total Sharp score ≤0.5), 63% achieved functional remission (HAQ-DI ≤0.5), and 51% achieved low disease activity (DAS28-ESR ≤3.2) over 52 weeks [72]. The most common serious adverse events were infections which occurred in 13% of patients and required discontinuation of RA therapy in only three patients [72]. Modern day RA therapeutics can be effective in the elderly and remission can be achieved in this age group. This study is commendable in that it begins to explore the application of current treatment paradigms to older RA patients with comorbidities. It opens the door for future studies to examine intensive (or less intensive) treatment regimens specific to older RA patients.

Comorbidities, risk of infection, and drug interactions are all important considerations in DMARD selection for older RA patients. In addition, we propose the following medication precautions. Methotrexate remains the first-line DMARD for all patients with RA regardless of age. Potential methotrexate hepatotoxicity can be worsened by concomitant medications (such as statins) or fatty infiltration of the liver, issues not uncommon among older individuals. Methotrexate is renally excreted, and creatinine should be calculated for all older patients in whom it is being considered and doses adjusted as appropriate [73]. Of particular importance in older individuals are methotrexate-induced CNS side effects such as headache, altered mood, or memory impairment [74]. This rare complication has been described primarily among older RA patients (>60 years) and should be monitored for closely in this population.

Leflunomide shares many of the same adverse effects as methotrexate in terms of hepatotoxicity and cytopenia. However, the gastrointestinal side effects of leflunomide can be severe and indolent in older individuals. Anorexia, nausea, and diarrhea may occur with drug initiation or in a subtle manner in the weeks following even small dose escalations. Weight loss in the absence of gastrointestinal symptoms has been attributed to leflunomide and often prompts fruitless, but expensive and exhaustive, evaluations for malignancy and infections [75]. The mechanism for leflunomide-associated weight loss is not known, but it seems to occur predominantly in older individuals. Awareness of these leflunomide toxicities in older RA patients can prevent extensive and invasive workups.

Glucocorticoids are often used in the treatment of RA, typically as a bridge to DMARD therapy. The use of low-dose glucocorticoids chronically (defined as ≤10 mg/day prednisone equivalent), usually in combination with synthetic (nonbiologic) DMARD therapy, is controversial. There are data which suggest improvements in structural outcomes and symptom severity with low-dose steroid use [76]. The risks with corticosteroids are well established in older patients and include infection osteoporosis, hyperglycemia, hypertension, and cataracts. However, many glucocorticoid side effects correspond with high doses [77]. The risk benefit ratio of low-dose glucocorticoids, specifically for older RA patients, has not been assessed. We propose that the risk assessment for the use of low-dose prednisone in older individuals with RA may be unique. In elderly RA patients, comorbidities, infection risk, and specific DMARD toxicities may limit the use of synthetic and biologic DMARDs in select older patients. Therefore, in very specific cases, low-dose prednisone may be a reasonable option. Future research regarding the utility of low-dose glucocorticoid therapy and algorithms for its use (or not) in older RA patients will be important to guide future recommendations.

Biologic DMARDs have revolutionized the treatment of RA. TNFi have demonstrated equal efficacy among older and younger RA patients with a comparable safety profile regardless of age [78, 79]. Risk of infection is always a concern when treating older RA patients with TNFi. Whether or not infection risk with TNFi is influenced by age alone remains a matter of debate. A large retrospective cohort study of older Canadian RA patients (>66 years) in a nested case–control analyses demonstrated an increased risk of infection associated with TNFi, although the greatest infectious risk was attributed to prednisone with an associated dose response [80]. In a study using data from the US Medicare and Medicaid population, the rate of serious infections among older RA patients on TNFi was found to occur at a constant rate (~1–4 infections per 100 person years) above the rate predicted by age, comorbidity, and other factors that contribute to infections independent of exposure to biologics [81]. These data support the observation that the increased risk of infection with TNFi is constant across age groups, although the background risk of infection is higher among older individuals in general. In summary, older RA patients should be educated about infections and closely monitored for infections while on treatment with TNFi, but this general risk alone should not be a reason to withhold TNFi therapy from the elderly.

Rituximab is an attractive biologic option for older individuals with RA because of the ease of administration. In a study of 1709 RA patients treated with rituximab from a French multicenter prospective cohort, patients in the 65–75 year age group had the highest percentage of responders at 12 months [82]. Patients in the >75 year age group had the lowest response rates. The incidence of severe infections was highest in the oldest age group (26.5%) and decreased accordingly (19.5% age 65–74 years; 6.8% 50–64 years; 5% <50 years) in the younger strata [82]. It cannot be established if the increased number of infections was attributable to rituximab or aging alone from these data.

Tocilizumab, an IL-6 inhibitor, demonstrated a good short-term safety profile among a retrospective cohort of older (≥65 years) French RA patients; however, after 6 months of treatment, older RA patients were less likely to have a high EULAR response category (representing low disease activity) compared to their younger counterparts [83]. Sarilumab is another FDA-approved IL-6 inhibitor that is also available for clinical use. It is important to note that medications that inhibit the IL-6 cytokine receptor have demonstrated increased risk of gastrointestinal perforation [Jagpal A, Curtis JR. Gastrointestinal Perforations With Biologics in Patients With Rheumatoid Arthritis: Implications for Clinicians. Drug Saf. 2018 Jun;41(6):545–553]; thus, it is important to screen patients for a recent history of active diverticulitis before initiating such therapy.

The class of medications known as janus kinase inhibitors includes tofacitinib, baricitinib, and upadacitinib, which are the first oral biologic agents available for treatment of rheumatoid arthritis. The efficacy of these medications to treat RA is well established. However, side effect profile is particularly notable for an increased risk of zoster infection [84, 85]. Indeed, a recent study indicated that the rate of herpes zoster infection may be up to 4% per year in patients treated with tofacitinib, and this rate doubles with glucocorticoid exposure [86]. These data are extremely relevant for older individuals where the risk of zoster is high, even before starting biologic therapy. Ideally, patients are vaccinated for zoster before starting the biologic agent (at least 2 weeks). If biologic therapy has already begun, do not delay vaccination, but as live vaccines are contraindicated, the inactivated recombinant zoster vaccine, Shingrix, should be administered.

Abatacept is a medication that, like the protein receptor CTLA-4, selectively modulates a costimulatory signal necessary for T-cell activation. In a study comparing sustained clinical remission in younger and older patients with biologic-naïve rheumatoid arthritis, the percentage of patients achieving sustained clinical remission at 24 and 48 weeks was similar in both groups; however, differences existed in predictive factors, such as anticitrullinated protein antibody (ACPA) positivity and patient-reported outcome scores [87]. In general, abatacept therapy in older patients appears to be as effective and well tolerated as in younger patients [88].

There are no data specifically for the use of anakinra and other IL-1 inhibitors among older RA patients.

Screening for latent tuberculosis (TB) risk is always advised before starting any biologic therapy. Among older RA patients, a positive TB screen (PPD or quantiferon-TB gold testing) will raise important clinical management issues regarding treatment with isoniazid (INH), which carries considerable risk of hepatitis among older individuals [89]. Data using a Markov decision analytic model examining the risk of INH versus the risk of TB reactivation found that withholding prophylaxis prior to TNFi may be an appropriate option in low-risk elderly RA patients [90]. These decisions need to be considered carefully and discussed with the patient and family members.

In summary, while risks associated with traditional and biologic DMARD treatment in older RA patients are real, these are generally manageable and preventable with careful patient selection, education, and close monitoring. The risk of undertreating older adults with RA is significant and may lead to CVD, precipitous functional decline, and poor quality of life.

18.2.2.6 Special Considerations in Older Patients with RA

Older RA patients have a higher prevalence of age-related syndromes (cognitive impairment, depression, falls, urinary incontinence, malnutrition) compared to younger RA patients [91]. Risk factors for the presence of geriatric syndromes among elderly RA patients include high RA disease activity, long disease duration, and functional impairment as measured by the Health Assessment Questionnaire (HAQ) [91]. Functional impairment, as measured by HAQ, increases with age among the general population and is highest among female RA patients over age 70 [92, 93]. Evaluation for geriatric syndromes is not routine practice for rheumatologists. Further, it is not included as a component of instruments frequently used to measure RA disease activity, such as the CDAI or DAS28. Such instruments focus primarily on the number of tender and swollen joints, ESR/CRP values, and general disease activity impressions alone. These authors propose that consideration of geriatric syndromes in the routine assessment of older individuals with RA by rheumatologists when evaluating disease activity could have important benefits. For example, when making a decision about the treatment regimen for an 87-year-old RA patient, if cognitive impairment is recognized, then complicated RA regimens, such as triple therapy with methotrexate, sulfasalazine, and hydroxychloroquine, would be quickly ruled out. However, if cognition is not considered in the evaluation of an older RA patient with mild-moderate cognitive impairment, then this issue may be easily overlooked. Geriatric syndromes are intimately tied to RA because of the synergistic effects on functional status, nutrition, and comorbidities. There is great opportunity for research in care models and care delivery systems which incorporate comanagement of RA and geriatric syndromes to optimize the health of this vulnerable population. See Chap. 8 for additional information on detection of geriatric syndromes suitable for research and clinical care.

Work disability can be a serious problem for individuals with RA. In a study using data from the National Data Bank for Rheumatic Diseases, a longitudinal study of RA outcomes, a sample of approximately 2500 patients with RA aged 55–64 years demonstrated significantly higher rates of premature work cessation and lower employment rates compared to age-matched controls [94]. As expected, early workforce withdrawal had a significant impact on the financial security of these patients in their retirement years [94]. In a subsequent study (from the same data source) using a nested case–control design, older age was the most prominent predictor of work disability among individuals with RA [95]. These findings demonstrate the effect of this chronic disease on finances, work satisfaction, quality of life, and retirement planning for individuals aging with RA as they transition into the seventh and eighth decades of life. Healthcare providers should recognize these issues that are unique to older RA patients in order to formulate comprehensive, yet feasible, treatment plans for their geriatric patients.

18.3 Crystalline Arthritis

18.3.1 Epidemiology

Deposition of monosodium urate crystals (gout) or calcium pyrophosphate crystals (pseudogout) are the most common causes of crystal-induced arthritis. Over 9 million individuals in the USA have gout, which is an increase of approximately 1 million from a decade prior [96]. Pseudogout has a point prevalence of 5.2 cases per 1000 people with an average age of 68 years in affected individuals and 30–50% of patients presenting over the age of 85 [97, 98]. Deposition of calcium phosphate hydroxyapatite crystals (chondrocalcinosis), a frequent precursor to pseudogout, is extremely common in the elderly [99]. Calcium phosphate *hydroxyapatite* crystals are part of the category of basic calcium phosphate (BCP) crystals, and it is known that, while periarticular BCP crystal deposits occur at all ages, intra-articular BCP crystal deposition associates strongly with older age and OA [100].

18.3.2 Diagnosis

The majority of gout attacks present with an inflammatory arthritis of the metatarsophalangeal joints (first MTP), foot, or ankle joints. However, in older patients, the first attack of gout may be polyarticular or involve the hands. Once the acute attack has resolved, patients enter an intercritical period during which time they are asymptomatic from gout. However, a large majority of patients will eventually experience another acute attack. Over time, if left untreated, the intercritical period shortens and gout becomes chronic. Elderly patients with chronic gout may have tophi, which are often misinterpreted as the bony hypertrophy of OA or chronic inflammation of RA.

The presentation of pseudogout can closely resemble that of gout, though with a few important differences. Pseudogout has a predilection for the wrists, hands, and knees. It is less common (but not absent) in the favored feet and ankles of gout. For example, an inflammatory monoarthritis of the wrist would raise suspicion for pseudogout (instead of gout or RA) in an older patient. Hence, definitive diagnostic testing is crucial. Crowned dens syndrome (CDS) is a complication of pseudogout, which presents with severe neck pain, headache, and fever. This can be confused with meningitis or giant cell arteritis. Imaging is key to diagnosis, and cervical spine CT will reveal characteristic calcifications from calcium pyrophosphate dihydrate crystals superior to and surrounding the dens, which results in a "crown-like" appearance on coronal views.

Calcium phosphate hydroxyapatite crystals and other BCP crystal-related arthritis can cause an inflammatory syndrome similar to gout or pseudogout. BCP crystals can cause a robust, destructive shoulder arthritis (Milwaukee shoulder) and had a predilection for older female patients, in which patients who are typically BCP is unique in that it can also cause a very inflammatory periarthritis and tendonitis

The gold standard for diagnosis of a crystalline arthritis is synovial fluid analysis. The synovial fluid of an acutely inflamed joint in a patient with active crystalline arthritis should show >2000 white blood cells/mm^2 and the presence of specific crystals, such as strongly negative birefringent monosodium urate crystals in gout or weakly positive birefringent rhomboid-shaped CPPD crystals in pseudogout. Special stains, such as with alizarin red, are required to identify calcium phosphate hydroxyapatite crystals. It is important to also evaluate for infection in cases of suspected crystalline arthritis, because septic arthritis may coexist or closely mimic the clinical picture. Synovial fluid cell count in crystalline arthritis may be extremely high, as in a septic arthritis; hence, gram stain and culture, if infection is suspected, are critical.

Imaging is helpful in the diagnosis of crystalline arthritis, with radiographs showing chondrocalcinosis in pseudogout and erosions with sclerotic margins and overhanging edges in advanced gout. Dual-energy computed tomography (DECT) is a noninvasive method for the visualization, characterization, and quantification of monosodium urate crystal deposits. In a recent meta-analysis of DECT imaging for gout diagnosis, the modality was found to have a sensitivity of 87% and a specificity of 84% [101]. In another study that excluded patients with tophaceous disease, the sensitivity was 90% and specificity was 83%, indicating that this imaging tool may be helpful even in patients without advanced disease [102].

18.3.2.1 Treatment

The treatment of gout involves management of acute flares and chronic prevention/prophylaxis. For acute flares, NSAIDs or corticosteroids (either oral or intra-articular depending on the number of joints involved) are the typical treatment modalities in the general population, but special attention must be paid to the use of these medications in elderly patients. The IL-1 inhibitor anakinra has been used for the treatment of acute gout flares [103], but the cost of this treatment can be prohibitive.

For the chronic treatment of gout, the key concept is reduction of serum uric acid level through medication and diet. The 2020 American College of Rheumatology guideline for the management of gout recommends uric acid-lowering therapy for anyone with tophi, erosions, or at least two flares per year [104]. While a low purine diet can help achieve this target, the majority of patients will require urate-lowering therapy (ULT). Xanthine oxidase inhibitor (XOI) therapy with either allopurinol or febuxostat is recommended as the first-line pharmacologic urate-lowering therapy (ULT) approach in gout. However, a recent study investigating the cardiovascular safety profiles of febuxostat and allopurinol found that all-cause mortality and cardiovascular mortality were higher with febuxostat than with allopurinol [105]. In response to these data, the FDA has added a black box warning for febuxostat stating that it is associated with an increased risk for cardiovascular (CV) death with the drug and that febuxostat use should be limited to patients who do not respond to or cannot tolerate allopurinol [106]. Probenecid and pegloticase are FDA-approved treatments for lowering uric acid in gout.

While titrating uric acid lowering therapy to a target of less than 6 mg/dL, pharmacologic anti-inflammatory prophylaxis is recommended. This may be in the form of low-dose colchicine, NSAIDs, or corticosteroids. Prophylaxis should be continued if there is any clinical evidence of gout disease activity and/or the serum urate target has not yet been achieved [104].

With respect to pseudogout, acute treatment also relies on use of NSAIDs or corticosteroids when appropriate. Long-term, there is no equivalent to urate lowering therapy as there is in gout with respect to a treat-to-target approach. Secondary causes of pseudogout should be screened for, namely, hemochromatosis, hypomagnesemia, hyperparathyroidism, hypothyroidism, and hypercalcemia. Correction of these metabolic conditions may improve disease. Low-dose colchicine has been used for prophylaxis in pseudogout, and there is some evidence to support efficacy [107].

Special considerations for the management of crystalline arthritis in older patients centers on medication toxicity and comorbidities. The use of NSAIDS versus steroids versus intra-articular injections needs to be carefully considered in the older patient presenting with an acute crystalline arthritis flare. Appropriate genetic screening (HLA-B*58:01) and patient education prior to the initiation of allopurinol can minimize the risk of toxicity. Assessing for medication interactions is always an issue when caring for older patients, but of particular importance in crystalline arthritis given the catastrophic interaction between allopurinol and azathioprine (6-MP).

18.4 Myositis and Myopathy in Older Individuals

18.4.1 Idiopathic Inflammatory Myopathies

18.4.1.1 Epidemiology

Muscular weakness is a common complaint among older individuals. The differential diagnosis for weakness is broad and includes nutritional deficiencies, poor conditioning, frailty, and metabolic derangements such as thyroid dysfunction or anemia. However, objective findings such as rash, fever, dyspnea, dysphagia, elevation in creatine kinase (CK), and measurable impairments in muscular strength should raise red flags for a systemic autoimmune myopathic process.

The idiopathic inflammatory myopathies (IIM), which include dermatomyositis, polymyositis, and immune-mediated necrotizing myopathies, are relatively rare with an estimated incidence of 1.16–19/million/year and prevalence of 2.4–33.8 per 100,000 individuals [108]. The incidence of IIM increases with age and peaks in 35–44 and 55–64–year-old age groups [109–111]. Age is an important predictor of mortality in IIM and may convey a poorer prognosis overall with regard to treatment response [112–114]. In 2017, the European League Against Rheumatism (EULAR) and the American College of Rheumatology (ACR) jointly issued classification criteria for adult and juvenile idiopathic inflammatory myopathies and their major subgroups [115], and these have been helpful for research purposes and in guiding clinical evaluation of patients.

18.4.1.2 Clinical Features of IIM in Older Adults

Few studies have investigated the clinical presentation and phenotype of IIM among older individuals. A retrospective study of 23 older (median age 69 years) patients with IIM compared to younger (age <65 years) adults found similar frequencies of myalgias, muscle weakness, skin manifestations, and interstitial lung disease [113]. Older patients had more esophageal dysfunction [113]. A case–control study of 21 older IIM patients (mean age 69.9 years) compared to 21 younger (mean age 46.4 years) patients yielded similar findings with the exception of lower CK at diagnosis among the older group [116].

The association between IIM and cancer is well established with advanced age being a key risk factor. Individuals with cancer-associated myositis are generally older and have a dermatomyositis phenotype and shorter survival [113, 116–118]. In a retrospective study of 139 patients with a new diagnosis of dermatomyositis, 8.6% were diagnosed with cancer within 12 months. Age at dermatomyositis onset was significantly older (by more than 15 years) among those who developed a malignancy compared to those who did not [119]. The risk of malignancy with IMM is thought to be greatest within the first year of diagnosis and does not normalize to the general population even after 5 years [120]. Therefore, a careful and thorough search for cancer should be performed in older individuals who develop a new IIM, particularly dermatomyositis.

18.4.2 Statins and Myopathy

At least 60–80% of Medicare beneficiaries with coronary heart disease are currently on statin therapy [121]. Overall, statin-induced myopathy is rare with a spectrum of myotoxicities that range from mild myalgias without CK elevation to rhabdomyolysis [122, 123]. Genetic variants and undiagnosed metabolic myopathies can predispose individuals to statin-associated myopathy [124–126]. Additional risk factors for the development of high CK levels while on treatment with a statin include older age (>65 years), diabetes, and male gender [127]. Several medications frequently prescribed for older patients such as verapamil, macrolide antibiotics, and amiodarone may also increase the risk of statin myotoxicity [128].

The National Lipid Association Statin Safety Assessment Task Force recommends obtaining baseline CK levels in adults at high risk for developing a statin-related myotoxicity [129]. Older adults, particularly those with polypharmacy or on medications which may increase myotoxicity risk when given concomitantly with a statin, fall into this category. Repeat CK measurements are not necessary unless the patient develops muscle symptoms. The presence of intolerable muscle symptoms, with or without CK elevation, should prompt discontinuation of the drug. In most instances, this should be sufficient to resolve the statin myopathy within a relatively short period of time (<2 months). Then if the symptoms resolve, a thoughtful discussion with the patient, the generalist, and cardiologist about the long-term benefit and burden of reinstituting a statin must occur so the patient's goals of care can be honored.

In cases of persistent muscle symptoms, despite termination of statin therapy, the patient may be suffering from an autoimmune process that is a distinct clinical entity from self-limited statin-associated myopathy and can be further evaluated with serologic testing. Specifically, patients should be tested for antibodies to 3-hydroxy-3-methylglutaryl-coenzyme A reductase (anti-HMGCR). The presence of these antibodies is highly suggestive of an immune-mediated necrotizing myopathy that may have been "unmasked" in the presence of statin therapy. Individuals with anti-HMGCR myopathy have proximal muscle weakness, very high CK levels (mean 10,000 IU/L), and a necrotizing myopathy on muscle biopsy [130, 131]. Additionally, despite its name, anti-HMGCR antibodies are frequently, but not always, associated with statin-triggered autoimmune myopathy. In fact, studies have shown that 33–56% of anti-HMGCR-positive patients had no prior exposure to statins [131, 132]. It is not yet known what triggers the IIM in these non-statin-exposed individuals. Although there is no established age association with anti-HMGCR at this time, it is clear that the prevalence of statin exposure increases with age, thereby placing older individuals at disproportionate risk.

18.4.3 Inclusion Body Myositis

Inclusion body myositis (IBM) is a common mimic of inflammatory myositis in older adults. It rarely occurs among individuals less than age 50, and it has a male predominance [133]. Slow, progressive, asymmetric muscular weakness is common and can initially appear very similar to polymyositis. However, IBM has key clinical features which distinguish it from the inflammatory myopathies, such as distal weakness in the wrist and deep finger flexors with sparing of wrist and finger extensors. Facial weakness and dysphagia may also be present [133–135]. A diagnosis of IBM can be made on the basis of clinical features, muscle pathology, and new biomarkers with relatively high specificity but varying sensitivity, according to current diagnostic categories [136]. Distinguishing IBM from IIM is extremely important because immunosuppressive and immunomodulatory agents, which are highly effective in treating IIM, have not shown efficacy in IBM and may be detrimental [134]. Resistance exercise and orthoses are the primary treatment modalities for IBM [137].

18.4.4 An Approach to Diagnosis and Management of Older Patients with Myopathy

When faced with an older patient who has symptoms of weakness, we propose a systematic approach to diagnosis and management. Diagnostic precision is key because without an accurate diagnosis, the wrong or unnecessary treatment may be prescribed to an elderly frail individual which could be devastating. Although diagnostic testing in this evaluation may be extensive and include imaging and invasive procedures, such as muscle biopsy and EMG/NCS, the acquisition of data will be valuable when teasing out the source of this vague common complaint in older patients.

On physical exam, the pattern of *objective* weakness (proximal vs. distal) can narrow the differential diagnosis if it is consistent with IIM, IBM, or spinal cord pathology (myelopathy). The presence of a new rash, Raynaud's phenomenon, inflammatory arthritis with synovitis, or cuticular abnormalities (abnormal nailfold capillary microscopy) in an older individual with muscular complaints suggests an immune-mediated process. A thorough review of a patient's medication and supplement lists, particularly the presence (or absence) of statin therapy, may reveal a single myotoxic agent or medications which when used together predispose to myopathy. Laboratory data, namely myositis-specific autoantibodies, thyroid studies, and CK measurements, are incredibly useful although these need to be interpreted in the context of the clinical picture. Normal or very minor CK elevations in older patients with sarcopenia, low BMI, and weakness may be highly significant. Similarly, elevated CK (above the upper limit of normal) in a very physically active older individual with high muscle mass, normal strength, and who engages in resistance training may be a normal finding.

Therapeutic interventions for myopathy in older adults are targeted at the disease process. For IIM (including anti-HMGCR immune-mediated necrotizing myopathy), immunosuppression with corticosteroids, methotrexate, intravenous immunoglobulins, and other agents is a standard of care. Adverse events which may be seen more frequently in older individuals include volume overload, infection (typical and opportunistic), cognitive impairment, and anorexia. Regular surveillance for these complications should be conducted routinely.

Resistance exercise should be a part of the treatment plan for every patient with IIM or IBM. Multiple studies, including randomized controlled trials, have demonstrated safety and efficacy of resistance exercise in IIM and IBM [138, 139]. Little is known specifically about how to tailor resistance training programs to the needs of older adults with myopathy, and this is an important area for future investigation. We propose that a resistance exercise program with a focus on large muscle groups (legs, back, and chest) in order to improve functional mobility and increase muscular strength should be prescribed routinely for older individuals with myopathy as a standard part of their treatment plan.

18.5 Vasculitis in Older Individuals

18.5.1 Giant Cell Arteritis and Polymyalgia Rheumatica

Giant cell arteritis (GCA) is a systemic inflammatory disease that occurs almost exclusively in the elderly. It is the most common form of systemic vasculitis in older persons in North America with an annual incidence which is highest among those over age 70 [140, 141]. Common symptoms of cranial GCA are headache, jaw claudication, and diplopia with the latter two symptoms having the highest positive predictive value for a positive temporal artery biopsy [142]. Jaw claudication is a red flag in older patients, because it is associated with a high likelihood of visual symptoms in GCA [143]. Large-vessel GCA may occur with cranial GCA or independently. Large-vessel GCA can present with indolent nonspecific symptoms such as arthralgias, myalgias, fever, and/or limb claudication. GCA should always be considered in the evaluation of an older patient with fever of unknown origin or unexplained laboratory evidence of inflammation (high ESR/CRP, hypoalbuminemia, anemia of chronic inflammation) and systemic symptoms [144]. An accurate diagnosis of GCA is important in order to avoid unnecessarily treating older patients with high-dose corticosteroids. Temporal artery biopsy (>1 cm length) and imaging of the aorta can provide important data for diagnostic certainty [145–148]. MRI, CT angiography, or PET-CT can be useful to demonstrate aortitis in a patient in whom GCA is suspected, but the temporal artery biopsy is negative, or in a patient presenting with signs and symptoms of large-vessel GCA alone. Imaging of the large vessels to identify large-vessel giant cell arteritis is particularly useful when faced with an older patient with fever of unknown origin.

Corticosteroids, starting at a dose of 1 mg/kg, are still the first-line treatment for GCA [149]. Yet more than half of patients with GCA experience two or more adverse steroid-associated events with the majority being bone fractures [150]. The well-established morbidity of corticosteroids in older individuals makes the recent advances in steroid-sparing therapies for GCA encouraging. There are data that support the use of methotrexate in GCA. However, the overall effect size of methotrexate for GCA is modest, and the use of methotrexate has not translated into fewer steroid-associated side effects [151]. The same caveats apply to the use of methotrexate in older patients with GCA as for older individuals with RA.

Tocilizumab, a recombinant humanized monoclonal antibody that acts as an interleukin 6 (IL-6) receptor antagonist, has been approved by the FDA for the treatment of GCA. A landmark 2017 study demonstrated higher rates of sustained steroid-free remission at 52 weeks in GCA patients treated with tocilizumab versus placebo [152]. In terms of safety profile, transaminitis, neutropenia, and infections have been observed during treatment with tocilizumab for GCA [153, 154]. Other medications that have been tested in the treatment of GCA include abatacept [155], ustekinumab [156], and anakinra [157], but none are currently FDA approved. Anti-TNF therapy has not demonstrated efficacy in the treatment of GCA [158–160].

In a systemic disease which generates robust inflammation and primarily utilizes a therapy that is fraught with complications in older individuals, it is not surprising that additional non-vasculitis complications are common. Patients with GCA are at increased risk (compared to non-GCA age-matched individuals) for infections, particularly in the first 6 months after diagnosis [161]. GCA patients are also more likely to be hospitalized for pneumonia, hip fracture, and stroke than those without GCA [154]. During hospitalization, GCA patients are more likely to have inpatient complications, namely, delirium, adrenal insufficiency, deep vein thrombosis, and pulmonary embolism [154]. The mechanism for increased risk of venous thromboembolism in GCA is not known, but the phenomenon appears to be a real trend [162]. Small, retrospective studies have suggested the low-dose aspirin may be beneficial in GCA as its use was associated with decreased risk of vision loss and stroke [163]. However, there have not been any randomized controlled trials to establish the safety and efficacy of aspirin as adjuvant therapy in GCA [164].

GCA is a disease of older individuals, and when managing elderly GCA patients (>70 years), it is our opinion that it is important to consider the following issues. In the context of high-dose steroids, close monitoring and frequent follow-up can be helpful to regularly assess for complications which may occur suddenly, namely, infections, delirium, changes in blood pressure, and hyperglycemia. Appropriate initiation of bone-protective strategies and counseling on fall risk should be addressed at every visit. Due to the increased thromboembolic risk associated with GCA, patients and their family members should be advised and educated about this risk. If an older GCA patient is hospitalized, appropriate prophylaxis for thromboembolic disease should be utilized. We recommend that a prescription for physical therapy and/or an exercise program is provided to older patients at the time of GCA diagnosis in order to combat steroid myopathy, fat gain, and muscle loss associated with corticosteroids. There has been little research on how to prevent musculoskeletal complications from corticosteroids among older GCA patients, and this is an area of research which is desperately needed.

Polymyalgia rheumatica (PMR) is a systemic inflammatory condition which presents with disabling pain and stiffness in the shoulder and hip girdle regions. It occurs exclusively in individuals over the age of 50 with an incidence that increases with age (mean age onset 73 years) [165, 166]. There is a relationship between PMR and GCA. Approximately 40–60% of patients with GCA have PMR, and 16–21% of patients with PMR have GCA [167].

The diagnosis of PMR in an older individual can be challenging because there are many mimics such as malignancy, chronic infections, and other inflammatory musculoskeletal conditions. The 2012 Provisional Classification Criteria developed by ACR/EULAR include the key components of PMR: age (≥50 years), abnormal ESR and/or CRP, morning stiffness, and bilateral shoulder symptoms [168]. However, it is well recognized that early in the disease course, late-age onset RA can look clinically just like PMR. Therefore, the absence of ACPA, RF, and other joint symptoms (i.e., inflammatory arthritis of the small joints of the hands and feet) increases the likelihood of a PMR diagnosis by the 2012 ACR/EULAR criteria [168]. ACPAs, in particular, have shown value in distinguishing late-age onset RA from PMR. In a study of 57 late-age onset RA patients, 49 PMR patients, and 24 aged healthy controls, it was found that 65% of late-age onset RA patients were positive for ACPA, while none of the PMR or healthy controls were positive for ACPA [169]. Therefore, serologic testing for ACPA is an important part of the evaluation for PMR in older individuals.

Low-dose corticosteroids remain the mainstay of treatment for PMR (<20 mg daily). The 2015 ACR/EULAR recommendations for the management of PMR acknowledge the morbidity of corticosteroids in older individuals and endorse some key geriatric practices and principles to minimize toxicity [170]. For example, comprehensive assessment of comorbidities and frequent physician visits with direct and easy access to providers are strategies advised by these recommendations [170]. In that regard, Chap. 8 describes basic elements for evaluating and tracking the common problems likely to be encountered in this population.

18.5.2 ANCA-Associated Vasculitis

The ANCA-associated vasculitis (AAV) includes granulomatosis with polyangiitis (GPA, Wegener's), microscopic polyangiitis, and eosinophilic granulomatosis with polyangiitis (Churg–Strauss syndrome). Although AAV is rare in the general population, there is an increased incidence in older age groups [171]. The spectrum of organ involvement is similar among older and younger individuals with AAV [172]. GCA is often on the differential diagnosis of an older patient presenting with fever, headache, myalgias, and systemic inflammatory symptoms. In a descriptive study of 22 patients with newly diagnosed AAV after age 75, 18% had undergone TA biopsy prior to AAV diagnosis [172]. However, in retrospect, there were clues to the diagnosis of AAV in these older individuals, namely, hematuria, neuropathy, and otolaryngologic manifestations of GPA [172]. ANCA testing can be very helpful in the evaluation of an older patient with systemic inflammatory signs and symptoms.

The treatment paradigm for AAV is the same for older and younger individuals. Life- and organ-threatening manifestation of vasculitis are managed with induction therapy (cyclophosphamide or rituximab) followed by long-term immunosuppressive maintenance therapy. Older individuals are particularly susceptible to cyclophosphamide toxicities such as leukopenia and infection [173]. A recent randomized controlled trial of older patients (≥65 years) with systemic necrotizing vasculitis (93% AAV) demonstrated that an induction protocol using *lower* doses of cyclophosphamide and corticosteroids than conventional protocols was comparable in terms of efficacy [174]. Importantly, there were fewer serious adverse events in the low-dose cyclophosphamide group [174]. Rituximab, as an induction agent for AAV in an older individual, is an attractive option because of the lower risk of cytopenias and less frequent monitoring that is required compared to cyclophosphamide. The decision to treat an older patient with severe renal failure from AAV and requiring dialysis can be challenging. Renal recovery is a realistic expectation even for older patients with AAV if appropriate treatment is initiated [175]. See Chap. 25 for discussion of the special considerations around dialysis decisions in older patients.

18.6 Connective Tissue Disease and Raynaud's Phenomenon in Older Individuals [176–184]

18.6.1 Raynaud's Phenomenon in Older Individuals

Cold hands and feet are common complaints among older individuals. However, a careful history and physical exam will distinguish between cold hands and Raynaud's phenomenon (RP). RP is characterized by recurrent vasospasm of the fingers and toes in response to stress or cold exposure. Primary RP is a benign process, usually among young women (<40 years of age), and it is characterized by symmetric bilateral RP, normal laboratory studies (negative autoantibodies), and normal physical exam (no evidence of ischemia, normal nailfold capillaroscopy) [185]. Often, primary RP will diminish with time and age.

The new onset of RP in individuals over age 40 years should prompt investigation for a systemic inflammatory condition, because late-age onset RP is strongly associated with the development of connective tissue diseases [186–188]. When presented with an older patient with RP, a careful history can determine the age of onset. Physical exam should focus on evaluation for clinical features of connective tissues disease (scleroderma, lupus, myositis, etc.) and mimics of RP (atherosclerosis, hyperviscosity syndromes, malignancy, medication effects) with close attention to the vascular exam and nailfold capillaries [189]. Evaluation of autoantibodies may be a helpful guide to longitudinal monitoring for the development of systemic autoimmune disease, such as scleroderma, in older patients with new RP [190].

18.6.2 Late-Age Onset Scleroderma

Scleroderma or systemic sclerosis (SSc) is a relatively rare condition across all age groups with a prevalence of 240 patients per 1 million US adults, and a peak age of onset between 40 and 50 years old [191, 192]. However, incident disease after age 60 is not uncommon with at least one study demonstrating a peak incidence in Caucasian women occurring between the ages of 65–74 years [191, 192]. Older patients with late-age onset SSc (≥65 years of age) are at increased risk for pulmonary hypertension, cardiac disease, muscle weakness, and renal impairment compared to those with onset of disease at younger ages [193]. Pulmonary hypertension, in particular, should be screened for regularly in the older SSc population. A relationship between SSc and malignancy has been clearly identified, particularly among individuals with antibodies against RNA polymerase III [194]. Given the increased overall prevalence of malignancy in the elderly, the new onset of SSc features in an older individual should prompt a comprehensive cancer evaluation as well [195].

The differential diagnosis for fibrosing conditions of the skin should include eosinophilic fasciitis (also known as Shulman's syndrome), nephrogenic systemic fibrosis (particularly in patients with renal impairment exposed to gadolinium contrast, scleromyxedema (associated with the presence of a monoclonal gammopathy), and scleredema (which can be seen with diabetes). Although these conditions can be seen at any age, the comorbidities which tend to accompany them (e.g., malignancy, gammopathies, and diabetes) are more frequent in the older population.

18.6.3 Late-Age Onset Systemic Lupus Erythematosus

The incidence of systemic lupus erythematosus (SLE) after age 50 is estimated to be between 3% and 18% [196–198]. Although SLE is predominately seen in women, advanced age decreases this gender gap [199]. The phenotype of late-age onset SLE is heterogenous, and most manifestations in younger patients have also been described in older individuals [199, 200]. When considering a diagnosis of late-age onset SLE, it is particularly important to exclude drug-induced lupus. Many of the medications implicated in drug-induced lupus are commonly used in older individuals such as procainamide, hydralazine, carbamazepine, methyldopa, minocycline, interferon-alpha, TNFi agents, and rarely beta-blockers [201]. There are no age-specific recommendations regarding management of SLE. Hydroxychloroquine (HCQ) is a cornerstone of therapy for SLE. Careful attention should be paid to HCQ dosage in older SLE patients, as this should be based on weight (not exceeding 56 mg/kg/day) and creatinine clearance to minimize risk of retinal toxicity [202, 203]. The risk of HCQ retinopathy may not be associated with age, but it clearly increases with duration of therapy [204]. Therefore, it is important to considering total cumulative exposure of HCQ when determining screening intervals for older SLE patients.

18.6.4 Primary Sjogren's Syndrome

Primary Sjogren's syndrome (SS) is a systemic inflammatory condition that affects the salivary and lacrimal glands. The hallmark feature is sicca or dryness of the eyes and mouth. The overall prevalence of SS is about 0.5–1%, and estimates in older populations are higher [205, 206]. Dry mouth is very common in the geriatric population. Older individuals (without SS) have less salivary secretion and higher rates of xerostomia than younger individuals [207, 208]. This is due to a combination of factors including age-related decreases in acinar cells and commonly prescribed medications (anti-histamines, SSRIs, diuretics, etc.) [207, 208]. Since sicca symptoms alone lack specificity for SS, it becomes particularly important to obtain objective evidence of an immune-mediated process when considering a diagnosis of SS for an older patient. The 2016 ACR/EULAR classification criteria for primary Sjogren's syndrome are based on the weighted sum of five items: anti-SSA/Ro antibody positivity; focal lymphocytic sialadenitis with a focus score of $\geq$1 foci/4 mm^2, each scoring 3; an abnormal ocular staining score of $\geq$5 (or van Bijsterveld score of $\geq$4); Schirmer's test result of $\leq$5 mm/5 minutes; and an unstimulated salivary flow rate of $\leq$0.1 ml/minute [209]. Cancer, namely lymphoma, is a concern in SS regardless of age. Red flags which should prompt thorough investigation for an occult lymphoproliferative process in an older patient with SS include low C4 levels, new development of vasculitis, monoclonal gammopathy, and cryoglobulinemia [210]. Treatment of SS in elderly patients does not differ from management in younger adults, and in both cases, the goals are to manage glandular and extra-glandular manifestations, prevent organ damage, and decrease morbidity and mortality [211].

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Cardiovascular Disease

19

Susan P. Bell and Michael W. Rich

19.1 Introduction

The number and proportion of adults over the age of 65 worldwide is increasing at a rapid rate due to improved sanitation, nutrition, access to health care and medical advances in prevention, diagnosis and treatment for both communicable and non-communicable diseases [1]. In the United States, 16.9% of the current population is over the age of 65 and it is estimated that the proportion will increase to 20.6% by the year 2030, including 9 million people aged 85 and older [2].

In parallel, the global burden of cardiovascular disease (CVD) has increased exponentially over the last 30 years despite remarkable advances in CVD prevention and treatment. This includes a disproportionate burden of ischemic heart disease deaths occurring in individuals over 80 years of age, especially women, where they represent 50% of all IHD deaths [3]. In the United States, approximately 40 million adults over the age of 65 report one or more cardiovascular (CV) disorders and CVD is the leading cause of major morbidity and mortality in that population, which accounts for over 80% of all deaths attributable to CVD [4]. Notably, although advancing age is the most potent predictor of CVD, it is a non-modifiable risk factor. Nonetheless, biological aging and the effects of aging on the CV system vary considerably from individual to individual, and there is evidence that behavioral factors, including diet, physical activity, and smoking, modulate the aging process and the incidence of age-related disease. It is therefore essential that cardiovascular providers understand the marked interactions between aging and CVD, the impact of co-existing disease processes, limitations of currently available evidence, and the inherent complexities involved in providing patient-centered care aligned with individual patient preferences. This chapter examines the principal effects of aging on the CV system, geriatric factors that modulate CVD in older adults, and differences in the management of CVD in older compared to younger individuals.

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19.2 Aging and the Heart

Biological aging has a fundamental effect on the development and progression of CVD through two different but synergistic mechanisms. Age-associated vascular changes do not independently cause vascular disease, but alterations in cellular and molecular mechanisms, especially those responsible for regeneration and response to stress, greatly increase the vulnerability of the heart and vasculature to the development of CVD [5, 6]. In addition, the longitudinal nature of aging allows for the accumulation of genetic risk factors, acquired risk factors (e.g., hypertension), lifestyle choices, and environmental factors, which taken together, greatly increase the likelihood of developing CVD with increasing age. Cardiovascular changes associated with aging are widespread and include alterations in both structure and function. Table 19.1 lists major changes in the heart, vasculature, hemodynamics, and response to exercise that impact the clinical presentation of CVD in older adults.

19.3 Traditional Cardiovascular Risk Factors

19.3.1 Hypertension

Age-associated increased central arterial stiffness, increased peripheral resistance, and impaired vascular reactivity contribute to hypertension being the most prevalent risk factor for CVD in older adults. By age 75, approximately 80% of women and 70% of men in the United States are classified as

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Table 19.1 Cardiovascular changes associated with aging

Arterial structure and function
Increased lumen size
Increased wall thickness (intima-media thickening)
Increased calcification
Increased tortuosity of large vessels
Increased collagen cross-linking
Degeneration and fragmentation of elastin
Decreased endothelial function
Increased stiffness of large and medium-sized arteries (decreased distensibility)
Cardiac anatomy
Increased atrial size (LA > RA)
Increased LV wall mass and thickness
Increased LV stiffness (decreased compliance)
LV fibrosis and collagen accumulation
Degeneration (calcific) of valve leaflets and annulus
Decreased LV cavity size and longitudinal shortening
Fibrosis, calcification, and degeneration of conducting system
Decline in number of sinoatrial node pacemaker cells
Hemodynamics
Increase in systolic blood pressure
Increase in pulse wave velocity
Earlier reflection of pulse wave and augmentation of blood pressure in late systole
Decrease in aortic peak flow velocity
Reduction in peak LV filling rate
Decreased ratio of early LV filling (E) to atrial filling (A)
Changes during exercise
Decrease in maximum heart rate (220-age)
Decline in heart rate variability
Increase in atrial and ventricular ectopy
Reduced cardiac output reserve
Reduction in end systolic volume reserve
Reduction in VO_2 max
Impaired peripheral vasodilation

LA Left Atrium, *RA* Right Atrium, *LV* Left Ventricular/Ventricle, *A-V* Atrioventricular, *VO_2 Max* Maximal Oxygen Consumption

hypertensive, yet they have the lowest rates of optimal control. With vascular aging, the systolic blood pressure increases progressively, whereas the diastolic blood pressure peaks at approximately age 50 and then plateaus before declining after 60 years of age in both men and women. As a result, isolated systolic hypertension (ISH) is the dominant form of hypertension in older adults. In turn, ISH is strongly associated with an increased risk for stroke, end-stage renal disease, myocardial infarction (MI), heart failure, and CV and all-cause mortality. While the treatment of hypertension at any age (including ≥85 years) reduces CV and cerebrovascular events, optimal treatment thresholds and target blood pressures have not been clearly defined for older adults, especially those with multimorbidity and other geriatric syndromes.

In the Hypertension in the Very Elderly Trial (HYVET), 3845 patients 80 years of age or older (mean 83.6 years, 60.5% women) with systolic blood pressure ≥160 mmHg were randomized to the diuretic indapamide 1.5 mg or matching placebo [7]. Perindopril or placebo was added as needed to achieve a target blood pressure <150/80 mmHg. The primary outcome was fatal or nonfatal stroke. After a mean follow-up of 1.8 years, active treatment was associated with a 30% reduction in the primary outcome, and reductions in secondary outcomes of incident heart failure and all-cause mortality. The results of HYVET led to a recommendation by several hypertension guideline committees to aim for a goal of <150 mmHg when treating systolic hypertension in patients ≥80 years of age.

More recently, the Systolic Blood Pressure Intervention Trial (SPRINT) randomized 9361 patients ≥50 years of age (28.2% ≥ 75 years of age) at increased cardiovascular risk (as defined by subclinical or clinical CVD, chronic kidney disease, 10-year risk of CVD ≥ 15% based on the Framingham Risk Score, and/or age ≥75 years) and with baseline systolic blood pressure 130–180 mmHg to intensive treatment (target blood pressure <120 mmHg) or standard treatment (target blood pressure <140 mmHg) [8]. Patients with diabetes mellitus, symptomatic heart failure in the preceding 6 months, recent acute coronary syndrome (ACS), prior stroke, orthostatic systolic blood pressure <110 mmHg, unintentional weight loss (a component of frailty), or residence in a nursing home or assisted living facility were excluded. Women and patients with multimorbidity were also underrepresented. The primary outcome was a composite of myocardial infarction (MI), other ACS, stroke, heart failure, or cardiovascular death. A substudy (SPRINT MIND) examined the impact of the intervention on the incidence of mild cognitive impairment (MCI) and dementia [9]. The study was stopped prematurely at a median follow-up of 3.26 years due to a significant benefit of intensive treatment on the primary outcome (2.19% per year with standard treatment vs. 1.65% per year with intensive treatment, hazard ratio 0.75, 95% CI 0.69–0.89, $p < 0.001$). Outcomes were similar in patients ≥75 years of age compared to those <75 years, but the absolute benefit was numerically greater in the older subgroup. All-cause mortality, CV mortality, and incident heart failure were significantly reduced with intensive treatment, but there was no effect on MI, ACS, or stroke. The number needed to treat for 1 year to prevent one primary outcome event was 185. Treatment-related serious adverse events, including acute kidney injury, electrolyte abnormalities, hypotension, and syncope (but not injurious falls), were all significantly more frequent in the intensive therapy group. The incidence of adverse events was similar among patients older or younger than age 75. In the SPRINT-MIND substudy, at 5-year follow-up, there was no difference between groups in the primary outcome of incident dementia, but intensive treatment was associated with reductions in both secondary outcomes of incident MCI and a composite of dementia and MCI; however, these findings were attenuated when stratified for gait speed and frailty status.

The SPRINT study provides strong support for more intensive blood pressure treatment of older adults in relatively good health with a low burden of multimorbidity. For individuals who would not have met the SPRINT inclusion/exclusion criteria (up to two-thirds of those age 75 or older), the applicability of the findings is uncertain and the possible reduction in CV events and death must be balanced against the potential for adverse events, increased burden of medications, and unknown impact on quality of life, functional status, and cognition. Based on the results of HYVET, SPRINT, and current guidelines, it is reasonable to treat individuals ≥75 years of age who are suitable candidates for antihypertensive drug therapy to a goal blood pressure of <130/80 mmHg based on the clinical profile and patient preferences. However, in more frail individuals and those with significant multimorbidity or limited life expectancy, BP treatment should be individualized.

Management of hypertension in older adults is often complicated by orthostatic or post-prandial hypotension, which may be associated with light-headedness and increased risk for falls and syncope. In addition, "white coat" hypertension is common in older adults (i.e., office blood pressure higher than home blood pressure), and older individuals with stiff arteries may exhibit pseudohypertension (blood pressure measured by sphygmomanometer higher than central aortic pressure). For these reasons, it is important to measure blood pressure in the sitting and standing positions and, more critically, to obtain blood pressure readings in the home environment adhering to AHA guidelines. In some cases, 24-hour ambulatory blood pressure monitoring may be helpful in determining the presence and severity of hypertension, as well as the variability in blood pressure readings. In patients with significant orthostatic hypotension (decline in systolic blood pressure ≥20 mmHg on standing), titration of antihypertensive therapy should be very gradual and should include periodic assessments of orthostatic blood pressure changes and evaluation for symptoms attributable to orthostasis. Notably, orthostasis often improves with effective antihypertensive therapy.

19.3.2 Hyperlipidemia

Dyslipidemia remains an important risk factor for CVD in older adults up to age 85; after age 85, the association of lipid levels with CVD is less clear [10]. In addition, the strength of association between cholesterol levels and CVD declines with age, such that total cholesterol and LDL cholesterol become less predictive of CV events at older age. Factors affecting the relationship between cholesterol and CVD risk at increased age include survival bias among individuals with low CVD risk despite increased cholesterol levels, and the impact of co-existing diseases (e.g., malignancy, chronic inflammatory disorders) and malnutrition (a common condition in older adults). Statins are highly efficacious for the treatment of dyslipidemia, and numerous trials have documented the benefits of statins on CVD outcomes, although persons over age 80 have been markedly under-represented in these trials. Nonetheless, statins are universally recommended for secondary prevention irrespective of age [11]. The separation between primary and secondary prevention has blurred as noninvasive methods for detection of subclinical CVD have advanced. Coronary artery calcium (CAC) scores provide a noninvasive marker of subclinical atherosclerosis that correlates with risk for future coronary events in younger and older adults. CAC scores increase with age leading to reduced specificity for identifying patients at low risk for a coronary event. However, current guidelines provide a class IIB recommendation for assessing CAC score in adults 76–80 years of age with LDL-cholesterol 70–189 mg/dl and no known atherosclerotic CVD. In these individuals, a CAC score of 0 portends very low risk for coronary events over a 10- to 15-year time horizon and may therefore allow avoidance of statin therapy.

In primary prevention trials, fewer patients over age 80 have been enrolled, and patients with complex comorbidity have frequently been excluded. In addition, statin side effects, such as myalgias, may be more common in older adults. Recognizing the paucity of evidence on statins in older patients, current guidelines recommend that treatment decisions consider anticipated benefits and adverse effects (including their time horizon), life expectancy, comorbidities, and individual treatment priorities [12]. In addition, the guidelines advise caution in using high-intensity statin therapy in individuals over 75 years of age. To address the paucity of evidence on statins for primary prevention in older adults, two large randomized trials are currently underway. STAREE (STAtins for Reducing Events in the Elderly, NCT02099123) is randomizing 18,000 community-dwelling Australians age 70 or older without known atherosclerotic CVD or diabetes to atorvastatin 40 mg daily or placebo. The primary outcome is disability-free survival and the estimated trial completion date is late 2023. PREVENTABLE (Pragmatic Evaluation of Events and Benefits of Lipid-lowering in Older Adults, NCT04262206), sponsored by the National Institutes of Health, is randomizing 20,000 community-dwelling adults age 75 or older without known atherosclerotic CVD (but including those with diabetes) to atorvastatin 40 mg or placebo. The primary outcome is survival free of new dementia or persistent disability. The planned completion date for the study is 2024, but this may be delayed due to the SARS-CoV-2 pandemic.

As an alternative or adjunctive therapy, ezetimibe provides modest lipid-lowering effects and is usually well tolerated in those with statin-related adverse effects or inadequate lipid lowering at maximally tolerated statin doses. More recently, PCSK9 inhibitors have been shown to markedly lower total and LDL-cholesterol levels with corresponding reductions in CV events. These agents have become second-line therapy for individuals when target cholesterol goals are not achieved through standard therapies. The data suggest that these cardiovascular benefits extend to adults over the age of 70 and these agents should be considered for achieving secondary prevention goals in selected patients [13, 14].

19.3.3 Diabetes Mellitus

Diabetes mellitus (DM) is a powerful and independent predictor of the development and progression of CVD in older adults, imparting an increase in relative risk of CAD of 1.4 in men and 2.1 in women 65 and older with a significant sex interaction (i.e., stronger association in women). Although the relative risk in individuals over the age of 65 is lower than in younger individuals with DM, the high prevalence of DM in older adults (26.8%) results in greater absolute risk [15].

Management of CV risk in patients with DM should focus on treating co-existing CVD risk factors, including hypertension and dyslipidemia, which are present in 71% and 65% of older diabetics, respectively [21]. Additionally, utilization of an angiotensin converting enzyme inhibitor (ACE-I) or an angiotensin receptor blocker (ARB) in older adults with diabetes is effective for reducing CV mortality [16]. More recently, data have supported the use of SGLT2 inhibitors and GLP-1 receptor antagonists as first-line therapy for CVD risk reduction in patients with type 2 DM with consistent cardiovascular benefit demonstrated in multiple randomized controlled trials [17, 18]. In subgroup analyses of SGLT2 inhibitors, these benefits extend to and are more significant in individuals over 65 years of age; however, older adults may be more prone to side effects, such as urinary tract infections, bone fractures, and hypotension. In contrast, older adults may derive less benefit with GLP-1 receptor antagonists than younger adults. Regular physical activity and maintaining a healthy body weight should also be encouraged. Additional recommendations for managing DM in older adults are provided in Chap. 24.

19.3.4 Smoking

Smoking accounts for 30% of the attributable risk of all strokes and 36% of first acute coronary events [19]. The prevalence of smoking decreases with age, but it remains a significant risk factor in older adults. Although the relative risk for MI or death as a result of smoking in an individual over the age of 70 is twice that of an individual age 55–60, older patients are less likely to receive smoking cessation counseling or interventions.

Individuals who smoke should be advised of the risks associated with smoking and given guidance on cessation strategies. In addition, the USPSTF recommends one-time screening for abdominal aortic aneurysm with ultrasonography in men aged 65–75 years who have ever smoked.

Older individuals may be resistant to changing life-long habits, but the negative effects of continued smoking irrespective of age demand continued efforts to promote smoking cessation.

19.4 Geriatric Syndromes and Cardiovascular Disease

19.4.1 Multimorbidity

Multimorbidity, defined as the presence of two or more chronic conditions, increases exponentially with age and is present in over 70% of individuals 75 years or older [20]. By the age of 65, more than 60% of individuals have two or more chronic conditions, >25% have four or more chronic conditions, and nearly 10% have six or more conditions; by age 85, >50% of individuals have four or more chronic conditions and 25% have six or more conditions. The accumulation of chronic conditions culminates in a vastly heterogeneous population of older adults for whom balancing the management of multiple medical problems becomes paramount.

Among Medicare beneficiaries with CVD, the burden of multimorbidity is substantial; for example, over 60% of individuals with a diagnosis of heart failure or stroke have five or more coexisting chronic medical conditions. In older adults with CVD, the most common concomitant non-CVD conditions are arthritis, anemia, and diabetes mellitus, with prevalence rates ranging from 40% to 50%. Other common conditions include chronic kidney disease, cognitive impairment, chronic obstructive lung disease, and depression, each of which must be considered when developing individual treatment strategies for the management of CVD [21].

19.5 Polypharmacy and Drug Interactions

Older adults with multimorbidity are frequently seen by numerous general and specialist providers, which can result in competing management strategies and numerous prescriptions for medications. In addition, the high cost of several new medications, such as angiotensin receptor-neprilysin inhibitors, SGLT2 inhibitors, GLP-1 receptor antagonists, and PCSK9 inhibitors, may be prohibitive for older adults with limited financial resources. Polypharmacy, often defined as concomitant use of five or more medications, is associated with markedly increased risk for drug-drug interactions, drug-disease interactions, and therapeutic competition (the recommended treatment for one condition may adversely affect and/or compete with another coexisting condition). Approximately 50% of older adults are taking at least one medication with no active indication, and many of these drugs are initiated during hospitalization, such as stress ulcer prophylaxis and antipsychotics for delirium. Careful medication reconciliation including prescribed medicines, over the counter pharmaceuticals and herbal therapies should be performed at each provider interaction. Adverse consequences of polypharmacy, including poor adherence, adverse drug events, hospitalization and mortality, are related not only to the number of medications but also to the regimen complexity, so attention should be given to limiting the number of medications as well as simplifying the dosing schedule.

Non-steroidal anti-inflammatory drugs (NSAIDs) are frequently taken by older adults to relieve burdensome pain or for treatment of arthritis. However, NSAIDs, including the cyclo-oxygenase 2 (COX-2) inhibitors, increase the risk of atherothrombotic vascular events and incident heart failure [22]. In addition, NSAIDs have adverse interactions with many CV medications, including diuretics, other antihypertensive agents, and anti-thrombotic drugs. NSAIDs have also been associated with worsening renal function and increased risk for gastrointestinal bleeding. For these reasons, the FDA and the American Heart Association suggest minimizing use of NSAIDs when feasible, and using the lowest possible doses for the shortest period of time. Polypharmacy and medication management are discussed in greater detail in Chap. 6.

19.5.1 Cognitive Impairment

Approximately 13% of community-dwelling adults over the age of 65 have a diagnosis of dementia. However, the total burden of disease is likely to be much higher due to underrecognition of dementia by patients, families, and healthcare providers, particularly in the early stages [23]. In people over the age of 80, the prevalence of dementia increases to 40%, and in advanced heart failure patients, 30–60% have comorbid dementia [24]. Older individuals with CVD also have a high prevalence of mild cognitive impairment (the prodromal phase of dementia) as compared to individuals without CVD, and patients with cognitive impairment and CVD have worse outcomes than those with CVD alone. Older adults with heart failure have a twofold increased risk of impaired cognition, including deficits in attention, executive function, and episodic memory, and these impairments tend to be more pronounced during episodes of decompensation. Executive dysfunction, in particular, can reduce the ability to adhere to recommended therapies and participate in disease management programs [25]. In part for these reasons, the presence of cognitive impairment increases cost, management complexity, and mortality rates in older adults with CVD. Diagnosis and management of dementia are discussed in Chap. 5.

19.5.2 Frailty

Frailty is a geriatric syndrome that represents an accelerated path of biological decline across multiple interrelated organ systems with a loss of homeostatic reserve and impaired response to stressors [26]. Different criteria for frailty have been proposed; Chap. 1 discusses the various criteria in detail and management. The frailty phenotype was originally described in the Cardiovascular Health Study and comprises unintentional weight loss, exhaustion, weakness, slowness, and low physical activity (pre-frail: 1–2 criteria; frail: ≥3 criteria) [26]. More recently, cognitive impairment has emerged as an additional component of frailty. The estimated prevalence of frailty in community cohorts is 7% but increases to 20% in individuals over age 80. In older patients hospitalized with CVD, especially heart failure, it is estimated that frailty rates approach 50%. Frailty is associated with an increased risk of adverse outcomes including falls, functional decline, disability, institutionalization, and death [26]. A bidirectional relationship exists between frailty and CVD, possibly reflecting shared pathogenic mechanisms, such that frailty is an independent predictor of the development and progression of a wide range of CV disorders [27]. Conversely, the presence of CVD increases the risk of frailty, and older adults with concomitant frailty and CVD have significantly worse outcomes than those with CVD alone (hazard ratios ranges from 2 to 4 depending on the specific disease).

19.5.2.1 Comprehensive Geriatric Evaluation

Although disease-focused evaluation of symptoms may facilitate assessment of the primary CV diagnosis, it does not allow for a more comprehensive evaluation of the multitude of factors that may impact optimal management. Implementing a more patient-centered approach to prioritizing goals of care within the context of co-existing multimorbidity, geriatric syndromes, cognitive impairment, and social and psychological factors can result in a management strategy better aligned with patient preferences. Table 19.2 provides an overview of commonly used tools for assessment of geriatric patients. The reader is also referred to Chap. 8 for practical guidance on office-based geriatric assessment.

Table 19.2 Screening tools for common geriatric conditions

Geriatric condition	Assessment tool
Frailty	Fried Frailty Scale: grip strength, gait speed, exhaustion, weight loss, and physical activity questionnaire Rockwood Frailty Index FRAIL scale
Functional Status	Short Physical Performance Battery Katz Activities of Daily Living Lawton Instrumental Activities of Daily Living Timed Up and Go Functional Reach
Cognition	Montreal Cognitive Assessment (MoCA) Mini-Cog Mini Mental State Examination (MMSE)
Weight loss/ Sarcopenia	Grip strength Body Mass Index or Weight Change, 3–5% decline annually
Depression	Geriatric Depression Scale Patient Health Questionnaire-9

19.6 Cardiovascular Diseases Common in Older Adults

19.6.1 Coronary Artery Disease

While chest pain or discomfort is the most common presenting symptom in patients of all ages with coronary artery disease (CAD), dyspnea is frequently the presenting symptom in older adults and women, particularly in the presence of multimorbidity. Atypical or nonspecific symptoms are also common in older adults with CAD and may include weakness, confusion, decline in functional status, reduced physical activity, nausea, and loss of appetite. For these reasons, a high clinical suspicion for CAD in older adults should be maintained (especially the very elderly). Older adults may also be less likely to recognize or report symptoms of CAD due to reduced physical activity or cognitive impairment. Furthermore, older adults may minimize symptoms owing to fear of possible interventions, hospitalization, and loss of independence.

19.6.2 Acute Myocardial Infarction

Ischemic heart disease is the leading cause of mortality in both men and women in the United States, with nearly 85% of deaths occurring in individuals 65 years and older and over 50% in those 75 and older. The high prevalence of ischemic heart disease in older adults contributes to the increased number of deaths, but greater in-hospital and 6-month mortality rates are also a significant factor. Additionally, readmission to hospital within 30 days after MI is highest in individuals over the age of 75, with non-cardiac risk factors, especially impaired functional mobility, playing significant roles [28].

A critical step in optimum management of older adults with acute myocardial infarction (AMI) is prompt diagnosis and re-vascularization, if appropriate, but such treatment is contingent upon recognition of symptoms in addition to supportive clinical and laboratory data. In the Global Registry of Acute Coronary Events (GRACE), almost 50% of participants >85 years with an ACS presented with dyspnea rather than chest pain [29]. In the Framingham cohort, silent or unrecognized infarcts accounted for almost 60% of all MIs in individuals over age 85 [30]. Current practice guidelines recommend that an ECG should be obtained and reviewed within 10 minutes of presentation in individuals with symptoms consistent with ACS. In older adults, particularly women, the time to first ECG is considerably longer than in younger patients and it is more likely to be non-diagnostic [30]. The higher prevalence of nonspecific symptoms, pre-existing ECG abnormalities, and non-ST segment elevation MI (NSTEMI) in older patients can further delay treatment initiation.

Reperfusion therapy in the form of fibrinolysis or more commonly primary percutaneous coronary intervention (PCI) in ST-elevation MI (STEMI) is associated with reduced in-hospital mortality, subsequent heart failure, and long-term morbidity and mortality. Despite a greater incremental benefit obtained by older patients, they are less likely to receive reperfusion therapy [31]. In the Myocardial Infarction National Audit Project (MINAP), only 55% of patients ≥85 presenting with STEMI received reperfusion therapy as compared to 84% of patients age 65 or younger. Primary PCI is the treatment of choice if performed within 90 minutes of arrival to the hospital and within 12 hours of onset of symptoms [32]. Increased actual and perceived risks in older adults undergoing PCI likely contribute to lower utilization rates.

19.6.2.1 Antiplatelet Therapy

In the second International Study of Infarct Survival-2 (ISIS-2), early aspirin therapy in patients with STEMI reduced 35-day mortality by 23% overall with corresponding effects in individuals over the age of 70. Chronic aspirin therapy following MI also decreases recurrent MI, stroke, and all-cause mortality irrespective of age. Clopidogrel in addition to aspirin reduces recurrent MI and death in the 12 months following hospital admission for ACS, whether or not PCI is performed [33, 34]. The emergence of alternative and adjuvant antiplatelet therapies in the treatment of ACS has been conflicting in older adults and has complicated post-MI therapy. Use of ticagrelor post ACS has been associated with a reduction in CV death, MI, or stroke as compared to clopidogrel without increasing bleeding risk. However, these effects were attenuated in older adults and more recent observational data suggest that the findings may not be reproducible outside the clinical trials setting [35, 36]. Data on prasugrel compared to clopidogrel are also conflicting. Prasugrel 10 mg was associated with increased risk of intracranial hemorrhage in patients ≥75 years of age, leading to the recommendation that use be limited in this age group to those undergoing PCI and stenting who are at high risk for stent thrombosis [37]. A further study examining a lower dose of prasugrel (5 mg) as compared to clopidogrel was stopped early due to low event rates and lower than expected enrollment with no significant difference between treatments with respect to either efficacy or safety [38]. Vorapaxar is rarely utilized due to significantly higher risk of bleeding in patients over age 75 [35]. The choice of antiplatelet therapy, therefore, should be individualized based on perceived risks for cardiovascular events and major bleeding in conjunction with patient preferences.

In patients requiring oral anticoagulation (OAC) who develop ACS, preventing stroke, recurrent ACS, and related morbidity and mortality must be balanced against the significantly increased risk of bleeding. This has led to several studies examining the optimum strategy for antithrombotic and antiplatelet therapy. In individuals who require a vitamin K antagonist (e.g., mechanical valve prosthesis), dual therapy with a P2Y12 inhibitor, without aspirin, is superior with respect to bleeding complications without an increased risk for ischemic events [39]. Studies investigating direct oral anticoagulants (DOACs) in combination with antiplatelet therapy have demonstrated similar findings but with a trend to increased risk for stent thrombosis with double versus triple therapy [40]. Additional studies comparing double and triple antithrombotic therapy are ongoing.

19.6.2.2 Antithrombotic Therapy

Activation of thrombin plays an important role in the pathway of ACS and antithrombotic therapy with heparin is recommended. Unfractionated heparin is associated with higher rates of bleeding in older adults as a result of low protein binding and impaired renal function. If appropriate, low molecular weight heparin (LMWH) provides a more reliable therapeutic effect and has been shown to reduce recurrent angina, MI, and death. However, LMWH should be used with caution in patients with stage IV-V chronic kidney disease (est. creatinine clearance <30 cc/min).

Following a large anterior MI, the risk of apical LV thrombus warrants treatment with warfarin for at least 3 months to reduce thromboembolic events. As noted above, the risk of bleeding on triple antithrombotic therapy is increased in older adults, and this factor should be carefully considered in therapeutic decision-making [41]. As a general principle, intensive antithrombotic therapy should be continued for as short a duration as clinically warranted, especially in patients at high risk for bleeding complications.

19.6.2.3 Secondary Prevention

In addition to aspirin, oral beta-blockers reduce recurrent events and mortality irrespective of age after ACS [42]. However, the benefit of beta-blocker therapy beyond 3 years post MI in older adults is unproven, and cessation of beta-blocker therapy should be considered in context with multimorbidity profile and risk of adverse side effects [43]. Risk factors for drug-disease interactions with beta-blockers (i.e., bradycardia, hypotension, exacerbation of heart failure) are more common in older adults but should not preclude administration of these medications; close observation and careful titration are recommended [44].

Angiotensin-converting enzyme inhibitors (ACE-I) are beneficial in older adults following AMI, particularly in the setting of LV dysfunction and heart failure. ACE-I therapy initiated in the hospital and continuing after discharge reduces mortality, hospitalizations, and the progression of LV dysfunction. Angiotensin receptor blockers (ARBs), including losartan and valsartan, have comparable effects to ACE-I and are appropriate second-line agents when ACE-I are not tolerated due to cough. Combination treatment with an ACE-I and ARB does not reduce mortality but increases risk of adverse drug events.

19.6.3 Stable Coronary Artery Disease

The management of chronic CAD with or without antecedent MI focuses on optimum risk factor modification and symptom control. As a result of vascular aging and accumulation of risk factors, CAD in older adults tends to affect multiple arteries and to be more diffuse and more severe than in younger adults. Diagnostic stress testing is indicated in symptomatic older adults to investigate suspected CAD, but baseline ECG abnormalities warrant concomitant imaging (echo, magnetic resonance imaging, or nuclear perfusion) to improve accuracy. Physical limitations may restrict the use of exercise stress testing but pharmacological stress testing (e.g., adenosine, regadenoson, or dobutamine) provides a suitable alternative. Coronary computed tomographic angiography (CTA) is an alternative to stress imaging in selected cases; a limitation of this technique is the need for intravenous contrast administration and potential risk for acute kidney injury. In addition, dense coronary calcifications and atrial fibrillation may limit accurate interpretation of CTA in older adults. Coronary angiography is appropriate in selected older patients with markedly abnormal stress test or CTA findings and/or limiting symptoms that do not respond adequately to medical therapy.

Management of stable CAD is designed to alleviate symptoms, improve quality of life, and reduce the risk of adverse ischemic events. Although aspirin for primary prevention does not improve outcomes in older adults [45, 46], the benefits for secondary prevention are evident irrespective of age. Similarly, statins are recommended for secondary prevention across the age spectrum, although data in multimorbid older adults are sparse. Caveats for aspirin and statin use relate to circumstances when life expectancy is limited. First-line anti-anginal therapy should include a beta-blocker if tolerated. Alternative medications include calcium channel blockers, nitrates and ranolazine. Side effects from beta-blockers and calcium channel blockers are more common in older adults and may include fatigue, weakness, loss of energy, constipation, dizziness, low blood pressure, lower extremity swelling, and depressive symptoms.

Elective PCI for the management of stable angina is an alternative treatment strategy and may be beneficial in individuals intolerant of optimal medical therapy or in those who remain symptomatic despite medications. Although PCI is effective in reducing symptoms, data from the COURAGE trial indicate that among patients with stable CAD and defined coronary anatomy, routine PCI does not reduce mortality or risk of MI compared to optimal medical therapy alone (including aggressive CV risk reduction) [47]. The findings of COURAGE were similar in patients younger or older than 65 years. Data from the more recent ISCHEMIA trial confirmed that in individuals without suspected left main stem disease, routine cardiac catheterization and revascularization (when feasible) did not reduce mortality, MI, or hospitalization for cardiac causes compared to medical therapy alone [48]. However, the ISCHEMIA trial did demonstrate an improvement in quality of life in individuals randomized to the invasive arm as compared to non-interventional therapy, especially among patients with more severe symptoms at baseline.

In appropriately selected patients, coronary artery-bypass grafting (CABG) reduces symptoms and improves quality of life and in high-risk individuals, CABG also confers a mortality benefit. Older patients undergoing CABG are more likely than younger patients to have multimorbidity, cognitive impairment, reduced functional status, and more advanced and diffuse CAD. As a result, perioperative morbidity and mortality are higher, with higher rates of respiratory failure, bleeding, acute kidney injury, atrial fibrillation, heart failure, and delirium. In addition, postoperative cognitive impairment is more common in older individuals. For additional information on cardiothoracic surgery, see Chap. 11.

In the past few years, ischemia with non-obstructive coronary arteries (INOCA) has gained recognition as a cause of recurrent angina, repeat hospitalizations, impaired quality of life, and increased mortality. INOCA reflects a mismatch between myocardial blood supply and myocardial oxygen demand that is not due to hemodynamically significant epicardial stenoses as defined by fractional flow reserve on coronary angiography. It is hypothesized to be caused by chronic microvascular disease or coronary spasm in the setting of non-obstructive epicardial lesions. The prevalence is much higher among women and can be a complicating factor in older patients with and without epicardial CAD. Diagnosis includes noninvasive imaging via PET or magnetic resonance imaging with differential myocardial perfusion assessment, but measurement of coronary flow reserve during diagnostic coronary angiography is the definitive test. Management includes aggressive treatment of CV risk factors including blood pressure, cholesterol, and metabolic disease, in addition to antianginal therapy tailored to improve supply-demand mismatch.

19.7 Heart Failure

Heart failure is primarily a disorder of older adults in part because CV aging, especially increased vascular and myocardial stiffness, increases vulnerability for developing heart failure. In addition, heart failure is the “final common pathway” for nearly all CV disorders afflicting older adults. Heart failure affects 6.2 million Americans with approximately 1 million new cases annually in individuals ≥55 years [4]. The prevalence of heart failure increases progressively with age and exceeds 12% among men and women ≥80 years of age. In adults >75 years of age, the annual incidence of heart failure ranges from 2.6% to 3.5% among black and white women and men. Heart failure is the most common cause of hospital admission in individuals >65 years of age and is responsible for over 800,000 hospital discharges as primary diagnosis each year at a cost of approximately $30.7 billion in 2012 [49]. Heart failure contributes to more than 250,000 deaths annually in the United States, of which >85% are in individuals over the age of 65. Not only does heart failure account for significant adverse health outcomes, it has a major impact on quality of life, disability, and independence in older patients.

Dyspnea on exertion, reduced exercise tolerance, orthopnea, lower extremity and abdominal swelling, and general fatigue are characteristic symptoms in both young and older adults with heart failure. Reduced baseline physical activity in older adults due to disability or sedentary lifestyle can mask exertional symptoms. In contrast, nonspecific symptoms including confusion, reductions in physical activity and functional status, nausea, and loss of appetite are more common expressions of heart failure in older patients.

The goals of heart failure management in older adults should focus on reduction of symptom severity, improving quality of life, maintenance of functional status and independence, avoidance of hospitalization and institutionalization, and extending life in alignment with patient-centered goals. An interprofessional team approach to care is critical and should incorporate cardiovascular, non-cardiovascular, and social factors. Studies have shown that team care reduces readmissions and improves quality of life in older patients with heart failure. However, data indicate that up to two-thirds of readmissions are due to causes other than heart failure, which underscores the need to individualize care and to address prevalent comorbidities [50].

19.7.1 Medical Therapy

The mainstay of treatment for heart failure with reduced ejection fraction (HFrEF) includes beta-blockers, ACE-I or ARBs, diuretics, and mineralocorticoid antagonists. In addition, digoxin and vasodilators can be beneficial in selected cases. During long-term use, beta-blockers reduce hospital admissions and mortality and may improve LV systolic function [51]. These effects are evident for all stages of heart failure and across all age groups, including beneficial effects in the older patients. Beta-blockers shown to be effective in clinical trials and approved for use in the United States for treatment of heart failure include metoprolol succinate, carvedilol, and bisoprolol. Nebivolol has also demonstrated improved outcomes in heart failure patients but is not FDA-approved for that indication [52]. As with use in coronary artery disease, side effects and adverse events are more common in older adults; hence, it is appropriate to start with low doses, titrate gradually, and monitor closely.

ACE-I have favorable effects on left ventricular remodeling and are beneficial in patients with HFrEF irrespective of symptoms. However, since most landmark ACE-I trials included low numbers of older patients, the benefits of these agents in patients over 75–80 years of age are less well established. Nonetheless, ACE-I for HFrEF carry a class I indication regardless of age [25]. ARBs are a suitable alternative in the setting of ACE-I intolerance and benefits of ARBs have been shown in both young and older adults [53, 54]. ACE-I and ARBs are generally well tolerated but should be started at lower doses in older adults and titrated slowly while monitoring closely for hypotension, renal dysfunction, and electrolyte abnormalities (especially hyperkalemia).

The neprilysin inhibitor sacubitril in combination with the ARB valsartan demonstrated superior benefit compared to the ACE-I enalapril in the PARADIGM-HF trial involving 8442 patients with heart failure and a left ventricular ejection fraction of ≤40% [55]. The study was stopped prematurely due to significant reductions in all-cause and CV mortality, repeat hospitalizations, and physical limitations attributed to heart failure in the sacubitril/valsartan group, without increasing adverse events. The study included 4120 patients over the age of 65 and 1563 patients over age 75 with similar benefits across age strata. Because neprilysin is one of several enzymes involved in clearance of β-amyloid in the central nervous system, there is theoretical concern that inhibition of β-amyloid degradation could adversely affect cognitive function. Results from PARADIGM-HF did not show a difference in prevalence of dementia, but follow-up was short (mean 27 months) and detailed assessments of cognitive function were not performed; therefore, additional studies are needed for clarification.

Mineralocorticoid receptor antagonists (aldosterone receptor antagonists), including spironolactone and eplerenone, reduce mortality in patients with New York Heart Association (NYHA) class II-IV HFrEF and are recommended in these patients unless contraindicated [56]. Patients with NYHA class II heart failure should have a history of prior CV hospitalization or elevated plasma natriuretic peptide levels to be considered for mineralocorticoid receptor antagonists [25]. Mineralocorticoid receptor antagonists are not recommended if the estimated glomerular filtration rate (eGFR) is <30 mL/min/M^2 or if the serum potassium level is >5 meq/L. Adverse effects include hyperkalemia, especially in the setting of chronic kidney disease, but with close observation severe hyperkalemia is uncommon.

Diuretics, in combination with sodium restriction, are essential for treating acute decompensation and for maintaining euvolemia in the outpatient setting. In older patients, management of fluid and sodium balance must be considered in the context of social support, as well as functional and physical limitations. Titrating diuretic therapy according to daily weights and close monitoring of daily sodium and fluid intake may not be feasible in older adults with limited social support or significant functional, physical, or cognitive impairments. Urinary incontinence is common in older adults, especially women, and is a frequent cause of non-adherence to diuretic therapy.

Digoxin reduces heart failure symptoms and heart failure admissions in patients with HFrEF. However, digoxin has no effect on mortality, and it has a low therapeutic index with relatively high potential for serious adverse events, especially in older patients with reduced renal function. In older adults with preserved renal function (est. GFR ≥60 cc/min), digoxin may be useful as an adjunctive agent in patients who remain symptomatic despite standard therapy. In such cases, low doses (e.g., 0.125 mg daily or every other day) should be utilized and levels should be monitored periodically, targeting a therapeutic range of 0.5–0.9 ng/mL.

The vasodilators hydralazine and isosorbide dinitrate are indicated in African American patients with HFrEF and moderate to severe heart failure symptoms; they may also be useful in patients who are unable to take ACE-I or ARBs due to renal insufficiency or side effects. Limitations of these medications in older adults include the relatively high side effect profile and thrice daily dosing, which impacts the complexity of the regimen and may reduce medication adherence.

19.7.2 Implantable Cardioverter-Defibrillators and Cardiac Resynchronization Therapy

Despite optimal medical therapy, patients with HFrEF are at an increased risk for sudden cardiac death due to ventricular arrhythmias. Implantable cardioverter-defibrillators (ICDs) reduce CV and all-cause mortality in selected patients and are recommended for individuals with irreversible heart failure (ischemic or non-ischemic), an LV ejection fraction ≤35%, NYHA class II-III heart failure symptoms, and a life expectancy of at least 1 year [57, 58]. In the United States, >40% of ICDs are implanted in patients over age 70 and 10–12% are implanted in individuals over the age of 80. However, the majority of trials for primary and secondary prevention of sudden cardiac death with ICDs did not enroll patients over the age of 80 [59], and data from clinical trials and observational studies indicate that the mortality benefit of ICDs declines with age, primarily due to competing risks of death. For these reasons, the decision to implant an ICD in an older adult must be considered carefully and should include an estimation of the individual's likely benefit in the context of other medical problems. In addition, shared decision-making to ensure alignment with the patients' preferences and goals is essential. For example, frail individuals with recurrent hospital admissions are unlikely to benefit from an ICD. On the other hand, older adults who are otherwise suitable candidates should not be denied an ICD-based solely on age. However, prior to implanting a device, there should be a discussion about the potential for recurrent shock therapies and associated post-traumatic stress and anxiety, as well as options and preferences for disabling the device in the setting of terminal illness.

Cardiac resynchronization therapy (CRT) aims to improve hemodynamic parameters associated with impaired left ventricular function resulting from dyssynchronous LV contraction. In patients with HFrEF, a prolonged QRS duration (≥120 msec), and class II-IV symptoms, CRT has demonstrated improvements in symptoms, quality of life, and survival [60, 61]. Patients with left bundle branch block and QRS duration ≥150 msec are most likely to benefit, and there is evidence that women derive greater benefit than men. Although patients over the age of 80 were excluded from most of the randomized CRT trials, observational studies suggest that appropriately selected older adults often experience improved symptoms and quality of life. Therefore, CRT should be offered as an option in the management of advanced heart failure in older adults who are suitable candidates for the device.

19.7.3 Heart Transplant and Advanced Heart Failure Devices

Although there is no widely accepted upper age limit for heart transplantation, most transplant centers use a cut-off of either 70 or 75 years. Among patients 65–74 undergoing orthotopic heart transplantation, outcomes are comparable to those in younger individuals [62]. However, due to low availability of donor hearts, few older individuals are selected for transplantation and they generally have low rates of co-existing diseases. To address this disparity, some centers are performing transplants using hearts from older donors for an increasing number of older adults who previously would have been declined for transplantation.

Left ventricular assist devices (LVADs) for destination therapy (DT) are increasingly used in patients with advanced heart failure with reduced left ventricular ejection fraction who are ineligible for heart transplantation [63]. Patients over the age of 75 now account for more than 10% of LVAD implantations, despite a paucity of data on outcomes. LVAD implantation is associated with substantial morbidity, mortality, and expense despite improvements in device technology and operative skills, and older age is an independent risk factor for adverse outcomes. The prevalence of frailty in patients with advanced heart failure approaches 50% as a result of reduced cardiac output, deconditioning, cognitive impairment, and muscle cachexia [64]. Additionally, hallmark symptoms of advanced heart failure, including exhaustion, reduction in physical activity, and weakness are also fundamental components of frailty. The presence of frailty and/or cognitive impairment, in addition to end organ dysfunction and malnutrition, negatively impacts short- and long-term outcomes. Whether elements of frailty can be reversed with restoration of adequate cardiac output has not been determined. The concept of "LVAD responsive" and "LVAD un-responsive" frailty has been proposed in an effort to optimize patient selection for DT-LVAD implantation, but additional studies are needed.

With careful patient selection, 2-year survival rates following LVAD implantation exceed 85% with currently available devices, with disabling stroke rates of 5–7% [65]. Optimal patient selection requires a multidisciplinary team to screen for multimorbidity, cognitive impairment, functional status, and social determinants of health [66]. In addition, palliative care consultation prior to LVAD implantation is mandated by the Center for Medicare and Medicaid Services.

19.7.4 Heart Failure with Preserved Ejection Fraction

Up to 50% of patients with heart failure have normal or near normal LV ejection fractions [i.e., heart failure with preserved ejection fraction (HFpEF)]. The majority of patients with HFpEF have antecedent hypertension (60–80%), and HFpEF prevalence is substantially higher in women than in men. Multimorbidity is common and often includes other CV disorders, such as CAD, atrial fibrillation, and valvular heart disease. Although prognosis is somewhat better for HFpEF than for HFrEF, symptoms, quality of life, and hospitalization rates are similar between the two forms of heart failure. However, unlike HFrEF, for which numerous therapies have been shown to improve symptoms and clinical outcomes, to date no pharmacological or device-based interventions have reduced mortality in HFpEF (Table 19.3). Following the success of sacubitril-valsartan in HFrEF, a complementary study examining the effects of this combination compared to valsartan alone (PARAGON-HF) was conducted in patients with HFpEF [67]. Although there was a 13% reduction in the composite primary outcome of CV mortality and total heart failure hospitalizations, the difference was not significant ($p = 0.06$). Prespecified subgroup analyses suggested that women and individuals with EF less than the median value of 57% may have benefited from combined therapy [68]. Further investigation is needed, including evaluation of the effects on cognition, to better define the role of sacubitril/valsartan in older patients with HFpEF.

Currently, the management of HFpEF focuses on optimizing blood pressure control (see above Sect. 19.3.1), treating ischemia in patients with concomitant CAD, controlling heart rate in patients with atrial fibrillation, and avoiding excess dietary salt and fluid intake. In addition, aerobic exercise improves exercise tolerance in older adults with HFpEF, and weight loss provides additional benefit in obese patients [69]. Diuretics are indicated to maintain euvolemia and minimize symptoms of shortness of breath and edema, but must be used judiciously to avoid over-diuresis, which may lead to reduced organ perfusion and pre-renal azotemia.

Table 19.3 Clinical trials in heart failure with preserved ejection fraction

Trial[a]	Patients	Treatment	LVEF	Age	Outcomes compared to placebo[b]
PEP-CHF [101]	850	Periondopril	65 (56–66)	75 (72–79)	Death/hospitalization by 1 year – HR 0.69 (0.47–1.01, $p = 0.055$). HF hospitalization by 1 year – HR 0.63 (0.41–0.97, $p = 0.033$)
CHARM-Preserved [102]	3023	Candesartan	54 ± 9	67 ± 11	CV death/HF admission – HR 0.89 (0.77–1.03, $p = 0.118$). HF admission – HR 0.85 (0.72–1.01, $p = 0.072$)
I-PRESERVE [103]	4128	Irbesartan	60 ± 9	72 ± 7	Death/hospitalization – HR 0.95 (0.86–1.05, $p = 0.35$)
SENIORS (EF > 35% subgroup) [104]	643	Nebivolol	49 ± 10	76 ± 5	All-cause death/CV hospitalization – HR 0.81 (0.63–1.04)
TOPCAT [105]	3445	Spironolactone	56 (51–62)	69 (61–76)	CV death/HF hospitalization/aborted SCD – HR 0.89 (0.77–1.04, $p = 0.14$). HF hospitalization – HR 0.83 (0.69–0.99, $p = 0.04$)
Aldo-DHF [106]	422	Spironolactone	67 ± 8	67 ± 8	Reduced E/e' avg 1.5 ($p < 0.001$)
RELAX [107]	216	Sildenafil	60 (56–65)	69 (62–77)	No difference Δ VO2 peak at 24 wks.
ESS-DHF [108]	192	Sitaxsentan	61 ± 12	65 ± 10	Median 43-second relative increase in Naughton treadmill time ($p = 0.03$)
DIG Ancillary [109]	988	Digoxin	55 ± 8	67 ± 10	HF hospitalization – HR 0.79 (0.59–1.04, $p = 0.09$). Hospitalization for unstable angina – HR 1.37 (0.99–1.91, $p = 0.06$)
PARAGON-HF [67]	4822	Sacubutril-Valsartan	58 ± 8	73 ± 9	HF hospitalizations and death from CV cause – RR 0.87 (0.75–1.01, $p = 0.06$)

Age (in years) and LVEF (%) presented as mean ± SD or median (IQR)
CV cardiovascular, *E/e' avg* echocardiographic mitral inflow velocity/tissue Doppler velocity ratio, *HR* hazard ratio with (95% confidence interval), *LVEF* Left ventricular ejection fraction, *SCD* sudden cardiac death
[a]Trial acronyms: *PEP-CHF* Perindopril in Elderly People with Chronic Heart Failure, *CHARM-Preserved* Candesartan in Heart failure: Assessment of Reduction in Mortality and morbidity – Preserved LVEF, *I-PRESERVE* Irbesartan in Heart Failure with Preserved Ejection Fraction Study, *SENIORS* Study of the Effects of Nebivolol Intervention on Outcomes and Rehospitalization in Seniors with Heart Failure, *TOPCAT* Treatment of Preserved Cardiac Function Heart Failure with an Aldosterone Antagonist, *Aldo-DHF* Aldosterone Receptor Blockade in Diastolic Heart Failure, *RELAX* Phosphodiesterase-5 Inhibition to Improve Clinical Status and Exercise Capacity in Heart Failure with Preserved Ejection Fraction, *ESS-DHF* Effectiveness of Sitaxsentan Sodium in Patients With Diastolic Heart Failure, *DIG Ancillary* Digitalis Investigation Group Ancillary Trial, *PARAGON-HF* angiotensin–neprilysin inhibition in heart failure with preserved ejection fraction
[b]All-cause mortality was not significantly reduced in *any* trial

Cardiomyopathy attributed to amyloidosis (TTRcm) is an increasingly recognized cause of HFpEF in older adults. Myocardial amyloid deposition may be due to a chronic systemic illness (e.g., multiple myeloma), systemic amyloidosis, or as a primary cardiac condition. Transthyretin (TTR) amyloidosis is characterized by abnormal folding of protein fibrils that accumulate in tissues including the myocardium. Two forms of the disease exist. Wild-type TTR (ATTRwt) is a systemic disorder preferentially affecting older adults, especially men, and is present in up to 25% of individuals over the age of 80. This form of amyloidosis derives from an amino acid transporter protein of thyroxine and retinol (TTR) produced by the liver, and can involve the atria, conduction system and on occasion the entire heart. A less common form of TTR amyloidosis associated with several specific mutations of the TTR gene (mutant transthyretin, ATTRm) appears to be inherited in an autosomal-dominant pattern. The most prevalent mutation (Val12Ile) is predominantly found in African Americans with an estimated carrier prevalence of 3–4% [70].

The clinical presentation of cardiac amyloid is highly variable, ranging from asymptomatic disease that runs a relatively benign course to severe restrictive cardiomyopathy associated with heart failure, atrial fibrillation, conduction abnormalities, and poor prognosis. Non-cardiac manifestations include autonomic neuropathy, polyneuropathy, vitreous opacities, and carpal tunnel syndrome. The condition is frequently under-recognized, leading to treatment delays. Biomarkers (troponin and natriuretic peptides), echocardiography, magnetic resonance imaging, bone scans, and nuclear scintigraphy are useful for evaluating suspected cardiac amyloid, but in many cases, tissue biopsy is needed to confirm the diagnosis. Low voltage on the electrocardiogram despite marked left ventricular hypertrophy on echo or magnetic resonance imaging is a hallmark of cardiac amyloid but the sensitivity of this finding is low. Biomarkers and clinical parameters, including intolerance of heart failure medications, can be useful for assessing prognosis. Until recently, treatment was primarily supportive, but in the ATTR-ACT trial, tafamidis, a transthyretin-binding agent, reduced mortality and CV hospitalizations while slowing the decline in exercise tolerance and quality of life in older patients with TTR cardiomyopathy [71]. Tafamidis was subsequently approved by the FDA and several additional novel agents are currently under investigation.

19.8 Valvular Heart Disease

19.8.1 Aortic Valve

Aortic stenosis (AS) is the most common valvular heart disease requiring intervention in older adults, with an estimated prevalence of severe AS of approximately 8% by 85 years of age. Risk factors for developing AS include age, male sex, smoking, hypertension, and increased LDL cholesterol levels. Classical symptoms of AS include angina, syncope (and pre-syncope), and shortness of breath, which occur as a result of severe obstruction to left ventricular ejection. This culminates in increased LV systolic and diastolic pressures and prolonged emptying time of the LV. Pathological consequences include increased myocardial mass and ischemia due to increased myocardial oxygen consumption in the face of decreased oxygen supply.

Aortic valve replacement is the definitive treatment for severe symptomatic AS and both surgical AVR (SAVR) and transcatheter AVR (TAVR) have been associated with excellent outcomes in older patients. Prior to 2010, SAVR was the gold standard treatment for severe AS. However, older patients are at increased risk for perioperative morbidity and mortality and 30–40% of older patients are not considered to be good surgical candidates or refuse surgery due to real or perceived increased perioperative risk.

In the last decade, TAVR has emerged as a highly successful alternative to SAVR across a broad range of surgical risk categories. Initial studies demonstrated TAVR to be superior to medical therapy in patients with severe AS at prohibitive surgical risk and non-inferior to SAVR in patients at high operative risk [72, 73]. Subsequent studies have confirmed the efficacy and safety of TAVR in intermediate and low risk surgical patients [74, 75]. Older adults comprised the majority of patients enrolled in these trials, as a result of which TAVR has now become the preferred treatment in older patients with severe AS in the absence of other indications for cardiac surgery (e.g., mitral valve disease, aortic root repair, severe CAD not suitable for PCI). However, not all patients derive benefit from TAVR, and 25–40% of patients in the high and prohibitive surgical risk categories either die within one year of the procedure or fail to experience a meaningful improvement in functional status or exercise tolerance. Thus, optimal patient selection is crucial, and incorporating simple frailty indicators into risk assessment models has demonstrated benefit in identifying patients likely to have a favorable or unfavorable outcome following either SAVR or TAVR [76]. Distinguishing which patients will likely obtain significant improvements in quality and quantity of life from those for whom the procedure may be futile is now part of tertiary referral center protocols aligning patient-centered goals with available therapeutic options. This includes specific scenarios such as the likely diminished benefits and significantly increased risk in individuals with end stage renal disease [77]. See also Chap. 11 for further discussion of AVR.

Aortic regurgitation in older adults occurs as a result of valve leaflet degeneration (e.g., rheumatic or calcific aortic valve disease, endocarditis) or dilatation of the ascending aorta and aortic root (e.g., long standing central aortic hypertension, atherosclerosis, and other disorders affecting the aortic root). Chronic moderate or severe aortic regurgitation leads to chronic LV volume overload and increased stroke volume. Over time increased LV dilatation and an imbalance between myocardial oxygen consumption and supply results in myocardial ischemia and LV dysfunction, ultimately leading to LV failure. Symptoms related to aortic regurgitation can manifest late in the disease process and may include shortness of breath, exercise intolerance, and angina. Treatment of aortic regurgitation in older adults is similar to that in younger individuals. Medical therapies aimed at reducing LV afterload, such as ACE-I or nifedipine, can provide symptomatic benefit. In patients with severe aortic regurgitation, surgical valve replacement should be performed prior to the development of irreversible LV dysfunction (if feasible) [78]. Preliminary studies suggest that TAVR may be an acceptable alternative to SAVR for treating selected patients with severe aortic regurgitation, and additional research is ongoing.

19.8.2 Mitral Valve

The prevalence of mitral valve regurgitation increases with age as a consequence of ischemic heart disease, degenerative valve disease, or mitral valve annulus enlargement from LV dilatation in the setting of HFrEF. Chronic moderate or severe mitral regurgitation leads to LV volume overload with increasing left atrial and left ventricular pressures, pulmonary venous hypertension, and pulmonary arterial hypertension. As with aortic regurgitation, mitral regurgitation may not cause symptoms until LV dysfunction is evident. For those with mild to moderate disease, medical management with afterload reduction and maintenance of euvolemia is appropriate [78]. In patients with severe mitral regurgitation, surgical mitral valve repair is the treatment of choice when feasible and is preferred to mitral valve replacement due to more salutary outcomes [79]. Older adults with severe mitral regurgitation may be high-risk surgical candidates or ineligible for surgery due to co-existing conditions such as chronic kidney disease, neurological disease, and pulmonary disease, and outcomes are less favorable in individuals with impaired LV systolic function. In addition, decision-making should consider patient preferences with respect to quality of life versus length of life, as well as functional, cognitive, and geriatric factors central to surgical outcomes regardless of type of procedure (also see Chap. 11).

For older adults at high or prohibitive surgical risk, percutaneous transcatheter techniques to repair the mitral valve have emerged [80]. The EVEREST II trail randomized individuals with degenerative mitral valve regurgitation to mitral valve surgery or percutaneous repair using the MitraClip device [81]. Mortality at 4 years was similar between groups, although a small number of individuals who received the MitraClip required subsequent surgical intervention. In addition, the MitraClip was less efficacious in reducing the severity of mitral regurgitation. Although EVEREST II enrolled primarily low-risk surgical candidates, registry data have demonstrated that transcatheter mitral valve repair is safe and associated with favorable clinical outcomes in older individuals with significant or prohibitive surgical risk. The presence of frailty in older adults undergoing the MitraClip procedure did not impact technical success or quality of life benefits but was associated with short- and long-term mortality. More recently, the MITRA-FR trial did not find a difference in outcomes between guideline-directed medical therapy (GDMT) alone versus dGDMT and the MitraClip in patients with LV ejection fraction 15–40% and severe functional MR. [82] However, the subsequent COAPT trial, which enrolled patients with an LV ejection fraction 20–50% and moderate-to-severe or severe functional MR, showed a significant 47% reduction in heart failure rehospitalizations, as well as a 38% reduction in 24-month mortality in patients randomized to receive the MitraClip device [83]. Of note, the mean age of patients in both studies was 70 years and more than one-third of patients were over age 75. The differential findings between these studies is likely attributable to patient selection with the COAPT study suggesting that transcatheter MV repair may be a suitable option for selected older adults with severe symptomatic functional MR.

Transcatheter mitral valve replacement (TMVR) poses substantially more anatomical and technical challenges than TAVR [84]. Nonetheless, studies are evaluating various TMVR devices for use in patients with severe mitral valve disease not suitable for surgery or valve repair procedures.

The leading cause of mitral stenosis globally is rheumatic heart disease. In developed countries, however, the prevalence of mitral stenosis has declined, and in older adults, mitral valve obstruction due to mitral annular calcification has become the most common cause of mitral stenosis. Additional risk factors include systemic hypertension, genetic connective tissue disorders, and diabetes. Clinical features of rheumatic mitral stenosis tend to develop over several decades; as a result, the condition occasionally presents in older adults. Predominant symptoms include shortness of breath, fatigue, and weakness. Medical therapy includes sodium restriction, diuretics, and anticoagulation with warfarin in the presence of atrial fibrillation (AF). Rates of thromboembolic events in individuals with AF and mitral stenosis are high, ranging from 7% to 15% annually. Newer oral anticoagulants have not been studied in this setting and are not approved for AF attributable to valvular heart disease. Isolated rheumatic mitral stenosis (without significant mitral regurgitation) with favorable valve characteristics may be suitable for percutaneous mitral valvuloplasty, which often results in prompt improvement in symptoms and hemodynamics. In addition, 60–70% of patients with successful valvuloplasty are free of recurrent stenosis at 10-year follow-up. Older adults often have unfavorable characteristics of the mitral valve and annulus, such as calcification, leaflet immobility, disease involving the subvalvular apparatus, and significant mitral regurgitation, which, taken together, may make them poor candidates for valvuloplasty. In addition, the presence of left atrial thrombus prior to the procedure is a contraindication. Surgical mitral valve replacement is an alternative for very symptomatic older adults who are not candidates for valvuloplasty, but perioperative mortality rates are 5–15% and recovery can be slow, especially in patients with diminished pre-operative functional status. Data on the use of TMVR for treatment of severe rheumatic or calcific mitral stenosis are very limited and the role of this procedure, if any, in treatment of these conditions remains to be established.

19.8.3 Tricuspid Valve

Increased utilization of cardiac imaging modalities has led to greater recognition of the prevalence and clinical importance of tricuspid regurgitation (TR). TR can be primary (i.e., due to an abnormality of the tricuspid valve itself), but it is more commonly functional due to annular dilatation and/or elevated right ventricular pressure. Implanted devices, such as pacemakers, can also lead to significant TR. Symptoms from severe TR can include, but are not limited to, right upper quadrant fullness or discomfort due to hepatic congestion, peripheral edema and ascites, fatigue, and palpitations (especially in patients with AF). Current guidelines for medical therapy recommend loop diuretics to reduce volume overload and congestion and addition of aldosterone antagonists particularly with hepatic congestion [85]. Surgical repair can be beneficial in individuals with moderate or severe TR at the time of left-sided heart valve surgery or as isolated procedure for symptomatic severe TR unresponsive to medical therapy. Transcatheter tricuspid valve interventions show promise but are in early stages and their potential utility requires further investigation [86].

19.9 Arrhythmias

Age-related changes in the cardiac conduction system, including degeneration, fibrosis, and calcification (Table 19.1), lead to increasing prevalence of cardiac arrhythmias with age. Aging is associated with a decrease in the number of cardiac myocytes and an increase in collagen content throughout the heart and conduction system. In addition, there is an increase in fat deposition adjacent to the sinoatrial node and progressive fibrosis of the node itself resulting in a gradual loss of sinoatrial pacemaker cells such that by age 75 only about 10% of these cells remain functional. The diversity of symptoms related to cardiac arrhythmias tends to be greater in older as compared to younger adults, and may include falls, weakness, fatigue, confusion, and exacerbations of other coexisting diseases. As a result, cardiac arrhythmias should be considered in the differential diagnosis of a broad spectrum of presenting symptoms.

19.10 Bradyarrhythmias

Individuals over the age of 65 account for more than 80% of pacemakers placed in the United States, and approximately half of these pacemakers are for treatment of sick sinus syndrome. Although bradyarrhythmias are the hallmark of sinus sick syndrome, the condition is frequently accompanied by tachyarrhythmias and atrial-ventricular conduction abnormalities. In particular, treatment of a supraventricular tachycardia can precipitate or exacerbate symptomatic bradyarrhythmias. Bradyarrhythmias commonly associated with sick sinus syndrome include chronic and inappropriate sinus bradycardia (i.e., too slow to maintain resting cardiac output and/or an inadequate response to stress), sinus pauses, and sinus arrest. Symptomatic bradycardia not attributable to a reversible cause (e.g., beta-blocker, donepezil, hypothyroidism) is a class I indication for pacemaker placement, and in the setting of sinus rhythm, a dual chamber device is appropriate. For individuals with symptomatic bradycardia due to medication, indications for that therapy should be reviewed, and only if compelling (e.g., beta-blocker for heart failure) should a pacemaker be considered; otherwise, an alternative medication should be used.

19.11 Atrial Fibrillation

Atrial fibrillation (AF) is the most common sustained cardiac arrhythmia and the incidence and prevalence of AF are increasing due to the aging of the population. In 2010, the estimated prevalence of AF in the United States was 5.2 million with an anticipated rise to 12.1 million by 2030 [4]. AF is predominantly a disorder of older adults, with approximately 50% of cases occurring in individuals 75 years of age or older. In addition, with the aging population, it is projected that the median age for patients with AF will approach 80 years by mid-century. Although AF is more common in men than women, increasing prevalence of heart disease in women with aging and their longer life expectancy results in more women with AF at older age. In older adults, AF is nearly always associated with underlying CVD with hypertensive heart disease, ischemic heart disease, and valvular heart disease comprising a large majority. AF can present with varied symptoms; a large proportion of older adults with AF experience mild or no symptoms, whereas others report fatigue, weakness, lightheadedness, decreased activity tolerance, chest discomfort, or shortness of breath. Palpitations, fluttering, and racing heartbeat are also commonly reported. In addition to symptoms caused by AF, the risk of stroke attributable to AF is substantial. In the Framingham Study, AF was associated with a two- to three-fold increased risk of stroke, and 23.5% of strokes were attributed to AF in those over age 80 (Table 19.4).

The management of AF should include (1) identification of underlying cause and potential reversibility, (2) control of symptoms through a rhythm or rate-control strategy, and (3) stroke prevention [87]. Reversible causes are numerous and include hyperthyroidism, anemia, obstructive sleep apnea, alcohol, excess caffeine, drugs (prescribed, illicit and herbal/OTC medications), and electrolyte imbalance. Additionally, optimum treatment of underlying CVD, such as controlling blood pressure, can reduce the burden of AF and help maintain sinus rhythm.

The balance between rhythm control (aiming to maintain sinus rhythm) and rate control (aiming to reduce ventricular response rate) strategies remains controversial. The AFFIRM trial randomized older adults with AF to rate control or rhythm control and demonstrated a non-significant increase in mortality in individuals in the rhythm control group, as well as a significant increase in hospitalizations [88]. Among patients over age 65, mortality was significantly higher in patients randomized to rhythm control. Mortality was also higher among patients treated with amiodarone compared to other antiarrhythmic drugs. Another key observation was that most strokes occurred in patients either not taking warfarin or with subtherapeutic international normalized ratios (INR). This has contributed to the strong recommendation to maintain older adults with AF on anticoagulation whether or not they are in sinus rhythm. Medications commonly used as first-line agents for rate control include beta-blockers and

Table 19.4 Risk prediction tools for anticoagulation use in atrial fibrillation

Prediction tool	Variables included (points)	Reported risk	
CHA$_2$DS$_2$-VASc [110]	C Congestive Heart Failure (1) H Hypertension (1) A$_2$ Age >75 years (2) D Diabetes Mellitus (1) S$_2$ Prior Stroke, TIA or thromboembolism (2) V Vascular Disease (1)* A Age 65–74 years (1) Sc Female Sex (1)	CHA$_2$DS$_2$VASc Score	Annual Stroke Risk %
		0	0
		1	1.3
		2	2.2
		3	3.2
		4	4.0
		5	6.7
		6	9.8
		7	9.6
		8	6.7
		9	15.2
HAS-BLED [92]	H Hypertension (1) A Abnormal renal/liver function (1)** S Prior Stroke (1) B Bleeding (1) L Labile INRs (1)*** E Elderly >65 years (1) D Drugs or Alcohol (1)****	Score of ≥3 indicates increased 1 year bleeding risk on anticoagulation. Risk is for bleeding requiring hospitalization or hemoglobin decrease >2 g/L or transfusion required	
ATRIA [93]	Anemia (3) Severe Renal Disease (3) Age ≥ 75 years (2) Prior Bleeding (1) Hypertension (1)	ATRIA score	Major Hemorrhage (% per year)
		0	0.4
		1	0.6
		2	1.0
		3	1.0
		4	2.6
		5	5.7
		6	5.0
		7	5.2
		8	9.6
		9	12.4
		10	17.3

ATRIA Anticoagulation and Risk Factors in Atrial Fibrillation non-dihydropyridine calcium channel blockers (diltiazem, verapamil). Digoxin is relatively ineffective as a single agent but may be a useful adjunct in patients with inadequate rate control despite maximally tolerated doses of beta-blockers and/or calcium channel blockers.

A strategy of maintaining sinus rhythm is appropriate in patients with moderate or severe symptoms related to AF that do not respond to rate control interventions. In addition, rhythm control may be associated with improved quality of life and exercise tolerance, and there is preliminary evidence that cognitive outcomes may be better in patients with AF who are maintained in sinus rhythm [89]. Rhythm control usually includes a trial of antiarrhythmic drug therapy; however, available agents have relatively low efficacy rates and side effects are common. Catheter ablation of AF foci in the left atrium is an alternative to antiarrhythmic drugs for maintaining sinus rhythm. Success rates range from about 65–85% but tend to be lower in older adults, who are also less often suitable candidates for the procedure due to an enlarged left atrium or other factors. Recent data from the CABANA trial comparing catheter ablation to drug therapy did not demonstrate superiority of ablation for the primary outcome of death, disabling stroke, serious bleeding, or cardiac arrest at 5 years [90]. Subgroup analysis by age showed a trend favoring catheter ablation in younger patients (age <65 years) and drug therapy in older patients (age ≥75 years; p-value for interaction 0.07). Symptom burden and quality of life were better in those undergoing catheter ablation as compared to those maintained on drug therapy, with similar findings across age groups [91]. Data from CABANA do not support catheter ablation as a first-line treatment for AF in older adults but indicate that it is a reasonable option in patients who remain highly symptomatic despite medical therapy.

The surgical Maze procedure is effective in maintaining sinus rhythm in up to 90% of patients with AF, but is usually reserved for severely symptomatic patients or those undergoing cardiac surgery for another reason (e.g., CABG) [87].

Anticoagulation markedly reduces the risk of stroke in older patients with either paroxysmal or chronic AF, and since increasing age is associated with increasing stroke risk, the oldest patients derive the greatest absolute benefit from anticoagulation. Conversely, the oldest patients are also at increased risk for bleeding complications. As a result of this tension, decisions regarding anticoagulation in older adults with AF are often challenging. In general, if there are no significant contraindications or high-risk co-existing conditions, older adults with AF should receive systemic anticoagulation. In other cases, risk assessment tools such as CHA_2DS_2-VASc, ATRIA, and HAS-BLED can be useful for assessing benefits and risks of anticoagulation (see Table 19.5) [92, 93]. In the past 10 years, new options for anticoagulation have become available. In general, the direct oral anticoagulants (DOACs) are at least as effective as warfarin for stroke prevention in patients with non-valvular AF, including those ≥75 years of age [94]. DOACs are also associated with lower risk for intracranial hemorrhage than warfarin, while the incidence of other major bleeding complications varies across agents. Among patients age 75 or older, gastrointestinal bleeding is more common with dabigatran and rivaroxaban than with warfarin, and this should be considered when selecting an anticoagulant in older patients [95]. Recently, andexanet alfa and idarucizumab have been approved as reversal agents for the factor Xa inhibitors (rivaroxaban, apixaban, edoxaban) and dabigatran, respectively, in the event of serious or life-threatening bleeding.

As noted previously, bleeding risks are increased for individuals on triple antithrombotic therapy. While optimal management of patients with indications for both antiplatelet therapy and anticoagulation remains an area of active investigation, recent data suggest that clopidogrel in combination with warfarin is as effective as triple therapy (i.e., including aspirin) and associated with lower bleeding risk, and that it may be safe to shorten the duration of triple therapy in selected patients following PCI [41, 96].

In patients at high risk for stroke who are also poor candidates for anticoagulation, device therapy, such as the WATCHMAN device or LARIAT procedure, may be considered [97]. The WATCHMAN left atrial appendage occlusion device is inserted via percutaneous catheterization, while the LARIAT procedure involves percutaneous closure of the left atrial appendage using a specialized suture delivery system; both have been approved by the FDA as alternative therapies for stroke prevention in selected patients with non-valvular atrial fibrillation. In the United States, the WATCHMAN device has become a commonly used approach to left atrial appendage occlusion, and a study of over 38,000 procedures in patients with a mean age of 76 years and high risk for both stroke and bleeding demonstrated an excellent safety profile, though data on subsequent clinical outcomes are not available [98].

19.12 Ventricular Arrhythmias

Ventricular arrhythmias, including isolated ventricular premature depolarizations, couplets, and runs of non-sustained ventricular tachycardia, increase in prevalence with age. The management of ventricular arrhythmias focuses on symptom severity and the risk of sudden cardiac death. In the absence of disturbing symptoms or very high frequency, ventricular premature depolarizations do not require treatment in most patients. Non-sustained and sustained ventricular tachycardia (VT) in older adults are usually associated with structural heart disease, and treatment is predicated on the severity of symptoms and the underlying heart condition. In most cases,

Table 19.5 Anticoagulants – For use in patients with non-valvular atrial fibrillation (NVAF)

	Trial* (Sample size)	Intervention versus Control	Outcomes	Age	Bleeding Risk	Precautions/Geriatric Considerations (per Lexicomp®)
Warfarin/ Vitamin K inhibitors	SPAF [111] *N* = 627	Warfarin versus Placebo	Ischemic Stroke and Primary Embolism: Risk reduction in warfarin group was 67% ($p = 0.01$)	Mean age 65 in Only 4% above 75	Major bleeding: 1.5%/year in Warfarin group versus 1.6%/ year in Placebo group	Risk for bleeding complications secondary to falls, drug interactions, living situation, and cognitive status
	BAFTA [112]	Warfarin versus Aspirin 75 mg daily	Fatal or disabling stroke, intracranial hemorrhage, or clinically significant arterial embolism: 1·8%/year Warfarin 3·8%/year Aspirin RR 0·48, 95% CI 0·28–0·80, $p = 0{\cdot}003$	Inclusion criteria >75 years Mean 82 (±4)		
Direct Thrombin inhibitors						
Dabigatran	RE-LY [113] *N* = 18,113	Dabigatran 110 mg or 150 mg twice daily versus Warfarin	Stroke or Systemic Embolism: 1.53%/year in 110 mg Dabigatran RR 0.91 ($p < 0.001$) 1.11%/year in 150 mg Dabigatran RR 0.66 ($p < 0.001$) 1.69% in Warfarin group	≥75 years or 65–74 years with DM, HTN, CAD. 110 mg: Mean 71 (±9)	Major bleeding: 2.71%/year in 110 mg Dabigatran RR 0.8 ($p = 0.003$) *and* 3.11%/year in 150 mg Dabigatran RR 0.93 ($p = 031$) 3.36% in Warfarin group	80% excreted renally; dose adjustment for patients with kidney disease: 75 mg BID for eGFR 15–30 cc/min; not recommended for eGFR <15 cc/min Increase in bleeding risk with age
Xa inhibitors						
Rivaroxaban	ROCKET AF [114] *N* = 14,264	Rivaroxaban 20 mg or 15 mg daily (CrCl 30–49 mL/ min) versus Warfarin	Stroke or Systemic Embolism: 1.7%/year in Rivaroxaban group versus 2.4%/year in Warfarin group HR 0.79 ($p < 0.001$)	Median = 74 IQR = 65–78	Major and Minor bleeding: 14.9%/year in Rivaroxaban group versus 14.5%/year in Warfarin group HR 1.03 ($p = 0.44$) *Subgroup analysis by age* ($p = 0.118$)	The mean AUC was 41% greater in persons >75 years of age. Dose reduction to 15 mg daily in patients with NVAF and creatinine clearance 15–50 cc/min; avoid in patients with creatinine clearance <15 cc/min. Avoid in: Moderate to severe hepatic impairment (Child-Pugh classes B/C) Patients with any hepatic disease associated with coagulopathy.

(continued)

Table 19.5 (continued)

	Trial* (Sample size)	Intervention versus Control	Outcomes	Age	Bleeding Risk	Precautions/Geriatric Considerations (per Lexicomp®)
Apixaban	ARISTOTLE [115] $N = 18{,}201$	Apixaban 5 mg twice daily versus Warfarin 2.5 mg twice daily in patients with ≥2 risk factors: age ≥ 80 years, weight ≤ 60 kg, creatinine ≥1.5 mg/dL	Stroke or Systemic Embolism: 1.27%/year n Apixaban group versus 1.6%/year in Warfarin group HR 0.79 ($p < 0.001$) *Outcomes by age (p = 0.12)*	Median = 70 IQR = 63–76	Major or clinically relevant bleeding: 4.07% year in Apixaban group versus 6.01% in Warfarin group HR 0.68 ($p < 0.001$)	Not recommended in: Severe hepatic impairment (Child-Pugh class C) Significant renal impairment (CrCl <30 mL/minute) (not included in trials) Dosage reduction for patients with ≥2 risk factors: serum creatinine ≥1.5 mg/dL, ≥80 years of age, ≤60 kg. Bleeding risk may be increased in severe renal impairment (CrCl <30 mL/min) Patients with ESRD have not been studied
Edoxaban	ENGAGE AF-TIMI [116] $N = 21{,}105$	Edoxaban 30 or 60 mg daily Versus Warfarin	Stroke or Systemic Embolism: 1.61%/year in 30 mg Edoxaban group HR 1.07 $p = 0.005$ *and* 1.18%/year in 60 mg Edoxaban group Versus 1.5%/year in Warfarin group HR 0.79 $p < 0.001$	Median = 72 IQR = 64–78	Major Bleeding: 2.75%/year in 30 mg Edoxaban group and HR 0.8 ($p < 0.001$) *and* 1.61%/year in 60 mg Edoxaban group HR 0.47 ($p < 0.001$) versus 3.43%/year in Warfarin Group	Do not administer to patients with CrCl >95 mL/minute Reduce dose to 30 mg/day in patients with CrCl of 15–50 mL/minute or venous thromboembolism (DVT and/or PE) and body weight ≤ 60 kg Not recommended in patients with moderate or severe hepatic impairment (Child-Pugh class B and C) or patients with CrCl <15 mL/minute

HR Hazard Ratio, *OR* Odds Ratio, *RR* Relative Risk, *IQR* Interquartile Range, *CrCl* Creatinine Clearance, *DM* Diabetes Mellitus, *CAD* Coronary Artery Disease, *HTN* Hypertension, *CNS* Central Nervous System

Trial Acronyms: *SPAF* Stroke Prevention in Atrial Fibrillation, *BAFTA* Birmingham Atrial Fibrillation Treatment of the Aged Study, *RE-LY* Randomized Evaluation of Long-Term Anticoagulation Therapy, *ROCKETAF* Rivaroxaban Once Daily Oral Direct Factor Xa Inhibition Compared with Vitamin K Antagonism for Prevention of Stroke and Embolism Trial in Atrial Fibrillation, *ARISTOTLE* Apixaban for Reduction In Stroke and Other ThromboemboLic Events in Atrial Fibrillation, *ENGAGE-TIMI* The Effective Anticoagulation with Factor Xa Next Generation in Atrial Fibrillation–Thrombolysis in Myocardial Infarction

short runs of non-sustained VT do not require specific therapy. Patients with symptomatic sustained VT should be referred to an electrophysiologist for further evaluation and management. Patients with reduced LV ejection fraction (≤35%) are at risk for sudden cardiac death, whether or not ventricular arrhythmias are manifest, and should be considered for an ICD (see above).

19.13 Cardiac Rehabilitation and Exercise

Regular physical activity, including structured cardiac rehabilitation, provides substantial benefits for older adults through multiple mechanisms. Physical activity improves physical strength and function, cardiovascular function, social and psychological well-being, and cognitive function. Despite these benefits, older adults are less likely to be active and tend toward a sedentary life due to reduced motivation, social barriers, and physical limitations.

Cardiac rehabilitation is a comprehensive secondary prevention program incorporating physical exercise and lifestyle changes that can have particular benefit for older patients with cardiovascular conditions. The benefits of cardiac rehabilitation are diverse and include a reduction in symptom burden, increased exercise capacity, positive metabolic profile changes, weight loss, and improvements in non-cardiac outcomes such as cognition, depression, and social isolation. Cardiac rehabilitation has been significantly underutilized in older adults for reasons related to both patients and providers. Compared to younger adults, referral rates to cardiac rehabilitation are lower following a qualifying event. There is also poor communication to and understanding by patients and their families of the benefits of cardiac rehabilitation. In addition, there may be significant social, financial, and psychological barriers to participation, including transportation issues, costs, and fears about ability to exercise. Older adults are also less likely to maintain participation in cardiac rehabilitation, even when recommended by their physicians. As a result, home-based cardiac rehabilitation programs have been developed and demonstrate feasibility and benefit but limitations involving standardization of programs, safety, and reimbursement have hampered use. Despite these challenges, the current and ongoing coronavirus disease pandemic (COVID-19) has stimulated interest in further developing and implementing home-based cardiac rehabilitation services.

Physical activity beneficial to cardiovascular health can also be achieved outside of the structure of a cardiac rehabilitation program, and indeed for many diagnoses (e.g., HFpEF, AF), formal cardiac rehabilitation is not covered by Medicare. Individuals who remain physically active have a lower incidence of CVD as well as lower rates of frailty, disability, and cognitive decline. Currently, there are numerous activity programs, some of which may be covered by Medicare Advantage, that specifically focus on older adults. Importantly, exercise programs for older adults must be able to accommodate and adapt to multimorbidity and physical limitations; nonetheless, the value of exercise even in very old adults is substantial. Good communication between providers, physical therapists, patients, families, and trainers increases the feasibility and safety of exercise for older adults at any age and regardless of functional status (see also Chap. 19, Rehabilitation).

19.14 Advanced Care Planning and End-of-Life

CVD is the leading cause of major morbidity and mortality in older adults and in the advanced stages often results in disabling symptoms that greatly diminish quality of life. Whereas evidence-based care tends to focus on a primary goal of increasing longevity, symptom severity, complexity of care, and multimorbidity can undermine the perceived value of prolonging life [99]. In addition, aggressive therapies expose patients to increasing risk of harm. For some older patients, living as long as possible may be the primary health-care goal, but for others, achieving an acceptable quality of life, maintaining independence, avoiding hospitalization, or dying at home may be more important. Since these preferences are highly personal, conversations regarding goals of care and health-care choices need to occur prior to life-threatening events.

The prognosis for an older adult with advanced heart failure is similar to that of advanced lung cancer; however, this information is infrequently communicated to and comprehended by patients and families. Even when eligible for advanced treatment options (DT-LVAD or rarely heart transplantation), the associated morbidity and mortality rates are high. This obliges providers to discuss patient preferences, short- and long-term goals, and views on life-prolonging therapies.

Palliative care and hospice services improve symptoms, patient and family quality of life, and in some cases may even prolong life [100]. In one non-randomized study of individuals with end-stage heart failure, those that received hospice care survived 81 days longer on average than those not in hospice programs. Patients enrolled in home hospice programs are far more likely to die in their own homes in alignment with their expressed wishes. In addition, there are fewer hospital admissions and doctor visits, as well as reduced overall expenditures. For some older adults, palliative care and hospice provide an acceptable patient-centered alternative to standard disease-focused care. For further information on palliative and end-of-life care, see Chap. 7.

19.15 Summary

Aging is associated with substantial changes in cardiovascular structure and function, as well as alterations in other organ systems that significantly impact the incidence, clinical features, response to therapy, and prognosis of virtually all cardiovascular disorders. In addition, the increasing prevalence of geriatric-specific conditions, including multimorbidity, polypharmacy, frailty, and physical and cognitive impairments, greatly increases the complexity of managing older adults with CVD. Although additional research is needed, optimal care of older adults with CVD requires an individualized multidisciplinary approach that is patient-centered rather than disease-centered, and which incorporates patient preferences and goals of care into the decision-making process.

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20 Endocrinology

Willy Marcos Valencia and Hermes Florez

This chapter focuses on frequent endocrinology problems in older adults looking through a “geriatrician prism.” The following learning cases facilitate discussion of pertinent topics:

20.1 Case 1

Mr. F. is a 78-year-old white non-Hispanic patient without any known major chronic disease. His body mass index (BMI) is 29 kg/m^2. He exercises daily, mostly at home due to the 2020 pandemic, he tries to walk in the park nearby, but no longer attends the supervised group exercise program. He remains active at home, but he stopped volunteering in a local hospital. Instead, he tries to communicate more with his family, and he learned to use his cell phone to join videoconference with his family. He reports good memory and enjoys a happy life with his wife. Both his parents survived into their 90s.

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20.2 Case 2

Mrs. O. is a 67-year-old Hispanic patient with recently diagnosed type 2 diabetes. She does not have micro- or macrovascular complications but is concerned about being at risk for them. Her BMI has increased over the past few years, despite her efforts, and currently is 33 kg/m^2. She shares the same household with her daughter, son-in-law, and grandson. She tried to be physically active but reports limitations as she needs to focus on supervising and troubleshooting the virtual education of her 7-year-old grandson. Her functional status is preserved, but she now manifests features of mild cognitive impairment.

20.3 Case 3

Mr. P. is a 66-year-old African American patient with longstanding type 2 diabetes and metastatic prostate cancer, treated with bilateral orchiectomy 4 years ago. Since then, he has been receiving androgen-suppression therapy. His medical history includes controlled coronary heart disease, diastolic heart failure, and embolic stroke, without residual neurological deficits. He complains of weight gain, depression, lack of energy, and has recently become more forgetful. His family (ex-wife, children, and brothers) is supportive, but he has limited contact with them due to the pandemic. Now, he only attends virtual visits with his providers and reports he does not feel as strong as he used to be 1 year ago.

20.4 Case 4

Mrs. B. is a 72-year-old white non-Hispanic patient with type 2 diabetes and coronary heart disease who was recently discharged home from a skilled-nursing facility after com-

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pleting rehabilitation following her recovery from hospitalization due to SARS-COV-2 pneumonia. Her BMI is 26 kg/m^2 and she has tolerated her new regimen of medications for diabetes and osteoporosis. She is now at home, where she lives alone. She reports she feels less strong than before going to the hospital. She lost 10 lb during the hospitalization, but she also describes persistent edema in her legs. She used to enjoy the support from neighbors who used to visit her, but this stopped due to the pandemic.

The chapter will be presented in four sections addressing the most common endocrine problems in the elderly: diabetes (including prediabetes and obesity), osteoporosis (and hypercalcemia), thyroid diseases, and male hypogonadism.

20.5 Diabetes in Older Adults

Diabetes is a chronic progressive disease with genetic, perinatal, and environmental risk factors that affect patients throughout their lives. While pharmacologic interventions have made significant progress, and there is potential reversibility or "cure" (postbariatric surgery or major lifestyle change and weight loss), the latter are not applicable to most older adults. Moreover, the consequences from advanced disease with its complications jeopardize their independence, quality of life, social and economic welfare. Thus, it remains one of the most relevant public health issues we need to continue working and educating the world. The 2020 National Diabetes Statistics Report estimates that in the USA, 13 million or 26.8% of adults aged 65 years and older have diabetes, and 15.3 million or 22.6% have prediabetes [1]. While the incidence of diabetes showed a declining curve during 2000–2018, the rates of diagnosed diabetes were higher in adults aged 45–64 and 65 years and older, when compared to those aged 18–44 years [2], and the rates of diagnosed diabetes were greater in those aged 65–74 and 75+ years (21.4% and 21.8%, respectively, of all cases) [3]. Worldwide, type 2 diabetes (T2D) is most commonly diagnosed in older adults [4].

Understanding the challenges associated with the diabetes epidemic in this age group is paramount for both endocrinologists and geriatricians. Older patients with diabetes have significant clinical and functional heterogeneity that should impact the choice of pharmacologic agents and management targets [5–7]. Most providers recognize the importance of a patient-centered approach, considering specific features such as diabetes duration, life-expectancy, comorbidities, complications, attitudes, resources, and support systems [8].

There is variability in the development of diabetes-related complications. Using the clinical vignettes, Mr. F. (Case 1) is at risk of developing diabetes due to his age and high BMI, but has no comorbidities, while Mr. P. (Case 3) has longstanding diabetic macrovascular complications, metastatic prostate cancer and is experiencing a decline in physical function and depression. These very different patients warrant very different approaches to prevention and treatment. In addition, Mr. P.'s. clinical presentation is typical of older adults with diabetes that often includes several comorbid conditions that impact functional status, life-expectancy, and increase the risk for side effects and adverse reactions from diabetes interventions [9].

Life-expectancy varies significantly depending on the number and severity of diabetic complications and comorbidities, functional reserve, physical and cognitive function, social support and environment, as well as genetic background (i.e., parental longevity vs. those with a family history of premature death). Diabetes duration and advancing age independently predict diabetes morbidity and mortality rates [10]. While an accurate determination of life-expectancy is not possible, an estimation of short, intermediate, and long-term life-expectancy can facilitate establishing goals and the management intensity needed to reach them [11].

While there is still a need for more trials addressing specific issues of the older adult, we observe an increasing number of publications in the recent years. Nonetheless, it remains challenging to implement evidence-based care in this age group, due to its heterogeneity [5]. Decisions should be individualized using data available from clinical studies, recommendations from clinical guidelines, and the clinical experience of the providers.

Most endocrinologists implement a comprehensive approach for diabetes management [12]. This includes coordination of care and specialized services (ophthalmology, podiatry, nephrology, cardiology, neurology, home health care, etc.), while engaging the patient's family and any other support available. Additional geriatric assessments for geriatric syndromes, cognitive and physical function assessments, and the role of new technologies and approaches for diabetes in the older adult, will be useful to enhance the clinical care and outcomes in older adults [13, 14].

20.5.1 Diabetes and Clinical Inertia

The concern about clinical inertia in older patients with diabetes has been previously described [15] and remains an important marker for provider and institution performance and, most importantly, for its negative impact which can result in either under- or overtreatment, complications, and mortality [16]. These factors can be described with the three different scenarios: (1) resistance to implement early intensive preventive therapies for weight and glucose control in healthy older adults with newly diagnosed diabetes or prediabetes; (2) lack of adoption of current recommendations for the management of older adults with diabetes that tailor targets according to the health status, multimorbidity, cognition, and life-expectancy; and (3) lack of awareness of patient's preferences and circumstances related to their functional, mental, and social domains.

The first inertia scenario may occur among primary care providers related to concerns about overtreatment, underestimation of life-expectancy, and low confidence in the ability of older adults to respond to lifestyle interventions. For example, Mr. F. (Case 1) is at risk for developing diabetes due to his BMI of 29 kg/m^2. He should be screened with an HbA1c, and if in a prediabetic range he would be an ideal candidate for the Diabetes Prevention Program (DPP) [17]. While most clinicians are aware of the efficacy of these programs in younger adults, the benefits from lifestyle improvements are even greater for older individuals [18]. If despite DPP interventions Mr. F. develops diabetes at age 78, the recommended HbA1c target would be <7.5% [5], and lower HbA1c values would be appropriate only if this is accomplished without hypoglycemia and done in consideration of the patient's preferences, access, and support [8]. Using targets for the general adult population may be reasonable for some healthy older adults with short diabetes duration [19] but may not apply for the patient approaching age 80. Individualized targets [5–8] require further assessment of physical and cognitive function, life-expectancy, and patient's preferences and avoid hypoglycemic events.

The second inertia scenario may occur when older patients with diabetes are not treated according to recommendations from the American Geriatrics Society (AGS) and American Diabetes Association (ADA) guidelines for this age group [6], which recommend less intensive glycemic control in older adults with diabetes. Even these guidelines were based on major studies that recruited "young" old adults (62.2 ± 6.8 years in Action to Control Cardiovascular Risk in Diabetes (ACCORD) [20], 66 ± 6 years in Action in Diabetes and Vascular Disease Preterax and Diamicron MR Controlled Evaluation (ADVANCE) [21], and 60.4 ± 8.7 years in Veterans Affairs Diabetes Trial (VADT) [22]). For adults in their late 70s and 80s, even great caution and clinical judgment must guide therapeutic targets and interventions, since there are no clinical trials in those age groups.

Lastly, the third inertia scenario occurs when there is failure to recognize that geriatric syndromes are more common in older people with diabetes. These syndromes (impaired mobility, dementia, depression, etc.) impact the patient's ability for self-monitoring, and others (falls syndrome, osteoporosis, frailty syndrome, poor dentition, malnutrition, etc.) increase the risk for negative outcomes from hypoglycemia or hyperglycemia. Thus, tight glycemic control in the older adult and particularly in the oldest old can be difficult and potentially detrimental.

Table 20.1 illustrates the evolving targets for an older individual whose diabetes progresses, when diabetic complications occur and when there is a decline in physical and cognitive function or when geriatric syndromes develop.

20.5.2 Diabetes and Renal Disease

Progressive loss of renal function is associated with aging, although the degree of loss is highly variable. Chronic kid-

Table 20.1 Evolving glycemic targets and changes in geriatric domains during diabetes disease progression in the older patient

Clinical scenario	HbA1c goals ADA and AGS[a]	Comments
Mrs. O. (Case 2) 67-year-old Hispanic patient *Medical:* recently diagnosed T2D *Functional:* preserved functional status *Mental:* mild cognitive impairment (MCI) *Social:* lives at home, is independent, and has family support	<7.5% Or 6.5–7.5% As long as there are no hypoglycemic events	There is potential harm in lowering HbA1c <6.5% in older adults [21]. Implement lifestyle changes toward modest intentional weight loss. Start low, go slow, with pharmacologic interventions, and monitor; follow up and titrate to reach the target
Two years later, Mrs. O. presents with one or several of the following scenarios: *Medical (1):* a myocardial infarction and heart failure *Medical (2)*: Parkinson's disease, chronic kidney disease stage 3, and emphysema *Medical (3):* newly diagnosed colon cancer *Functional*: requires assistance with activities of daily living (ADLs) (bathing and dressing) *Mental:* MCI has progressed to dementia *Social:* lives in an Assisted Living Facility which cannot administer insulin four times per day	<8.0% Or 7.0–8.0% As long as there are no hypoglycemic events	Studies support avoiding intensive glycemic control in individuals with macrovascular complications A similar approach applies in multimorbidity (more than three chronic diseases), cancer, or mild to moderate cognitive impairment, and with two or more instrumental ADL impairments

(continued)

Table 20.1 (continued)

Clinical scenario	HbA1c goals ADA and AGS[a]	Comments
Six years later, Mrs. O. presents with one or several of the following scenarios: *Medical (1):* has a massive stroke with major neurological and functional sequel *Medical (2):* develops severe liver damage due to acetaminophen toxicity, and now presents end-stage liver disease *Medical (3):* develops rapidly progressive chronic kidney disease and requires hemodialysis *Functional:* loss of physical function, bedridden, dependent for most activities of daily living *Mental:* advanced dementia *Social:* admitted to a nursing home Her family requests a focus on quality of life and avoidance of polypharmacy	<8.5% Or 8.0–8.5% And up to 9% in cases unlikely to benefit from lower values, due to limited life-expectancy	Higher targets relate to lack of benefit from more aggressive interventions and the need to avoid hypoglycemia Still aims to avoid severe hyperglycemia and glycosuria, which may be associated with impaired wound healing, infection, and urinary incontinence, volume depletion, hypernatremia, delirium, falls, as well as hyperosmolar hyperglycemic nonketotic syndrome or diabetic ketoacidosis

Goals must be achievable without recurrent or severe hypoglycemia or undue treatment burden. For cases experiencing those problems, reducing antihyperglycemic medications and allowing higher HbA1c values are appropriate. This recommendation increases in relevance as the clinical scenarios progress to situations with end-organ failure, long-term care, and end-of-life care

Note: HbA1c might not be reliable in severe illness or disease, and targets may be based on measured glucose values

[a]Recommendations based on the American Diabetes Association and the American Geriatrics Society, including individualization of targets and patient-centered characteristics [5–9, 16, 23]

ney disease (CKD) is a complication of diabetes or can be associated with hypertension (HTN), another common age-related disease. In addition, older adults may be treated with pharmacologic agents that could lead to kidney damage. Since several antihyperglycemic medications (Table 20.2) are renally excreted, the management of older adults with diabetes and kidney disease is challenging, particularly in those with advanced CKD.

The reader is also referred to Chap. 25, Nephrology.

20.5.3 Geriatric Syndromes and Diabetes

Geriatric syndromes are prevalent in older adults, associated with aging and comorbidities, and often lead to poor quality of life, loss of independence, and admission to long-term care facilities [26]. These syndromes include cognitive decline, depression, persistent pain, polypharmacy, urinary incontinence, and reduced mobility and falls. Some of these may impair diabetes self-management, lead to poor glycemic control, and increase the risk for hypoglycemia, especially those described below [27].

20.5.3.1 Polypharmacy

In prescribing for an older person with diabetes, it is important to recognize that older people may carry chronic diseases from earlier life, as well as develop new diseases, and that multimorbidity leads to being prescribed a great number of medications, with higher risk for drug–drug or drug–disease interactions. In addition, adherence to medications declines as the number of medications and the frequency of dosing increase. Polypharmacy in older people with diabetes has also been driven by pay-for-performance and the use of HbA1c as a quality outcome measure [28]. Often when providers follow guidelines for a series of conditions, the result is polypharmacy. Guidelines are not based on studies of patients with multimorbidity . The shift toward quality outcomes that include reduction of polypharmacy by incorporating age- and patient-specific factors to assess quality and performance should lessen medication burden [29].

The American Geriatrics Society published the 2015 "Beers criteria," a list of medications that should be avoided or used with caution in older patients [24]. Among them, glyburide is listed as a drug to avoid, as it is associated with a high risk for hypoglycemia due to its long half-life. While sulfonylureas may have decreased due to new alternative agents, these agents are still sometimes useful, especially due to their low cost and oral route. Notably, the 2019 updated AGS Beers Criteria [25] added glimepiride to the list, due to the risk for prolonged severe hypoglycemia. This leaves glipizide as the only sulfonylurea that we consider acceptable. Nonetheless, it is widely available, low cost, and can be considered when applicable. Following our prior recommendations, now we would recommend providers to work with their pharmacists to titrate/adjust/switch their patients on glimepiride, and transition to them to glipizide. Regarding insulin use, the routine use of regular insulin sliding scale is discouraged in older adults with diabetes. Table 20.2 presents an overview of pharmacologic options, and considerations in the geriatric population.

20.5.3.2 Cognitive Impairment

There is epidemiological evidence that diabetes increases the risk for cognitive impairment [30, 31]. Long-standing diabetes

Table 20.2 Pharmacotherapy for diabetes in the older adult

HbA1c target based on clinical scenarios in Table 20.1	Management	
	First line	Second line ([a])
<7.5% Or 6.5–7.5% As long as there are no hypoglycemic events	Maximize lifestyle interventions. Avoid medications associated with weight gain *Metformin* May help with weight loss Start 500 mg PO with the largest meal, monitor tolerance, increase slowly, toward the target of 1000 mg PO BID Monitor renal function, counsel patients when to hold medication in settings where the renal function may be impaired (procedures using iodinated contrast)	*Glucagon-like peptide-1 receptor agonists (GLP-1 RA)* Reduces appetite, useful if the patient has concomitant obesity Requires injection (check manual dexterity, vision) *Dipeptidyl peptidase-4 (DPP-4) inhibitors* Weight neutral May be preferred if the patient has limitations in vision or prefers an oral agent Dose adjustment based on the renal function; except linagliptin *Sodium-glucose cotransporter-2 (SGLT-2) inhibitors* Risk of urinary tract infections and ketoacidosis Reduces glucose resorption from kidney; caution in patients with urinary incontinence (UI); may cause or contribute to UI. If UI is identified, refer to primary care or geriatrics for further evaluation and management *Second-generation sulfonylureas* May cause hypoglycemia and weight gain, start with low-dose glipizide or glimepiride, monitor and titrate Useful when drug cost is important (generics available) Do not use glyburide [24] and avoid glimepiride [25] due to long-acting effect and risk for severe prolonged hypoglycemia Evolving concern on cardiovascular safety *Basal insulin* for patients who are not eligible or amenable to any of the above options Start 0.2 units/kg/day, monitor and titrate [16] Older patients with new-onset diabetes and HbA1c above 10%; patients may not fully respond to oral agents. Start basal insulin and preprandial short-acting insulin
<8.0% Or 7.0–8.0% As long as there are no hypoglycemic events	*Metformin*	*DPP-4 inhibitor* (same as above) *GLP-1 RA* (same as above) *SGLT-2 inhibitor* (same as above) *Insulin*: (same as above)
<8.5% Or 8.0–8.5% And up to 9% in selected cases unlikely to benefit from lower values, due to limited life-expectancy	Most noninsulin antihyperglycemic agents will require to be stopped due to limitations in renal excretion and disease status *Begin* Insulin basal bolus and preprandial Daily home skilled-nursing services not feasible long term Basal insulin plus oral agents, as long as the glycemic target can be achieved *Other considerations* Use alternatives to insulin if the patient/caregiver cannot check glucose or inject insulin 4 times/day Most patients with advanced chronic kidney or liver disease require insulin, due to risks, lack of evidence, unpredictability, or contraindications to noninsulin options Insulin can be challenging, if caloric intake fluctuates, for procedures, for example, hemodialysis, etc.	*DPP-4 inhibitor alone* (reduces HbA1c by 0.7%): consider when this may be sufficient to reach the target *DPP-4 inhibitor plus alpha-glucosidase inhibitor (if tolerated)* *Long-acting GLP-1 RA* (weekly), if effective and safe, may be convenient in certain settings, especially when the patient requires assistance with medications *Other considerations* Avoid glucose values above 220 mg/dl, since this can be associated with glycosuria (dehydration and UI) Not only avoid glucose values close to 100 mg/dl, but if a trend toward these values is detected, a decrease in the intensity of regimen may be required, before a hypoglycemic event occurs Avoid weight loss, which will mostly be from muscle and bone mass, due to low physical activity levels in many of these patients

[a]With proper monitoring, titrate up as needed to accomplish the desired target

may contribute to the development of dementia; however, there are insufficient longitudinal studies to address the impact of patient attrition (i.e., patients with diabetes may not live long enough to develop dementia). The Atherosclerosis Risk in Communities study showed the association between diabetes in midlife and long-term cognitive decline [32], suggesting that diabetes prevention and control in midlife may protect against cognitive decline later in life.

Poor glycemic control with recurrent especially severe hypoglycemic events is independently associated with accelerated late-life cognitive decline [33], and there is no evidence that more intensive glycemic control will slow progression toward dementia.

The Memory in Diabetes study (ACCORD MIND) evaluated patients with type 2 diabetes with a mean age of 62.5 years and showed no benefit from intensive glycemic or blood pressure interventions on cognitive testing [34]. Similarly, an ancillary analysis from the Look AHEAD study showed no benefit in cognitive function after 8 years of intensive lifestyle intervention in adults with obesity and type 2 diabetes [35]. Studies on older adults at high risk or with newly diagnosed type 2 diabetes may provide better understanding on the potential benefits of earlier interventions to reduce the risk of cognitive decline and preserve function in these patients.

Hypoglycemia in older adults with type 2 diabetes is associated with increased risk for cognitive decline and dementia [36]. Conversely, impaired cognitive function can increase the risk for hypoglycemia. A post hoc analysis in the ACCORD study showed that poor cognitive function may increase the risk of severe hypoglycemia [37]. While of lesser prevalence compared to T2D, patients with type 1 diabetes (T1D) are aging as well. Recently published results from the Study of Longevity in Diabetes (SOLID) addressed severe hypoglycemia (SH), defined as a hypoglycemic episode that requires external help, in their cohort of 718 older adults with T1D. They described that 32% of participants reported a recent SH, and 50% reported prior lifetime SH [38]. The researchers found those events were associated with impaired global cognition.

We recommend providers to keep in mind that impaired cognition could lead to greater risk for hypoglycemia. While the relationship between increased hypoglycemia risk and cognitive impairment is likely bidirectional [39, 40], we emphasize the need to screen for geriatric for routine cognitive assessments as well as hypoglycemia reduction strategies in the older adult with diabetes.

The reader is referred to Chap. 8, Office Tools for Assessment for recommendations on screening for cognitive impairment.

20.5.4 Challenges with Injectable Agents

There have been an increased availability and evidence supporting the use of noninsulin injectable GLP-1 RA [41]. On the other hand, increasing numbers of older adults with long-standing disease may eventually require insulin, due to the progressive natural history of diabetes. However, the dexterity and ability needed to implement an injectable regimen could be affected by neuropathy, arthritis, cognitive impairment, and other comorbidities [16]. If self-management skills are limited, then providers should assess the availability of informal (i.e., family or friends) or formal (e.g., home health nursing) support to implement and monitor an injectable regimen. In addition, documenting in the patient's record the presence of these chronic conditions and comorbidities will help providers reach the level of complexity needed for appropriate clinical reimbursement and facilitate coordination of care for older adults with diabetes on insulin. Providers will benefit from considering the potential advantages from long-duration formulations (e.g., once per week), which could facilitate the regimens, albeit always considering the feasibility of access (e.g., insurance coverage) [16].

20.5.5 Challenges with Obesity Management

The prevalence of obesity and its comorbidities increase with age [42]. Obesity could impact the medical (e.g., type 2 diabetes, cardiovascular disease, and cancer), mental (e.g., depression and dementia), social (e.g., stigmatization and isolation), and functional domains (e.g., impaired mobility) in the geriatric population [43–45]. However, the assessment and management of obesity in older adults with diabetes may not be common practice among providers. One contributing factor may be the limited evidence on potential benefits associated with weight loss medications and bariatric surgery in older adults. However, modest intentional weight loss through lifestyle (healthy nutrition and increased physical activity) could reduce the burden of obesity-related comorbidities and improve the quality of life of otherwise healthy older adults with obesity [46].

The "obesity paradox" is a term used to describe observations of better outcomes in older people at higher BMIs compared to younger people [47–49]. Epidemiological studies have described better survival in overweight older adults with heart failure, hypertension, stroke, and end-organ damage. However, better outcomes are also seen in each BMI category, when better fitness was also present [50, 51], suggesting that fitness and not simply fatness is important. Therefore, it is important that cardiovascular and physical conditioning with modest weight management should be a part of the plan of care in older patients with diabetes. In Case 1, Mr. F. who has a BMI of 29 kg/m^2 would benefit from the lifestyle interventions consisting of exercise and modest intentional weight loss. He may lose 10 lb in 1 year and lower his BMI to 28 kg/m^2. While remaining in the overweight group, he has likely improved his clinical, metabolic, and functional profiles.

20.6 Osteoporosis in Older Adults

Osteoporosis increases with age. In addition to age-related decline in bone, the loss of gonadal function in both women and men, and conditions associated with inflammation may contribute to increased risk of fracture [52, 53]. Furthermore, there are gender differences in its consequences. Approximately 50% of women and 20% of men are at risk for an osteoporosis-related fracture during their lifetime. This is probably related to accelerated bone loss in the postmenopausal period, but mortality is greater in older men within the first year after a hip or femoral fracture [54, 55]. In addition, the prevalence of osteoporosis significantly increases in the oldest old (age 80 and older), in whom the average T-score is lower than −2.5 SD. More than 50% of patients hospitalized with hip fracture belong to this age group [56, 57].

Osteoporotic fractures accelerate functional decline in older adults and have a major economic impact [58, 59]. The annual costs of incident fractures are estimated at $17 billion with men accounting for 29% of fractures and 25% of costs. An economic model incorporating the growth of the older adult population projected that by 2025 the annual fractures and costs will increase by 50% [58]. Forty percent of people who break their hip do not fully recover to their prefracture functional level, and 20% have such major functional decline that they lose independence and require long-term care placement [59].

Prevalence studies find nearly half of all women age 80 and older have a vertebral fracture [60]. Additionally, older adults with vertebral fractures present with progressive height loss, pain, loss of mobility and independence, psychological distress, decreased quality of life, and increased risk of disability [61–63]. Furthermore, patients with vertebral fractures also have increased risk for nonvertebral fractures.

A 2006 systematic review aimed to quantify the global burden of osteoporotic fractures worldwide [64]. They found that among noncommunicable chronic diseases, osteoporosis was fifth in disability burden behind coronary heart disease, lung disease, osteoarthritis, and Alzheimer's dementia. More current studies (2016 and 2019) showed similar concerns about the burden of osteoporotic fractures, leading to loss of function and disability [65–67]. A 2017 pooled analysis of six cohorts, for a total of 223,880 adults who presented a hip fracture, found that 5.3% died as a result, and 5964 disability-adjusted life-years (DALYs), 1230 of whom were in those aged 75–79 years [68]. Therefore, timely assessment and appropriate therapy could reduce the growing burden associated with osteoporosis.

20.6.1 Osteoporosis Screening

The updated guidelines from the US Preventive Services Task Force (USPSTF) (2018) [69] and American Association of Clinical Endocrinologists (AACE)/American College of Endocrinology (2020) [70] renew their recommendation for osteoporosis screening in women aged 65 years and older. While the latter focuses on postmenopausal women, the former does include opinions in men, and the USPSTF again describes there is insufficient evidence to assess the balance of benefits and harms of osteoporosis screening in men. There have been no updated AACE guidelines for osteoporosis in men since their 2012 guidelines [71]. They had considered screening men aged 70 years and older, and in younger with risk factors. Nevertheless, updated guidelines and expert publications have placed more emphasis on a risk-driven approach, to accomplish not just a diagnosis, but to reduce fractures.

In the past few years, studies have addressed the cost-effectiveness of osteoporosis screening. A 2018 Danish study randomly assigned 34,299 women aged 65–80 to osteoporosis screening and usual care [72]. After a median follow-up of 5 years, the screening group had greater osteoporosis mediation use, but there was no significant difference in fractures between screening and control, after an intention-to-treat analysis. Prior to our first edition, a British study had randomly assigned 12,483 women aged 70–85 to osteoporosis screening or usual care [73]. There was also a greater use of osteoporosis medications in the screening group, but with lower risk of hip fractures [HR 0.72, 95% CI 0.59–0.89]. They found no difference in other osteoporosis-related fractures, mortality, or health-related quality of life. Notwithstanding, a separate publication from this UK team described that the intervention group gained costs per quality-adjusted life-year (QALY) of £2772, when compared with the control group. In addition, they described that the intervention reduced costs of £4478 for osteoporosis-related and £7694 for hip fractures, when compared with the control group [74]. We encourage providers to maximize the proper utilization of osteoporosis screening, including tools for risk assessment.

20.6.2 Osteoporosis Risk Assessment

In the World Health Organization (WHO) Fracture Risk Algorithm (FRAX®), available at https://www.shef.ac.uk/FRAX/), increasing age is one of the strongest predictors for fracture risk, only second to personal history or family history of previous fragility fracture. Of interest, there is a remarkable variation in the age-specific risk for fracture worldwide. In the 45 countries studied, there was greater heterogeneity between countries than between gender differences within a country [75]. The 2010 revision of FRAX (3.0) uses updated epidemiological information in the USA and shows the predictive value for hip fracture, even in men and women aged 70 years and older [76]. The 2017

FRAX update addressed concerns about the identification of patients solely based on their clinical risk factors, with findings that supported the efficacy of the intervention even when bone mineral density was not available [77]. It also emphasized that treatment should focus on patients with the highest fracture risk, and that subsequently, treating high-risk men and women would improve the cost-effectiveness of the intervention. Finally, it also addressed the potential correction of the results for variables that were not originally included. From a geriatrician's standpoint, the most important one was the history of recurrent falls and falls risk.

Data from the Osteoporotic Fractures in Men Study (MrOS) suggest that pharmacologic treatment would be needed in one-third of the USA; white men aged 65 years and older and one-half of those aged 75 years and older [78]. A practical approach to screening for men is to address height loss, especially if ~1.5–2 in., as potentially associated with asymptomatic vertebral fractures [79]. Additional clinical risk factors that should prompt earlier screening include low body weight, history of prior fragility fracture, family history of osteoporosis, smoking, excessive alcohol intake, and long-term use of high-risk medications (e.g., glucocorticoids at doses >5 mg/d of prednisone, or its equivalent) [77].

20.6.3 Special Considerations in Older Adults

Geriatric syndromes of falls, sarcopenia, and frailty are not included in FRAX, but they are associated with older patients with fractures [80–83]. In addition, more than 50% of people hospitalized due to hip fracture are older than 80 years, and many of them will sustain another fracture [84–87]. We emphasize the prevention of new or subsequent fractures, which many times occur after a fall, by incorporating a brief assessment of gait and balance, especially if there is a history of falls [88]. For details, see Chap. 8 on Office-Based Assessment. While not specific to osteoporosis, the practice guidelines from the American Geriatrics Society and the British Geriatrics Society [89] outline recommendations for older adults who present with the falls syndrome. Patients with osteoporosis may benefit greatly from a multifactorial risk assessment for falls if they present with more than two falls per year, or if a fall leads to an injury or is the chief complaint in the clinical visit. The endocrinologist should ask about falls and refer the patient to a geriatrician or to a falls clinic. The prevention of falls plays a major role in the prevention of morbidity in patients with osteoporosis. The CDC Stopping Elderly Accidents, Deaths & Injuries (STEADI) program offers tools for assessment and prevention of falls (available at http://www.cdc.gov/steadi/) [90]. Furthermore, for patients at high risk for falls, home safety assessment and modification in those with a previous fall can reduce the rate of falls and risk for falling [91].

Regarding secondary prevention, it is important to recognize patient characteristics that are associated with greater risk for a subsequent fall. A recent systematic review and meta-analysis found that female, institutionalization, decreased vision, dizziness, dementia, cardiac and respiratory diseases, in addition to osteoporosis, increased the risk for a second contralateral hip fracture [92]. Special attention ought to be placed for secondary prevention in those cases.

Regarding pharmacologic interventions, osteoporosis medications are generally safe, even in the oldest old, as described in a 2020 review [93]. The authors highlighted that while adverse events are similar, we still need to pay attention to comorbidities and polypharmacy. In older adults with CKD stages 4 and 5, bisphosphonates are practically contraindicated, and proper monitoring is required to avoid a dynamic bone disease [94, 95] (see also Chap. 25, for a discussion of metabolic bone disease.) However, the alternative antiresorptive monoclonal antibody denosumab could be considered.

Before starting either type of antiresorptive therapy, examination of the oral cavity by a dental professional is indicated. This is especially important in the older people who are at greater risk for oral disease (poor dentition requiring dentoalveolar surgery, tooth extraction, dental fractures) and poor oral health (including periodontal disease, caries, infections) [96]. Oral disease increases the risk of osteonecrosis of the jaw. While most cases have been reported after IV formulation in frail older adults with multimorbidity and/or a history of malignancy, it is recommended to treatment dental diseases prior to beginning antiresorptive agents [97].

In addition, calcium and vitamin D supplementation and exercise (see below) are important in the prevention and management of osteoporosis [98, 99]. The recommended calcium intake for older adults is 1200 mg per day, ideally from dietary sources [70, 99]. The National Institutes of Health offer a fact sheet for calcium supplementation, with detailed information on the dietary sources of calcium (available at https://ods.od.nih.gov/factsheets/Calcium-HealthProfessional/#h3). However, the dietary intake of calcium in older adults is usually insufficient (about 600 mg per day), thus prescription supplementation is often required to reach the target (additional 500–600 mg per day). Furthermore, older adults have an increased prevalence of chronic or atrophic gastritis, with achlorhydria, leading to malabsorption of calcium [100]. Therefore, some experts suggest calcium citrate over calcium carbonate [101]. Constipation may develop with either, and it is important to advise proper hydration and measures to avoid this geriatric syndrome. Concomitant intake and maintenance of proper vitamin D are required to ensure calcium absorption. However, older adults commonly have low levels of 25 hydroxyvitamin D (25(OH)D) and, in spite of reports of measurement inconsistencies [102, 103], this should be measured. Vitamin D supplementation is recommended when levels are below 30 ng/ml, aiming to maintain levels above 35 ng/dl using vitamin D3 (cholecalciferol) [104, 105]. Toxicity is rare, as vitamin D has a wide therapeutic range. Finally, the impact of vitamin D supplementation on falls and functional status has been controversial, with multiple studies showing inconsistent results. A 2020 review concluded that vitamin D and calcium supplementation does reduce fracture risk, when pooling data of studies with institutionalized and community dwelling individuals [101]. However, the researchers emphasize that the evidence is limited due to the limitations in the included studies and data. This does not mean that it does not work, nor that every patient should receive it. What this means is that providers need to assess calcium and vitamin D status in their patients, and implement supplementation when appropriate, but mostly favor reaching intake targets from nutritional sources.

On the other hand, there is no question about the role of exercise in the treatment of osteoporosis, and in addition, a myriad of additional beneficial outcomes, importantly to treat and reverse frailty, and to reduce fracture risk by reducing falls risk [88, 106–110]. Falls are reduced particularly with the combination of aerobic, flexibility, resistance, and balance training. Exercise recommendations must be tailored, especially for those with severe osteoporosis, who should avoid forward flexion exercises, using heavy weights, or side-bending exercises, because pushing, pulling, lifting, and bending exert compressive forces on the spine that may lead to fracture [70]. For the majority of older patients, at risk for or with osteoporosis, resources include the National Institute on Aging Go4Life program, which offers free education materials (available at https://go4life.nia.nih.gov) [111] and the National Council on Aging, which lists a number of evidence-based programs (available at https://www.ncoa.org/center-for-healthy-aging/physical-activity/physical-activity-programs-for-older-adults/) [112].

20.6.4 Problems with Calcium Metabolism

The incidence and prevalence of primary hyperparathyroidism (PHP) is greater with aging. Similarly, the prevalence of cancer associated with nonparathyroid hormone-dependent hypercalcemia also increases with aging. For PHP, advanced age is not a contraindication for parathyroidectomy; however, assessments of function, cognition, life-expectancy, and other age-related conditions are needed to complete the assessment and recommendation toward surgery, or chronic medical management with a calcimimetic (Cinacalcet) [113], as well as the pertinent interventions for diagnosis and management of secondary osteoporosis, falls, and fracture prevention.

Acute delirium with altered mental status is a frequent medical urgency in the inpatient setting. Notably, it can be confused by age-related comorbidities, such as cognitive decline and dementia. Clinicians must be aware of mental status changes, evaluate and treat hypercalcemia appropriately [114].

Older adults are a heterogeneous population with a range of comorbidities that influence treatment in all illnesses including calcium disorders. If 10 years pass and PHP is found in Mr. F. (Case 1) who is now 88 years old, with well-controlled diabetes, and preserved physical and cognitive function, parathyroidectomy will be the procedure of choice. However, for Mrs. B. (Case 4), now 82 years old, with cardiovascular disease, severe heart failure, advanced dementia, and poor physical function, parathyroidectomy may not be applicable, and medical management may be the first option to discuss with her family.

20.7 Thyroid Disorders

Thyroid disorders are common in older adults, with clinical presentations that include both long-standing and new-onset illnesses. The majority of these include clinical and subclinical hypothyroidism, hyperthyroidism, thyroid nodular disease, and differentiated thyroid cancer (DTC).

20.7.1 Hypothyroidism

The prevalence of hypothyroidism (defined as high TSH and low T-4) increases with age because of the long-standing hypothyroid disease, following treatment for hyperthyroidism and differentiated thyroid cancer (DTC), postthyroidectomy or radioactive iodine (RAI) ablation, or as a side effect of amiodarone therapy. There are limited studies addressing the prevalence and epidemiology of thyroid disease in the older population [115]. Notably, hypothyroidism diagnosis can be both masked and interact with the presentation of age-related comorbidities such as depression and cognitive decline. Pertinent screening must be implemented.

The American Thyroid Association has not yet updated their 2014 guidelines for the treatment of hypothyroidism. They described that therapeutic thyroid hormone replacement with levothyroxine (LT4) is usually based on lean body mass (~1.6 mcg per kg-weight) for healthy middle-aged patients [116]. Older literature suggests that age-related loss of lean body mass often means dose adjustments are needed with increasing age [117]. In addition, lower starting dosages (25–50 mcg per day) are recommended for healthy older adults, going even lower (12.5–25 mcg per day) for those with known or possible cardiovascular disease. Replacement therapy must strive to avoid overtreatment, with careful monitoring every 4–6 weeks, and dose adjustments of 12.5 mcg, until TSH target is reached. A "start low and go slow" approach may also provide more stable TSH values over time [118, 119]. While quite rare, it is worth mentioning that the European Thyroid Association published guidelines for central hypothyroidism [120]. With regard to older adults, they also recommended starting LT4 at a lower dosage and progressively increasing up to 1.0–1.2 ug/kg/day, and that treatment for patients 75 and older may be dispensable.

For older patients with a clinical presentation similar to Mr. F. (Case 1), who is otherwise healthy and recently developed primary hypothyroidism, LT4 therapy could reach a full dose replacement, similar to a younger person. In contrast, for patients similar to Mrs. B. (Case 4), a more careful approach is required, given concerns for bone and cardiovascular risk.

Guidelines recommend TSH targets for the age-specific range, but normal age-specific TSH values are higher in older adults when compared with younger people [121]. The National Health and Nutrition Examination Survey (NHANES) study has shown that the 97.5 centiles for TSH in the 20- to 29-year and the 80-year and older groups were 3.56 and 7.49 mIU/L, respectively, and 70% of older patients with a TSH greater than 4.5 mIU/L were within their age-specific reference range [122]. It had been suggested that higher TSH values in healthy older individuals might be associated with better cognitive and physical function [123]. On the other hand, counterarguments and more recent research expand the discussion of how worth it is to treat mild thyroid dysfunction in the elderly. A 2020 review considered that mild thyroid hypofunction may be less significant with progressive age [124]. The author raised the interesting possible explanation that lower metabolic rate may be beneficial for longevity, as it had been previously hypothesized [125] that lower thyroid hormone signaling during maturity might be advantageous for aging and longevity.

While there are no randomized controlled trials addressing different TSH targets for older adults, we recommend caution when treating hypothyroidism in this age group, especially in the oldest old. A TSH closer to 2.5 mIU/L, and perhaps higher (within the normal range), may be more appropriately close to the observed normal TSH values in the older euthyroid population, whereas reaching a TSH of 1 mIU/L may be potentially harmful. With regard to the type of replacement, specifically, if adding triiodothyronine to the regimen, this is a question that remains unanswered for younger adults. We agree with a recent publication that describes the need to explore explanations for persistent symptoms or metabolic abnormalities, despite normalization of serum TSH [126]. Rightfully, those authors recommended new clinical trials with sufficient power to identify differences with monotherapy and combination therapy. We would add the need to consider older adults in future study recruitment.

Finally, for older adults with hypothyroidism related to Hashimoto's thyroiditis, it is important to be aware of the risk of autoimmune atrophic gastritis [127], given potential clinical implications for nutrition and pharmacologic therapies.

20.7.2 Subclinical Hypothyroidism

This condition is defined as a high TSH and normal T-4. The European Thyroid Association provides guidelines for subclinical hypothyroidism management [128] with two potential scenarios: the first one with TSH values ranges between the upper limit of normal and 10 mIU/L, and the second when TSH is greater than 10 mIU/L. About 75% of cases fall in the first scenario [129], and when the TSH is <7 mIU/L, up to 46% of patients may present normalization within 2 years [130]. Persistently elevated and greater than 10 mIU/L carry more clinical implications. Guidelines recommend careful monitoring and a watchful waiting in the oldest old [9], avoiding a rush to diagnosis based on one value and rather rechecking TSH at 3- to 6-month intervals, while ensuring the timely decision to treat. Caution with overscreening leading to overtreatment has been raised, particularly if age-adjusted normal limits of TSH are not used [131].

Increased fatigue, depression, and cognitive dysfunction may be described as symptoms, albeit there is a myriad of potential alternative explanations in the older population. Studies are not conclusive to determine if these are exclusively related to the thyroid dysfunction, or if they might improve with therapy [132–134]. A meta-analysis [135] found no association between subclinical hypothyroidism and cognitive performance (impaired mini-mental state examination, executive function, and memory). The much-awaited 2017 report of the Thyroid Hormone Replacement for Untreated older adults with Subclinical Hypothyroidism Trial (TRUST), which recruited 737 adults aged 65 years and older and persistent subclinical hypothyroidism (TSH 4.6–19.99 mIU/L), found no apparent benefits with levothyroxine therapy in the two primary outcomes (hypothyroid symptoms score and tiredness score) [136]. We are left wondering if different results might have followed the recruitment of solely cases with TSH >10 mIU/L. A secondary analysis of 638 subjects who completed the 1-year follow-up, and included the functional test of handgrip strength, also did not find improvements of symptoms or quality of life with LT4 therapy [137]. An ancillary study to the TRUST (which included 105 subjects and added 146 subjects), for a total of 251 participants aged 80 years and older, again, found no improvements in hypothyroid symptoms or fatigue [138].

Regarding the quality of life, a small randomized trial compared the impact of thyroid hormone replacement versus placebo in adults who screened positive for hypothyroidism and those with subclinical hypothyroidism [139]. They found less tiredness for the hypothyroid but not among those with subclinical hypothyroidism. A 2018 systematic review and meta-analysis examined 21 of 2088 publications and found that thyroid hormone therapy was not associated with improvements in the quality of life, despite normalization of TSH [140].

There has been extensive description of the potentially negative cardiometabolic and hemodynamic effects of subclinical hypothyroidism [141–143]. A 2018 prospective cohort study of 1365 patients with preexistent heart failure reported that those cases with TSH >7 mIU/L and isolated low T3 levels were associated with more severe heart failure ($p < 0.001$) and the composite of ventricular assist device placement, heart transplantation, or death (HR, 3.25; 95% CI, 1.96–5.39; $p < 001$) [144]. On the other hand, a 2014 systematic review and meta-analysis of 11,309 participants with 665 stroke events did not find sufficient data to exclude significant risk for stroke [145]. The researchers who followed with a 2015 individual participant data analysis on 3451 subjects with subclinical hypothyroidism did not find the overall effect on stroke, albeit it considered an increased risk in subjects younger than 65 years and in those with higher TSH [146], and in 2016, they published results from a prospective-based population study on 10,318 participants and found that higher, not lower, FT4 was associated with sudden cardiac death [147].

Finally, with regard to functional outcomes, an older report indicated that older adults with subclinical hypothyroidism did not present increased mobility problems [148].

In conclusion, clinical judgment is crucial in the management of subclinical hypothyroidism in older adults presenting with nonspecific symptoms. Individualized and careful assessment of these symptoms might include the need for referral to a geriatrician or providers with expertise in the diagnosis and management of these geriatric syndromes. Notwithstanding, many patients will remain concerned about their symptoms, and their quality of life, and perhaps there is enough evidence to provide an informed discussion that the available data indicate no benefit from hormone supplementation. Otherwise, when the concern is cardiovascular, decisions should include a specific evaluation of the preexistent cardiovascular risk, degree of TSH elevation, and comorbidities. Future research may address the role of T3 in heart failure cases with subclinical hypothyroidism. There is a beautiful description about the genetic and epigenetic implications of thyroid function, and the need for future studies, using personalized and precision medicine to identify cases in whom hormone replacement could be beneficial [149].

20.7.3 Hyperthyroidism

Excess thyroid hormone may have a major impact on bone and cardiovascular health in older adults [150, 151]. Graves' disease is the most common cause of hyperthyroidism, while toxic multinodular goiter and toxic adenoma are more prevalent in iodine deficiency regions [152] and have a faster progression to hypothyroidism posttreatment [153].

Any abnormality in thyroid function can present with nonspecific symptoms. For example, apathetic hyperthyroidism in seniors classically has none of the typical symptoms of younger onset hyperthyroidism such as heat intolerance, tremor, nervousness, tachycardia, and others [154], and rather presents with cardiovascular features (atrial fibrillation), depression, lethargy, weakness, weight loss, and without goiter or ocular manifestations [155]. In general, anorexia and atrial fibrillation are more frequent in older than in younger patients [156]. Furthermore, the greater prevalence of HTN and cardiovascular disease in this age group may lead to chronic use of beta-blockers, which mask hyperadrenergic symptoms [154].

Radioactive iodine (RAI) is the preferred therapeutic approach, based on better success rate and safety profile with lesser risk for recurrence. Thionamides become second-line alternative therapy, and consideration should be given to the risk benefit, due to potential adverse reactions, medication interaction, and the greater prevalence of liver and bone marrow diseases in this age group.

20.7.4 Subclinical Hyperthyroidism

Regarding subclinical hyperthyroidism, two scenarios have been described: the first one with a TSH between 0.1 mIU/L and the lower limit of normal (grade 1), and the second one with a TSH below 0.1 mIU/L (grade 2). There is greater concern in grade 2 for cardiovascular risk (heart dysfunction, coronary heart disease, and atrial fibrillation), osteoporosis, and progression to overt hyperthyroidism. Therefore, both American and European guidelines recommend treatment for grade 2 subclinical hyperthyroidism [150, 157]. Nonetheless, persistently suppressed TSH in the grade 1 range may need treatment in older adults given the increased risk for atrial fibrillation and heart failure.

A 2015 analysis from the Rotterdam Study examined the association between increased thyroid hormone levels and risks for atrial fibrillation [158]. Among subjects with normal free T4 (FT4) levels, higher risks for atrial fibrillation were found in those with FT4 levels in the highest quartile when compared to those in the lowest quartile. The absolute 10-year risk was greater in subjects older than 65 compared to younger subjects.

A 2015 meta-analysis of 70,298 participants, of which 2219 subjects had subclinical hyperthyroidism, and 762,401 person-years of follow-up, found that endogenous subclinical hyperthyroidism (excluding iatrogenic) was associated with increased risk for hip fracture (HR 1.52, 95% CI 1.19–1.93), any fracture (HR 1.42, 95% CI, 1.16–1.74), and spine fracture (HR 1.74, 95% CI 1.01–2.99) [159]. While the authors concluded that studies assessing the treatment of subclinical hyperthyroidism could prevent fractures, we recommend providers to incorporate the whole picture, including the concepts previously described in this chapter about osteoporosis, fracture risk evaluation, and implement interventions accordingly.

20.7.5 Differentiated Thyroid Cancer

Late-onset DTC typically presents in older patients and has unique recurrence features, an atypical TNM model, different responses to total thyroidectomy, and a different survival [160]. The older the age the greater the risk for more advanced stage at presentation and the greater the risk for recurrence.

Older adults undergoing TSH suppression with thyroid hormone replacement, postthyroidectomy for DTC, may be at greater risk of adverse events (e.g., atrial fibrillation and osteoporosis) compared to younger individuals [161, 162]. Potential benefits with beta-blockers for prophylaxis have been suggested, but more research is needed [163]. Guidelines also suggest therapy for osteoporosis [150] and recommendations to preserve bone health such as exercise and supplementation with calcium and vitamin D.

20.8 Hypogonadism

The endocrine evaluation of older men should include evaluation of their gonadal function. Most symptoms associated with gonadal dysfunction are nonspecific but may impact the quality of life and well-being.

20.8.1 Clinical Diagnosis

There is significant heterogeneity in the way older men with hypogonadism present clinically. For men with early-onset hypogonadism due primary to testicular failure or secondary to pituitary tumor resection, long-term monitoring and management is required. Many of the symptoms of testosterone deficiency of late onset (i.e., erectile dysfunction, depression, decreased energy, weakness) may also occur in age-related comorbidities (diabetes, cardiovascular disease, depression, frailty syndrome) and will not improve with testosterone replacement alone. Thus, counseling about expectations from evaluation and treatment is advised, consistent with the 2002 guidelines from AACE [164] and the updated 2018 guidelines from the Endocrine Society [165]. There is emphasis on the following statement: "make a diagnosis of hypogonadism only in men with symptoms and signs consistent with testosterone deficiency and unequivocally and consistently low serum testosterone concentrations" [165].

Two additional concepts ought to be discussed when considering the diagnosis, and especially before committing to pharmacologic interventions. First, late-onset hypogonadism (LOH) as an entity that may be losing recognition, based on the number of publications in journals with reasonable impact factor. However, it has endured time, described as a combined primary and secondary hypogonadism following an impaired function of both the testes and the pituitary [166]. In 2010, the European Male Aging Study (EMAS) reported the clinical and hormonal profile in middle-aged and older men [167]. Sexual symptoms (poor morning erection, low sexual desire, and erectile dysfunction) were significantly related to low testosterone levels. Less specific symptoms such as depression and fatigue were more typically related to coexisting conditions and had greater impact on the quality of life and ability for self-care [168–170]. However, concomitant diseases such as obesity increase its prevalence, and LOH is uncommon in lean individuals. The second concept, functional hypogonadism, is defined as the coexistence of androgen deficiency with potentially reversible conditions suppressing the hypothalamus-pituitary-testicular axis (macroprolactinoma, endogenous Cushing) [171]. This 2017 review described there is modest evidence that functional hypogonadism responds to lifestyle measures and optimization of comorbidities.

20.8.2 Laboratory Assessment

It is important to recognize that chronic diseases may impact hormonal values [172]. Obesity was associated with lower testosterone values in the Massachusetts Male Aging Study and the European Male Aging Study [173, 174]. Diabetes and heart failure have also been associated with hypogonadism [175, 176]. These diseases are associated with fatigue, poor sleep, insomnia, and other nonspecific symptoms, which may lead to impaired metabolism, obesity, and impaired gonadal function. In addition, older patients may require medications (opioids, glucocorticoids, and spironolactone) which decrease testosterone levels [177]. Thus, after thorough discussion with patients, laboratory screening for hypogonadism can be considered in older adults with symptoms of hypogonadism [164, 165].

There are changes in the circadian rhythm for testosterone, so blood sample collection is recommended early in the morning after a good night's rest and tested using reliable assays; low levels should be confirmed with a second morning sample. An older person with insomnia or sleep disorders may have inaccurate levels. Consider assessment of free testosterone in the setting of abnormal sex-hormone binding globulin, especially in older men with total testosterone concentrations near the lower limit of the normal range and in whom alterations of sex-hormone binding globulin are suspected [165].

Late-onset hypogonadism develops in a relatively small percentage of all older men (2.1% in the European Male Aging Study) [178]. Those with testosterone levels well below the lower limit of 300 ng/dl, that is, values below 150 ng/dl [179] ought to be reassessed (diagnosis requires confirmation on separate occasions). Then, further informed discussion for treatment should follow if results are consistently low in the setting of syndromal presentation (low values alone do not justify treatment). It is paramount to consider potential risks affecting those in whom therapy may be clinically indicated. In parallel, assessment for osteoporosis risk should be implemented [180].

Finally, there is the issue of reliability in laboratorial tests, and the role of free testosterone to enhance the accuracy of the diagnosis, and to observe agreement in threshold diagnostic values among guideline recommendations [181, 182].

20.8.3 Adverse Effects of Testosterone Replacement Therapy

The concern with the increase in testosterone prescriptions and potential health consequences had been described, especially if the indications were unnecessary [183]. In 2015, the American Association of Clinical Endocrinologists addressed the potential cardiovascular risks and concluded there was no compelling evidence that testosterone therapy either increased or decreased cardiovascular risk [184]. They remarked treatment in older adults should be extra cautious.

Thus, authors have proposed the need for adequate randomized trials, powered to assess the impact of testosterone on cardiovascular health and outcomes in the older population [185, 186]. As described in a 2019 review, "no trials of testosterone replacement therapy published to date were designed or adequately powered to assess cardiovascular events; therefore, the cardiovascular safety remains unclear" [187]. For those cases in whom testosterone treatment clearly offers greater benefits than risks, recommended monitoring includes surveillance for erythrocytosis, hypertension, prostate disease, and liver abnormalities [164, 165], accompanied by a clear discussion on the ongoing concerns about cardiovascular and mortality events.

20.8.4 Testosterone Replacement Therapy

Practitioners are recommended to proceed with caution when implementing pharmacologic therapy in older adults.

The decision to treat hypogonadism in older adults must be based on a clinical approach considering the patient's health status, physical and cognitive function, and incorporating the patients' goals, risks, and any special considerations [188]. It might be reasonable to avoid treating patients with significant cardiovascular and cerebrovascular diseases, hypercoagulable states, prostate cancer, and overly symptomatic benign prostate hypertrophy [189], while coordination with a geriatrician specialized in frailty might be considered when treating an older patient with sarcopenia and frailty [190]. When treatment is warranted, replacement should aim for testosterone levels in the mid-normal range [179, 191], with suggested target around 400 ng/dl for older men, which is less than in younger individuals.

Building on the clinical scenarios of the learning cases: If an otherwise healthy older adult, like Mr. F. (Case 1), returns to the clinic for a yearly follow-up, and reports decreased libido, and erectile dysfunction, his symptoms may be due to hypogonadism and require evaluation. Assuming the laboratory assessments confirm low testosterone values, for example, 180 and 140 ng/dL, with corresponding increased gonadotropins, the diagnosis of testicular hypogonadism is established, and it will be appropriate to discuss testosterone replacement. For this relatively healthy older man, with preserved physical function, cognition, and good social support, treatment can improve symptoms and his quality of life.

However, there will be more complex scenarios. For example, a 70-year-old man who has diabetes, coronary artery disease, and a known family history of prostate cancer presents with complaints of fatigue, depression, and inability to perform vigorous activity. Laboratory assessment shows borderline low testosterone values of 290 and 280 ng/dL. Given the family history of prostate cancer and the potential concerns about cardiovascular safety, testosterone therapy may not be initially recommended. These nonspecific symptoms could be explained by stress, poor sleep, and impaired physical function. Furthermore, the risk-benefit ratio of testosterone replacement is not clearly favorable. On the other hand, a healthy, functional, and cognitively intact 68-year-old man with hypertension and family history (cousin) of prostate cancer is found to have osteoporosis, and unequivocally low testosterone values (e.g., 150 and 140 ng/dL), and a normal prostate-specific antigen. In this case, testosterone replacement will improve bone health, quality of life, function, and future outcomes, since a fracture could be devastating to him.

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Gastroenterology

21

Marc S. Piper and Karen E. Hall

21.1 The Extent of the Problem

Gastrointestinal symptoms are common in patients aged 65 years and older and can range from mild self-limited episodes of constipation or acid reflux to life-threatening episodes of infectious colitis or bowel ischemia. This chapter highlights common GI problems in older patients that may affect care by specialists.

21.2 Gastroesophageal Reflux Disease

Gastroesophageal reflux disease (GERD) is one of the more common GI disorders affecting older people [1]. Population studies indicate that more than 20% of adults over age 65 have heartburn at least weekly. This may actually underestimate the true prevalence of GERD because symptoms appear to decrease in intensity with age, and the severity of reflux and complications increase. The use of proton pump inhibitors (PPIs) has probably resulted in the treatment of unsuspected GERD. GERD is straightforward to diagnose if it presents with the classic symptoms of pyrosis (substernal burning with radiation to the mouth and throat) and sour regurgitation, however, older patients may present with more subtle symptoms, such as a chronic cough, difficult-to-control asthma, laryngitis, recurrent chest pain, or may be asymptomatic and present with anemia or dysphagia due to dysmotility or stricture. Patients with chest pain should be evaluated for cardiac conditions before a diagnosis of GERD is given. Complications associated with GERD such as esophagitis, esophageal ulceration, bleeding, strictures, Barrett's esophagus, and esophageal adenocarcinoma are more common in patients over 65 years of age [2]. Upper endoscopy (EGD) should be performed in all patients with new-onset GERD over age 50, persistent symptoms of reflux despite medical therapy, patients with a history of acid reflux longer than 5 years, and those with possible complications from acid reflux, as these groups have an increased risk of malignancy. EGD is safe even in the very elderly frail patient—the main contraindication is end-stage chronic obstructive pulmonary disease (COPD) or when sedation is contraindicated. Other testing, such as 24-h pH monitoring or esophageal manometry, is reserved for patients who do not respond to therapy or who have atypical symptoms. Treatment of GERD in older people is essentially the same as that in younger patients. While the "step-up" approach of lifestyle changes followed by acid-reducing drugs may work for mild GERD, immediate initiation of a PPI along with lifestyle modifications usually results in fewer office visits, a reduction in procedure, improved patient satisfaction, and reduced overall costs (Table 21.1).

Histamine 2 receptor antagonists (H2RAs) are effective for mild symptoms, and avoid the side effects of PPIs such as fracture and *Clostridium difficile* infection. Cimetidine is not recommended in older patients because of drug interactions and greater anticholinergic effects compared with other H_2RAs. While effective, chronic PPI use is associated with an increased relative risk of osteoporosis of 1.97 (>7 years) [3]. There have been reports of other concerns, such as decreased efficacy of clopidogrel against coronary stent occlusion when used in conjunction with certain PPIs and increased risk of pneumonia in ventilated ICU patients and *C. difficile* infection [4]. Reevaluate the need for PPIs in patients who have been taking them for longer than 6 months or who had PPIs started for ulcer prophylaxis during hospitalization. Antireflux surgery is reserved for patients with severe refractory GERD with complications. Results from high-volume centers indicate that mortality and morbidity

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Table 21.1 Treatment of GERD in older patients

Step 1
Lifestyle modifications
Smaller, more frequent meals Weight loss for patients who are overweight
Can consider avoiding foods that decrease lower esophageal sphincter (LES) pressure such as chocolate or peppermint, acidic foods, or foods that stimulate acid production (caffeine-containing foods)
Stop eating 3–4 h before going to bed
Minimize fats, alcohol, caffeine, and nicotine, especially at night
Sleep with head of bed elevated 6 in.
Proton pump inhibitors (reevaluate after 8–12 weeks). Traditional delayed-release PPIs should be administered 30–60 min before meal for maximal pH control
Esomeprazole (Nexium; 20–40 mg qd)
Lansoprazole (Prevacid; 15–30 mg qd)
Omeprazole (Prilosec; 20–40 mg qd)—available OTC as Prilosec 20 mg
Pantoprazole (Protonix; 40 mg qd)
Rabeprazole (Aciphex; 20 mg qd)
Step 2
Add antacid liquids or tablets for occasional breakthrough
Mylanta, Maalox, Gaviscon, Tums, Rolaids
Add H_2 receptor antagonists (H_2RAs) at night[a]
Cimetidine (Tagamet; not recommended in older patients because of drug interactions and delirium risk)
Famotidine (Pepcid; 20 mg qd or bid)
Nizatidine (Axid; 150 mg qd or bid)
Step 3
Surgery
Laparoscopic fundoplication
Nissen fundoplication

[a]This entire class of medications appears on the Beers List of Potentially Inappropriate Medications. All agents have some anticholinergic activity and have been implicated in delirium; all require dose adjustment for creatinine clearance <50 ml/min

are not increased in patients over 70 years who are at low surgical risk for complications. However, while only 10–15% of patients have symptoms immediately postsurgery, 5–15 years later 60% of patients are taking acid-suppressive medications.

21.3 Dysphagia

Dysphagia is prevalent at older ages (20% compared to 5–9% in the general population). It is a cause of difficulty eating in 40–60% of older nursing home patients. The incidence of dysphagia increases with increasing obesity [5], as obesity increases the risk of GERD . In a review of patients presenting with dysphagia in a primary care setting, the most common etiologies were GERD (44%), benign strictures (36%), esophageal motility disorder (11%), neoplasm (6%), infectious esophagitis (2%), and achalasia (1%) [6]. Eosinophilic esophagitis (EoE), while rare (18.6 per 100,000 people), can present with difficulty swallowing and food impactions in older patients rather than the atopic symptoms routinely found in the pediatric population [7].

Patients over 65 years have multiple changes with aging that predispose to oropharyngeal dysphagia , such as painful or diseased teeth, xerostomia, poorly fitting dentures, slow muscle function resulting in impaired transfer of food into the pharynx, and delayed relaxation of the upper esophageal sphincter (UES). Barium cinefluroscopic studies of normal adults over age 85 demonstrate that approximately 10% have silent aspiration of food or fluids. Comorbidities that increase the risk of dysphagia still further include cerebrovascular disease, Parkinson's disease, multiple sclerosis, Alzheimer's disease, upper motor neuron diseases, myasthenia gravis, polymyositis, amyloidosis, and a history of surgery or radiation to the oral cavity or neck. In the latter group, recurrence of cancer should be in the differential diagnosis.

Patients with oropharyngeal dysphagia typically cough, gag, choke, or aspirate their food during the initiation of a swallow. Patients may also complain of odynophagia, painful swallowing. Those with esophageal dysphagia often complain of solid foods or liquids "sticking," "catching," or "hanging up" in their chest, and may point to their substernal area as the location. This does not always indicate the true location of the problem, as patients with distal esophageal obstruction may have sensations referred higher up in the chest. Dysphagia only to solids often reflects mechanical obstruction, whereas dysphagia to both liquids and solids starting simultaneously suggests a neuromuscular motility disorder. Causes of odynophagia are listed in Table 21.2.

Review of a patient's medication list may suggest pill-induced esophagitis. Older patients are at an increased risk for this due to more medications, decreased saliva production, and anatomical abnormalities compressing the esophagus such as strictures, cervical osteophytes, webs, rings, and vascular anomalies (i.e., enlarged left atrium and dilated aortic arch). History of smoking or heavy alcohol use is associated with increased risk of squamous cell esophageal cancer. Physicians should inquire about these conditions and look for anemia and unintentional weight loss. Finally, symptoms of GERD should be elicited, as it can cause peptic strictures, Barrett's esophagus, and adenocarcinoma [2].

A speech-language pathologist can coordinate a cinefluroscopic swallowing study using thin, thick, and solid food materials for patients suspected of having oropharyngeal dysphagia . Patients can be taught proper swallowing techniques and how to modify their posture to improve their swallowing.

In addition to a barium esophagogram, an EGD should be performed to check for malignancy and take biopsies [8]. The diagnostic yield of EGD is approximately 55% in the initial evaluation of patients >40 years old who present with heartburn, odynophagia, and weight loss [9]. If upper

Table 21.2 Causes of odynophagia

1. Medications
Tetracycline
Quinidine
Doxycycline
Oral bisphosphonates
Iron
NSAIDs
ASA
Vitamin C
Potassium chloride
2. Infections
Viral (HSV, CMV, HIV, VZV)
Bacterial (*Mycobacterium*)
Fungal (*Candida, Aspergillus*)
3. Acid reflux disease
4. Malignancy
Squamous cell carcinoma
Adenocarcinoma
5. Miscellaneous
Ischemia
Chemotherapy
Radiation
Crohn's disease
Sarcoidosis

NSAIDs nonsteroidal anti-inflammatory drugs, *ASA* acetylsalicylic acid, *HSV* herpes simplex virus, *CMV* cytomegalovirus, *V2V* varicella-zoster virus

endoscopy is normal and complaints of dysphagia persist, then esophageal manometry should be performed. Treatment is directed toward the underlying disorder in addition to ensuring adequate nutrition and preventing aspiration. Patients with dysphagia due to decreased esophageal contractility and increased lower esophageal sphincter (LES) pressure (achalasia), who are fit and willing to undergo surgery, may benefit from graded pneumatic dilation, laparoscopic surgical myotomy, or peroral endoscopic myotomy (POEM). Botulinum toxin injection is recommended for patients who are not good candidates for more definitive therapy [10]. In addition to being diagnostic, EGD also offers therapeutic interventions such as dilation, which can be accomplished safely in older patients (Table 21.3).

Drugs that decrease smooth muscle contractions (anticholinergics, calcium antagonists, nitrates) may treat diffuse esophageal spasm. Laparoscopic Heller myotomy to open the LES has been performed in older patients with achalasia with reasonable safety and efficacy. If aspiration occurs or the nutritional status of the patient suffers, a feeding jejunostomy or gastrostomy can be considered, but ideally the patient should participate in the decision to proceed with a feeding tube. Current recommendations are to avoid placing G tubes in patients with dementia, as those have not been shown to improve quality of life. Table 21.4 provides practice tips for dysphagia.

Table 21.3 Dysphagia: Conditions for which EGD may provide therapeutic interventions

Benign conditions
1. Peptic strictures
2. Schatzki rings
3. Esophageal web
4. Eosinophilic esophagitis
5. Caustic injury
6. Radiation injury
7. Anastomotic stricture
8. Pill-induced stricture
9. Cricopharyngeal bar
Malignant conditions
1. Esophageal adenocarcinoma
2. Esophageal squamous cell carcinoma
3. Pseudoachalasia
Motility disorders
1. Achalasia

Modified from Pasha et al. [9], Copyright 2014, with permission from Elsevier
EGD cannot provide therapeutic intervention in extrinsic compression, diffuse esophageal spasms, and hypomotility disorders secondary to connective tissue disorder
EGD endoscopic gastroduodenoscopy

Table 21.4 Practice tips for dysphagia in the older patients

Dysphagia in older people is common and should always be investigated
Dysphagia is associated with aspiration, weight loss, and poor quality of life
Dysphagia may be oropharyngeal (mostly caused by neurological disorders) or esophageal; the causes of esophageal dysphagia are often suggested by history
Common causes of dysphagia include neuromuscular, mechanical, motility, neoplastic, and inflammatory conditions
Check history of smoking, alcohol use, review medications, do neurologic exam
EGD can be diagnostic and therapeutic
Patients considered for a feeding tube should be able to participate in the decision
Esophageal cancer usually presents in an advanced stage in older people, with symptoms of progressive dysphagia and weight loss
Surveillance of Barrett's esophagus without dysplasia should be performed at 3- to 5-year intervals to detect early adenocarcinoma

EGD esophageal gastroduodenoscopy

21.4 Peptic Ulcer Disease

Peptic ulcer disease (PUD) refers to both gastric (GUs) and duodenal ulcers (DUs), with the two most common causes being NSAIDs and *Helicobacter pylori* [11]. Approximately 5 million cases of PUD will occur this year in the USA, and the demographics are shifting toward older age of presentation. Older people are more likely to suffer complications of PUD, including hospitalization, need for blood transfusions, emergency surgery, and death. Patients may present with overt bleeding with hematemesis or coffee-ground emesis, or occult

Table 21.5 Practice tips for peptic ulcer disease in the older patients

Peptic ulcer disease is usually caused by NSAIDs or *Helicobacter pylori*
Complications of peptic ulcer disease are more common in the older patient and morbidity and mortality are higher in this age group
PUD in the older patient may present without pain, particularly with NSAID use, and hemorrhage or perforation may be the first sign of an ulcer
Dyspepsia is a common complaint in the older people and requires endoscopy to rule out ulcer or cancer
Consider depression as a cause of dyspepsia in an older patient with a negative workup and other symptoms of depression
A CT scan of the abdomen may be helpful to diagnose abdominal pain, as older patients often present with atypical symptoms of diseases such as cholecystitis, appendicitis, and renal stones
Mesenteric ischemia is a diagnosis often missed in older adults: consider it if pain occurs after meals and is progressively worse with time

NSAIDs nonsteroidal anti-inflammatory drugs

bleeding with anemia. Older patients are less likely to have epigastric pain than younger patients, due to decreased visceral sensitivity. About half of patients have minimal pain, and complications such as perforation are more common in this age group [12]. Patients should be asked about a history of PUD ; use of aspirin, NSAIDs, and oral anticoagulants; and previous diagnostic studies (upper GI series, testing for *H. pylori*). Upper endoscopy should be performed in patients suspected of having PUD to identify the lesion, perform a biopsy for *H. pylori*, rule out a malignancy, and initiate endoscopic therapy if necessary [13]. Morbidity and mortality of GI bleeding is higher in patients over 70 years due to a higher risk of continued hemorrhage causing hypotension and cardiac ischemia. If an ulcer is found, therapy should be initiated with a PPI for at least 8 weeks and NSAIDs should be discontinued. In PUD, the continuation of aspirin (including 81 mg ASA) should be personalized [14]. If the patient is found to be *H. pylori* positive, therapy with antibiotics and a PPI should be started. In the case of a GU, a follow-up EGD should be performed 8–12 weeks later to confirm healing and rule out malignancy. Patients with a prior history of PUD who did not have a significant bleed and who require chronic NSAID or aspirin use should be treated concurrently with a PPI or misoprostol. Both agents reduce the risk of PUD in chronic NSAID users, although the PPIs are generally better tolerated. Older patients with hemorrhage or perforation should avoid NSAIDs and ASA, as risk of bleeding even with prophylaxis is high and outweighs potential benefit (Table 21.5).

21.5 Dyspepsia

Dyspepsia is defined as chronic or recurrent pain or discomfort in the upper abdomen with or without nausea, bloating, early satiety, or reflux and affects 20–30% of older adults. Dyspeptic pain lasts for hours, distinguishing it from spasmodic pain of colonic contractions or renal stones. There is overlap with the symptoms of cholecystitis and patients often are evaluated for gallbladder disease. It is important to distinguish patients with structural problems such as ulcers from those with "functional" or nonulcer dyspepsia. Patients should be asked about unintentional weight loss, odynophagia, dysphagia , prior PUD, pancreatitis, biliary tract disease, bleeding, prior trauma, a family history of GI tract cancer, and evidence of blood loss or jaundice. Patients with dyspepsia aged 60 years or over should have an endoscopy to exclude upper gastrointestinal neoplasia [15]. *Helicobacter pylori* infection accounts for a significant number of cases of dyspepsia in patients aged <60 years. Older patients are more likely to be infected, but most are asymptomatic. Noninvasive tests for *H. pylori* infection that can be done in the outpatient setting include *H. pylori serum* antibody, urea breath test, and *H. pylori* stool antigen .

If prevalence in community is below <20%, then a *H. pylori* antibody test (iGG) will have a low positive predictive value, as a positive result is more likely to be a false positive than a true indication of infection. A negative test has a high negative predictive value (>95%). Both the urease breath test and stool antigen test for active infection can be used before and after treatment. Both have an excellent positive predictive value and negative predictive value of over 90% regardless of prevalence [16]. Therefore, because of the higher pretest probability of infections, patients with documented peptic ulcer disease represent a rare group where it is acceptable to utilize the *H. pylori* antibody. In most other circumstances where the pretest probability of infection is lower, tests which identify active disease are preferred [17]. If urea breath test is performed, bismuth and antibiotics need to be stopped for at least 28 days, and PPIs discontinued for at least a week prior to testing due to suppression of active infection by these agents. Stool antigen detection in the setting of use of PPIs or antibiotics may also be affected for the same reason.

In addition to other noninvasive tests for abdominal pathology (complete blood count [CBC], erythrocyte sedimentation rate [ESR], liver function tests [LFTs], electrolytes, amylase, and lipase), consider performing upper endoscopy in patients over 60 years old. If *H. pylori* testing is negative, endoscopy is normal and symptoms persist, then it is reasonable to check for biliary pathology and gastroparesis. In older patients with persistent symptoms, workup should include a CT scan of the abdomen with both oral and intravenous contrast if renal function does not preclude use of IV contrast. If no organic cause is found, patients are categorized as having nonulcer dyspepsia. There are few data to support routine use of antacids, antimuscarinics, or sucralfate. Routine treatment with H_2RAs is of slight benefit, but better results are obtained with once- or twice-daily PPIs in patients with burning pain or pain relieved by food. This suggests that these patients have GERD or some effect of acid on gastroesophageal motility.

Nonulcer dyspepsia may be the presenting symptom for depression with somatization. Data from the Rome III classification of GI motility disorders support a relationship between chronic abdominal pain and depression based on evidence that patients with chronic abdominal pain (without irritable bowel-type relief with defecation) respond better to antidepressants than GI-directed medications [15, 18]. Somatic manifestations of depression (chest pain, abdominal pain, nausea, and early satiety) are more common in older people. While there are no controlled studies of selective serotonin reuptake inhibitors in treatment of dyspepsia in older patients, if there are other symptoms and signs of depression, a trial of antidepressants may be warranted. Choice should be guided by the side effect profile, as some antidepressants (e.g., tricyclics, mirtazapine) may worsen other common conditions such as constipation.

21.6 Gastric Cancer

In 2020, there is an estimated 28,000 new cases of gastric cancer in the USA [19]. Gastric cancer is increasing in the older population worldwide, while it is decreasing in younger cohorts. The average age of diagnosis is 68 years old. The overall 5-year survival rate is estimated at 32% [20]. Nearly 95% of gastric cancers are adenocarcinomas, followed by lymphoma at 4%. Stromal tumors (GISTs), carcinoids, and sarcomas make up 1%. Risk factors for gastric cancer include chronic atrophic gastritis, *H. pylori*, pernicious anemia, family history of gastric cancer, partial gastrectomy, tobacco use, alcohol use, and consumption of large quantities of salted or smoked foods containing nitrites and nitrates. Presenting symptoms are often nonspecific (nausea, early satiety, epigastric fullness, intermitted vomiting, weight loss, and abdominal pain). Physical examination may reveal a mass, a succussion splash from gastric outlet obstruction, or peripheral lymphadenopathy. By the time symptoms or physical examination findings are apparent, patients usually have advanced disease. There are no specific chemical tests for gastric cancer, although CEA is often elevated, which can be used to monitor treatment. Gastric cancer is best detected by upper endoscopy. CT scanning with contrast, endoscopic ultrasound, or MRI can assess depth of tumor invasion and lymphadenopathy. Endoscopic ultrasonography and positron emission tomography scans are increasingly used to improve tumor staging, as patients undergoing EUS are 1.26× more likely to have >15 lymph nodes examined and undergo both pre- and postoperative chemotherapy (Table 21.6) [21]. The general approach to the older patient with cancer is discussed in Chap. 26, Geriatric Oncology.

Table 21.6 Practice tips for gastric cancer

Symptoms of gastric cancer are nonspecific, and diagnosis is often delayed
Gastric cancer is most common in China, Japan, Korean, and Eastern Europe, therefore consider this diagnosis in patients from those areas
MALT lymphoma, while uncommon, has a relatively good prognosis and appears to be sequelae of chronic *H. pylori* infection
Patients need continued endoscopic and EUS surveillance for at least 5 years after surgical resection of gastric cancer

MALT mucosal-associated lymphoid tissue

Mucosal-associated lymphoid tissue (MALT lymphoma), which is confined to the gastric mucosa, has the best prognosis of all gastric cancers with a 10-year overall survival around 75% [22]. There appears to be an association between this tumor and infection with *H. pylori*, and treatment of *H. pylori* (if present) is first-line treatment of low-grade MALT lymphoma. Surgery offers the only cure for non-MALT gastric cancer; however, the overall 5-year survival is poor (20–40%) and operative mortality high (15–25%). Patients undergoing surgery should have EGD and EUS surveillance at least yearly for at least 5 years. Endoscopic resection of large masses, laser therapy, and stent placement may provide palliation for patients with obstructive symptoms and inoperable disease. Neoadjuvant chemotherapy may improve survival by a few months. Palliative chemotherapy may prolong survival and preserve quality of life. Both chemotherapy and radiation are used for treatment of high-grade MALT lymphoma.

21.7 Diarrhea

Patients with diarrhea most often complain of frequent stools (>3/day) or loose stools; however, the term *diarrhea* is also used to describe fecal incontinence or fecal urgency. Most cases of acute diarrhea (lasting <2 weeks) in the older patient are related to viral or bacterial infections, but medications, medication interactions, or dietary supplements should also be considered. *Clostridium difficile* colitis is more prevalent in older people because of colonization during hospitalizations, antibiotic use, and care in institutional settings. *Clostridium difficile* colonization in long-term care facilities is estimated to be at least 50% in the USA. Lactase deficiency can develop acutely after an episode of diarrhea due to other causes such as viral gastroenteritis. This usually resolves but may take weeks or months.

Causes of chronic diarrhea, lasting >2 weeks, include fecal impaction, medications, irritable bowel, microscopic or lymphocytic colitis, inflammatory bowel disease, obstruction from colon cancer, malabsorption , small bowel bacterial overgrowth, thyrotoxicosis, and lymphoma. Patients with neuromuscular disease such as Parkinson's disease who use anticholinergic medications that decrease GI transit are at risk of small bowel bacterial overgrowth and may present with diarrhea.

Celiac disease is an increasingly recognized cause of diarrhea and bloating in older adults. It is not clear whether this develops de novo in later life or reflects chronic undiagnosed gluten intolerance. Uncommon causes of diarrhea in older patients include Whipple's disease, jejunal diverticulosis, bowel ischemia, amyloidosis, lymphoma, and scleroderma with bacterial overgrowth. An appropriate history and physical examination, including a rectal examination should be performed. Medication history may reveal the cause. A history of weight loss raises concern for malignancy, inflammatory bowel disease (IBD), microscopic colitis, malabsorption, or thyrotoxicosis. Fluid status with orthostatic blood pressure measurement should be assessed in all older patients with diarrhea. Stool cultures should be obtained to exclude infection in patients with acute diarrhea accompanied by fever, abdominal pain, or blood in the stool [23]. Routine stool cultures usually give a specific diagnosis in only 20–30% of cases. This is likely due to the fact that most infectious diarrheas are due to viruses such as rotavirus and Norwalk agent. For chronic diarrhea, qualitative or quantitative stool fat or fecal elastase should be checked for steatorrhea, and a TSH for thyroid disease. *Clostridium difficile* toxin assay of the stool should be obtained if there is recent antibiotic use. Colonoscopy should be performed in patients with a history of weight loss, bloody diarrhea, and diarrhea lasting >4 weeks. Even if the colonoscopy appears normal, biopsies should be taken for microscopic colitis. X-rays and oral and IV contrast CT scan may demonstrate bowel wall thickening with severe enteritis or colitis; they are also useful if complications such as perforation or abscess are suspected. In patients with possible small bowel bacterial overgrowth due to a variety of risk factors such as motility disorders or structural changes in the GI tract that cause slow GI transit, prior use of antibiotics or immune deficiencies, a positive breath hydrogen/methane test confirms fermentation of ingested sugars in the small bowel [24]. Serum antibodies to tissue transglutaminase (tTG) are often positive in celiac disease. Diagnosis is confirmed by villous damage and atrophy in small bowel biopsies.

Treatment of diarrhea focuses on the underlying cause if one is found. In patients without sepsis who are *C. difficile* negative and have no blood in the stool, loperamide (≤8 tablets/day) can be effective in treating symptoms. Diphenoxylate/atropine (Lomotil®) may cause CNS toxicity, and should be avoided, as should antispasmodics such as dicyclomine. Bismuth subsalicylate, which has bactericidal action on common bacterial pathogens, can also be used. Initial episodes of mild-to-moderate *C. difficile* infection should be treated with either oral vancomycin or fidaxomicin. Metronidazole can be used for nonsevere *C. difficile* in settings where access to oral vancomycin or fidaxomicin is limited [25]. Older patients have a decreased response to metronidazole compared to younger patients (85% vs. 95%), and relapse of *C. difficile* diarrhea is more common in older patients. Antidiarrheal agents should be avoided in *C. difficile* colitis due to the risk of toxic megacolon. In microscopic colitis, antidiarrheal agents such as loperamide and bismuth subsalicylate can be tried; however, budesonide is the most effective treatment [26]. If small bowel overgrowth is present, bismuth-containing medications may be helpful in mild cases. For severe cases, treatment with nonabsorbable antibiotics (such as rifaximin) for 14–21 days eradicates the offending bacteria [27]. If the cause of slow transit is not addressed or is not treatable, then overgrowth is likely to recur. Elimination of gluten is the treatment for celiac disease and improvement in diarrhea usually occurs within 4 weeks, although healing of the small bowel mucosa can take several months. Medication review is helpful in patients with refractory celiac disease, as medications are an unsuspected source of gluten. For those with irritable bowel syndrome (IBS) , a focus on stress and depression reduction, and referral to a nutritionist to discuss a low fermentable oligo-di-monosaccharides and polyols (FODMAP) diet may help (Table 21.7).

Table 21.7 Practice tips for diarrhea in older patients

Acute diarrhea is usually self-limited and caused by infections. Chronic diarrhea has many causes, and an extensive workup may be needed
Consider early hospitalization or admission to an observation unit for older patients with diarrhea: increased risk of dehydration, falls, and inability to perform activities of daily living
Avoid diphenoxylate/atropine (Lomotil®) due to risk of confusion and ileus from atropine
Avoid antidiarrheals until bleeding and *C. difficile* ruled out
Chronic diarrhea—check for:
metabolic causes (thyroid disease)
microscopic colitis
medications
malabsorption
small bowel bacterial overgrowth (slow transit)
celiac disease
IBS (FODMAP diet)

FODMAP fermentable oligo-di-monosaccharides and polyols

21.8 Diverticular Disease

Diverticular disease is common in industrialized nations and increases with age; >60% of those older than 70 years and nearly 80% of those older than 80 years have diverticular outpouchings of the colonic mucosa and submucosa. Diverticuli are most common in the sigmoid colon probably due to increased colonic luminal pressures, with constipation and straining. Approximately 15–20% of older adults with diverticulosis will have a complication such as diverticular bleeding or diverticulitis.

21.8.1 Diverticular Bleeding

While bleeding from the GI tract can have many origins (Table 21.8), diverticular bleeding is a disease of old age. Forty-five percent of all diverticular bleeding occurs in patients over age 80 [28]. It can present with sudden onset of painless hematochezia. Although most diverticula are on the left side of the colon, 70% of diverticular bleeding comes from right-sided diverticulae [13]. Eighty percent of diverticular bleeding episodes stop spontaneously, however, patients should be hospitalized if bleeding persists, if they are hemodynamically unstable, or if blood loss compromises other organ systems. Older patients are at higher risk for poor outcomes with bleeding, and the threshold for hospitalization should be lower than in younger patients. In hemodynamically unstable patients with lower GI bleeding, CT angiography, rather than colonoscopy, is the recommended initial step in investigation [29]. For stable patients presenting with lower GI bleeding, a colonoscopy is a reasonable intervention to exclude other sources of bleeding, such as arteriovenous malformations (AVMs) , ischemia, IBD, and cancer. Diverticular bleeding is a diagnosis of exclusion in patients with diverticulitis. If significant bleeding persists, angiography may show the site. In refractory cases, surgical resection of the bleeding area may be required.

21.8.2 Diverticulitis

In uncomplicated diverticulitis, patients have lower abdominal pain, fever, and an elevated white blood cell count [30]. They may have diarrhea or may have decreased bowel movements from spasm in the inflamed colon. On physical examination they may have mild tenderness on palpation over the inflamed site, however, there are usually no palpable masses or peritoneal signs such as rebound tenderness or rigidity of the abdominal wall (guarding). An abdominal radiograph should be performed to look for pneumoperitoneum. If there is no evidence of perforation or sepsis, treatment can be initiated in the outpatient setting with clear liquids for 2–3 days and oral antibiotics to cover anaerobes and gram-negative organisms. The provider should call the patient within 24 h to assess the situation and a follow-up visit in 48–72 h is important. If no improvement occurs, the patient should be hospitalized and a CT scan of the abdomen performed, preferable with IV and oral contrast if renal function allows use of IV contrast. Complications of diverticulitis include abscess, stricture, large volume bleeding, or fistula. In addition to presenting with tachycardia or hypotension, older patients may present with delirium. Abdominal examination may reveal a mass in the left lower quadrant, with or without signs of peritonitis; significant blood in the stool; or a fistula to the bladder, uterus, or skin. Patients with complicated diverticulitis require hospitalization. Older patients with an episode of diverticulitis have a 35% chance of a second episode within the next 5 years. Patients with more than two episodes of diverticulitis in the same segment of colon, particularly with complications, should be referred for consideration of segmental resection. Older patients tolerate elective resection with primary anastomosis well. Emergency colon resection has a higher morbidity and mortality in patients over 70 years compared to younger patients and diverting colostomy may be a better alternative.

Table 21.8 Causes of GI bleeding in older patients

UGI bleeding	LGI bleeding
Gastric, duodenal, or esophageal ulcer	Colonic diverticula
Gastritis, duodenitis, or esophagitis	Ischemic bowel disease
Esophageal varices	Inflammatory bowel disease
Mallory–Weiss tear	Angiodysplasia
Neoplasm	Infectious diarrhea
Telangiectasia	Radiation proctitis
Angiodysplasia	Postpolypectomy
	Hemorrhoids
	Stercoral ulcer

GI gastrointestinal, *UGI* upper GI, *LGI* lower GI

21.9 Inflammatory Bowel Disease

While most patients with IBD are under age 65, it is now believed that one-third of all new cases of Crohn's disease occur in older people [31, 32]. Older patients with Crohn's disease may have less abdominal pain or cramps, possibly due to reduced visceral sensation or use of medications that suppress pain or decrease intestinal motility. Patients typically have nonbloody diarrhea, unintentional weight loss, and fatigue. They may have anemia causing pallor, shortness of breath, and reduced exercise tolerance. Extraintestinal manifestations of Crohn's disease are common including joint effusions, oral ulcers, painful nodular lesions on the extremities (erythema nodosum), uveitis, and back pain from sacroiliitis. Although Crohn's disease develops anywhere from the mouth to the anus, in older patients it is less likely to involve large portions of the GI tract. Diagnosis is often delayed in older patients because symptoms of Crohn's disease mimic other diseases, including malignancy, infectious diarrhea, ischemic colitis, lactose intolerance, irritable bowel disease, medication-induced diarrhea, diverticulitis, celiac disease, microscopic colitis, or bacterial overgrowth. Serologic antibody panels detecting autoantibodies in IBD can help in distinguishing between ulcerative colitis and Crohn's disease when patients present with indeterminate colitis. These tests are expensive, and their use should be deferred to specialists in IBD.

Ulcerative colitis (UC) usually presents with tenesmus and frequent bloody stools, without the weight loss associated with Crohn's disease . Extraintestinal manifestations of UC include dermatological manifestations such as pyoderma gangrenosum (round or oval lesions on the shins and forearms). Older patients are more likely to have limited left-sided disease or proctitis compared with younger patients. The first attack in an older patient is generally more severe and more likely to require steroids than in a younger patient. Approximately 15% of older patients with UC will eventually require surgery. The diagnosis of either UC or Crohn's is made on physical examination and history supplemented by laboratory studies and imaging. Patients require endoscopy for definitive diagnosis; however, this is undertaken with caution in patients with severe colitis due to risk of perforation. CT enterography (a CT scan that uses special contrast and image reconstruction to evaluate the small bowel wall more accurately) is used to detect small bowel involvement in Crohn's disease. Patients should be followed by an IBD specialist. There are limited data on IBD treatment in patients over age 70, as few older patients have been included in clinical trials [33].

21.10 Colon Cancer

The incidence and prevalence of colon cancer increases with age, and most cases occur in patients over age 65. There are several points that are worth reviewing regarding screening. Colon cancer is one of the best understood malignancies in terms of the mechanism of transition from normal tissue to cancer, and there is strong evidence that screening and removal of precancerous growth decrease subsequent colon cancers in older patients. The controversy in screening is primarily based on what techniques to use and how long to continue. Several recent consensus statements indicate that screening should start at age 45–50 years and continuing as long as patients have a life expectancy greater than 10 years. Life tables incorporating morbidity and functional status suggest that the utility of colon cancer screening decreases after age 80–85 years (Table 21.9).

Table 21.9 Indications for colonoscopy in older patients

Screening at age 50 and every 10 years afterward (if no lesions identified) Stop screening around age 80–85 years or earlier if less than 5 years of life expectancy
Shorter frequency of surveillance if risk factors:
First-degree family member with colon cancer Multiple second-degree family members with colon cancer
Personal history of colon cancer, colonic polyps, inflammatory bowel disease
History of breast cancer or other genetic conditions associated with colon cancer
Diagnostic colonoscopy if alarm symptoms present:
Hemoccult positive stool on routine screening
New change in bowel habits
Anemia secondary to blood loss from the gastrointestinal tract
Hematochezia
Unintentional weight loss and other causes less likely
New unexplained abdominal pain

21.11 Constipation and Fecal Incontinence

Constipation is very common in older patients due to changes in colonic motility with age and superimposed risks such as immobility and medication use [34]. Constipation is a risk for fecal impaction and resultant fecal incontinence and can contribute to other conditions such as urinary retention and urine infections in older patients. Constipation and fecal impaction has also been associated with increased agitation and behavioral changes in patients with dementia who cannot indicate their need to toilet (Table 21.10).

Acute and chronic fecal incontinence (FI) occur commonly in older patients with comorbid conditions. Fecal incontinence is socially embarrassing, incapacitating [35, 36], and underreported. Up to 7% of the older population are incontinent of solid or liquid stool at least weekly. The prevalence is nearly 50% in patients in nursing homes and is the second leading precipitant of nursing home placement of patients with underlying physical or cognitive impairment in the USA. Fecal incontinence is closely associated with urinary incontinence and constipation . Because overflow of liquid stool is a complication of constipation , the latter should always be considered in the workup. A difficult aspect of treating overflow fecal incontinence is convincing the patient and/or family that constipation is actually the problem, not diarrhea.

Evaluation of constipation and FI should include evaluation of cognitive status, a history of the circumstances of the incontinence episodes, abdominal, neurological, and rectal examinations. Hard stool in the rectal vault suggests a fecal impaction, however, a negative rectal examination does not exclude a proximal fecal impaction, fecal masses, or stool back-up. Mental status examination identifies the patient with dementia or delirium who may have lost self-toileting capacity. Absence of anal sphincter tone or anal wink suggests denervation of the pudendal nerve (S2–4) from a local or spinal cord lesion. An abdominal plain film to assess fecal load is helpful when fecal impaction is suspected. Acute onset of incontinence should prompt examination for fecal impaction and spinal imaging to rule out cord compression.

Table 21.10 Common causes of constipation

Motility disorders	
Slow colonic transit	
Pelvic floor dysfunction (anismus, persistent puborectalis contraction)	
Constipation-predominant irritable bowel syndrome (abdominal pain relieved by defecation)	
Medication-induced	
Opiates	Anticholinergics
Calcium channel blockers	Tricyclic antidepressants
Antipsychotics	Ganglion-blocking agents
Mechanical obstruction	
Cancer	Large rectocele
Volvulus	Intussusception
Stricture	Anal fissure
Extrinsic compression	
Descending perineum syndrome	
Neurological disorders	
Parkinson's disease	Prior colon surgery
Spinal cord or sacral root tumors	Spinal cord injury
Multiple sclerosis	
Systemic disorders	
Hypothyroidism	Amyloid
Diabetes mellitus	Connective tissue disorders
Congestive heart failure	
Metabolic disorders	
Hypokalemia	Uremia
Hypophosphatemia	Hypercalcemia
Hypomagnesemia	
Miscellaneous	
Dehydration	
Immobility	
Cognitive impairment	
Autonomic neuropathy	
Diminished rectal sensation	

For patients not responding to empiric treatment, consider referral to a group specializing in anorectal motility disorders for additional testing such as anorectal manometry. This measures the resting pressure of the anal canal (predominantly from the internal anal sphincter [IAS]), tone, and contractile pressures of the external anal sphincter [EAS]), and sensation within the anorectal area. Pudendal nerve testing may be required in some patients. Candidates for referral to a bowel disorders program are generally ambulatory and cognitively intact, as interventions include biofeedback and maneuvers requiring patient participation. These studies are not usually feasible in bed-bound or debilitated patients, and often the focus in the latter is detecting fecal impaction and reviewing medications for those that may cause diarrhea or constipation [37]. The treatment of constipation and fecal impaction include dis-impaction, bowel cleansing, modification of risk factors, and a maintenance regimen. Dis-impaction should start with manual removal of stool and/or enemas, before administering oral polyethylene glycol. Warm tap water enemas of 1–2 L may be needed. Milk and molasses (one cup each) enemas are both osmotic and mildly stimulating, are often effective when tap water enemas are not, and can be safely administered in the hospital or nursing home setting. Avoid magnesium citrate solutions and Fleet Phospho-soda enemas in patients with underlying cardiac or renal disease due to risk of fluid overload or phosphate nephropathy. Soapsuds enemas may precipitate ischemic colitis and should probably be avoided. Preventing constipation and recurrent impaction involves risk factor modification including mobilization, adequate hydration and nutrition, and minimizing constipating medications. Scheduled toileting after breakfast may be helpful for patients with cognitive impairment. Add fiber supplements when bowel function has been regularized. Regular use of a stimulant laxative such as senna or bisacodyl, or polyethylene glycol (PEG) or lactulose may prevent impaction in high-risk patients. Intermittent use of glycerin or bisacodyl suppositories is warranted if patients have infrequent episodes of constipation , but if used more than once a week, the entire bowel regimen should be reviewed and adjusted. The role of lubiprostone, linaclotide, and plecanatide is not clear; however, these are an alternative in patients unable to take other laxatives. These agents increase stool frequency in patients aged 70–75 years, but older patients also respond to much cheaper alternatives such as senna and PEG solution (Table 21.11).

21.12 Colonic Ischemia

The colon is more commonly affected by ischemia than the small bowel due to silent occlusion of the inferior mesenteric artery (IMA) in older patients (present in up to 10% of autopsies aged >80 years) [38, 39]. The causes of this (CI) include acute and chronic mesenteric ischemia from inferior mesenteric artery (IMA) thrombus or embolus, hypoperfusion (CHF, cardiac arrhythmias, shock, and vasculitis), hematological disorders/infections, medications (NSAIDs, digitalis, vasopressin, pseudoephedrine, sumatriptan, cocaine, amphetamines, gold), constipation , surgery, and trauma. The usual site of ischemia is the splenic flexure (so-called watershed area) of the colon primarily supplied by the IMA. Most colonic ischemia is precipitated by hypotension. The extent of injury ranges from mild, reversible mucosal damage to gangrene or fulminant colitis. Abdominal aortic aneurysm repair is a risk for acute CI, with 3% of elective and 14% of emergent repairs developing CI, from SMA occlusion. This can also result in small bowel ischemia, which has a very high mortality. Rapid recognition and reversal of the ischemia is essential in treating severe ischemic colitis or small bowel infarction. Patients with acute CI

Table 21.11 Treatment of constipation

Initial management—occasional mild constipation
Increase fluid intake (only effective if dehydrated)
Exercise
Bowel training regimen (try to toilet when gastrocolic reflex active after meals)
Second-line therapy—active otherwise healthy older adults
Bulking agents (avoid as initial therapy in Parkinson's disease and severe constipation)
Stool softeners
Glycerin suppositories
Third-line therapy—consider first if history of chronic constipation or starting narcotic medications
Osmotic agents (milk of magnesia, lactulose, sorbitol)
PEG solutions (Miralax)
Stimulating agents (senna, bisacodyl)
Fourth-line therapy—start first if no bowel movement in several days
Bisacodyl suppository
Tap water enema or milk and molasses enema (1/2 cup molasses: 1 l milk)
Fifth-line therapy
Misoprostol, colchicine
Other prescription laxatives (lubiprostone, linaclotide, plecanatide)
Methylnaltrexone (if on opiates and failed stimulant/osmotic laxatives)
Agents to avoid
Prokinetics (erythromycin, metoclopramide, cisapride)
Lubricating agents (oral mineral oil because of aspiration)
Routine use of enemas (increased risk of rectal perforation in older patients)
Phosphate laxatives in renal disease (phosphate nephropathy)
Soapsuds enemas (increased risk of ischemic or chemical colitis)

PEG polyethylene glycol

usually present with cramping lower left quadrant pain and loose, bloody stools. GI blood loss sufficient to cause hemodynamic instability is atypical and suggests other diagnoses. Physical examination often reveals tenderness over the affected portion of bowel. Peritoneal signs may be present, and persistence of these signs for several hours suggests transmural infarction necessitating rapid surgical exploration. Strictures, chronic colitis, gangrene resulting in perforation, and intra-abdominal sepsis are complications of CI. Chronic CI, which is probably more common than previously thought, may present with diarrhea, left-sided abdominal cramps, and gas or bloating due to postprandial dysmotility caused by the mismatch of blood supply to demand. Symptoms usually occur after meals, can be slowly progressive and insidious, and patients have often been investigated extensively for other causes. Endoscopy may show mild inflammation in the left colon near the splenic flexure, but the mucosa can appear relatively normal if the ischemia is progressing slowly because slow IMA occlusion allows collateral blood supply to develop.

Table 21.12 Practice tips for mesenteric ischemia in older patients

Mesenteric ischemia is primarily a disease of older people, particularly those with underlying cardiovascular disorders
Acute mesenteric ischemia presents with pain out of proportion to physical findings and may be caused by an embolus, thrombus, or hypoperfusion state
Mesenteric artery angiography is required for diagnosis and, often, for treatment
Chronic mesenteric ischemia presents with postprandial pain (intestinal angina) and weight loss. It is seen in older patients with arteriosclerotic changes in the mesenteric circulation
Colonic ischemia presents with left lower quadrant pain and loose bloody stools. It is diagnosed by colonoscopy, but the findings may mimic infectious or inflammatory colitis
Most patients with colonic ischemia recover with bowel rest, fluids, and IV antibiotics and do not require surgery

Even if CI is suspected, stool cultures should be obtained to exclude infectious colitis. The patient with suspected CI who does not have peritoneal signs should have CT or MR angiography and possibly careful sigmoidoscopy within 48 h of symptom onset. Patients with peritoneal signs should undergo urgent/emergent CT or MR angiography and surgical exploration. CT scans are normal in up to 66% of patients with chronic or slowly progressive CI but may show colonic thickening, mucosal edema, or pericolonic fluid and/or stranding suggestive of inflammation. Evaluation of the intestinal blood flow using Doppler ultrasound may indicate a superior MA (SMA) occlusion; however, more invasive procedures such as MR angiogram or interventional angiography are often required. The latter allows treatment with thrombolytics or angioplasty. The greatest difficulty is early recognition before development of an acute abdomen or hypotension. If no signs of peritonitis or perforation are present, treatment includes fluids, bowel rest, and broad-spectrum antibiotics. Hypotension should be aggressively reversed, CHF or cardiac arrhythmias treated, and vasoconstricting medications stopped. The persistence of peritoneal signs should prompt surgical exploration. Recurrence of CI occurs in only 3–10% of older patients. Congenital or acquired thrombophilic states account for a significant percentage of ambulatory younger patients presenting with colonic ischemia, and though less likely, should be tested in older patients (Table 21.12) [40].

21.13 Viral Hepatitis

Hepatitis A (HAV) is less frequent in older than younger populations, but older people may have a more severe course and higher risk of fulminant liver failure and death. International travel to endemic areas is the main risk factor. Comorbidities and a decreased likelihood of liver transplantation due to age contribute to the lower survival of older patients with fulminant disease. Older patients planning travel should be tested for HAV antibody and vaccinated if negative 2–3 months prior to travel. A second vaccination may be required in older patients due to decreased immune responsiveness with age.

Acute hepatitis B virus (HBV) infection is uncommon in the older population and often runs a mild and subclinical course. Symptoms, when present, include fever, malaise, arthralgias, myalgias, nausea, vomiting, abdominal pain, and jaundice [41]. Chronic hepatitis B is endemic in sub-Saharan Africa and the Far East, and patients from high-risk areas should be screened as should patients with risk factors for acquisition (IV drug use, sexual exposure, and transfusions or blood products prior to 1980). PEG interferon-α, used to treat chronic HBV in patients with decompensated liver disease, may cause more side effects in older people. Other viral suppressive agents such as entecavir and tenofovir are well tolerated by older patients. Patients diagnosed with chronic viral hepatitis should be referred to a hepatologist and undergo a liver ultrasound to determine whether they have cirrhosis or hepatocellular carcinoma. A noninvasive fibroscan may demonstrate fibrosis. Liver biopsy is recommended for patients with significant elevation in liver enzymes or evidence of active viral replication.

Diagnosis of hepatitis C (HCV) is becoming more common in patients over age 65 years due to exposure to IV drugs or blood products before 1990. Most patients with chronic hepatitis C are asymptomatic and diagnosed when routine laboratory studies reveal elevated aminotransferase levels. Acute HCV symptoms are similar to those seen in acute HBV. Those who acquire HCV infection at an older age are at increased risk of cirrhosis and mortality [42, 43]. Daily alcohol use worsens the prognosis. Because of the increasing prevalence of chronic hepatitis C in the older population, all patients aged 18–79 years should have one-time screening for HCV antibody. PEG interferon-α with ribavirin had been the standard treatment for chronic HCV infection. Heart disease is a relative contraindication to ribavirin therapy. Several newer interferon-free treatments, such as direct-acting antiviral (DAA) therapies, have proven to have greater efficacy and reduced side effects compared to interferon-based therapies. Decisions concerning screening and treatment of chronic viral hepatitis in older patients should take into account life expectancy, likelihood of progression to cirrhosis, and the treatment side effects.

21.14 Drug-Induced Liver Disease

Polypharmacy and altered pharmacodynamics accounts for the increased incidence of drug-related hepatotoxicity in older people. Many drugs are liver toxic and a reliable information can be found on the NIH LiverTox website (http://livertox.nih.gov/). NSAIDs, amiodarone, hydroxymethylglutaryl coenzyme A reductase inhibitors, and antituberculosis medications may cause hepatotoxicity [44]. LFTs should be monitored in patients receiving these medications. Several herbal medications cause liver injury, including kava, chaparral, black cohosh, and germander. A list of herbal medications should be elicited from all older patients. Statin drugs often cause modest elevation in transaminases, and if these remain <2× normal, studies indicate a low risk of liver damage and favorable risk–benefit ratio in patients with hyperlipidemia, cardiac disease, diabetes, or metabolic syndrome.

21.15 Hepatic Ischemia

Patients of any age can develop steep elevations in aminotransferase levels after a hemodynamic insult. Older patients are at increased risk due to comorbidities that cause hypoperfusion (acute myocardial infarction, CHF, valvular heart disease, cardiac arrhythmias, cardiomyopathy, sepsis, trauma, and burns). The magnitude of the aminotransferase elevation does not correlate with the extent of liver injury and does not predict outcome. Most patients recover after correction of hemodynamic instability and abnormal coagulation, with normalization of aminotransferase levels within 10 days.

21.16 Primary Biliary Cirrhosis

Up to 40% of patients with primary biliary cirrhosis (PBC) are older than age 65, and women outnumber men by 6:1. Patients present with fatigue, pruritus, and elevated alkaline phosphatase (ALP) levels. As osteoporosis can also elevate ALP, patients should be monitored for progressive elevation, and the ALP fractionated if over 200 units/L. Diagnosis can be established, without liver biopsy, if patient has both biochemical evidence of cholestasis based on ALP elevation and presence of AMA or other PBC-specific autoantibodies. Liver biopsy can help in diagnosis if the patient does not meet above criteria or if other etiologies (such as autoimmune hepatitis) are possible [45]. Treatment with ursodeoxycholic acid improves survival and delays need for liver transplantation. As with all patients with cirrhosis, patients with PBC should avoid NSAIDs and alcohol. Doses of hepatically excreted drugs should be adjusted in patients with significant cholestasis to avoid toxicity.

21.17 Hepatocellular Carcinoma

More than 50% of patients with hepatocellular carcinoma (HCC) in the USA are older people and survival rates are significantly lower in patients diagnosed with HCC aged

Table 21.13 Liver disease in older patients

Older patients should be vaccinated against hepatitis A prior to international travel
Screen patients who have immigrated from endemic areas for chronic hepatitis B
Screen all patients between the ages 18 and 79 years old for hepatitis C (if expected life span >5 years and do not have end-stage liver disease)
Nonalcoholic fatty liver disease (NAFLD) is the most common cause of elevated liver enzymes, and can progress to fibrosis and cirrhosis in 20% of patients
Alcohol is an underdiagnosed cause of liver disease in old age
Both prescription and OTC/herbal drugs can cause elevated liver enzymes and liver damage: withdraw any culprit drug and monitor until enzymes normal
Check fractionated alkaline phosphatase (ALP) in patients with total ALP >200
Best candidates for treatment of hepatocellular carcinoma by surgical resection or liver transplantation have small tumors without vascular invasion, no portal hypertension, and normal liver function
Consider gallstones in patients with acute RUQ pain and fever. Laparoscopic cholecystectomy is well tolerated by stable older patients. Unstable patients should have cholecystotomy drainage followed by delayed cholecystectomy

>65 years. Cirrhosis from chronic HCV or HBV infection and alcoholic liver disease are the most frequent causes of HCC. HCC can present with acute onset of right upper quadrant pain, elevated alpha-fetoprotein (AFP) levels or incidental mass on imaging. Patients with cirrhosis should be screened with ultrasonography every 6 months for early detection of HCC. In select patients with a high likelihood of having an inadequate ultrasound, a CT or MRI may be utilized for screening. Surgical resection is the treatment of choice if the tumor is small and there is no vascular invasion. Liver transplantation is indicated for patients with one tumor <5 cm, or up to three tumors <3 cm without vascular invasion. Unfortunately, the mortality of liver transplantation increases over age 70, and 5-year survival is lower. Older patients who are poor surgical candidates may be treated with transarterial chemoembolization (TACE), mechanical ablation, or systemic chemotherapy, however, only survival benefit for TACE has been reported (Table 21.13) [46].

21.18 Cholelithiasis

Age-related increases in cholesterol secretion in bile, combined with decreased bile acid secretion, leads to increased cholesterol saturation and increased bile lithogenicity. Cholelithiasis is twice as common in women as in men, often asymptomatic and discovered during radiological studies performed for unrelated reasons. Of patients with asymptomatic gallstones, 10–25% will become symptomatic each decade [47]. Symptomatic gallstones typically present with RUQ pain, nausea, and vomiting. Diagnosis is suggested in the appropriate clinical setting by elevated alkaline phosphatase and bilirubin levels and is confirmed by ultrasonography. Diagnosis of gallstones in the biliary ducts is made using abdominal ultrasound, magnetic resonance cholangiopancreaticogram (MRCP), endoscopic retrograde cholangiopancreatography (ERCP), or endoscopic ultrasound (EUS) . Choosing between MRCP/EUS versus ERCP is often made by pretest probability, patient preference, local expertise, and availability. Patients with low to intermediate probabilities of having a biliary stone can proceed with preoperative MRCP or EUS. Patients with high probability (i.e., has biliary stone seen on ultrasound, clinical ascending cholangitis, or bilirubin >4 mg/dL) can proceed with preoperative ERCP [48]. Laparoscopic cholecystectomy is the treatment of choice for symptomatic cholelithiasis in older people; postoperative mortality and morbidity in selected older patients are comparable to that for younger patients if the patient is hemodynamically stable. Poor surgical candidates may be treated with ERCP with sphincterotomy or ursodeoxycholic acid. Patients with Charcot's triad (RUQ pain, fever, jaundice) likely have cholangitis, and should undergo emergency ERCP or percutaneous transhepatic cholangiography (PTC) to assess and decompress the biliary system. Asymptomatic cholelithiasis should not be treated.

21.19 Cholecystitis

Symptoms of gallbladder inflammation (cholecystitis) such as epigastric or RUQ pain, nausea, and vomiting may be less severe in older patients or mistaken for other disease processes. Elevations in serum bilirubin, alkaline phosphatase, aminotransferases, and white blood cell counts are characteristic. The diagnosis is made clinically and confirmed with RUQ ultrasound. Complications such as necrosis of the gallbladder and cholangitis are more common in older patients and are associated with increased morbidity and mortality. Treatment of cholecystitis consists of stabilization with intravenous fluids, bowel rest, pain control, and broad-spectrum antibiotics followed by cholecystectomy. Older patients with acute cholecystitis frequently have significant comorbidities that increase risk of complications and death with emergent cholecystectomy. Immediate percutaneous cholecystostomy followed several weeks later by definitive surgery or ERCP has less morbidity and mortality compared to urgent surgery [49]. Gallbladder carcinoma is rare in the USA. Gallstone disease, female gender, and smoking are risk factors. The diagnosis is often made incidentally at surgery. The prognosis is poor.

21.20 Acute Pancreatitis

Gallstones, medications, and cancer account for a higher proportion of acute pancreatitis in older compared with younger patients. Alcohol is a common precipitating factor in both age groups [50, 51]. Typical presenting symptoms include epigastric pain radiating to the back along with nausea and vomiting. The diagnosis is made by elevations in amylase and lipase levels. Elevations in alkaline phosphatase and bilirubin suggest gallstone pancreatitis, which can be confirmed by ultrasonography, CT, or MRI. Patients with altered mental status, hemodynamic instability, BUN over 25, or those meeting three or more of Ranson's criteria (Table 21.14) should undergo a dynamic CT scan to rule out pancreatic necrosis. Patients with elevated BUN should be considered for ICU admission, as this predicts increased mortality. The cornerstones of therapy remain intravenous hydration, and pain control. Patients with acute pancreatitis, including necrotizing pancreatitis, generally do not need prophylactic antibiotics. More recent data have favored early oral feeding (within 24 h) rather than keeping patient nil per os [52]. Surgical or endoscopic debridement should be considered if necrotic tissue is infected. Morbidity and mortality of elective laparoscopic cholecystectomy with preoperative ERCP or intraoperative cholangiography is comparable to that for younger individuals. In patients who are poor surgical candidates, ERCP with sphincterotomy decreases the risk for recurrent gallstone pancreatitis. Drug-induced pancreatitis can be caused by azathioprine, 6-mercaptopurine, estrogen, mesalamine, furosemide, and angiotensin-converting enzyme inhibitors. Suspected medications should be stopped when pancreatitis is diagnosed. Other causes of pancreatitis, such as hyperlipidemia or hypercalcemia, should be sought and treated.

Table 21.14 Ranson's criteria in acute pancreatitis

On admission
1. Age >55 years
2. WBC count >16,000/μL
3. Serum glucose >200 mg/dL
4. Serum LDH >350 units/L
5. Serum AST >250 units/L
Over the first 48 h
1. Increase in BUN exceeding 5 mg/dL
2. Arterial PO_2 <60 mmHg
3. Hematocrit drop >10 percentage points
4. Serum calcium <8 mg/dL
5. Base deficit >4 mEq/L
6. Fluid sequestration exceeding 6 L

Presence of three or more on admission predicts severe course with a sensitivity of 60–80%
WBC white blood cell, *LDH* lactate dehydrogenase, *AST* aspartate aminotransferase, *BUN* blood urea nitrogen, PO_2 partial pressure of oxygen

21.21 Chronic Pancreatitis

The diagnosis of chronic pancreatitis in older patients is difficult. Structural changes associated with chronic pancreatitis (ductal irregularity or dilation, calcification, abnormal echogenicity) are also observed in aging patients without pancreatitis. Because pancreatic function is maintained in old age, functional testing demonstrating enzyme insufficiency may aid in diagnosis. Patients should also be screened for fat-soluble vitamin deficiencies as vitamin D malabsorption is common in chronic pancreatitis. Treatment consists of pain management, pancreatic enzyme and vitamin replacement, and avoidance of alcohol.

21.22 Pancreatic Cysts in the Older Patient

Pancreatic cysts are often found incidentally during cross-sectional imaging. The incidence of pancreatic cysts in the USA is between 3% and 15% and increases with age; 0.5% in those <40 years old, 25% in those 70–79 years old, and 37% in those >80 years old. The debate of what to do with pancreatic cysts is ongoing. Many are benign and the major consequence for patients is stress and anxiety. The risk of a pancreatic cysts being malignant at time of diagnosis is only 0.017%. The overall risk of any cyst developing into a cancer over a 20-year period is about 1% [53]. Cystic lesions of the pancreas can be divided into non-neoplastic and neoplastic lesions. Pancreatic cysts can be isolated or found in conditions such as Von Hippel–Lindau or polycystic kidney disease. Historically, pseudocysts (inflammatory cysts) represented the majority of benign cysts. These cysts are often found in those who have already been diagnosed with chronic pancreatitis or with a history of trauma. However, if a cyst is associated with new acute pancreatitis, there is more concern for malignancy. Non-neoplastic cysts include retention cysts, mucinous non-neoplastic cysts, and lymphoepithelial cysts. Cystic neoplasms include (descending order of frequency) intraductal papillary mucinous neoplasm (IPMNs) (38%), mucinous cystic neoplasms (23%), serous cystic tumor (16%), and solid pseudopapillary neoplasm (SPNs) (5%), which usually occur in the younger population. Mucinous cysts are exclusively found in women [54]. The initial approach is to determine if the patient is experiencing symptoms from the cysts, which can include abdominal pain, pancreatitis, or rarely biliary obstruction, and review previous imaging to assess the timing and growth of the cyst. If a cyst is <1 cm, lacks concerning features on imaging (i.e., dilated pancreatic duct), then it is reasonable to reassess with imaging in 1 year. The likelihood ratio of a cyst being malignant increases to 2.97 for cysts >3 cm, 2.38 for dilated pancreatic duct, and 7.73 if the cyst has a solid component. Based on this, the American Gastroenterological Association (AGA) recommends that if the cyst is <3 cm, lacks a solid component, and has no associated pancreatic duct dilation to repeat an MRI in 1 year and then every 2 years for 5 years [55]. If no changes in characteristics have occurred after 5 years, surveillance can be stopped. If any concerning findings are found, then consider performing an endoscopic ultrasound and fine needle aspiration. Surgery is generally indicated for lesions with malignant potential, which include mucinous cystic neoplasms, main duct IPMNs, and solid pseudopapillary neoplasms. Pancreatic surgery often carries a high risk of morbidity and mortality. Decisions regarding the management or surveillance of a pancreatic cyst should be made in a multiple disciplinary approach with patient preferences and life expectancy in mind [53].

Table 21.15 Practice tips for malnutrition and weight loss in older patients

Malnutrition is a common problem in older patients and is often multifactorial
A detailed diet history is very helpful to determine whether the patient is unable to eat or is unwilling or disinterested in eating
Depression is a common cause of involuntary weight loss in older people, as is cognitive impairment
Low albumin/prealbumin and vitamin deficiencies are indicators of malnutrition
In addition to treating diseases associated with weight loss, interventions may need to address social isolation, ability to obtain and prepare meals, and cognitive impairment
The decision to place a percutaneous gastrostomy tube should take into account the cognitive status and quality of life of the patient. Patients with advanced dementia, while at risk for weight loss, do not benefit from feeding tubes

21.23 Pancreatic Cancer

Pancreatic cancer accounts for 5% of all cancer deaths in the USA, and the majority of cases occur in patients >45 years increasing in incidence from 1/100,000 at age 44 to 100/100,000 at age 85. Painless jaundice, pruritus, and weight loss are common presenting symptoms but usually occur late in the disease. Elevated CA 19–9 levels and abnormal imaging are suggestive of the diagnosis. The diagnosis is confirmed histologically. Pancreaticoduodenectomy (Whipple procedure) is the only treatment with demonstrated benefit and should be offered to select older patients with high overall fitness and low comorbidity. The prognosis of pancreatic cancer remains grim as most patients are not surgical candidates.

21.24 Management of Malnutrition and Weight Loss in Older Patients

While not specific for GI disease, weight loss is a common finding in older patients. Unintentional loss of 5% or more of usual body weight in the past month or 10% in the past 6 months is associated with increased morbidity and mortality in older patients [56] even after excluding other causes such as underlying malignancy. Weight change during an individual's lifetime is characterized by a gradual increase in weight that peaks in the fourth to fifth decade of life, followed by a period of stable weight and a gradual decline in weight after the sixth to seventh decades. Major indicators of poor nutritional status include weight loss over time, low weight for height (body mass index of 18.5 kg/m^2 or less), a loss of independence in two basic activities of daily living (e.g., bathing and dressing), midarm circumference or triceps skinfold thickness less than the 10th percentile of ideal, and the presence of nutrition-related disorders (e.g., osteoporosis, vitamin B12 deficiency, or folate deficiency). A serum albumin level below 3.5 g/dL is generally the most reliable, although nonspecific, indicator of chronic malnutrition. After excluding other causes of weight loss, the major need is to increase calorie intake. If the gastrointestinal tract is functional, enteral nutrition is preferred over parenteral nutrition as it is safer, and enteric food provides trophic stimulus to the gastrointestinal tract [57, 58]. Patients who have the cognitive ability to participate in a discussion about tube feeding and are unable to swallow or who cannot eat sufficient calories to maintain adequate nutrition are the best candidates for tube feeding. Nasogastric tubes are a short-term alternative, however, percutaneous gastrostomy tube placement is preferred when tube feeding is anticipated for weeks to months, or for palliative care in cases of irreversible bowel obstruction. Aspiration precautions (elevating the head of the bed, checking residuals) should be carefully observed because gastrostomy tube feeding does not prevent aspiration. Gastrostomy tube feedings are not recommended for patients with severe dementia, given the absence of data to show that tube feedings improve quality of life or survival. In older patients with other irreversible causes of dysphagia (stroke, Parkinson's disease), particularly those who cannot make their own decisions, it is important to have a thoughtful discussion with the patient and/or their decision maker about the risks of feeding tubes and overall goals of care prior to insertion of a tube. Total parenteral nutrition (TPN) is appropriate only in carefully selected older patients whose GI tract cannot be used. Complications of parenteral feeding include catheter-related thrombosis and sepsis. Older patients have a higher mortality on TPN than younger patients (Table 21.15).

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22 Infection and Immunity in Older Adults

Kevin P. High

22.1 Clinical "Take Home Points"

1. Older adults are at increased risk of infection versus younger adults due to:
   (a) The presence of multiple comorbid illnesses, functional limitations, and frailty
   (b) Waning immune function with age
   (c) More frequent contact with healthcare, which increases the risk of exposure, particularly to antibiotic-resistant organisms
   (d) Social/environmental factors such as congregate living (assisted living or skilled nursing facility), food insecurity/poor nutritional status
2. Older adults with infection frequently present in "atypical" fashion; they are less likely to develop fever, leukocytosis, and typical symptoms than younger adults, and more likely to present with altered behavior (e.g., poor oral intake), decline in functional status, or exacerbation of an underlying chronic illness (e.g., congestive heart failure).
3. Diagnostic tests (e.g., echocardiography, chest x-ray) are less sensitive in seniors than in younger adults due to age-related changes in structure and/or comorbid illness. However, making a specific microbiological diagnosis is of great importance in older adults as narrow, targeted antibiotic therapy can reduce the risk of side effects (e.g., *Clostridium difficile* colitis, renal toxicity) and development of colonization with resistant organisms.
4. Colonization without infection occurs frequently in seniors, particularly skin/nasal colonization with methicillin-resistant *Staphylococcus aureus* and positive urine cultures without specific urinary symptoms (i.e., asymptomatic bacteriuria). Only those with symptoms or about to undergo surgical procedures should undergo treatment to attempt eradication. Other than in those specific circumstances, asymptomatic colonization should *not* be treated; in randomized trials, this has been found to be harmful, not helpful.
5. Specific infectious syndromes (e.g., sepsis, pneumonia) are more common and more severe in seniors than younger adults, particularly in those with multiple chronic conditions or frailty. Early, aggressive antibiotic therapy is essential for optimizing outcomes in serious infections.
6. Prevention strategies differ in older versus younger adults particularly with regard to vaccine recommendations and formulations. Clinicians should stay current with such recommendations at https://www.cdc.gov/vaccines/schedules/index.html.

22.2 Predisposition of Older Adults to Infection

A number of factors increase infection risk as one ages into late life. Some risk factors are quite unique and changing as different cohorts enter seniority, while others are more "universal truths" and affect every older cohort. For example, many older individuals have latent infection with *Mycobacterium tuberculosis* (i.e., asymptomatic infection), but the percentage of U.S. seniors harboring TB is declining. Similarly, herpes zoster risk will likely climb for the next several decades, but the risk of zoster in those immunized against varicella is unknown and is likely to be quite different in 30 years. In contrast, age is now and will remain the strongest risk factor for many chronic illnesses that predispose individuals to infection such as diabetes, chronic obstructive pulmonary disease, and heart failure. The resulting diminished reserve/accumulation of deficits and reduced resilience often result in frailty in seniors – and frailty itself irrespective of comorbid illness is associated with decreased immune responses and increased infection risk. Further, age itself is associated with waning immune function and host defense mechanisms, increasing the risk of infection.

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Comorbid conditions (e.g., COPD, diabetes mellitus) most often result in reduced innate immunity, nonspecific barriers such as skin integrity, cough, and mucociliary clearance, as well as immune responses triggered by recognition of microbial products without the need for prior exposure such as complement, polymorphonuclear neutrophils, etc. Age-related changes predominantly affect the adaptive immune response with dysregulation of antibody and cellular immunity that further compromises host defenses. This waning of immunity with age is called immune senescence and is not merely a global state of reduced immunity, but an altered immune milieu at multiple levels. Some aspects of immunity are upregulated, including the inflammatory response, which demonstrates constitutive activation in older adults, as evidenced by elevated C-reactive protein and interleukin (IL)-6 blood levels. However, T-cell function and development of highly specific and high-affinity antibodies after exposure to either an infectious organism or vaccine are markedly impaired with advanced age and synergistically reduced when frailty is present. Finally, the kinetics of an immune response after exposure to an infectious agent appears to slow as one ages emphasizing the need for more rapid diagnosis and treatment of serious infection in seniors.

The health of seniors is not only a function of biology, but also socioeconomic status, environment, and access to healthcare services. These social determinants of health greatly influence infection risk in older adults. Population-based studies reveal that lower income is associated with higher rates of community-acquired pneumonia and invasive pneumococcal infections among elderly individuals. Lower socioeconomic status may predispose to infection because of either increased exposure to infectious agents (e.g., overcrowding) or increased susceptibility due to common exposures (e.g., tobacco smoke). Long-term care residents emphasize the concept of "multiple determinants of health" as well – this subset of the aging population has a particularly high incidence of respiratory, urinary, gastrointestinal, and skin infections versus community-dwelling seniors. The close contact residents have with other residents and workers who often have few or no symptoms plays a key role in the spread of infections such as influenza, coronavirus, and norovirus. Frail residents in a confined setting can lead to severe outbreaks with high mortality rates such as that seen in the recent SARS-CoV-2 pandemic. Further, intense use of antibiotics in long-term care facilities – of which >50% are deemed unnecessary upon careful review – results in higher rates of antibiotic-resistant bacteria such as methicillin-resistant *S. aureus* (MRSA), vancomycin-resistant enterococci (VRE), and multidrug-resistant gram-negative rods.

22.3 Principles of Diagnosis and Management of Infections in the Elderly Patient

Presentation of illness Serious infections can occur in seniors with minimal or atypical symptoms such as nonspecific declines in functional or mental status, or anorexia with decreased oral intake. Exacerbation of underlying illness (e.g., congestive heart failure [CHF] or diabetes mellitus) can be an initial manifestation of infection. Fever is frequently absent in older patients due to a lower baseline body temperature than the currently accepted normal of 98.6 °F (37 °C) and blunted immune responses that trigger fever. The importance of a "normal" or reduced temperature in the face of significant infection cannot be overemphasized as poor recognition and subtle diagnoses delay antimicrobial administration which has been shown to adversely affect outcomes. Thus, a heightened suspicion for infection is critical when evaluating older adults for nonspecific changes in function, reduced oral intake, cognitive impairment including delirium, and exacerbations of chronic diseases.

Finally, age- and comorbidity-related changes in anatomy and physiology may confound interpretation of diagnostic evaluations. For example, age-related calcium deposition reduces sensitivity of transthoracic echocardiography for detecting valvular vegetations in infectious endocarditis from 85% to 90% in adults age ≤55 to <50% for those aged 70+ years; transesophageal echocardiography vastly improves sensitivity.

Antibiotic Management Age and comorbidities markedly alter drug distribution, metabolism, excretion, and interactions. Antibiotic dose reductions or widening of the dosing interval are frequently required in older adults because of changes in renal function or predisposition of the elderly adult to important side effects. In addition, antibiotic interactions are more frequent because most elderly persons are taking multiple medications. These changes and the increased incidence of side effects in the elderly often lead clinicians to the dictum of "start low, go slow" when new drugs are started in older adults. However, for antibiotics, this is *not* an appropriate strategy. Data suggest early achievement of therapeutic antibiotic levels is *more* important in seniors than in younger adults. The reason for this is not fully known, but likely due to slowed ramp up of defense mechanisms rendering the need for antibiotic administration more urgent in seniors.

Many ethical dilemmas surround antibiotic use in frail elderly persons and terminally ill patients. The 1998

American Medical Association (AMA) Council of Ethical and Judicial Affairs included antibiotics, along with mechanical ventilation, as “life-sustaining” treatment. Others argue that antibiotics are part of ordinary care, even those who are designated to be receiving “comfort measures only,” and their use may be appropriate to alleviate symptoms. While every clinical situation is unique prohibiting blanket recommendations, it seems prudent to include antibiotic administration in the discussion of advanced directives as a potentially life-sustaining maneuver and to treat it no differently than any other medical intervention such as feeding tubes or mechanical ventilation.

22.4 Unique Aspects of Infectious Syndromes in Older Adults

Selected common infections in older adults and their unique aspects versus younger adults are outlined in the following.

Bacteremia and Sepsis Compared to younger adults, older patients with bacteremia are more likely to have a gastrointestinal or genitourinary source, and thus, isolation of gram-negative rods is more frequent in older adults, and the risk of bacteremia is increased by the use of invasive devices (e.g., pacemakers, urinary catheters). Poor outcomes of sepsis are more likely in those with underlying comorbid illness. The prevalence of MRSA and other drug-resistant bacteria increases with age and therefore a bug/drug mismatch is more likely often prompting the need for broad initial antibiotic therapy, but if an organism is isolated and if de-escalation of therapy to a narrow drug is possible, it should be done.

Fever of Unknown Origin (FUO) The differential diagnosis of FUO in older patients differs from that in younger adults. Roughly a third of older patients with FUO have treatable infections (e.g., intra-abdominal abscess, bacterial endocarditis, tuberculosis, perinephric abscess, or occult osteomyelitis), but only endocarditis and tuberculosis are more common in older adults than in younger patients. Giant cell arteritis (GCA) also known as temporal arteritis and polymyalgia rheumatica (PMR) account for nearly one of every five cases of FUO in persons aged 60 years and older; thus, evaluation of FUO in patients >60 years should include a high suspicion for GCA and early temporal artery biopsy, particularly if the erythrocyte sedimentation rate or liver enzymes are elevated. Malignant disease as a cause of FUO occurs with similar frequency in old and young adults with non-Hodgkin lymphoma accounting for the majority of FUOs due to malignancy.

Infective Endocarditis Native valve infective endocarditis (IE) is most often related to degenerative disease which occurs more frequently in seniors. Older adults have about a fivefold higher risk for IE than the general population with streptococci and staphylococci isolated in about 80% of older adults with IE. However, when compared to younger adults, enterococcal and gram-negative organisms occur more commonly, likely explained by a greater incidence of gastrointestinal and genitourinary sources of bacteremia. Age alone does not impair survival after IE, but comorbid conditions do lead to poorer outcomes. Older adults are also much more likely than younger adults to have undergone valve replacement surgery and are therefore also at higher risk than younger adults for prosthetic valve endocarditis (PVE) predominantly caused by staphylococci (MSSA, MRSA, CoNS), but gram-negative bacteria are common after a recent hospitalization and yeast occasionally cause infection in this setting. Culture-negative endocarditis can be due to organisms that are hard to grow (e.g., nutritionally variant streptococci, *Legionella* spp.), and serologic and PCR studies for *Bartonella*, *Coxiella*, and *Tropheryma whipplei* are helpful in such cases.

Valvular vegetations can be difficult to detect by TTE; thus, a low threshold for transesophageal echocardiography (TEE) increases detection from 50–60% to over 90% in older patients with IE.

HIV Infection Antiretroviral therapy (ART) has turned HIV into a chronic illness; patients infected in their 20s can anticipate a life expectancy at least into their 70s resulting in a large cohort of patients aging with HIV. Newly acquired infections in seniors are more prevalent than most believe as well. Older Americans typically acquire HIV infection via sexual activity, and persons >50 years of age account for about 15% of all new diagnoses of HIV infection in the United States. Many older individuals did not grow up in an era when sexually transmitted diseases (STDs) were even discussed, and, of course, pregnancy prevention is not an issue in advanced age. Thus, older adults are the least likely group of adults to practice safe sex. Lack of HIV awareness affects both older patients and their clinician providers when nonspecific symptoms such as poor appetite and weight loss and some infections common in advanced age (herpes zoster, tuberculosis, or recurrent pneumonia) may be mistaken for aging rather than triggering HIV testing. Importantly, HIV testing should be part of an initial workup for dementia. HIV is a potentially treatable cause of dementia – much more likely to be a true cause and reverse with therapy than syphilis which is routinely investigated in those with memory loss.

HIV infection in older adults tends to present at a more advanced stage than in younger adults due to delayed diagnosis, but treatment is effective and older adults are actually *more* likely than younger adults to be adherent to antiretroviral therapy. Living with HIV is associated with the accumulation of multimorbidity earlier in life than in HIV-negative adults. Further, frailty rates are equal to those 10–20 years later in HIV-uninfected persons. Classic geriatric syndromes such as falls and fractures also occur at younger ages in those with HIV.

Community-Acquired Pneumonia (CAP) Adults age ≥65 years have hospitalization rates for pneumonia that are sixfold higher than younger adults if they reside in the community, and 15-fold higher if they reside in a nursing home. Several prognostic formulas are available to assess severity and determine indications for hospitalization in those with CAP (e.g., pneumonia severity index [PSI], CURB65 [confusion, uremia, respiratory rate, low blood pressure, and age >65 years]) and have been validated in older adults. However, prediction rules are not intended to override clinical judgment and factors not included may be important (living conditions, underlying psychiatric or cognitive issues, comorbid illness, caregiver status, etc.). Comorbidity is the strongest predictor of mortality in older patients with CAP, other independent risk factors include severe vital sign abnormalities on admission (temperature <36.1 °F, blood pressure <90 mmHg systolic, or pulse >110 bpm), renal dysfunction (creatinine clearance <50 ml/min), impaired activities of daily living (ADLs), and extreme age (>85 years).

The causative organisms of pneumonia in older adults differ from younger adults. *Streptococcus pneumoniae* is still the most common but polymicrobial infection and gram-negative organism occur more commonly, particularly in patients with COPD or in residents of long-term care facilities. *Staphylococcus aureus* and respiratory viruses (influenza, respiratory syncytial virus, SARS-CoV-2, and others) are also common causes of CAP in nursing home residents and can have devastating consequences. Tuberculosis is more common in older adults since they are more likely to have been exposed to *M. tuberculosis* and should be considered early in the diagnostic workup. Treatment for CAP in older adults follows usual guidelines. However, the risk of MRSA and gram-negative organisms should be taken into account for patients who reside in nursing homes.

Prevention of pneumonia is a complex issue in older adults. Immunization for influenza and pneumococcus is important preventive strategy (see below). Some data suggest use of angiotensin-converting enzyme inhibitors when indicated for hypertension or other comorbid illness may reduce the risk of pneumonia versus use of other antihypertensive agents presumably due to stimulating cough reflexes.

Prosthetic Device Infections Implanted prosthetic devices (e.g., artificial joints, pacemakers, vascular grafts) are more commonly used in aged versus younger adults. Microbial biofilms that reduce antibiotic penetration and alter the typical amount of antibiotic needed to kill organisms are universally present on infected devices. Thus, the use of bactericidal antibiotics in high doses is preferred. A second agent that penetrates biofilm well (e.g., rifampin for staphylococci) has been associated with improved outcomes, but drug-drug interactions are important to consider. Two-stage procedures with device removal, prolonged antibiotic administration (usually for many weeks), and subsequent reimplantation are considered the gold standard of therapy. However, comorbidities and poor functional status may alter the risk/benefit ratio; prolonged immobility may be relatively contraindicated in some and cure infeasible in others. Return to premorbid functional status or preservation of current status may be more relevant and achievable with debridement and long-term antibiotic suppression in the absence of microbe eradication.

Urinary Tract Infection (UTI) UTI is the most common infectious illness in older adults with an incidence of nearly 10% in women and 5% in men over the age of 80 years. Typical pathogens still predominate, but resistant isolates such as *Pseudomonas aeruginosa* and enterococci (*Enterococcus faecalis* and *Enterococcus faecium*) occur more commonly in seniors versus younger adults.

Asymptomatic bacteriuria occurs in many older women in the community (about 10–15%) and particularly those residing in nursing homes (up to 50%). Rates in men are about half than those in women. In both genders, rates approach 100% with the use of chronic catheters. Numerous studies show no clinical benefit when asymptomatic bacteriuria is treated, but treatment can lead to significant side effects, expense, and potential for selection of resistant organisms. Thus, treatment is not recommended, even in the presence of white blood cells in the urine. Clinical guidelines for the evaluation of UTI in older adults advise that urinalysis and urine cultures should *not* be ordered for asymptomatic individuals (i.e., culture stewardship as opposed to antibiotic stewardship). Of course, defining "symptomatic" is difficult in frail, often cognitively impaired seniors, but diagnostic testing should be reserved for those with fever, dysuria, gross hematuria, worsening incontinence, or suspected bacteremia. Symptomatic UTI in cognitively intact older women (aged 65 years or older) can be defined by the following criteria: fever or urinary symptoms (frequency, urgency, dysuria, suprapubic tenderness, or new onset costovertebral angle pain), a positive urine culture of at least 10^5 colony-forming units/mL with no more than two species present, and pyuria (≥10 white blood cells/mm^3 of unspun urine). When the diagnosis of UTI is in doubt, a reasonable management strategy is to withhold antibiotics for 1 week with follow-up since 25–50% of older women with UTI symptoms will improve without therapy in this time frame.

Clostridiodes difficile infection – Advancing age is a dominant risk factor for *C. difficile* infection and severe sequelae of infection. Risk factors include a recent stay in a healthcare facility and antibiotic exposure. *Clostridiodes difficile* infection can be symptomatic, mild, moderate, or severe/life-threatening with ileus and toxic megacolon, sepsis, and death. Testing of suspected patients with three or more unformed stools per day should start with enzyme immunoassays for glutamate dehydrogenase and toxins A and B – preferred over nucleic acid amplification testing which has a higher likelihood of false positives and should be reserved for highly suspected cases when EIA testing is negative. Treatment depends on initial versus recurrent infection and on the severity of the infection based on white blood cell count, serum creatinine level, and other clinical signs and symptoms. For an initial episode of nonsevere *C. difficile* infection, metronidazole is no longer first-line therapy; oral vancomycin or fidaxomicin is recommended. For severe disease (ICU or toxic megacolon), oral vancomycin + IV metronidazole is recommended. Multiple recurrent *C. difficile* requires treatment by a specialist with many options for prolonged and/or tapering antibiotic regimens, but refractory disease may require fecal microbiota transplantation which has high cure rates. The Infectious Diseases Society of America guidelines do not recommend the use of probiotics for primary prevention of *C. difficile* infection except in high-risk patients (>5%).

22.5 Immunizations

General Recommendations to Improve Immunization Rates In the United States, only about half of eligible older adults receive pneumococcal or annual influenza vaccine. Nearly all unvaccinated seniors diagnosed with invasive pneumococcal disease have had medical system contact in the prior 6–12 months.

CDC recommends a multipronged strategy to improve vaccine administration rates: (1) review of immunizations in all persons at age 50 and immunize those with an indication; (2) standing orders for hospitals and doctor's offices without requiring individual orders for each patient; (3) community-based strategies with public health promotions in underserved populations and outreach (senior centers, civic organizations, etc.); (4) physician-reminder systems (chart checklists, computer-assisted flags, prehospital discharge, etc.), and (5) simultaneous immunizations with >1 vaccine in the combinations (influenza and pneumococcal vaccine can be administered simultaneously at different anatomic sites, as can influenza and zoster vaccine or pneumococcal and zoster vaccine).

Tetanus/Diphtheria and Pertussis Older adults represent the group most "at risk" for tetanus and older adults are often implicated in pertussis outbreaks due to waning immunity. The diagnosis of pertussis in older adults is difficult due to the atypical presentation (usually just chronic cough, not "whooping" cough) and low index of suspicion by providers. If there is no documentation of an older adult having received a complete tetanus vaccine series, a series of three injections is indicated. A single dose of tetanus/diphtheria/acellular pertussis (Tdap) should be substituted for one of the Td doses in the three-dose series. Booster doses of Td should be given at 10-year intervals, but at least once after age 19, a Tdap should be substituted for Td.

Pneumococcal Vaccine Two vaccines are available: a 23-valent polysaccharide vaccine ((PPSV23) and a 13-valent pneumococcal conjugate vaccine (PCV13). CDC guidance for pneumococcal vaccination has been changed several times in the last 7 years. At the time of this writing, PCV13 vaccination is no longer recommended for all adults age ≥65 years, but "shared" decision making with immunization based on risk factors (e.g., nursing home residence, pediatric exposure risk, and presence of typical risk factors such as heart/lung disease, diabetes, smoking) is recommended. Regardless of whether PCV13 is given, one-time administration of PPSV23 is recommended for all adults aged 65 years and older at least 1 year after prior PCV13 (if given) and at least 5 years after the last PPSV23 dose (if previously given).

Seasonal Influenza Annual influenza vaccine is recommended for all older adults. A high-dose inactivated influenza vaccine is available and the vaccine of choice for individuals ≥65 years of age based on data showing increased immunogenicity, a 24% additional benefit for preventing disease in seniors versus the standard dose vaccine.

Many evaluations of influenza vaccine's efficacy have been performed; while protection is incomplete, the vaccine reduces the severity of disease and subsequent rates of respiratory illness, hospitalization, and mortality in elderly adults with estimated efficacy rates of 50–80%. Despite these findings, there is controversy as to whether the influenza vaccine is truly effective in those ≥70 years of age due to residual bias in case-control studies. Nevertheless, nearly all experts agree there is little risk and immunization should be given to all older adults along with "cocooning" – immunization of medical personnel and caregivers for high-risk patients.

Treatment of active influenza with antiviral therapy (neuraminidase inhibitors) reduces the duration of illness by about 1–1.5 days if started within 48 hours of symptom onset for outpatients and up to 5 days after symptom onset for hospitalized patients.

Herpes Zoster The risk of zoster in unvaccinated adults is about 50% for those who reach age 85 years. Two zoster vaccines are available – one live/attenuated and one recombinant – the recombinant is preferred due to greater efficacy. Two doses (2–6 months apart) are recommended for those 50 years and older regardless of prior zoster immunization or illness. The vaccine reduces herpes zoster by 97% regardless of age (even those >70 years). Injection site reactions are common within 7 days after vaccination with grade 3 symptoms in 15–20% of vaccine recipients.

23 Kidney Disease

C. Barrett Bowling and Rasheeda K. Hall

23.1 Introduction

Chronic kidney disease (CKD) is common among older adults and associated with mortality, cardiovascular disease, and increased heath care utilization. Despite the high burden of CKD at older ages [1], the general approach to kidney disease is based on evidence from young and middle-aged adults and may not apply to older adults with CKD. At younger ages, CKD is often a progressive disorder and the prevention of kidney failure is a key goal. Older patients with CKD may face different challenges [2]. Very old adults with CKD are 10–20 times more likely to die before progressing to kidney failure [3]. Older adults with CKD often have multiple chronic conditions and may be at increased risk for functional decline, cognitive impairment, and frailty. For the small proportion, but growing absolute number, of older adults who have CKD progression, initiation of dialysis is associated with a poor prognosis and high burden of functional impairment [4, 5].

The purpose of this chapter is to identify the unique aspects of caring for older adults from early stages of CKD through kidney failure and end of life. We describe an approach to older adults with CKD that recognizes the impact of non-CKD factors on the lives of CKD patients and recommends geriatric assessment to facilitate the development of individualized care plans. For background, we describe age-related changes in kidney structure and function, provide definitions of CKD, kidney failure, and related disorders, and report on the prevalence of kidney disease among older adults. Next we describe the limitations of a disease-oriented approach to kidney disease in older adults and propose an alternative approach that focuses on providing individualized, patient-centered care. Additionally, we provide detailed descriptions of the unique challenges that arise in older patients with acute kidney injury (AKI) in early stages of CKD, and among those with kidney failure. In the final two sections of this chapter, we describe kidney disease in special patient populations and end-of-life considerations.

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23.2 The Aging Kidney

Structural and functional changes in the kidney have been described with aging. Structural changes include a decrease in overall kidney mass with autopsy studies showing a decrease from 400 g at age 40 to less than 300 g at age 90 [6]. This decrease in mass has been shown to be primarily due to a decrease in the renal cortices with sparing of the renal medulla. While reductions in glomerular number have also been shown, there is a large amount of variability in glomerular number from one older adult to another. Additionally, the incidence of glomerular sclerosis increases with older age with sclerosis present in <5% of the glomeruli of those 40 years old compared to 30% of glomeruli, exhibiting evidence of sclerosis at age 80 [6]. The contribution of age-related increase in collagen production in the glomerulus versus disease-related pathology remains poorly understood [7].

Declines in kidney function at older ages including reduced glomerular filtration rate (GFR) have also been shown. Cross-sectional studies have shown a lower median estimated GFR (eGFR) at older ages, but do not provide information about changes in kidney function within individual patients [6]. In one longitudinal study, declines in creatinine clearance, a maker of GFR, were shown to decrease on average by 0.75 ml/min/year among healthy aging study participants [8]. However, one-third of participants without hypertension or urological disease experienced no decline in kidney function, raising the

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question of whether or not a decrease in GFR is inevitable with aging [8]. The decrease in GFR with age has been attributed in part to increasing glomerular sclerosis with age. However, one analysis of kidney biopsies from renal transplant donors that included older adults reported poor correlation between level of GFR and the amount of sclerosis [9]. Therefore, the burden of sclerosis may not predict the level of kidney function. The relationship between aging, disease-related pathology, response mechanisms to increase glomerular filtration, and clinical markers of kidney function is complex and many of the biological processes remain unknown.

23.3 Kidney Disease Terminology and Epidemiology

23.3.1 Kidney Disease Definitions

CKD is defined as abnormalities in kidney structure or function that persist for at least 3 months and have implications for health [10]. Markers of kidney damage include the abnormal presence of protein (proteinuria) or albumin (albuminuria) in the urine. Kidney function is assessed using GFR. Because measuring GFR is rarely available in the clinical setting, definitions of CKD rely on eGFR from formulas that use serum creatinine, age, and race. Reduced eGFR is defined as <60 ml/min/1.73 m^2. In Sect. 23.6 below, we discuss the challenges and controversies for identifying CKD in older populations using this cut-point to define CKD.

Current CKD clinical practice guidelines use these biomarkers of abnormal kidney function (i.e., eGFR and albuminuria) to both define CKD and stage the disease based on prognosis for CKD-related outcomes. Guidelines recommend a classification and staging system that is based on (1) cause, (2) GFR category, and (3) albuminuria category (ACR) (Table 23.1). While hypertension and diabetes are the most common causes of CKD among older adults, other causes include renal vascular disease, chronic urinary obstruction, systemic vasculitis, and multiple myeloma or intrinsic kidney disorders such as glomerulonephritis or nephrotic syndrome. As with many multifactorial geriatric syndromes in older adults, kidney disease may have more than one cause (e.g., renal vascular disease with chronic urinary obstruction). Clinical practice guidelines recommend categorizing kidney stage by both eGFR level and ACR level because of the improved risk stratification for mortality, kidney failure, AKI, and progressive CKD when eGFR and ACR are considered together. As an example, a patient with CKD related to diabetes with an eGFR of 32 ml/min/1.73 m^2 and ACR of 150 mg/g would be classified as diabetic CKD, G3b, and A2.

As CKD progresses, patients may develop kidney failure defined as an eGFR <15 ml/min/1.73 m^2 or the need to initiate renal replacement therapy (RRT; hemodialysis or peritoneal dialysis) or kidney transplant [10]. End-stage renal disease (ESRD) is a related administrative term based on the payment for health care by the Medicare ESRD Program. ESRD is used to identify those receiving RRT or who have received a kidney transplant, regardless of eGFR level [11]. In Sect. 23.7, we describe the treatment of advanced kidney disease in older populations including dialysis, kidney transplant, and conservative management.

The term AKI has replaced the diagnosis of acute renal failure to reflect that even small changes in kidney function may impact long-term kidney function and to emphasize the broad spectrum of kidney injury [12]. Current classification of AKI includes three stages based on both serum creatinine and urine output (UOP) (Table 23.2) [13]. In Sect. 23.5 below, we describe risk factors that predispose older adults to AKI and the impact of AKI on CKD progression.

Table 23.1 Classification of CKD by cause, GFR, and albuminuria

Cause	
Common causes in older adults: Hypertension Diabetes mellitus Renal vascular disease Chronic urinary obstruction Systemic vasculitis Multiple myeloma Glomerulonephritis Nephrotic syndrome Multifactorial etiology (e.g., renal vascular disease with chronic urinary obstruction)	
GFR	
Category	eGFR, ml/min/1.73 m^2
G1	≥90
G2	60–89
G3a	45–59
G3b	30–44
G4	15–29
G5	<15
Albuminuria	
Category	ACR, mg/g
A1	<30
A2	30–300
A3	>300

Table 23.2 Stages for acute kidney injury based on increase in serum creatinine from baseline or level of urine output (UOP)

Stage	Serum creatinine increase from baseline	UOP
1	1.5 to 1.9-fold, or Increase ≥0.3 mg/dL	<0.5 mL/kg per hour for at least 6 h
2	2 to 2.9-fold	<0.5 mL/kg per hour for at least 12 h
3	3-fold or greater, or Increase to ≥4.0 mg/dL	<0.3 mL/kg per hour for 24 h, or No UOP (anuria) for at least 12 h

23.3.2 Burden of Kidney Disease Among Older Adults

The prevalence of kidney disease increases with age [1]. Nearly half of those with CKD are 70 years of age or older, and there is a graded increase in the prevalence of CKD at older ages. Among US adults, the prevalence of CKD, defined as an eGFR <60 ml/min/1.73 m^2, was reported to be 0.9, 7.5, 26.5, and 51.1% among those aged <60, 60–69, 70–79, and ≥80 years old. A similar, but less dramatic, increase in the prevalence of albuminuria, defined as an ACR >30 mg/g, of 6.8, 14.2, 21.3, and 32.7% at ages 60–69, 70–79, and ≥80 years, respectively, has been reported.

An increase in the prevalence of CKD over the past two decades has also been reported in the general US population, especially among older adults [14, 15]. For example, the prevalence of decreased eGFR (<60 ml/min/1.73 m^2) in the US population ≥80 years was examined during three time periods: 1988–1994, 1999–2004, and 2005–2010. The prevalence of decreased eGFR was 40.5, 49.9, and 51.2% during these time periods. A disproportionate increase in the prevalence of more severe CKD (eGFR <45 ml/min/1.73 m^2) was found from 14.3% to 18.6% and 21.7% in 1988–1994, 1999–2004, and 2005–2010, respectively. These findings were not completely explained by an increase in the prevalence of diabetes and hypertension in the older population during this time. Assuming that the prevalence of CKD remains stable in this age group, with the aging of the US population, the number of US adults ≥80 years old with eGFR <60 ml/min/1.73 m^2 is estimated to increase from 4.6 million in 2005–2010 to 9.9 million and 15.8 million in 2030 and 2050, respectively (Fig. 23.1) [15].

While the prevalence of CKD defined as an eGFR <60 ml/min/1.73 m^2 is highest at older age, older adults are much less likely to progress to kidney failure. Very old adults with CKD may be 10–20 times more likely to die before progressing to kidney failure. The competing risk of death has been examined by determining at what eGFR level is the risk of requiring RRT greater than the risk of death for different age groups. For example, among younger adults, the risk of kidney failure requiring RRT is greater than the risk of death at an eGFR level of 45 ml/min/1.73 m^2 and below [3]. For adults 65–84 years old, the risk of kidney failure requiring RRT is only greater than the risk of death at an eGFR of 15 ml/min/1.73 m^2 and below. For those 85 years and older, the risk of death has been shown to exceed the risk of kidney failure requiring RRT at any eGFR level.

In addition to the competing risk of death before reaching kidney failure, there are other possible explanations for the age difference in risk of kidney failure, including a slower decline in kidney function among older adults. Additionally, older adults may be less likely to be offered or choose treatment with dialysis or transplantation in the face of kidney failure. For example, when kidney failure is categorized as treated (eGFR <15 ml/min/1.73 m^2 and dialysis or kidney transplant) or untreated (eGFR <15 ml/min/1.73 m^2, but no dialysis or kidney transplant), overall kidney failure is more common at older ages. However, at younger ages, treated kidney failure is more common than untreated kidney failure [16]. At older ages untreated kidney failure is much more common.

Although only a small proportion of older adults with CKD progress to kidney failure and receive RRT, the absolute number of older adults with ESRD (i.e., requiring RRT or kidney transplant regardless of eGFR) has increased over the past 20 years. Through 2010, the fastest growing group

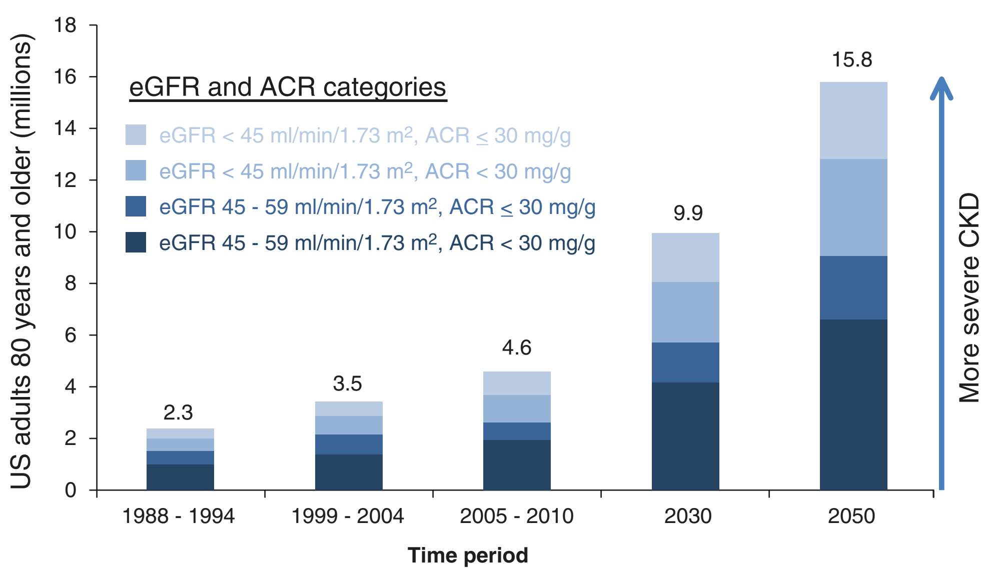

Fig. 23.1 The number of US adults ≥80 years old with CKD has doubled in the past two decades and will continue to increase with the aging of the populations. There has been a disproportionate increase in the prevalence of more severe CKD. *eGFR* estimated glomerular filtration rate, *ACR* albumin-to-creatinine ratio

with ESRD was those 70 years and older [17]. Several factors may be contributing to the increased incidence of ESRD among older adults. This may be due in part to the increase in CKD prevalence among older adults, the aging US population, as well as an increase in the use of dialysis among older adults.

A similar pattern of graded increase in the incidence of AKI at older ages has been shown. Among hospitalized adults, the incidence of AKI among those 85 years and older is approximately 40 cases compared to 20 cases per 1000 discharges among those <65 years old [12]. The incidence of AKIs has been reported to have increased over the last two decades and has been explained by an increase in AKI risk factors, the aging population, as well as improvements in recognition of AKI.

23.4 Disease-Oriented Versus Patient-Centered Approach

23.4.1 Disease-Oriented Approach

The disease-oriented model of care is the prevailing clinical paradigm for the diagnosis and treatment of chronic conditions. This approach emphasizes the prevention, diagnosis, and treatment of individual disease processes [2, 18]. In the disease-oriented approach, a direct causal relationship between clinical signs and symptoms and specific disease pathology is assumed. Treatments target the underlying pathophysiology and symptoms are thought to be best treated by interventions that impact the disease course, rather than as a target for intervention themselves. Treatment priorities are often determined by the availability of clinical trial evidence.

Disease-oriented clinical practice guidelines identify three main goals for CKD management: (1) slowing the progression of CKD to prevent kidney failure, (2) identifying and treating concurrent CKD complications, and (3) preparing for RRT [10]. Approaches to slow down the progression include blood pressure (BP) control for all patients with CKD. For those with albuminuria, renin–angiotensin–aldosterone system (RAAS) interruption with angiotensin-converting enzyme inhibitors (ACE-Is) or angiotensin receptor blockers (ARBs) are recommended. Currently recommended BP goals for CKD patients are ≤140/90 for those with an ACR <30 mg/g and ≤130/80 for those with diabetes or ACR ≥30 mg/g. However, these recommendations are subject to change, given the findings from a recent clinical trial showing better outcomes among older adults who achieve lower BP targets [19]. Guidelines also provide recommendations for protein intake, glycemic control, salt intake, and physical activity to prevent CKD progression.

The second category for CKD management is the recognition and treatment of concurrent CKD complications, including anemia, metabolic bone disease, acidosis, and cardiovascular disease. Guidelines provide specific drug and lifestyle recommendations to manage these complications. In CKD, anemia is related to reduced erythropoietin and defined as <13.0 g/dL for men and <12.0 g/dL for women. Guidelines encourage evaluation for other causes of anemia and when erythropoietin stimulation agents are used, increasing hemoglobin concentrations to levels above 11.5 g/dL should be avoided. CKD metabolic bone disease includes abnormalities of calcium, phosphate, and parathyroid hormone (PTH) and is associated with increased risk of fractures. Current recommendations include dietary phosphate restriction or using oral binder to maintain serum phosphate within the normal range. Targets for treatment of hyperparathyroidism are more controversial. While clinical trials provide evidence that treatment to reduce PTH improves biomarkers of metabolic bone disease, the impact of these intermediate outcomes on clinically important outcomes such as fractures is limited. Guidelines also recommend treatment with oral bicarbonate supplementation for patients with serum bicarbonate levels <22 mmol/L with the goal to maintain bicarbonate within the normal range.

Lastly, guidelines provide recommendations for referral to nephrologists and preparation and time of RRT. Referral to nephrology is recommended, even if dialysis or transplantation is not a consideration in the presence of AKI, eGFR <30 ml/min/1.73 m^2, significant albuminuria (ACR >300 mg/g), progression of CKD, urinary red cell casts, hypertension refractory to treatment with four medications, persistent elevated serum potassium, recurrent nephrolithiasis, and hereditary kidney disease. Planning for RRT is based on the risk for progression to kidney failure. Recent studies have shown that the trajectory of CKD progression is often nonlinear and difficult to predict for older adults. Timing of RRT initiation is determined by the presence of kidney failure symptoms, including serositis, acid–base or electrolyte abnormalities, pruritis, inability to control volume status or BP, and progressive deterioration in nutritional status or cognitive impairment due to uremia. Recent studies have shown a trend toward initiation of RRT at higher levels of eGFR; however, evidence suggests no benefit or an increased risk for mortality among those with earlier initiation of dialysis in the course of CKD progression.

23.4.1.1 Limitations of the Disease-Oriented Approach

Despite the acceptance of the disease-oriented approach, there are several limitations of this approach when applied to older adults. Here, we describe four characteristics of older populations that may limit the relevance of the disease-oriented approach to CKD management [2]. These include (1) limited life expectancy, (2) a high burden of multimorbidity, (3) heterogeneity in health goals and treatment preferences, and (4) exclusion from clinical trials.

Limited life expectancy is a key factor to consider for any disease-specific treatment plan for older adults. Both patients and providers recognize that there is a reduction in the years remaining in life expectancy at older ages and this has been shown in CKD. For example, a 70-year-old man with an eGFR 30–44 ml/min/1.73 m^2 and ≥2+ dipstick proteinuria may expect on average to live 5 more years. In contrast, an 85-year-old with the same level of kidney function may live on average 2.6 additional years [20]. However, reports of average survival do not capture the heterogeneity in life expectancy and complexity estimating survival in older adults. One approach to determine the heterogeneity in life expectancy is to calculate not only the median survival, but also the interquartile range (IQR) for survival defined as the 25th percentile to 75th percentile. The IQR for survival is 2.3–8.6 years for the 70-year-old man described above and 1.2–4.5 years for the 85-year-old man. This means that the highest 75th percentile of surviving 85 year-olds may expect to live 4.5 year or longer. This suggests that many 85 year olds will live as long as or longer than the average 70 year old. Similar findings have been shown among older ESRD patients. The median survival for an 80-year-old incident ESRD patient is 1.3 years; however, the interquartile range is 5 months to 3 years. Therefore, applying uniform recommendations to all older adults, some of whom may expect to live many more years and benefit from preventive treatments and others who are nearing end of life, is not appropriate.

Among older adults, CKD almost universally occurs in individuals with other chronic medical conditions. While multimorbidity is common among older adults with CKD, existing clinical practice guidelines follow a “single disease” framework and do not account for the presence of other chronic conditions. This is a challenge, as several conditions, such as arthritis and heart failure, have treatment recommendations that potentially complicate CKD management. The presence of these “CKD-discordant” conditions is associated with an increased risk for hospitalizations, emergency department care, and mortality [21]. Use of a novel CKD-Discordance Index may be helpful for identifying older patients with CKD who are at risk for discordance-related adverse health outcomes [22].

A third characteristic of older populations that may limit the relevance of the disease-oriented approach is heterogeneity in health goals and treatment preferences reported by older adults [2]. While CKD clinical practice guidelines prioritize the reduction of mortality and prevention of CKD-related outcomes, such as kidney failure, older adults often frame their health goals in terms of their overall health and maintaining functional independence. Universal health outcomes such as quality of life and functional independence may be viewed as more important than disease-specific outcomes. While a shift in health goals and preferences has been shown among older adults, it is important to recognize the variability in goals and preferences between older adults. The narrow focus on outcomes that are defined by the underlying disease pathology in the disease-oriented model often fails to address what is most important to an individual patient. Disease-oriented clinical practice guidelines lack the flexibility to allow providers to adapt the goals and treatment plans to the individual patient’s needs.

Lastly, older adults with complex multimorbidity or limited life expectancy are often excluded from clinical trials. This is often done because the magnitude of treatment effects for a given intervention is often larger in homogenous populations (i.e., smaller variability results in larger treatment effect) [18]. Exclusion of older adults limits the generalizability of individual studies to older adults and the clinical practice guidelines that generate recommendations based on these studies. For example, most of the trials underpinning the guideline recommendations for the use of ACE-Is and ARBs have been conducted in high-risk populations and did not enroll participants older than 70. Because ACE-Is and ARBs may be most effective in those at highest risk for progression (e.g., among those with albuminuria), findings from these studies of a number needed to treat (NNT) to prevent one case of ESRD ranging from 9 to 25 may not be generalizable to older adults. In fact, one simulation study using a real-world cohort of older adults with CKD showed large differences in the NNT based on the estimated baseline risk for ESRD. For older adults with the lowest risk of ESRD, they reported an NNT to prevent one case of ESRD to be 2500 [23].

23.4.2 Individualized, Patient-Centered Approach

There is an increasing awareness that a “one size fits all” approach to CKD management may not be appropriate. For example, the most recent CKD guidelines have added suggestions to tailor BP targets. However, approaches for how to individualize goals are not provided. Given the limitations of disease-oriented models of care in older populations, geriatricians often favor a more individualized patient-centered approach. The patient-centered approach embraces the complexity and acknowledges the importance of patient health goals and preferences for developing treatment plans. The patient-centered approach recognizes that existing evidence may not be relevant for individual patients. Symptoms are considered important targets for intervention, regardless of the underlying cause.

One approach to implementing a patient-centered approach to CKD is to include geriatric assessment as part of the clinical evaluation of CKD patients. Routine geriatric assessment could be used to identify contextual information (e.g., cognitive impairment, poor social support, caregiver stress, markers of frailty, and limited life expectancy) to guide clinical care. It has been suggested that the recognition of geriatric conditions, including functional impairment, frailty, mobility impairment, cognitive impairment, and depressive symptoms could be used to signal for the provider to consider a transition from the traditional disease-oriented approach to CKD care to a more individualized, patient-centered approach. For example, recognition of mild cognitive impairment and low social support may be used to tailor management goals such as glucose control in a patient with CKD and diabetes to reduce the risk for hypoglycemia. Recognition of these problems may also facilitate a shared decision-making approach to discussions about RRT. In these discussions, providers can address prognostic markers associated with poor survival on dialysis (e.g., non-ambulatory status, frailty) to help patients make an informed decision regarding dialysis versus conservative management. Eliciting goals of both the individual patient and family and caregivers can be used to prioritize outcomes beyond those reported in the CKD guidelines. In this approach, the CKD-specific diagnosis and management is not abandoned completely and may be incorporated into individualized treatment plans, depending on the extent to which disease-based recommendations are aligned with the preferences and goals of the patient. In Table 23.3, we highlight several components of geriatric assessment, their implications for CKD, and how these might be used to facilitate a patient-centered approach to CKD management.

23.5 Acute Kidney Injury

Older adults are vulnerable to AKI due to factors that are both intrinsic and extrinsic to the kidney. While several intrinsic factors underlying this increased risk have been proposed including age-related stress-induced cellular senescence, a key component of AKI risk in older adults is susceptibility to kidney injury from extrinsic factors. Older adults may have decreased physiologic reserve in the face of physiologic stressors. AKI in the older population may be thought of as multifactorial and explained by the presence of chronic predisposing factors and acute precipitating factors, analogous to the current conceptualization of geriatric syndromes such as delirium and falls [12]. Predisposing factors include age-related structural changes, including vascular sclerosis, age-related kidney function decline, chronic inflammation, and the presence of underlying CKD. Furthermore, the prevalence of multimorbidity increases at older ages and older patients often need multiple medications or diagnostic tests and procedures. For example, in an older patient with both CKD and arthritis, the addition

Table 23.3 Geriatric assessment[a] facilitates individualized, patient-centered approach to the management of CKD in older adults

Assessment	Relevance to CKD	Examples of how geriatric assessment facilitates a patient-centered approach
Functional status	Functional impairment increases at lower levels of kidney function. At dialysis initiation 50% of older adults are dependent in ADLs	Use a shared decision-making approach that considers prognosis Anticipate and plan for increased functional assistance after dialysis initiation
Cognition	The prevalence and incidence of cognitive impairment increases at lower eGFR. Cognitive impairment is common among older adults with kidney failure	Simplify CKD self-management tasks Include family or caregivers in decision-making
Mobility	CKD is associated with declines in community mobility	Recognize patient and family goals related to maintaining community mobility and social participation
Falls	Falls are common among older adults with CKD and kidney failure. Older adults with CKD mineral bone disease may be at increased risk for fractures. The risk of serious fall injuries increases at the time of dialysis initiation	Individualize BP goals to prevent hypotension Limit polypharmacy Evaluate for CKD mineral bone disease
Depression	Depressive symptoms are associated with prevalent CKD, worsening kidney function, and kidney failure In kidney failure, depression is associated with worse outcomes	Address depression to improve quality of life
Frailty	The prevalence of frailty increases at lower eGFR and is very common in kidney failure. Frailty is associated with increased mortality and surgical complications among older adults receiving a kidney transplant	Incorporate prognostic information from frailty assessment into discussion about kidney failure treatment options
Multimorbidity	CKD occurs in patients with complex multiple chronic conditions	Recommend alternative treatment options when discordance in treatment recommendations occurs as in patients with CKD and arthritis

CKD chronic kidney disease, *ADLs* activities of daily living, *eGFR* estimated glomerular filtration rate
[a]See also Chap. 8, Office Tools for Geriatric Assessment

of nonsteroidal anti-inflammatory drugs (NSAIDs) to a medication regimen that includes an ACE-I can precipitate AKI. Other medications that have been linked to AKI include diuretics, ARBs, and antibiotics. The co-occurrence of CKD and cardiovascular disease is also common and these patients may be at increased risk for contrast-induced nephropathy. Therefore, benefits of cardiac catheterization for diagnosing coronary artery disease must be balanced with the risk for AKI. Older adults may also be at risk for volume depletion due to renal sodium wasting, reduced renal response to antidiuretic hormone, and diminished thirst, putting those with vascular kidney disease at higher risk for AKI [24]. Older adults may also be at increased risk for infection and sepsis is a leading cause of AKI. In the older population, prevention of AKI may require improved recognition of both predisposing and precipitating factors, rather than addressing only factors intrinsic to kidneys.

As described above, a disease-oriented approach that focuses only on preventing kidney outcomes may not always be appropriate. Considering a patient's health goals and preferences may be necessary, especially when discordant recommendations arise in the setting of multimorbidity. For example, some older adults with arthritis pain may accept a small increased risk in AKI when taking NSAIDs in order to improve pain control and maintain functional independence.

When older adults have AKI they may be less likely to recover kidney function compared to younger adults. There is also growing recognition that the course of kidney disease progression is often not a predictable, linear decline toward kidney failure. For many older adults, kidney disease progression may result from repeated episodes of AKI. In these cases, it may be more effective to recognize AKI risk factors and prevent or lessen the impact of AKI to prevent progression to kidney failure, rather than management strategies such as BP and glucose control.

23.6 Chronic Kidney Disease

23.6.1 Disease Versus Normal Aging

Although the presence of CKD defined as an eGFR <60 ml/min/1.73 m^2 has been shown to be associated with mortality, CVD, concurrent CKD complications, and functional decline, even in older populations, the current CKD definitions remain controversial. The controversy around the current eGFR or ACR cut-points for patients of all ages is of concern that this approach identifies many millions of older adults with a disease, which may actually be age-related decline in kidney function due to organ senescence. Supporting this concern is evidence from meta-analyses that reveals that mortality is increased at eGFR<45, but not for eGFR 45–59 for older adults (when compared to older adults with eGFR >60) [25]. Additional studies of kidney anatomy and physiology across the age and disease spectrum suggest that normal aging and CKD differ by degree of glomerulosclerosis and albuminuria [26]. On the other hand, the mechanism underlying normal aging processes in the kidneys remains unclear as declining kidney function it is heterogeneous among older adults and the causes remain unknown [27]. While this controversy persists, a more important consideration is how to manage each older adult with an eGFR <60. Given the clinical course of CKD is variable, this management should be in consideration of a patient's overall health status. For example, an individualized approach to CKD care and related comorbidities (e.g., diabetes, hypertension) would be more consistent with goals of care for older adults with multiple comorbidities, functional impairment, and/or limited life expectancy.

23.6.2 Challenges Estimating GFR

A related controversy exists over the estimation of GFR in older adults. Measuring GFR in the clinical setting is not practically possible [1]. Very few research studies have a large number of very old participants and available data on measured GFR; therefore, existing estimation equations were developed and validated in studies conducted primarily in the middle-aged and young-old. More recent studies have attempted to develop and validate estimating equations in the very old. However, these studies have been limited to white, European populations and questions remain about the equations' validity in African American older adults [28]. Novel biomarkers such as cystatin-C can be used to estimate GFR and have been shown to be strong predictors of mortality [29]. However, GFR estimating equations that use cystatin-C identify CKD in an even large proportion of older than creatinine-based equations [28]. For these reasons, an approach to diagnosis of CKD in older patients that takes into consideration the trajectory of renal function over time (e.g., stable versus declining), the presence of albuminuria, and the co-occurrence of conditions that worsen kidney function such as hypertension and diabetes may be more appropriate than relying on a single estimation of GFR to identify CKD.

23.7 Kidney Failure

23.7.1 Life Expectancy

Progression to kidney failure marks a significant decline in remaining life for older adults. Life expectancy for older adults who require RRT for kidney failure is approximately

25% less than the life expectancy of older adults without *kidney failure* [30]. Survival after kidney failure is typically better for older adults who initiate RRT compared to those who decline RRT (2-year survival rate 76% vs. 47%) [30]. This survival benefit is not only due to RRT itself. Older adults who initiate RRT tend to have fewer comorbid conditions and less functional impairment than those who decline RRT, confounding the association between treatment option and survival.

Among older adults who initiate RRT, life expectancy ranges from less than 3 months to 4.5 years [31]. Prognosis is worse as comorbidity burden, functional limitations, and age increases. Other factors that contribute to prognosis after dialysis initiation are shown in Table 23.4. These factors can be used to calculate risk scores to estimate the probability of death after initiating dialysis [30]. Although evaluated in a cohort of prevalent dialysis patients, the "surprise" question is an additional tool for prognostication. By answering the following question yourself: "Would I be surprised if this patient died in the next 12 months?," clinicians directly use their clinical judgment for prognostication. This clinical judgment is important for informing decisions for both initiation and withdrawal of RRT.

23.7.2 Shared Decision-Making

Because life expectancy is limited in older adults with kidney failure, it is essential to use shared decision-making for clinical decision-making for all medical procedures and intensive therapies (e.g., major surgery, chemotherapy). Most older adults make RRT decisions based on their personal preferences and consideration of the challenges of adjusting to life with RRT. Therefore, shared decision-making allows patients and their caregivers to communicate their preferences to the clinician. In turn, the clinician using a risk benefit analysis is able to guide the patient toward a decision that addresses the patient's health goals.

Table 23.4 Risk factors for early mortality among older adults receiving hemodialysis[a]

Active malignancy
Body mass index <18.5 kg/m^2
Congestive heart failure
Dementia
Diabetes mellitus
Dysrythmia
Peripheral vascular disease
Severe behavioral disorder
Serum albumin
Would I be surprised if this patient died in the next 12 months?
Total dependence for transfers
Unplanned dialysis initiation

[a]Factors can be used to calculate risk of death after initiating dialysis [30]

For frail older adults, the SPIRES communication framework is an ideal approach to the shared decision-making process [32]. SPIRES involves the following six steps: Setup, Perceptions and Perspectives, Invitation, Recommendation, Empathize, and Summarize and Strategize (Table 23.5). Through this process, the clinician combines prognostic information from the patient's medical records with patient perspectives to develop a recommendation in favor of or

Table 23.5 The "SPIRES" communication tool provides a helpful framework dialysis decision-making

Step	Description	Specific considerations for dialysis decision-making in older adults
Setup	Review medical records to understand patient's overall clinical picture; encourage patient to invite loved ones to the discussion	Evaluate for contextual factors including functional decline, cognitive impairment, frailty multimorbidity, and social support Review rate of decline of kidney function and prior nephrology referral Consider where the decision is being made—acute setting (e.g., sepsis) versus progressive CKD
Perceptions and perspectives	Identify patient values, concerns, and desires	Assess patients' understanding of kidney failure treatment options Elicit past experience with dialysis (e.g., family members with ESRD)
Invitation	Ask patient if they want a recommendation	
Recommendation	Provide a recommendation based on patient values and clinical picture	Incorporate information from geriatric assessment
Empathize	Acknowledge strong emotions that may arise during the conversation	Studies have shown that patients report regret, uncertainty, and anxiety when making decision about dialysis
Summarize and strategize	Provide an individualized treatment plan that can be reassessed if health worsens	For patients unfamiliar with dialysis, treatment options may be complex and patients and family may need more information over multiple visits

CKD chronic kidney disease, *ESRD* end-stage renal disease against RRT initiation. The clinician develops an individualized treatment plan that involves monitoring for signs or symptoms that RRT is meeting the patient's expectations. This monitoring allows the SPIRES shared decision-making framework to be cyclical. If the patient experiences worsening health status, the clinician can use this new prognostic information (and potentially new patient preferences) to develop a new recommendation regarding continuation of RRT. Thus, SPIRES would facilitate discussions about dialysis withdrawal and end-of-life care.

23.7.3 Treatment Options

Central to dialysis decision-making is consideration of treatment options [e.g., RRT (hemodialysis and peritoneal dialysis), transplantation, and conservative management] for managing ESRD. To provide a recommendation, the clinician should first determine if the patient has any contraindications to specific treatment options. Then, the clinician should determine the patient's preferences and psychosocial status to determine the potential challenges of each treatment option to the individual patient (Table 23.6).

23.7.4 Renal Replacement Therapy

Although RRT is the most common treatment option for older adults approaching kidney failure, it is not the most appropriate treatment option for all older adults. Age is not a contraindication to RRT. However, nephrologists may choose not to initiate RRT in older adults if the risks outweigh the benefits. The benefit of RRT is lower in older adults who have severe cognitive impairment lacking ability to follow commands or respond to their environment. Also, older adults with a terminal illness, aside from kidney failure, would also have low benefit from RRT (unless it is palliative) and are likely be advised to forgo RR [33].

Table 23.6 Treatment options for kidney failure and potential challenges for older adults

Treatment option	Potential challenges
Hemodialysis	Vascular access procedures Transportation to/from dialysis clinic Post-dialysis fatigue
Peritoneal dialysis	Functional limitations Home environment Inadequate ultrafiltration and waste removal Peritonitis
Transplantation	Functional limitations Multimorbidity Wait-list interval Diagnostic testing for referral process Infections and malignancies from immunosuppression

Timing of preparation for RRT can be challenging for older adults. Early preparation for RRT involves dialysis access placement for hemodialysis or peritoneal dialysis (e.g., arteriovenous access, central venous catheter (CVC), Tenckhoff catheter). However, it is not clear if an individual patient will progress to kidney failure or die before there is a need for RRT. This uncertainty is challenging for both patients and clinicians when deciding the appropriate timing for dialysis access placement. Early access placement, although recommended, can create physical and emotional burdens on a patient who may not ever initiate RRT.

Hemodialysis access placement is an additional potential challenge for older adults. Clinical guidelines recommend arteriovenous fistula (AVF) as hemodialysis access for all dialysis patients. However, AVF maturation time is approximately 6 months, and less than 50% of older adults have mature AVFs because of vascular calcifications and reduced vascular elasticity [30]. Compared to younger patients, older adults tend to undergo more procedures to create and maintain patency of AVF. Because of the maturation time and recurrent procedures, AVFs may be less ideal for older adults who have limited life expectancy (i.e., less than 2 years) [31]. Arteriovenous grafts (AVG) and CVCs are more likely to be successfully placed after a single procedure; however, these alternative accesses are associated with greater risks of infection and long-term patency issues. Thus, AVGs and CVCs are more appropriate for older adults with limited life expectancy and/or unsuccessful AVF maturation. Importantly, AVG should be attempted prior to CVC placement because of higher risk of mortality associated with CVC use. Still, some older adults prefer CVC because it allows avoidance of needles and recurrent procedures.

The benefits of RRT are similar with peritoneal dialysis and hemodialysis; however, some older adults may not be able to receive peritoneal dialysis. Peritoneal dialysis is typically conducted at home by the patient and/or caregiver after intensive training in sterile technique and equipment use. Therefore, older adults who would have difficulty with peritoneal dialysis include those who do not live in a home with dedicated space for equipment and those with functional limitations (e.g., visual impairment, cognitive impairment, activities of daily living [ADL] dependence, or mobility disability) and no caregivers available to conduct their treatments. Some older adults who receive peritoneal dialysis can encounter new challenges that require transition from peritoneal dialysis to hemodialysis. Such challenges can be recognized by recurrent peritonitis, inadequate ultrafiltration, or waste removal despite adjustments to the treatment regimen. Also, some older adults may develop functional limitations or experience loss of their social support that makes it difficult to continue peritoneal dialysis.

Renal replacement therapy significantly impacts quality of life for older adults. Observational studies demonstrate that quality of life is limited by impaired physical and mental health, perceived burden of kidney disease, and symptom burden [34, 35]. Risk factors for limited quality of life include frailty, specifically the exhaustion dimension, and depression [36, 37]. These findings are consistent with themes from a qualitative study on what matters most to older adults receiving hemodialysis: (1) having physical well-being and (2) having social support [38]. Frail participants who experienced functional decline after starting hemodialysis highly valued practical social support (e.g., meal preparation, transportation) to help buffer in areas of physical dependence, as well as socialization or opportunities to spend time with family. Compared to hemodialysis patients, frail older adults undergoing peritoneal dialysis may appear to report better quality of life because of more time spent at home. However, one observational study demonstrates that older adults, irrespective of dialysis modality, experience similar trajectories of quality of life, in terms of physical and mental well-being, symptom burden, depression, mood, and treatment satisfaction [39].

23.7.5 Transplantation

Renal transplantation provides better survival benefit and quality of life than RRT and is not contraindicated in older adults [31]. However, individual transplant centers have age limits for transplant listing. For transplant listing, older adults may find it burdensome to undergo multiple diagnostic tests (e.g., cardiac stress test, computed tomography [CT] scans). These tests may identify abnormalities or yield false-positive results that can lead to emotional distress [31]. Still, transplantation can be an ideal option for ESRD for older adults who are not frail and have minimal comorbidities and functional limitations. These patients are more likely to be able to survive their wait-list interval, withstand the physical stress of the surgery, and be adherent to the extensive immunosuppression medication regimen. Clinical trajectories can change over time; therefore, reassessment of comorbidity burden and functional status during the wait-list interval is important to ensure that the patient remains to be an eligible transplant candidate. After transplantation, older adults may develop problems with drug interactions between chronic medications and immunosuppression medications, as well as an increased risk of infections and malignancies.

23.7.6 Conservative Management

For many older adults with kidney failure, RRT or transplantation may not be appropriate. Aside from apparent contraindications to RRT described above, some older adults decline RRT because they value quality over quantity of life and prefer to not spend significant time in dialysis sessions during their remaining lifetime [32]. Traditionally, it was thought that there was little to offer these patients. However, there is growing appreciation that older adults who decline RRT benefit from active treatment. This "conservative kidney (non-dialytic) management" involves routine outpatient visits that focus on CKD management and symptom management as kidney failure progresses. These patients may also receive hospice care. Existing observational studies also suggest that patients who receive conservative management report similar limited health-related quality of life, but experience fewer hospitalizations and more palliative care services than those who receive RRT [34]. Increasing use of shared decision-making and prognostication of patient's life expectancy may yield an increase in the proportion of older adults receiving conservative management.

23.8 Kidney Failure in Special Patient Populations

23.8.1 Hospital Patients

Older adults receiving dialysis often require hospitalizations and are admitted on average twice per year. Additionally, the majority of older adults who start dialysis do so during an inpatient hospitalization. These patients often require prolonged hospitalization and receive high intensity health care during this time despite an overall poor prognosis. For example, among older Medicare beneficiaries, more than 20% require hospitalization for ≥2 weeks at dialysis initiation and over 15% of those require one or more intensive procedures including mechanical ventilation and feeding tube placement or cardiopulmonary resuscitation [40]. Higher intensity care during the hospitalization is associated with an increased risk for death. Among those 80 years and older who require ≥2 weeks in the hospital at dialysis initiation, median survival is only 1 year or less and 10–20% of their remaining days of life are spent hospitalized. These reports may suggest the need for earlier involvement of palliative care in the treatment of hospitalized ESRD patients.

Rehospitalizations are also common among older adults with ESRD. More than one in three older dialysis patients who are discharged from the hospital return within 30 days [41]. The high rates of rehospitalization have been reported to contribute to or parallel the high mortality, low quality of life, and increasing health care costs in this population. Data are limited on interventions to reduce rehospitalizations specifically for older adults with kidney failure. However, one analysis that used a quasi-experimental approach showed that more frequent provider visits in the month following hospitalization was associated with a decreased risk for readmission. Whether or not inpatient models of care that focus on improving outcomes for hospitalized older adults such as Acute Care of the Elderly (ACE) units in combination with care transition support and more frequent disease-specific follow-up with nephrology providers would reduce readmissions in this high-risk population needs to be determined. Chapter 7 provides detailed suggestions in caring for hospitalized seniors.

23.8.2 Post-Acute and Long-Term Care Patients

Because the majority of older adults initiating dialysis do so during a hospitalization, these patients are often eligible for post-acute care services in a skilled nursing facility (SNF). These patients may also be eligible for post-acute care services following hospitalizations not related to the initiation of dialysis. The Medicare SNF benefit is provided on a short-term basis after a hospitalization for patients who have skilled nursing or rehabilitation needs. The goal of this program is to improve the patient's condition within predetermined time period or to prevent the condition from worsening. However, because older ESRD patients are medically complex and three times a week dialysis may interfere with daily physical therapy treatments, they may experience worsening health and be less likely to return home or achieve functional independence. For patients who are discharged from an SNF, there are high rates of hospitalization or ED visits within 30 days of returning home [42].

Those requiring long-term nursing home care are a particularly high-risk group; however, this population has not been well studied. While utilization of nursing home care is common among older adults initiating dialysis, it is poorly recognized by nephrologists. For example, 28% of the 27,913 US older adults who started dialysis in 2006 required nursing home care at the time of initiation. However, only 33% of these patients were accurately identified by their dialysis providers as receiving nursing home care [43]. Older nursing home residents initiating dialysis also face a high burden of functional decline. One analysis of long-term nursing home residents found that initiation of dialysis was associated with a significant and sustained functional decline. In this patient group, mortality rates were 24%, 41%, 51%, and 58%, at 3, 6, 9, and 12 months, respectively [4].

23.9 End-of-Life Considerations

23.9.1 Symptom Burden

Older adults with kidney failure may experience a high burden of symptoms, especially at the end-of-life. For example, in the last month of life older adults with kidney failure treated with conservative management, more than half of all patients reported lack of energy, drowsiness, dyspnea, poor concentration, poor appetite, swelling of the arms or legs, dry mouth, constipation, and nausea [44]. A similar burden of symptoms has been reported among those who receive dialysis as well, suggesting that dialysis alone may not mitigate these symptoms.

23.9.2 Role of Palliative and Supportive Care

Palliative and supportive care is an important resource for older adults with kidney failure. While traditionally palliative care has been reserved for end-of-life or those who decline dialysis, the role of palliative care across the spectrum of kidney disease is increasing. Evaluation by palliative care specialist can provide prognostic information, help elicit patient and family health goals, and support advanced care planning and shared decision-making about dialysis. Palliative care support can also improve the recognition and treatment of complex symptoms. See Chap. 6. Palliative Care and End of Life Issues.

23.10 Summary

Clinical specialists caring for older patients will increasingly encounter those with CKD and/or AKI. While clinical practice guidelines exist for the diagnosis and management of CKD, providers should be prepared to recognize the limitations of these disease-oriented recommendations and the unique aspects of caring for older adults with CKD. We recommend an approach that considers a patient's health goals, life expectancy, and presence of multimorbidity and geriatric conditions, to help tailor treatment plans. Furthermore, clinicians should understand the challenges and controversies for using eGFR to define CKD in this population. For older adults, kidney failure carries a poor prognosis and a shared decision-making approach to RRT is necessary.

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24 A Geriatric Perspective on Oncology Care

Thuy T. Koll and William Dale

24.1 Introduction

Cancer is primarily a disease of older adults. By 2040, the projected total cancer incidence will increase by 30% [1]. Patients 65 years and older will make up 69% of new cancer diagnoses and patients 85 years and older will make up 13% of new cancer diagnoses [1]. The rapidly growing population of older adults with cancer adds significant complexity to cancer care, increasing the management challenges for an already difficult clinical scenario. Older adults are underrepresented in oncology clinical trials, particularly those with multiple chronic health conditions and low performance status, thus limiting the evidence base to evaluate risks and benefits of cancer treatments [2]. The 2014 Institute of Medicine (IOM) Report, "Delivering High Quality Cancer Care: Charting a Course for a System in Crisis" emphasizes the unique needs of older patients with cancer and outlines recommendations to improve quality of cancer care in this vulnerable population [3]. Quality cancer care must address the unique needs of older adults through geriatric assessments (GA), shared decision-making, and age-appropriate disease management [2]. There has been tremendous progress in the field of geriatric oncology resulting in the publication of the American Society of Clinical Oncology (ASCO) Guideline for Geriatric Oncology (2018) and studies are underway to identify interventions to improve outcomes for older patients with cancer [4–6]. This chapter provides a summary of the literature in geriatric oncology and outlines an approach and framework to guide cancer management decisions for older adults.

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24.2 Cancer in Older Patients

24.2.1 Physiology of Aging

A hallmark of aging is the gradual decline of physiological reserve across multiple organ systems resulting in overall loss of functional status. There is variable loss of reserve across systems due to the heterogeneity of the aging process. The complex interaction between age-related physiological changes, comorbid conditions, cancer and cancer treatments can all influence treatment tolerance and risk for treatment toxicity. Considerations of these changes can help tailor treatments and develop a plan for monitoring and minimizing toxicity. Table 24.1 highlights significant age-related organ system changes and notes potential implications for older patients with cancer.

24.3 Geriatric Assessment

Among older patients of the same chronological age, there is wide heterogeneity in physiological functioning. "Functional age" is therefore a more accurate measure of where an individual is on the aging continuum. It is characterized by heterogeneity in physiological reserve, number of comorbidities, overall functional abilities, and the presence of geriatric syndromes. This heterogeneity adds complexity to the estimation of life expectancy, has implications for the likelihood of treatment toxicities, and complicates treatment management decisions. Geriatric syndromes are common and multifactorial conditions that accompany aging and often results from diminished physiological reserves. Comprehensive GA is an approach to the systematic evaluation of multiple health domains and geriatric syndromes among older individuals. Ideally, evaluation of these domains using GA is followed by interventions to address any identified deficits in order to optimize health and prevent the loss of independence, particularly in vulnerable older adults.

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Table 24.1 Age-related organ system changes and potential implications [7, 8]

Organ system	Age-associated physiologic changes	Implications
Cardiovascular	Decrease in maximal heart rate in response to stress Decrease in ventricular compliance Increase in stiffness of vasculature	Increase risk of developing heart failure Increase risk of developing drug-related cardiomyopathy
Gastrointestinal	Alteration in mucosal protective mechanisms Alteration intestinal absorption and motility Decline in hepatic drug metabolism	Susceptibility to mucositis leading to compromised nutrition Increase risk of aspiration Variable absorption of drugs Susceptibility to adverse drug reactions
Pulmonary	Increase in lung compliance Increase in stiffness of chest wall Diminished function of the mucociliary escalator	Decrease in exercise tolerance and pulmonary reserve Increased susceptibility to pulmonary infections
Renal	Decrease in glomerular filtration rate Decrease in renal blood flow Decrease in tubular function: impaired water, glucose, and electrolytes handling Dysregulation of the renin-angiotensin system	Decrease in clearance of medications by the kidneys Increase risk of volume depletion, nephrotoxicity, and electrolyte disturbances
Nervous/ cerebrovascular	Decrease in number of neurons. Impairment in vision, hearing, and olfaction	Increase risk of impairment in memory and cognition Increase risk of anorexia due to decrease in olfaction Increase risk of delirium due to impairment in hearing and vision
	Increase incidence of peripheral neuropathy	Increase risk of developing peripheral neuropathy or worsening of existing neuropathy
	Impairment in response to postural change in arterial pressure and cerebral blood flow	Gait impairment Increase susceptibility falls due to orthostatic hypotension and neuropathy
Hematologic	Decrease in bone marrow function	Increase risk of developing anemia, thrombocytopenia, and febrile neutropenia
Endocrine	Increase in bone demineralization Altered temperature regulation.	Increase risk of fractures Decrease in fever response due to infection
Musculoskeletal	Loss of muscle mass and strength.	Loss of mobility Impairment in gait and balance increasing fall risk

GA is a collection of validated measures and/or tools that characterize multiple health domains. Potential components of GA include the following health domains: (1) *medical*: evaluation of comorbidity, polypharmacy, and nutritional status; (2) *mental health*: evaluation of cognition, depression, anxiety, and delirium; (3) *functional status*: assessment of activities of daily living (ADL), instrumental activities of daily living (IADL), mobility (physical performance), and falls; (4) *social*: evaluation of environment, resources, and social support/network. In oncology, the goals of GA are to guide treatment management decisions and develop a care plan that balances benefits and risks, with consideration of (noncancer) remaining life expectancy and implements targeted interventions to optimize outcomes and improve quality of life [9].

GA domains independently predict outcomes in older patients with cancer including chemotherapy toxicity [10–14], completion of chemotherapy [12, 14, 15], hospitalization [10, 12], mortality [16–19], and functional decline [20, 21]. Experts recommend at a minimum, the assessment of function, comorbidity, falls, depression, cognition, and nutrition [9]. GA information can be incorporated into chemotherapy toxicity risk calculators to evaluate risk of toxicity and treatment tolerance [11, 13, 22]. Information from GA should be provided to patients and caregivers to guide treatment decision-making and promote collaboration to implement GA-guided interventions [9]. Table 24.2 summarizes the ASCO Guideline for Geriatric Oncology recommendation on minimum components of GA.

Table 24.2 Summary of ASCO Guideline for Geriatric Oncology recommendation on minimum components of GA [9]

Function: Assessment of instrumental activities of daily living
Comorbidity: A thorough history or validated tool to assess comorbidity
Falls: A single question about falls
Depression: The Geriatric Depression Scale
Cognition: The Mini-Cog or the Blessed Orientation-Memory-Concentration test
Nutrition: Assessment of unintentional weight loss

24.4 GA Domains

24.4.1 Comorbidity

Many older patients have multiple chronic health conditions to manage in addition to cancer and cancer treatment. In a population of older patients with various types of cancer ($n = 539$, median age 72 years), >90% of older patients report one or more chronic health conditions with more than half of patients report a comorbidity that interferes with activities [23]. A careful review of comorbidity burden can also help assess remaining (noncancer) life expectancy. Comorbidity can be assessed by a thorough history or validated questionnaires. Charlson Comorbidity Index (CCI) is widely used in geriatric oncology research to characterize comorbidity burden. CCI is based on the 1-year mortality of patients admitted to a medical hospital service. It includes 19 diseases weighted from one to six points [24]. In a sample of Medicare fee-for-service beneficiaries aged 66 years or older, patients with high comorbidity based on the CCI have life expectancy approximately 3 years shorter than the average U.S. population [25]. In older adults with cancer, comorbidity is associated with functional status [23, 26–28], treatment tolerance [29], and survival [23, 28].

24.4.2 Functional Impairment

Function is often assessed by an individual's ability to perform activities of daily living (ADL) and instrumental activities of daily living (IADL). Disability is defined as difficulty or dependency in ADL. Comorbidity and frailty are associated with disability [30]. Disability may exacerbate comorbidity and frailty [30]. Impairment in IADL predicts survival and other poor outcomes in older patients with cancer [10, 14, 19]. Patients with impairment in IADLs should be further assessed for impairments in cognition, physical performance, and activities of daily living (ADL).

24.4.3 Cognitive Impairment

The prevalence of cognitive impairment increases with age. In patients 70 years and older, the prevalence of dementia is 13.9%, and an estimated 22.2% have mild cognitive impairment (MCI) [31]. Dementia is diagnosed when cognitive impairments interfere with the patient's ability to function independently. Mild cognitive impairment is conceptualized as a transitional stage between normal cognitive aging and dementia [32]. Patients with MCI have subjective cognitive complaints and objective evidence of cognitive impairment on cognitive testing, but preserved function when performing IADLs. Cognitive deficits are underrecognized in oncology clinics. Cognitive screening tests are available to identify patients who may benefit from more in-depth neuropsychological testing. Available screening tools used in geriatrics and geriatric oncology include the Mini-Cog [33, 34], Mini-Mental State Examination (MMSE) [34, 35], the Short-Blessed Test [36, 37], and the Montreal Cognitive Assessment (MoCA) [38, 39]. Chapter 8 provides further description and explanation of validated cognitive screening tools. The choice of the screening tool used may depend on feasibility of time and staff availability as well as the patient population.

The largest body of evidence on the cognitive effects of cancer and its treatment, particularly chemotherapy, is in breast cancer [40]. Risk factors for cancer and treatment-related cognitive impairment include older age [41, 42], lower cognitive reserve (i.e., education and occupational attainment) [41, 43], comorbidities [42], and high baseline anxiety and depression [43]. Cognitive impairment in older patients with cancer are associated with chemotherapy toxicity [11] and survival [44, 45]. In older adults with hematological malignancy, impaired working memory prior to treatment predicts poorer survival in patients receiving intensive chemotherapy [44].

Cognitive tests should be interpreted in the context of other clinical information including prior cognitive function and a history from a family member/collateral source. Expert consensus and guidelines suggest assessment of decision-making capacity, delirium risk counseling, medication review, potential referral for neuropsychological evaluation, counseling patients and family about the potential cognitive effects of the proposed treatment and completion of advanced care directives [9].

24.4.4 Delirium

Preexisting cognitive impairment and older age are risk factors for the development of delirium and the severity of delirium [46]. Delirium is common in the inpatient oncology setting [46–49]. It is a syndrome characterized by acute change in attention, alertness, cognition, and behavior [50]. The underlying causes are often multifactorial including polypharmacy, fevers, anemia, fatigue, pain, and electrolyte disturbances. (Chap. 2 describes this syndrome and Chap. 8 suggests screening tools.) Delirium is a risk factor for slower cognitive recovery, persistent cognitive decline, functional decline, increased number of hospitalizations, and prolonged hospitalizations [51–53]. Multicomponent nonpharmacologic interventions that focus on prevention of delirium and management of delirium by early identification of people at risk and minimizing precipitating factors have the strongest evidence to date [54]. The American Geriatric Society Section for Enhancing Geriatric Understanding and Expertise among Surgical and Medical Specialists released guidelines for prevention and management of postoperative delirium that may be applicable to the setting of geriatric oncology [55].

24.4.5 Depression

Depression in late life is underrecognized in the general population [56] and this may be more challenging in older patients with cancer because of the overlap with depressive symptoms and symptoms of cancer and cancer treatment. Older patients are less likely than younger patients to report sad mood or loss of pleasure or interest, which are known as the "gateway" symptoms [57]. They will more likely report somatic symptoms such as sleep difficulties, stomach aches, general aches, and pains [57]. Symptoms that overlap with cancer and cancer treatment, including sleep difficulties, pain, weight loss, and cognitive impairment, can add complexity to the diagnosis of depression in older patients. Depression in patients with cancer increase health- care costs if left untreated [58]. There are validated screening tools in geriatric and medical populations that can be administered in the clinic such as the Geriatric Depression Scale-Short Form, Patient Health Questionnaire (PHQ)-2 and PHQ-9, the Hospital Anxiety and Depression Scale, and the Center for Epidemiologic Studies Depression Scale-Revised [59]. However, these screening tools must be used with caution as one study suggests the established cut-off score may fail to identify older patients with major depression and minor depression [60]. It may also be helpful to obtain further information from caregivers and family members if clinicians suspect that an older patient may be minimizing symptoms and associated disability. It is important to ask about suicidal ideation and presence of firearms in the house. Older adults with cancer are at increased risk for suicide compared to general population [61] and those with other medical illnesses [62]. Substantial evidence support that a systematic approach using scheduled visits, a treatment protocol with dose titration of antidepressants monitored with validated scales, and psychoeducation result in better outcomes [63]. Thus, screening of depression should be linked to mental health consultation to ensure adequate treatment of depression and appropriate monitoring of treatment response.

24.4.6 Falls

Falls and their sequelae are major events for older adults that may lead to functional deficits and loss of independence [64]. Falls are more common in older patients with cancer compared to general population [65]. A fall is a risk factor for future falls in older adults with and without cancer [65]. In oncology, falls are associated with chemotherapy toxicity and poorer survival [22, 66]. Causes for falls are often multifactorial representing underlying issues such as muscle weakness, impaired gait and balance, and polypharmacy, which are common issues with aging that can be exacerbated by cancer and treatment [67]. Incorporating one simple question, "Have you experienced a fall in the last 6 months, or since our last visit," is important because older patients often do not report falls to their oncologist or primary care provider unless asked [68]. Fall assessment can include simple gait and balance tests that can be administered while the patient is waiting for the physician by support staff (refer to Chap. 8 for more details). Detailed fall assessment based on falls history may include muscle strength, cardiovascular status, medications, visual acuity, positional blood pressure, home environment [69]. Primary care providers, geriatricians, physical therapists, and home health-care providers (for home safety evaluation) are important team members to include in the care of a patient who has experienced a fall or at high risk for falling.

24.4.7 Malnutrition

Older adults are at risk for weight loss and malnutrition due to a multitude of age-associated changes [70] and comorbid conditions that directly or indirectly challenge nutritional status. There is a natural decline in appetite, food intake, and early satiation with aging [71]. Decline in physical activity and decreased resting metabolic rate result in a fall in total energy expenditure, decrease in muscle mass and increase in fat mass [71]. Functional impairment, polypharmacy, sensory impairment, dental issues, taste changes, social and environmental conditions (i.e., social isolation) can exacerbate nutritional issues [70]. Cancer and cancer treatment have a profound negative effect on nutritional status. Treatment side effects such as nausea, vomiting, and mucositis can lead to dehydration and weight loss. Fatigue can impair the ability to shop, prepare, and enjoy food. The prevalence of malnutrition defined as weight loss of 10% or greater is 71% in hospitalized older adults with advanced cancer [72]. Weight loss and malnutrition are associated with chemotherapy toxicity and decreased survival [11, 73]. The syndrome of cachexia, which combines weight loss, low BMI, and reduced muscle mass, was associated with impairment in IADL and poorer survival in a population of older patients with GI and lung cancer [74]. For more information on nutritional assessment tools, refer to Chap. 8. Nutritional assessment should also include an assessment of social and demographic factors, thorough review of medications, mood, and cognition [75]. Aggressive management of side effects of cancer treatment in cancer patients is important to prevent nutritional deficiencies, maintain weight, and quality of life [70].

24.4.8 Polypharmacy

Polypharmacy may be unavoidable as multiple medications are required to maintain control of health conditions. Most studies define polypharmacy as five or more daily medications [76]. Cancer treatment and supportive medications may add to an already complex regimen, add to the illness burden and potentially be harmful to an older adult [77]. Potentially inappropriate medications are medications that may lack evidence-based indications, medications with real or potential risk of side effects that outweigh the benefits, medications that are frequently associated with adverse drug reactions, or medications that may potentially interact with other medications or disease conditions [78]. Older adults with cancer are at high risk for drug–drug interactions [79]. While empirical evidence for management of this issue is limited, patient-centered medication therapy management with help from a clinical pharmacist is crucial at the beginning of treatment and periodically for reconciliation [80]. The goals of medication reviews are to optimize the medication regimen to only medications with indications and when benefits outweighs the risks of side effects and also to assess for drug–drug interactions. Whenever possible, simplify the medication routine and ensure the patient and caregiver understand medication changes through teach-back methods. There are numerous methods to determine which medications are candidates for deprescribing. For example, the Beers Criteria lists potentially inappropriate medications for older adults [81]. (Chap. 5 provides details on polypharmacy and the Beers Criteria).

24.5 Chemotherapy Toxicity

Two large prospective studies incorporated GA into chemotherapy toxicity risk models for older adults with cancer. The Cancer and Aging Research Group (CARG) (n = 500, Mean age 73 years) model includes 11 factors predictive of Grades 3–5 chemotherapy toxicity [13, 22]. Five factors are a part of the GA, and six are items normally obtained in everyday oncology practice. GA identified predictors included hearing impairment, history of falls, needing assistance with medication management, limited ability to walk one block, and a decrease in social activities due to health status. A risk stratification schema (risk score ranges from 0 to 19) divides patients into low (0–5 points), intermediate (6–9 points), or high risk (10–19 points) of chemotherapy toxicity. In the CARG model, the percent incidence of a Grades 3–5 toxicity was 83% for patients identified as high risk, 52% for those identified as intermediate risk, and 30% for those identified as low risk ($P < 0.001$) [22]. The Chemotherapy Risk Assessment Scale for High-Age Patients (CRASH) model predicts severe hematologic (Grade 4) and non-hematologic toxicity (Grade 3/4) in older cancer patients (N = 518, Mean age 75 years) [11]. IADL dependence predicts hematologic toxicity [11]. Self-rated health status, Mini-Mental State Exam score, and Mini-Nutritional Assessment score predict non-hematologic toxicity. In the CRASH model, 64% experienced severe toxicity (32% had grade 4 hematologic toxicity and 56% had grade 3 or 4 non-hematologic toxicity) [11].

24.6 GA-Driven Interventions

GA-driven intervention can be integrated to support older patients during their cancer treatment. There is a growing body of literature demonstrating that GA interventions improve treatment tolerance and outcomes [82]. Larger studies are emerging to evaluate the effect of GA-driven interventions on oncologic and non-oncologic outcomes such as toxicity, survival, treatment tolerance, and quality of life [4–6]. Table 24.3 summarizes potential interventions for GA domains so that oncology providers can address potential geriatric issues to optimize the older patient's cancer care.

24.7 Shared Decision-Making

Management choices among older patients diagnosed with cancer is a context where shared decision-making is crucial because treatments will often vary in their effect on the patients' physical, cognitive, and psychological well-being. The primary challenge is avoiding both undertreatment of healthy older adults and overtreatment of frail older adults [83]. This process involves a series of considerations that include estimating remaining life expectancy, knowing age-specific cancer mortality (with and without treatment), eliciting the goals of care of the patient/family, assessing the risks and benefits according to the goals of care, and knowing the feasibility and burden of available treatments. The patient's (and family's) overall treatment goal(s) is a central consideration, driving the cancer management decision based on the above considerations. Comprehensive GA can support patients, caregivers, and providers in shared decision-making. After a management plan is agreed upon, interventions for vulnerabilities should be implemented and communication with patients and family members of anticipated needs to improve treatment tolerance and minimize toxicity [84].

The Association of Community Cancer Centers survey in 2018 found that while 68% of health-care providers recognized the benefit of involvement of patients and family in decision-making, only 37% felt confident in engaging patients and families in cancer management decision-making and 44% report insufficient knowledge and training in shared decision-making model (https://www.accc-cancer.org/). The

Table 24.3 Geriatric assessment domains and potential interventions

Geriatric assessment	Interventions
Comorbidity	Consider disease-specific interactions Diabetes-avoid neurotoxic agents Heart failure-close monitor of volume status Kidney disease-avoid nephrotoxic agents
Functional status	Assess social support and implement visiting nurse and home health services Evaluate cognition Referral to physical and occupational therapy Medication review, address vision impairment, vitamin D repletion, and home safety evaluation
Cognition	Referral for neuropsychological testing Review medications-minimize medications with higher risk of delirium Delirium risk counseling Social work involvement Assess and treat depression and anxiety Assess ADL and IADL (medication management, driving). Check vitamin B12, TSH and free T4, and brain imaging Goals of care discussion Identify health-care proxy and complete advance directives
Depression	Referral to mental health provider for counseling Treatment with medication Consider psychotherapy Suicide risk assessment
Nutrition	Referral to dietician for nutritional assessment and recommendations Assess cognitive status, depression, access to food and social isolation Consider home-delivered meals
Polypharmacy	Medication review and periodic reconciliations Simplify the medication routine ensure comprehension by the patient and caregiver through teach-back methods
Social support	Elicit support from caregivers or implement supportive services such as transportation assistance, home care services, and home-delivered meals Monitor caregiver stress

American of Geriatrics Society Expert Panel on the Care of Older Adults with Multimorbidity treatment decision framework can be adapted to guide oncology providers in shared decision-making [85]. The following are recommended principles for prioritizing decisions and managing the care of older patients with cancer and multiple chronic health conditions.

24.7.1 Assessment of Decisional Capacity

The capacity to make medical decisions includes the abilities to communicate a choice, comprehend information related to the diagnostic or treatment choice, have an understanding of the current medical situation and personal values, and understand the consequences of a decision [86]. An abnormal screening for a cognitive deficit can alert clinicians to possible limits on decision capacity. Such assessment are a part of an overall clinical cognitive assessment and should not be the *only* criteria to determine decisional capacity. Studies of medical decision-making capacity find incapacity in 2% of healthy older adults, 20% in those with Mild Cognitive Impairment and 54% in patients with Alzheimer disease [87]. If a patient lacks capacity, decisions about care should be directed to the documented health-care power of attorney. Decision-making is situational and specific to a particular decision. Patients with dementia may have capacity to make low risk and low complexity decisions. For example, a person with mild-to-moderate Alzheimer dementia may understand the need for antibiotic in treatment for pneumonia but may not be able to communicate the overall risks and benefits of cancer treatment.

24.7.2 Determining Treatment Goals

Knowing a patient's overall treatment goal(s) is key to appropriate decision-making. Prior to recommending a management plan, physicians should work with older patients to identify and prioritize a set of treatment goals and evaluate the effect of potential treatment options on these goals [88]. Management decisions should focus on which available treatment option will best address the patient's most important goal(s), and prioritize treatments accordingly. Patient's preferences are dynamic and should be revisited as their health changes [89].

One possible approach for eliciting preferences is to use open-ended questions asking about life goals, important priorities, and concerns about a patients' current and future quality of life. For example, some possible questions to ask include: "At this stage, what is most important to you?" Some patients might say being with friends and family and not spending time in a hospital or nursing home matters most. Others might say that they are willing to undergo care away from home in the hope that they live even a little longer. Or ask "In your current situation, what are you most hopeful for or what are you most worried about?" or "Can you identify a point in your treatment when you would prefer comfort over life extension?" [90]. These questions can help clinicians clarify the overall goals to guide cancer management decision-making.

24.7.3 Establish Prognosis

For older adults with cancer and multimorbidity, two related but separate types of prognosis estimates are important: remaining life expectancy based on cancer (stage, grade, and location) and subsequent treatment possibilities (from the literature) and remaining life expectancy based on noncancer-related health status [91]. Prognostic indices incorporating (minimally) age, gender, comorbidities, and functional measures can be utilized to reasonably estimate mortality in older patients. There are six indexes for community dwelling older adults with various time-frame ranging from 1 year to 5 years [92]. (Available at http://www.eprognosis.org.) Physicians should help reconcile patient's cancer and noncancer prognosis, the potential benefits of cancer treatment (cure of disease, symptoms relief) versus the risks (functional decline, death) and patient's treatment goals. Taken together, this provides a framework for assessing various management options available for patients.

24.7.4 Feasibility and Optimization

The feasibility of the proposed treatment option should follow determination of patient preferences and prognosis. Cancer treatments can be complex and burdensome for patients and caregivers (multiple clinic visits, financial stress, and caregiver burden). Knowledge and understanding of the patient's physical, cognitive and psychologic function and available social support help determine feasibility. Patients with poor social support and/or cognitive impairment need treatment plans that are realistic and ensure appropriate supportive care throughout the process. Close collaboration and communication between primary care physicians and oncologists are important to ensure feasibility, minimize burden, and close monitoring of toxicity. Treatment optimization entails implementing interventions for areas of concerns identified on GA (i.e., strength and balance training, nutritional supplements, and delirium prevention).

24.8 Care Models

There are three major models for incorporating geriatric principles in oncology care: a consultative model, an "embedded" model, and a dually trained physician model [93]. In the consultative model, the geriatrics team makes recommendations prior to treatment and the final care decisions are made by the primary oncologist. Patients are typically not followed during treatment by the geriatrics team. The second model consists of a geriatrician or a geriatric-trained nurse practitioner "embedded" in an oncology clinic where they are part of the team, including oncology. Patients are followed throughout the course of treatment, and the team provides care for geriatric-related issues. Finally, in the third model, patients are cared for by a geriatric oncologist who is dual-trained in geriatrics and hematology and medical oncology [93]. Some centers have incorporated a geriatric-trained nurse practitioner or physician assistant to provide care for geriatric-related issues given the limited number of geriatricians and dually trained geriatric oncologists. Screening tools are also helpful to identify patients for referral who are most likely to benefit from a multidisciplinary geriatric evaluation.

The Vulnerable Elders Survey-13 (VES-13) is a 13-item survey including age, self-rated health, and functional status, and is scored from 0 to 13, with 13 being the most vulnerable [94]. A score of greater than three identifies vulnerable older adults at risk for mortality, morbidity, and hospitalization. Higher VES-13 scores predict death and functional decline in vulnerable community-dwelling older adults [94, 95]. VES-13 demonstrates high predictive value for having greater than two deficits on GA in older patients with prostate cancer [96]. Another tool, the G8 screening tool, includes age, self-rated health, nutrition, cognition, mobility, and polypharmacy, and is scored from 0 to 17, with 17 being the best [97]. A score of 14 or less predicts at least one deficit on GA domains in adults 70 years and older [97].

24.9 Summary

Optimal care for older patients with cancer should assess the age-associated physiologic changes, geriatric syndromes, functional and cognitive limitations, comorbidities and social support. Management decisions should reflect the patient's preferences and goals, prognosis, unique geriatric problems, consideration of interactions between treatment with coexisting conditions and feasibility of a treatment option(s), and the degree of social support available. GA identifies vulnerabilities in older adults and provide additional and actionable information to the standard oncology evaluation of performance status. Interventions for vulnerabilities identified on GA may improve treatment tolerance, reduce chemotherapy toxicity and improve quality of life. More robust studies are underway to define the effectiveness of GA-driving interventions and how these improve outcomes for older patients with cancer.

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Pulmonary and Critical Care Medicine

25

Derek A. Kruse and Kristina L. Bailey

25.1 Pulmonary

25.1.1 Changes in Pulmonary Physiology with Aging

Pulmonary physiology changes slowly and steadily becomes dramatic in old age. The natural aging process leads to a decline in lung function as well as structural changes in the lung parenchyma. A change in lung function that is found in an aging population is the loss of elastic recoil in the lung parenchyma [1], which results in expiratory flow limitation and can mimic obstructive lung disease. forced expiratory volume in one second (FEV_1) and forced vital capacity (FVC) both continuously decrease at a rate between 25 and 30 mL with each year of life after about age 20 years [2]. Common structural changes include alveolar enlargement, without destruction of the alveolar walls, and distal duct ectasia [3]. The lack of alveolar wall destruction is important because it delineates the aging process from emphysema-related destruction [4]. These structural and functional changes associated with aging, and the long-standing inflammation endured by the lungs throughout life, contribute to the increased prevalence of non-reversible airflow limitation in older patients (Table 25.1).

25.1.2 Chronic Obstructive Pulmonary Disease

Chronic obstructive pulmonary disease (COPD), including chronic bronchitis and emphysema, is characterized by non-reversible airflow limitation. It can be associated with cough, dyspnea, and chronic sputum production. COPD is a common lung disease that occurs more frequently in older people. In fact, the prevalence of COPD is 2.6 times greater in patients 65 years of age or older when compared to people age 45–64 years [15]. Worldwide, the prevalence of the Global Initiative for Chronic Obstructive Lung Disease (GOLD) stage II (moderate) COPD is 10.1% of people over the age of 40 years [15]. Given the relatively high prevalence of the disease, its chronic nature, and the possibility of frequent exacerbations necessitating hospitalization, COPD has a significant morbidity and mortality burden in older patients.

One reason that COPD is more common in older people is that COPD takes time to develop. Lung function naturally declines with age as noted previously, and even when cigarette smoking accelerates the process, it takes years to result in clinically evident disease [5]. A patient might smoke cigarettes for over 25 years prior to developing COPD [16]. In addition, there are pathophysiological changes observed in COPD patients that are similar to those seen with aging alone [5]. Both the natural aging process and the pathophysiology of COPD share a common theme of chronic inflammation, the production of reactive oxygen species, DNA damage, and telomere shortening, processes that underlie the accelerated cellular senescence in COPD [5]. Because of these changes, COPD has also been thought of as a disease of accelerated lung aging [17, 18].

25.1.2.1 Diagnosis

Given the aforementioned lung changes with aging, it is not surprising that the diagnosis of COPD in older patients can be difficult. In a patient with a compatible clinical presentation, COPD is diagnosed by spirometry before and after bronchodilator therapy. Traditionally, a fixed FEV_1/FVC ratio of <0.70 was used to diagnose COPD. This was based on the guidelines created by the GOLD criteria [19]. With time, concern grew regarding the overdiagnosis of obstructive lung disease in older patients. Given the natural decline in the FEV_1/FVC ratio with aging [20], an FEV_1/FVC ratio < 0.70 is not necessarily pathological in older patients. In fact, Hardie et al. demonstrated that approximately 35% of healthy patients over the age of 70 years had an FEV_1/FVC ratio of less than 0.70 [21]. In 2005, the American Thoracic Society (ATS) and the European Respiratory

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Table 25.1 Changes in physiological parameters with aging and various disease states

Parameter	Normal aging	COPD	Asthma	Pulmonary hypertension	Idiopathic pulmonary fibrosis
Lung tissue neutrophil concentration	Mildly increased [5]	Moderately increased	Moderately increased [6, 7]	NA	NA
Presence of reactive oxygen species in lungs	Mildly increased [5]	Moderately increased [5]	NA	Increased [8]	Increased [9]
DNA damage and oxidation	Mildly increased [5]	Moderately increased [5]	NA	NA	NA
Destruction of alveoli	Absent [3]	Present [4]	Absent	Absent	Absent
Enlargement of alveoli	Present [3]	Present	Absent	Absent	Absent
Elastic recoil	Decreased [1]	Decreased	No change	No change	Increased
Forced expiratory volume in 1 second	Decreased-fixed [1, 2] decline of approximately 20 ml/year [5]	Decreased with no to minimal response to bronchodilator FEV1 decline of 50–100 ml/year [5]	Intermittently decreased with exacerbations. Obstruction reversible with bronchodilators early but can become fixed and non-reversible in older patients	No change	No change or increased
DLCO	Decreased (but not clinically significant degree)	Deceased	Normal	Decreased	Decreased
Pulmonary artery pressure	Mildly increased [10, 11]	Mildly increased	No change	Moderate to severely elevated	Mild to moderately elevated
Respiratory muscle strength	Decreased [12]	Decreased [13]	No change	No change	No change
Mucociliary clearance	Decreased [14]	Normal clearance but increased mucous production	Normal clearance but increased mucous production	No change	Increased mucous production clearance may be reduced

Society (ERS) released a guideline recommending the use of a fifth percentile lower limit of normal (LLN) for the FEV_1/FVC ratio as a cut-off value to diagnose obstructive lung disease [22]. Large population studies have been used to determine "normal" lung function for patients from each of many different demographic groups. This method limits the overdiagnosis of obstructive lung disease in older patients by taking into account the natural decline in the FEV_1/FVC ratio in aging [23]. Given the accumulation of comorbid illnesses with aging, it is important to carefully evaluate all causes of dyspnea and avoid simply ascribing shortness of breath to COPD in all older patients with an FEV1/FVC of <0.70.

COPD has become more accurately recognized as a systemic disease in both young and older patients [24]. Patients with COPD are at risk of extra-pulmonary comorbidities, including coronary artery disease, lung cancer, peripheral skeletal muscle dysfunction, malnutrition, osteoporosis, hypertension, diabetes, depression, stroke, and obesity [25]. These comorbidities lead to increased morbidity and mortality in COPD [26]. This underscores the importance of recognizing and treating COPD as a systemic disease involving multiple organ systems. The approach to treatment therefore must be multifaceted and address comorbid malnutrition, depression, muscle wasting, and loss of exercise capacity. An important component of this multifaceted approach is pulmonary rehabilitation, which can include aerobic exercise and/or resistance training. A monitored regimen of either type of exercise has been proven to be successful at improving functional status, depression scores, and subjective measures of quality of life at all stages of COPD [27, 28].

25.1.2.2 Treatment

The pharmacotherapy for COPD in an aging population requires special considerations. The volume of distribution for medications can change significantly with age, as can the rate of metabolism, especially in patients with comorbid renal or liver disease [29]. Maintaining vigilance to avoid adverse effects associated with medical therapy is an important part of alleviating patients' symptoms and improving quality of life. Provider familiarity with common adverse effects is paramount in avoiding harm when prescribing medical therapy. Anticholinergic medications are commonly used in the treatment of patients with COPD, and adverse effects of these medications can be significant, especially in an older population. The two most prominent adverse effects of this drug class include urinary retention and mucosal dryness [30], both of which can contribute to significant morbidity in older patients. Beta-agonists are associated with tremors, anxiety, palpitations, and cardiac arrhythmias [30]. Finally, corticosteroids have significant adverse effects of their own. Inhaled steroids, although seemingly less likely to cause significant adverse effects than systemic steroids, do cause thrush and dysphonia, osteoporosis, and are associated with pneumonia [30]. Oral steroids are associated with hypertension, glaucoma, diabetes, bruising, myopathy, gastritis, adrenal insufficiency, and osteoporosis [30]. Considering the above, it is important to evaluate patients for adverse effects at each clinic visit. Something as simple as assuring patient understanding of proper inhaler technique can improve patient adherence, increase efficacy, and decrease morbidity associated with their therapy. There are three basic types of inhaler devices available including a dry powder inhaler (DPI), a metered-dose inhaler (MDI), and nebulized delivery of the therapy. Although studies have failed to establish a greater efficacy with one type of inhaler device over another [31], individualized therapy is recommended [31]. Individualized therapy can be based on several considerations including the patient's cognitive function and ability to follow instructions, their hand strength and dexterity to manipulate the inhaler device, whether they can generate an inspiratory flow rate sufficient to properly inhale dry powders, the drug availability in a given inhaler device, and the cost of a given inhaled therapy [32]. Older patients who have developed mild cognitive impairment or who have deficits in their coordination may benefit from the use of DPI devices. DPI devices require less coordination than MDI devices, which require the patient to actuate the inhaler and inhale nearly simultaneously. Manual dexterity and hand strength are also important when it comes to actuating either MDI or DPI devices. Rheumatoid arthritis, Parkinson's disease, and loss of hand strength can all contribute to difficulties for older patients when it comes to using inhalers. When cognitive function and manual dexterity limit a patient's ability to use either MDI or DPI inhalers, nebulized drug delivery can be more effective than either of these alternatives.

25.1.3 Asthma

For many years, asthma has been thought of as a disease of younger people. Asthma, however, is not uncommon in older patients, a population where asthma has a predicted prevalence between 4% and 6% [33–35]. This is a population that has been shown to have a higher hospitalization rate [36, 37] and a higher mortality rate than other age groups with asthma [38]. Patients older than 65 years of age have a significantly increased mortality rate when compared to patients of the same age who do not carry this diagnosis [39]. More than 50% of all deaths from asthma are in patients age 65 years or older [38]. Despite these facts, asthma is underappreciated in older patients and often the diagnosis is delayed [40]. Extrapolation of population data suggests that nearly a quarter of all older patients with asthma are currently undiagnosed [34]. This may be related to the often-atypical presentation of asthma in this patient population. Older patients with reversible airway obstruction most frequently present with cough rather than dyspnea, wheezing, or other typical symptoms of asthma [40]. Older patients may also not perceive chest tightness related to bronchospasm [41] and tend to decrease activity, masking exertional symptoms [34]. As a result, older patients tend to present later in the course of the disease process with fixed obstruction [35] and are commonly misdiagnosed with COPD [42]. Because of these barriers to diagnosis, one should be sure to include asthma in the differential diagnosis of respiratory complaints in older people.

In addition to the difficulties in diagnosing asthma in older patients, the data suggest that this population is also undertreated. A large, cross-sectional study revealed that the treatment of asthma in older patients was not congruent with the National Asthma Education and Prevention Program's treatment guidelines [43]. Older patients were less likely to be on a controller therapy, a long-acting beta-agonist or a short-acting beta-agonist rescue inhaler when compared to younger patients with asthma [43]. Even in older patients with optimal treatment of their asthma, it is estimated that one-third have uncontrolled asthma [44]. Additionally, patients age 65 years and older have fewer emergency room visits for asthma-related issues when their treatment is tailored around their physical, psychological [45], and environmental barriers to asthma management [46]. There are also some data that targeted education in older people improves adherence to the regimens and symptom control [47]. These studies demonstrate an opportunity for improvements to both the recognition and treatment of asthma in older patients.

25.1.4 Pulmonary Hypertension

Pulmonary hypertension (PH) is a pathological state that traditionally has been marked by a mean pulmonary artery pressure of 25 mmHg or greater [48] and is becoming a more frequent diagnosis in older patients [49]. During the 6th World Symposium on Pulmonary Hypertension, it was proposed that a mean pulmonary artery pressure of 20 mmHg should be considered pathological and supportive of a diagnosis of pulmonary hypertension. Adopting this change will only increase the prevalence of PH in older patients. PH is a diagnosis that includes a broad array of pathophysiological processes, hemodynamic characteristics, and treatment options [50]. It is traditionally divided into five subgroups based on their characteristics [50]. We will focus this discussion on group 1 pulmonary hypertension (PH), also known as pulmonary arterial hypertension (PAH), because it is a group where PH-targeted medical therapy is an effective treatment option. PAH requires a patient to have a mean pulmonary artery pressure of 25 mmHg or greater, a pulmonary vascular resistance of 3 Wood units or greater, and a pulmonary artery occlusion pressure of 15 mmHg or less.

The incidence of PAH is increasing in older patients [51]. Currently, the median age at diagnosis of pulmonary arterial hypertension is around 68 years of age [52]. The reasons underlying this increase remain unknown, but hypotheses suggest it may be related to the increasing life expectancy in developed countries and a greater awareness of the disease [53]. As the awareness of PAH increases, clinicians must remain vigilant of the pitfalls in making the diagnosis of PAH in older patients because pulmonary artery systolic pressure increases with aging in otherwise healthy patients [10, 11]. Two of the physiologic changes of aging that contribute to an elevated pulmonary artery pressure include a decline in the pulmonary capillary volume [54] and vascular stiffening of the pulmonary arteries [55]. Several disease processes that are common in older patients also increase pulmonary artery pressures including COPD [15], idiopathic pulmonary fibrosis [56], valvular heart disease, and systolic and diastolic heart failure [53]. These relatively common comorbidities can make the diagnosis of PAH in older patients more difficult. This is further supported by the fact that older age has been shown to be associated with a longer time to diagnosis as well as a shorter overall survival [52].

The multitude of causes for an elevated pulmonary artery pressure in older patients underscores the need for a thorough diagnostic evaluation. The diagnosis is based on a mean pulmonary artery pressure on right heart catheterization to be 25 mmHg or greater and the pulmonary capillary wedge pressure to be 15 mmHg or less [45]. Transthoracic echocardiography is becoming a much more commonly used, which has likely contributed to the increase in incidence of PAH in older patients. Notably, echocardiography can be used as a screening tool for PAH, but concern for PAH warrants a right heart catheterization. A diagnosis of PAH should not be made without right heart catheterization, nor should the treatment for PAH [57]. During right heart catheterization, vasoreactivity testing should be performed to assess the likelihood of a long-term response to oral calcium blockers [58]. Positive vasoreactivity testing is defined as a drop in the mean pulmonary artery pressure (PAP) by at least 10 mmHg and achieving an absolute value for the mean PAP of 40 mmHg or less [58]. A complete and detailed evaluation is vital, as the specialized medical therapy is not efficacious for treatment outside this group.

General treatment considerations for PAH include supplemental oxygen as needed to maintain a patient's oxygen saturation >88%. Additionally, anticoagulation is generally recommended in patients with idiopathic PAH, familial PAH, drug-induced PAH, and chronic thromboembolic pulmonary hypertension. Diuretics are used as needed for symptomatic right heart failure. Routine vaccinations and regular aerobic exercise are also encouraged for all patients with PAH. Advanced therapies for the treatment of PAH include intravenous, subcutaneous, inhaled, and oral pulmonary vasculature vasodilators. Consensus guidelines recommend treatment be started when patients develop at least WHO class 2 symptoms and have group 1 PAH based on a right heart catheterization, a thorough clinical history, physical exam, imaging, and laboratory testing [59]. Therapy generally starts with oral agents, but additional oral, inhaled, and intravenous agents can be added for lack of clinical response or worsening of a patient's symptoms [59]. Fairly high-quality studies demonstrate that patients with WHO class 2 or 3 symptoms have a significantly longer time to decompensation when treated with the combination of endothelin receptor antagonist and phosphodiesterase inhibitor rather than either agent alone [60]. The efficacy of these therapies has yet to be established in an older population and has been less well studied as compared to younger patients. Results from the COMPERA registry suggest older patients are less likely to be prescribed these therapies and those who are prescribed an advanced therapy are less likely to experience clinical improvement when compared to younger patients [61]. This is associated with a lower 1-, 2-, and 3-year survival in elderly patients when compared to age- and gender-matched individuals of the general population [61]. Given the increasing prevalence of PAH and poorer outcomes in older patients, further efforts to establish the most efficacious treatment regimen for this population are warranted.

Older patients are more likely to present with New York Heart Association (NYHA) class 3 or 4 functional limitations as compared to younger patients [49]. Despite the lower functional status, older patients are more likely to have lower pulmonary artery systolic pressures and to have lower levels of pulmonary vascular resistance [49]. This is likely secondary to comorbid conditions including a general decline in conditioning with aging. Finally, older patients are less likely to have a significant clinical response to therapy, to have a significant hemodynamic response, and are more likely to experience adverse events than younger patients [49, 61, 62]. As new therapies for the treatment of PAH are developed, a focus on diagnostic accuracy and establishing the most efficacious treatment regimen for an older population is of great clinical importance.

25.1.5 Pneumonia

More older patients die of pneumonia than any other infectious disease [63]. Older patients are four times more likely to develop pneumonia than younger age groups [64], and nearly 90% of deaths due to pneumonia occur in those 65 or older [65, 66]. The mortality rate of pneumonia increases exponentially with age, from 1.3% in those younger than 45 to 26% in those over 65 [67, 68]. The increase in incidence and mortality with age has been associated with the presence of multiple comorbidities in this population including chronic respiratory and cardiovascular diseases, cerebrovascular disease, Parkinson's disease, epilepsy, dementia, dysphagia, and chronic renal or liver disease [69]. However, age itself is an independent risk factor for pneumonia [70]. Likely contributing to this is the myriad of changes with aging that impair pulmonary innate immunity. Mucociliary function is impaired with aging [14], leading to inefficient clearance of pathogens, including bacteria. There is also diminished function of natural killer cells, macrophages, and neutrophils in normal aging [71]. Lung senescence and comorbidities in older patients developing community-acquired pneumonia are associated with an 11.4% rate of readmission within 30 days [72]. Not only is pneumonia associated with morbidity and mortality in these patients, but it is also a prognostic marker.

The diagnosis of pneumonia in older patients is complicated by the fact that they have fewer symptoms. Older patients are less likely than younger patients to report cough, pleuritic chest pain, fever, or chills. They are more likely, however, to present with tachypnea [73]. They are also more likely to present with confusion or delirium [74]. Despite differences in clinical presentation, there are similarities in regard to the causative pathogens in patients both younger and older than 65 years of age. Streptococcus pneumoniae is still the most frequent cause of community-acquired pneumonia (CAP) in all patients 65 years of age or older [75], but polymicrobial infection and gram-negative organisms occur more frequently in older patients, especially if they have COPD or reside in nursing homes [67].

Guidelines developed by the Infectious Disease Society of America and the American Thoracic Society offer guidance in the selection of empiric antibiotics for community-acquired pneumonia (CAP). These guidelines take into consideration a patient's comorbidities and risk factors for being infected with drug-resistant organisms [76]. The same guidelines address aspiration pneumonia, which is more common in older people as dysphagia becomes more prevalent. At this point, there is insufficient evidence to recommend anaerobic coverage of CAP, even if aspiration is suspected, unless there is lung abscess or empyema [76]. Guidelines for both hospital-acquired and ventilator-associated pneumonia also take into consideration previous hospitalizations, comorbidities, and pretest probability of Methicillin-resistant Staphylococcus aureus (MRSA) as well as drug-resistant gram-negative organisms [77]. These considerations become especially prudent when treating an older patient population.

25.1.6 Idiopathic Pulmonary Fibrosis

25.1.6.1 Epidemiology

Idiopathic pulmonary fibrosis (IPF) occurs nearly exclusively in patients over the age of 65. It is a chronic and progressive disease marked by interstitial fibrosis of the lungs and usual interstitial pneumonia (UIP) on histology [78]. The incidence of IPF is estimated to be between 6.8 and 16.3 cases per 100,000 persons per year in the USA, while the population prevalence is estimated to be between 14.0 and 42.7 cases per 100,000 persons [79]. Both the incidence and prevalence are highest in males over the age of 65 years [79]. For example, in people age 75 years and older, the prevalence is 227.2 per 100,000 persons [71].

25.1.6.2 Pathogenesis

The pathogenesis of IPF is complex and poorly understood. The current understanding suggests that the pathogenesis of IPF is based on multiple factors including a genetic predisposition, environmental factors, and accumulation of gene mutations with aging that lead to abnormal epithelial cell growth and fibrosis [80]. Genetic mutations in epithelial cell–associated proteins predispose to the development of lung fibrosis by leading to the development of short telomeres or endoplasmic reticulum (ER) stress [80]. Environmental factors suspected to play a role in the pathogenesis include tobacco smoke [81], occupational exposures [82], and viral infections [83, 84], among others.

25.1.6.3 Diagnosis

The clinical diagnosis of IPF in older patients needs to balance making a confident diagnosis with the risk associated with testing. Typical presenting symptoms include the insidious onset of dyspnea on exertion and a dry cough, which are non-specific findings, but when considering an IPF diagnosis, the patient's age alone is predictive [85]. The older the patient, the more likely they are to have IPF and not another type of idiopathic interstitial pneumonia [85]. The diagnosis of UIP, the histological component of IPF, can be made confidently in older patients with a compatible clinical presentation by radiographic evidence of a definite UIP pattern on high-resolution CT imaging (HRCT). A definite UIP pattern consists of sub-pleural, basilar, reticular changes with honeycombing, with or without traction bronchiectasis [86]. In cases with definite UIP on imaging, a lung biopsy is not necessary. HRCT findings consistent with "Possible UIP" or

"Inconsistent with UIP" require further evaluation with surgical lung biopsy for definitive diagnosis [87]. However, the patient's age, frailty, and comorbidities should be considered when discussing the option of a surgical procedure. The 90-day mortality for surgical lung biopsy in those over the age of 70 is reported to be 15% [88].

25.1.6.4 Treatment

The treatment of IPF has focused on treating the complications of the disease and not the disease process itself, until the 2014 release of two anti-fibrotic medications, pirfenidone, and nintedanib. Although nintedanib and pirfenidone have been shown to reduce the rate of decline in FVC in patients with IPF, they have a relatively modest effect on the clinical outcomes [89–91]. There is also intolerance of these medications from gastrointestinal symptoms, which is very common in older patients. As a result, continuation of these medications at 1 year is only about 35% [92]. Thus, the focus of treatment in the majority of older patients is management of comorbidities and symptoms. Frailty is a common comorbidity in older patients with IPF, and it is associated with lower lung function, shorter 6-minute walk distances, higher symptom scores, and a greater number of functional limitations [93]. Supportive measures that improve outcomes include oxygen therapy to maintain oxygen saturations >88% and pulmonary rehabilitation [94]. Lung transplantation may also be considered in patients felt to be an appropriate candidate [87].

Unfortunately, IPF has a relatively poor prognosis. The median time of survival for patients diagnosed with IPF is estimated at 3–4 years [95]. It is still uncertain if the new anti-fibrotic medications will significantly change that prognosis, but pooled analysis suggests that pirfenidone use conveys a mortality benefit when used through 52 weeks [96].

25.1.7 Lung Cancer

It is estimated that by the year 2030, 70% of all cancers will be diagnosed in patients 65 years of age or older [97]. This includes an expectation for a significant increase in the incidence of lung cancer in this population, the majority of which will be the non-small-cell type [97]. Lung cancer is currently the most common cancer diagnosis in all people, as well as the most common cause of death from cancer [98]. Despite lung cancer typically being a cancer of older patients, lung cancer treatment for older patients is frequently extrapolated from the treatment of younger patients [99]. This raises concern regarding the safety of these treatments in an older population, where comorbidities and frailty are more prevalent. The development of immunotherapy in treating non-small-cell lung cancer has gained the interest of oncologists with a hope that it may be better tolerated in older patients. Unfortunately, older people have higher rates of immune-related adverse events and hospitalization when treated with immunotherapy [100]. This underscores the need for approaching the treatment of lung cancer in older patients with an individualized assessment and treatment plan.

In older patients with lung cancer, clinicians should consider a comprehensive geriatric assessment (CGA) to determine the patient's fitness for a given cancer treatment regimen [99]. A comprehensive geriatric assessment (CGA) is a multidisciplinary assessment of a patient's medical, psychosocial, functional, and environmental problems [101]. The CGAs can help establish the most appropriate treatment plan and follow-up for each older patient diagnosed with lung cancer [101]. Utilization of a CGA can lead to improvements in mortality as well as improvement in patient's cognitive and physical functional status [101]. See Chap. 28. The Fried Frailty Index has also been shown to predict toxicity from chemotherapy therapy regardless of age, further supporting the importance of a patient's functional status in predicting adverse effects from chemotherapy in older patients [102]. See Chap. 1.

25.2 Critical Care Medicine for the Older Patient

Physiological changes of aging alter the most common ICU admission diagnoses and the optimal treatment for these disease processes. In patients 65–85 years of age, there is an increasing incidence of ICU admission for heart failure, cardiac arrhythmias, and valvular heart disease [103]. At the same time, there is a decreasing rate of ICU admissions related to complications of diabetes, alcohol abuse, COPD, and liver failure [103]. Vulnerability factors, such as frailty, disability, and multi-morbidity, are more prevalent with age and increase the risk of adverse outcomes [104]. No matter the admitting diagnosis, an age greater than 74 is considered an independent risk factor for 30-day and 1-year mortality [103]. One of the many causes of this increased mortality may be the higher rate of delirium.

25.2.1 Delirium

Delirium is a frequent comorbid condition in older patients in the ICU ranging between 31 and 79% of all older patients [105, 106]. Increasing age and APACHE II scores are both independent risk factors for ICU delirium [107]. Studies suggest a mean time to onset of approximately 2.6 days after admission and the mean duration of signs and symptoms of 3.4 days [108]. The duration of delirium is directly related to the ICU and hospital length of stay [108] and the 1-year post-admission mortality [109]. Delirium at any point during hospitalization is an independent risk factor for mortality [105]. For these reasons, there have been continued efforts to prevent delirium when possible, to improve early recognition when it occurs and optimize treatment.

Reducing the incidence of delirium is the first priority, although up to 72% of patients 60 years of age and older present for admission to the ICU with delirium [109]. Eliminating new cases of delirium and shortening the duration of delirium when present are both important and have a similar approach.

One important factor in preventing new cases of delirium is to avoid medications that are known to precipitate it. See also Chap. 6. The list of medications associated with delirium is extensive, but the most frequent offenders are sedatives, analgesics, and anticholinergic medications. In an unadjusted comparison, patients who received benzodiazepines or opioids had an average ICU delirium duration of 5.79 days for each week at risk, compared to 3.08 days for patients who did not receive benzodiazepines or opioids [110]. Given these data, benzodiazepines should be avoided, especially in an older population. Avoiding opioid analgesics is difficult due to the prevalence of severe pain in this population, and undertreatment of pain also leads to delirium. Optimizing pain management and age-adjusting doses of opiates is warranted. Anticholinergic medications including antihistamine receptor-2 antagonists (used for gastric ulcer prophylaxis) [111] are associated with delirium in hospitalized older patients [112]. In a critical care population, anticholinergic bronchodilators are commonly used but should be avoided if possible [109].

Antipsychotic medications are commonly utilized to minimize agitation in delirious patients but are not effective in preventing delirium. Haloperidol actually increases the risk of delirium in the 24 h following administration [113] and has been shown to increase the duration of delirium [110]. All antipsychotics carry a black-box warning for increased mortality in older patients with dementia.

Environmental disturbances in the ICU that likely contribute to the development of delirium include the absence of visible daylight, transfer to another hospital unit, and use of physical restraints [114]. Noise is an established cause of fragmented and poor quality sleep in ICU patients [115]. Patient questionnaires upon discharge from an ICU suggest that diagnostic testing and interactions with medical staff are also significant contributors to sleep deprivation [116]. Sleep deprivation is hypothesized to contribute to the development of delirium [117]. Therefore, promoting an appropriate sleep–wake cycle by dimming the lights at night, avoiding excessive noise in patient rooms (such as loud TVs, radios, and conversations), avoiding stimulating the patient at night when possible, and promoting wakefulness during the day are all advocated. A lack of sensory input can be disorienting as well [118]. Patients with visual and hearing impairment benefit from having their hearing aids and glasses on whenever possible. Similarly, patients benefit from being able to read calendars and clocks, which help keep them oriented to time [118].

There has also been work toward preventing ICU delirium with tools such as the ABCDE bundle [119] into daily practice in the ICU (Table 25.3). While this approach is designed to prevent delirium, it should also be viewed as the appropriate approach for patients with delirium in an effort to correct the factors that precipitated the episode of delirium. The ABCDE acronym is broken into three parts, which will be described separately. The "ABC" portion of the acronym stands for "Awakening and Breathing trial Coordination," the "D" stands for "Delirium Assessment," and the "E" stands for "Early Mobility." The purpose of the "ABC" portion of the bundle is to limit unnecessary sedation, support early liberation from mechanical ventilation, and coordinate an interprofessional effort to achieve these goals. This consists of a daily weaning of sedation and a spontaneous breathing trial for all mechanically ventilated patients deemed appropriate. Studies have shown that this can significantly reduce the number of days of mechanical ventilation, as well as complications of mechanical ventilation [120]. Again, the "D" in the acronym stands for "Delirium Assessment." This portion of the bundle focuses on the assessment for pain, agitation, and delirium. The routine assessment of pain with an observational pain assessment instrument can decrease the ICU length of stay and decrease the duration of mechanical ventilation [121]. There are multiple pain assessment tools available, including the Pain Assessment and Intervention Notation (PAIN) algorithm, the Nonverbal Pain Assessment Tool (NPAT), the Adult Nonverbal Pain Scale (NVPS), the Behavioral Pain Scale (BPS), and the Critical-Care Pain Observation Tool (CPOT; Table 25.2) [121]. Of these pain assessment tools, the CPOT has superior validity and reliability when used in nonverbal, critically ill adults [121] (Table 25.3). The treatment of pain must be balanced with the treatment of agitation and delirium. Agitation, treated after adequate pain control is assured, can also be assessed using multiple different assessment tools. The Richmond Agitation-Sedation Scale (RASS) is a validated assessment tool for the detection of changes in sedation status over consecutive days of ICU care, which is compared against constructs of the level of consciousness and delirium, and correlated with the administered dose of sedative and analgesic medications [122]. The evaluation for delirium is an extremely important part of daily assessments in ICU patients. The CAM-ICU delirium assessment tool is a rapidly administered, highly reproducible, sensitive, and specific tool for diagnosing delirium in ventilated and non-ventilated ICU patients (Table 25.4) [123]. The final portion of the bundle focuses on "Early Mobility." The literature

Table 25.2 Critical care pain assessment tool[a]

Behavioral parameter	Description	Score
Facial expression	No muscle tension in face—Relaxed	0
	Frowning, tightening of orbit—Tense	1
	Eyelid tightly closed—Grimacing	2
Body movements	No movement	0
	Slow cautious movements	1
	Restless, agitated, trying to sit up	2
Muscle tension (passive flexion and extension of upper extremities)	Relaxed—No resistance to movements	0
	Some resistance to movements	1
	Strong resistance—Inability to complete movements	2
Compliance with ventilator/intubated patients	No ventilator alarms—Easy to ventilate	0
	Intermittent ventilator alarms—Coughing	1
	Frequent ventilator alarms—Difficult to ventilate	2
Or		
Vocalization—Non-intubated patients	Not talking or talking in a normal fashion	0
	Sighing or moaning	1
	Crying out	2

[a]A CPOT score >2 is considered a positive test for pain

Table 25.3 ABCDE bundle: For delirium prevention and morbidity reduction

Components	Description
"A" awake	Promoting sedation weaning on appropriate patients daily
"B" breathe	Daily spontaneous breathing trials on appropriate patients to promote early liberation from mechanical ventilation
"C" coordination of care	Coordinating patient care to involve the respiratory, nursing, physical therapy [126], and physician teams in the daily plan
"D" delirium assessment	Monitor delirium, pain, and agitation using validated bedside screening tools like the CAM-ICU, CPOT, and RASS
"E" early mobility	Involving the nursing staff, respiratory therapist, physical therapist, and physician in promoting early mobility

suggests that not only is early mobility in ICU patients possible, but it also enhances the recovery of functional exercise capacity, self-perceived functional status, and muscle strength at hospital discharge [124]. The use of the "ABCDE" bundle in the ICU has been shown to significantly decrease the number of days a patient spends mechanically ventilated, to significantly decrease the incidence of delirium, and to increase the number of patients who are ambulating prior to ICU discharge [125].

Table 25.4 Confusion assessment methodology for the ICU

Components	Description
1. Altered mental status or abnormal behavior	Acute change in mental status, or fluctuating changes in mental status or behavior over the last 24 h
2. Inattention	Difficulty focusing attention based on abnormal results from either the auditory or visual Attention Screening Examination (ASE)
3. Altered level of consciousness	RASS not equal to 0, so either agitated or sedated, for example, Hyperalert, drowsy, difficult to arouse, unarousable, etc.
4. Disorganized thinking	Ask to follow simple commands or answer simple questions, for example, "Hold up four fingers" "Will a rock float on water?"

Patients are considered to have delirium if 1 and 2 are present and either 3 or 4 is present [123]

25.2.2 Treatment of Agitation in ICU Delirium

Environmental factors and the ABCDE approach described above should be the initial approach to agitation. Pharmacotherapy for agitation is a subject of ongoing debate, but current opinion favors avoiding benzodiazepine sedatives. Conventional and atypical antipsychotics should be avoided unless agitation in delirium is a danger to the patient or others. Currently, there are no pharmacological interventions that are recommended for the treatment of agitated delirium [127]. When antipsychotics are used, that should be at the lowest dose and for the shortest duration possible. When using antipsychotic medications, one should consider checking an electrocardiogram (EKG) for Qt prolongation which can be a contraindication. The reader is referred to Chap. 2, for additional information on the definition, diagnostic criteria, clinical presentation, risk factors, and evaluation for this important ICU condition.

25.2.3 Invasive Mechanical Ventilation (IPV) and Non-invasive Positive Pressure Ventilation (NIPPV)

A common reason for ICU admission is respiratory failure requiring invasive or non-invasive mechanical ventilation. Aging is associated with multiple anatomical and physiological changes in the lungs that are associated with an increased susceptibility to respiratory failure [2]. There are a few special considerations in respiratory failure in the older patient.

A common cause of respiratory failure in older patients is COPD exacerbations. Outcomes are improved when acute exacerbations of COPD, resulting in acute or acute on chronic hypercarbic respiratory failure, are treated with bi-level Non-invasive Positive Pressure Ventilation (NIPPV), compared to patients treated with medical therapy alone [128, 129]. Medical therapy consists of systemic steroids, bronchodilators, and antibiotics where indicated. NIPPV therapy also decreases the likelihood of intubation and leads to shorter hospital stays as well as a lower mortality during the hospitalization and up to 1 year later [128, 129]. This evidence strongly supports the use of NIPPV in the treatment of COPD exacerbations, but careful consideration should be given to selecting the correct therapy for each individual patient. Contraindications to NIPPV include the inability to clear secretions, the inability to cooperate with the medical staff, and the inability to protect their airway [130]. Delirium is also considered a relative contraindication to NIPPV. It can lead to poor patient-device synchrony, difficulty in keeping an acceptable seal with the mask, and a greater likelihood of needing sedation to achieve adherence with therapies. Concerns for aerophagia, vomiting, and aspiration exist as well. Combined, these factors can make using NIPPV in older patients difficult and leave the patient at an increased risk for complications. Despite this, older patients suffering acute or acute on chronic hypercarbic respiratory failure associated with COPD exacerbations are more likely to be treated with NIPPV as compared to younger patients [131] although these same patients are also more likely to fail to respond to NIPPV, necessitating intubation and mechanical ventilation [131]. Unfortunately, failure of NIPPV requiring invasive mechanical ventilation (IMV) is associated with a doubling of the in-hospital mortality rate [131]. Of significance, frailty is independently associated with an increased likelihood of NIPPV failure in older patients [132]. NIPPV use has also been studied in older patients with pneumonia. The use of NIPPV in patients hospitalized with pneumonia is not associated with a significantly increased 30-day mortality, even when the patient goes on to require IMV [133]. This suggests that non-invasive ventilation is a relatively safe intervention in older patients with pneumonia.

Increasing age is independently associated with a significant increase in ICU mortality in mechanically ventilated patients [134]. The increased mortality in older patients is multifactorial. Delirium contributes to this mortality [105, 107, 109], but the patient's severity of illness and the use of vasopressors are also associated with an increased mortality in older patients who require mechanical ventilation [135]. Age is also an independent risk factor for ventilator-associated pneumonia (VAP) [136], which has a 10% attributable mortality rate [137]. Measures to prevent VAP are similar in older and younger patients. Considerations include elevation of the head of the bed, daily sedation vacations to assess patient readiness for ventilator weaning, and daily oral hygiene with chlorhexidine. There is evidence that early tracheostomy, performed less than 7 days after intubation, results in fewer VAPs in the elderly, shorter hospital stays, and a trend toward a mortality benefit [138]. This concept requires further study but is a worthwhile consideration in older patients that are experiencing difficulty in being liberated from the ventilator.

Certain patient populations require special consideration when approaching spontaneous breathing trials (SBT) to assess for readiness for extubation. Patients at high risk for re-intubation include those with significant heart disease, chronic lung disease, and older patients. A standard 30-minute SBT may not be as accurate at predicting the re-intubation rate in older patients because the studies testing it did not include high-risk patients [139]. Older patients are more likely to have comorbid heart disease and chronic lung disease, which puts them at higher risk for re-intubation [140]. Although data supporting longer SBTs in older patients are limited, it has recently been proposed that a 2-hour SBT would reduce the need for re-intubation in high-risk patients [140]. This study also proposed performing an SBT using less ventilatory support, such as using a T-piece for older patients, as this would also reduce the need for re-intubation as compared to a pressure support mode of ventilation [140]. In summary, this study suggests that older patients would benefit from a more stringent SBT to avoid early re-intubation. Adjunctive testing may also help improve ventilator liberation in these patients. Further study including randomized and controlled studies would be helpful.

25.2.4 Venous Thromboembolic Disease

Venous thromboembolic disease (VTE), including deep vein thrombosis (DVT) and pulmonary embolus (PE), is a common cause of preventable in-hospital morbidity and mortality. Approximately, 1 out of every 1000 people in the USA will develop VTE each year [126]. The incidence of both DVT and PE increases with age, for example, there is a 2.5-fold increase in DVT/PE in patients older than 80 compared to those 60–69 [141]. The increase in incidence with age is attributed to both increased prevalence of comorbid disease and age as an independent risk factor [141]. Not only is age a risk factor for VTE, it is also a risk factor for death secondary to VTE. A large population-based cohort study demonstrated a 1-year mortality from PE with or without DVT to be 52.3%, and age was an independent risk factor for mortality [142].

Diagnosing DVT/PE in older patients can be more difficult, because the clinical presentation may be more subtle than in younger patients. On the other hand, nearly one-quarter of all older patients with PE present with collapse, a significantly greater proportion when compared to younger patients [143]. There are also limitations to our standard testing in older patients. D-dimer is more likely to be elevated in older patients, and an age-adjusted D-dimer cut-off value improves specificity without sacrificing sensitivity [144].

The formula for upper limit of D-dimer age × 10 is used. Renal impairment in older patients is more likely to limit the use of contrast-enhanced CT scan. Ventilation/perfusion scans (VQ) may also be limited due to underlying lung disease in the elderly [145].

Because patients over the age of 75 already have one major risk factor for VTE, age, and are more likely to have comorbidities that put them at higher risk for VTE, chemical VTE prophylaxis is commonly indicated in this population when hospitalized [146]. Unfortunately, age is also a risk factor for bleeding complications [147–149], which can complicate the choice of VTE prophylaxis. Having said this, enoxaparin has been specifically studied in patients >75 years old, and it reduced VTE by 78% and was not associated with more adverse events than placebo [150]. Likewise, dalteparin has been shown to be safe and effective in older patients [151]. Both of these agents need dose reduction for creatinine clearance less than 30 ml/min/.

25.2.5 Sepsis

From 2012 to 2018, the number of Medicare beneficiaries admitted to the hospital with a diagnosis of sepsis rose from 811,644 to 1,136,889 [152]. Of the hospital admissions for sepsis, approximately 750,000 were for severe sepsis and more than half of these patients required ICU admission [153]. The incidence of sepsis is the lowest in young adults and climbs slowly throughout adulthood, achieving a rate of 5.3/1000 persons by the age of 65 years [153]. The incidence then sharply increases to an estimated rate of 26.2/1000 persons by the age of 85 years [153]. Not only is age associated with an increasing incidence, it is also associated with an increasing mortality rate [153]. The overall hospital mortality rate for severe sepsis is 28.6%, which represents 215,000 deaths annually [153]. When controlling for comorbidities, age is an independent risk factor for mortality [153, 154].

The cause of the increasing incidence of sepsis in older patients is likely multifactorial. The acquisition of resistant and virulent organisms by residence in nursing homes and recurrent hospital admissions [155], along with a general decline in homeostatic processes and immunological defense mechanisms in older patients [156], likely contributes. As an example, patients in this age group are at an increased risk for gram-negative sepsis, especially from pneumonia [153, 154]. Specific organ dysfunction with aging includes the decrease in mucociliary clearance [136], a weaker cough, and anatomical and physiological changes in lung parenchyma [2], which may contribute to the high incidence of sepsis in pneumonia. The incidence of urinary tract infection (UTI) and asymptomatic bacteriuria increases with age, and UTI is the second leading cause of infection in community-dwelling older patients [157]. Other comorbid conditions leading to placement of indwelling devices such as pacemakers, artificial valves, chronic indwelling intravascular catheters, and urinary catheters all contribute to the increased rate of sepsis in this population.

The approach to making a diagnosis of sepsis in older patients warrants special consideration. Studies suggest the typical signs of sepsis may be absent in this patient population. In one study, 13% of bacteremic patients with an age >65 years were afebrile, while only 4% of those <65 years were afebrile [158]. Tachycardia and hypoxemia are also less common in patients >75 years of age [159]. Lactic acidosis, tachypnea, and delirium are more commonly present in these patients [159]. Remaining cognizant of these differences is necessary to institute appropriate therapy in a timely manner. Timely treatment of sepsis is especially important in older people. Treatment within 6 hours was shown to decrease hospital mortality, even in those over 80 years of age [160].

Given the high rate of sepsis in older patient populations, there are studies and evidence suggesting improved outcomes in older patients when a "sepsis bundle" is instituted [161]. The bundle assures early and aggressive fluid administration, early antibiotic therapy, if needed, after fluid resuscitation and steroids in those with septic shock that do not respond to fluids and vasopressor therapy. The Society of Critical Care Medicine supports the use of steroids in this setting, without the need to assess the patient's response to adrenal stimulation testing prior to starting steroids [162]. In one study, the absolute risk reduction in the 28-day mortality was 16% compared to a retrospectively, matched, control group when a sepsis bundle was utilized [161]. A specific consideration is the treatment of anemia. In septic older patients, anemia should prompt transfusion to maintain a hemoglobin concentration of 7–9 g/dl [163]. In this study, maintaining a hemoglobin concentration greater than 10 g/dl did not result in improved outcomes [163]. In a separate study, older patients who developed myocardial infarction had an improved mortality when their hemoglobin concentration is kept at >10 g/dl [164]. These data suggest that in the scenario of concomitant sepsis and myocardial infarction, the goal hemoglobin concentration should be >10 g/dl, although a recent pilot study enrolling patients >55 years with critical illness and randomizing to restrictive (Hgb 7–9) versus liberal (Hgb 9–11) did not show any differences in outcomes [165]. Likewise, another study did not show any improvement in delirium with liberal (Hgb >10) transfusions [166].

The reader is also referred to Chap. 26, for additional information.

25.3 Cardiopulmonary resuscitation (CPR) Outcomes/Palliative Care and Hospice

Cardiac arrest in the elderly is often a difficult experience for providers and families. Questions regarding the patient's wishes, adverse effects associated with treatment, and expected outcomes must be answered quickly. The first and most difficult question to be answered is "what is the probability of this patient surviving and if so, will their quality of life be acceptable to them?" This can be difficult to answer, but retrospective studies suggest that age is not an independent risk factor for the inability to achieve a return of spontaneous circulation (ROSC) or for in-hospital mortality after out-of-hospital arrest [167]. This is possibly because of the overall poor prognosis associated with out-of-hospital arrest, for which survival to hospital discharge is only 4–5%, no matter the age of the patient [167]. Prognosis appears to be driven by the initial cardiac rhythm and out-of-hospital life support rather than age [167]. Studies assessing in-hospital cardiac arrest in the elderly report that only 10–18.3% of patients experiencing in-hospital cardiac arrest survived with less than 5% discharged home [168]. After suffering in-hospital cardiac arrest male gender, increasing age, a greater number of comorbid illnesses, and admission from a nursing home were all predictors of a worse prognosis [169, 170].

Another consideration not addressed by these statistics is the cognitive function, physical function, and quality of life for the patients surviving to discharge. Age and length of hospitalization prior to in-hospital cardiac arrest are both predictors of a worse functional status after Cardiopulmonary resuscitation (CPR) and also death prior to hospital discharge [170].

Palliative care and hospice programs facilitate advanced care planning in older patients and improve end-of-life care and family satisfaction. It also reduces stress, anxiety, and depression in family members [171]. With the poor outcomes in older patients suffering cardiac arrest, severe sepsis, and those with end-stage lung disease, the benefit of discussing available services and utilizing palliative treatments in these settings is warranted. The reader is referred to Chap. 7, for further information.

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26 Behavioral Neurology

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26.1 Introduction

In order to successfully interact with the world, we make use of fundamental cognitive and behavioral skills. If we lose some of these capabilities, as occurs with dementing conditions, previously familiar activities such as driving, cooking, taking care of finances or social engagement become difficult. Brain disorders in older adults jeopardize functional independence due to the associated cognitive decline. The World Alzheimer Report 2015 estimates that every 3 seconds someone in the world developed dementia and 46.8 million people live with dementia [1]. The prevalence of dementia doubles every 5 years in individuals between the ages of 65 and 85 years and continues increasing after the age of 90 years [2]. The vast majority of cases are caused by neurodegenerative diseases, like Alzheimer's disease (AD), but there is also a high prevalence of cerebrovascular disease as a single or mixed etiology. In a small number, we find reversible causes of cognitive impairment [2–5].

Clinicians who are knowledgeable about cognitive impairment are able to provide better care for their geriatric patients. Early detection can lead to implementation of medical and lifestyle interventions as a potential way to delay or reduce cognitive decline [6, 7] and allows for the evaluation of reversible causes such as infections (HIV, syphilis), metabolic changes (hypothyroidism, hypercalcemia), or vitamin deficiencies (B12) [8]. Accurate and timely diagnosis helps guide treatment management and facilitates guidance for advance care planning. When diagnosis is determined early in the illness, it maximizes the likelihood that patients participate meaningfully in decision-making [9]. Discussion of what to expect is particularly important in neurodegenerative diseases. Knowing the expected clinical progression helps families and patients provide context to conversations and when decision-making is necessary, it allows the individual to guide management over the course of their illness, even after they have lost cognitive skills.

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26.2 Cognitive Aging, Mild Cognitive Impairment, and Dementia

Even early in the illness, cognitive changes can be present in one or more domains, such as memory, attention, executive function, language, visuospatial abilities, and behavior (refer to Tables 26.1 and 26.2 for examples). If a patient or family member expresses concern regarding any of these domains, the symptoms require formal evaluation as they often reflect the beginning of a neurodegenerative condition. Yet, according to the World Alzheimer Report in 2019 almost 62% of health-care providers worldwide think that dementia is part of normal aging [10]. For this reason, we begin by describing some of the nonpathological age-related cognitive changes.

Cognitive aging is a lifelong process of gradual, ongoing, yet highly variable changes in cognitive functions that occur as people age [11]. Some of the most common patterns of age-related changes include slower processing speed, decreased attention (selective and divided, i.e., multitasking), and working memory (ability to temporarily hold information in one's mind while it is processed or used), slower learning process, and effortful retrieval [11, 12]. By contrast, autobiographical memory, semantic knowledge, and emotional processing remain relatively stable as we age [13]. Some components of the clinical history help to discern if the reported concerns are due to cognitive aging or represent a neurodegenerative condition. For example, many healthy people have infrequent and nondisruptive memory lapses, such as the occasional inability to remember a word or a name and, while common at all ages, this is even more common with healthy aging [14]. Asking patients if their deficits are comparable to their peers can be useful, although self-awareness of deficits is often absent with dementias [15]. Hence, obtaining information from a knowledgeable informant is critical, whenever possible. Administration of brief

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Table 26.1 Cognitive domains

Cognitive domain	Common complaints
Memory	Forgetting recent events and important conversations Difficulty keeping track of appointments or medications Repetitiveness Misplacing objects frequently
Attention	Distractible Attentional fluctuations
Executive functions	Slower cognitive processing speed Difficulty planning or organizing Poor judgment and problem-solving
Language	Word finding difficulties Decreased speech output Effortful speech Word substitutions or speech sound errors Grammatical errors in verbal or written language Impaired reading or comprehension
Visuospatial skills	Topographical disorientation Getting lost in familiar places Difficulty recognizing objects or faces

Table 26.2 Behavior, sleep, and autonomic symptoms

Domain	Common complaints
Motor & coordination	Difficulty walking Imbalance Frequent falls Muscle weakness Involuntary movements like tremor, muscle jerking (myoclonus), and muscle twitching (fasciculations) Changes in handwriting or fine motor movements Swallowing difficulty
Behavior & mood	Irritability/lability Emotional blunting Apathy Disinhibition Delusions Hallucinations Agitation/aggression Depression, anxiety, restlessness Decreased empathy Changes in eating habits and weight Repetitive behaviors and compulsions
Sleep	Insomnia Hypersomnia Snoring and apneas Dream enactment behavior Poor reparative sleep and sleeping throughout the day
Dysautonomia	Lightheadedness/orthostatic hypotension Constipation Anosmia

cognitive assessments (refer to the next section) can help identify cognitive impairment. When patients have high scores on cognitive screening but, a subtle dementia is suspected, a full neuropsychological battery can provide an objective measure of cognitive deficits by comparing results to normative data accounting for age and education differences. We recommend performing a thorough evaluation before concluding that a change is due to normal cognitive aging. When there is uncertainty regarding whether there is progressive decline, a second evaluation, 6–12 months later, should be considered.

While the separation of *mild cognitive impairment (MCI)* from normal cognitive aging can be difficult, MCI is characterized by progressive decline associated with cognitive deficits in one or more domains without significant loss of function in the ability to perform activities of daily living. MCI can be subdivided into amnestic and nonamnestic subtypes, depending on whether or not memory is the predominant deficit [16]. When cognitive difficulties have progressed to a point when a person needs assistance in order to be able to function in daily life, we categorize them as suffering from *dementia* or from a *major neurocognitive disorder*, according to the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-V) [17, 18]. The differentiation between MCI and dementia is based on an accurate description of daily affairs, which needs to be corroborated with a reliable informant.

Predicting dementia progression in patients with MCI is complex but important for the development of early therapeutic interventions. While some patients with MCI do not progress to dementia and a few even improve, most progress, and with the advent of biomarkers like amyloid imaging, the ability to determine whether the MCI is due to Alzheimer's disease (AD) is possible [19, 20]. Longitudinal studies suggest that the annual rate of conversion to dementia ranges from 8% to 15%, with amnestic-MCI carrying the highest risk of progressing to Alzheimer's disease [21, 22]. A meta-analysis that included approximately 15,000 participants from 16 countries revealed that certain risk factors predicted progression from MCI to AD: atrophy of the hippocampus, medial temporal lobe, and entorhinal cortex, presence of APOEε4 allele, abnormal CSF p-tau and total-tau, depression, and diabetes [23].

26.3 Cognitive Testing

Multiple brief cognitive assessments have been developed to detect cognitive impairment. Two of the most commonly used are the Mini-Mental State Examination (MMSE) [24] and the Montreal Cognitive Assessment (MoCA) [25]. It is important to mention that these are screening tests (Table 26.3) and are not a substitution for a full neuropsychological evaluation, particularly in cases where there is diagnostic uncertainty.

The clinician should anticipate some factors that can affect the patient's performance or influence the interpretation of

Table 26.3 Cognitive testing

Screening instruments	Notes
MMSE: Mini-Mental State Examination	One of the most well-known tests Does not include executive function items
MoCA: Montreal Cognitive Assessment	Available in various versions and languages Certification enforced by developers
RUDAS: Rowland Universal Dementia Assessment Scale	Well studied cross-culturally
SLUMS: Saint Louis University Mental Status	Studied in US veterans
Memory Alteration Test (M@T)	Well studied in a low-literacy population
CSI-D: Community Screening Interview for Dementia	Useful in a low-literacy population. Includes informant interview and cognitive testing

results. For example, accommodating for sensory impairment when necessary, particularly for vision and hearing by ensuring that glasses or hearing amplifiers are available. Educational attainment should always be considered before interpreting results, and more recently some evidence exists that also early-life educational quality and literacy in late life explain race-related disparities in late-life cognitive function [26].

When evaluating older adults who belong to an ethnic minority and have a low educational attainment or illiteracy, the clinician should use a test that has less cultural, language, and educational bias. Some instruments that have been validated in these scenarios include the Rowland Universal Dementia Assessment Scale (RUDAS) studied cross-culturally [27–30] and the Memory Alteration Test (M@T) in populations with low literacy [31, 32], as well as instruments that combine a cognitive test and an informant interview like the Community Screening Interview for Dementia (CSI-D) [33].

Box 26.1 Vignette

A 74-year-old man presented with 6 years of progressive memory problems. Initially, he noticed difficulty at work when trying to remember information from documents and needed to rely on notes to keep up with plans. This made his work difficult, and he decided to retire. Over the year prior to assessment, his memory continued to worsen, and he developed mild word-finding difficulties. He acknowledged more irritability and difficulty staying asleep, frequently awakening in the middle of the night. He was quite concerned about his memory problems, but his wife believed his problems were mild and not much worse than other people his age. She noticed that he had problems troubleshooting on the computer and poorer planning skills, but he successfully carried on with all activities of daily living. His MMSE was 21/30 with points deducted for orientation, delayed recall, and missing 1 step out of 3 on a three-step command. A geriatric depression scale score was low at 5/30 with a few points for cognitive items and worry. Neuropsychological testing revealed severe deficits in visual and verbal memory as well as executive function below expected for age. Magnetic resonance imaging (MRI) showed disproportionate atrophy of medial temporal lobe, including hippocampi. He was diagnosed with amnestic-MCI, with concern for underlying Alzheimer's disease pathology. A year later, he was diagnosed with Alzheimer's type dementia.

This case illustrates the importance of objective evaluation by cognitive assessment after a report of cognitive concern, whether the complaint comes from the patient or the caregiver. Generally, there is congruence of appraisal for cognitive deficits between the informant and the patient during earlier stages of the illness. As cognitive deficits worsen, the emergence of higher informant concern, compared to patient's awareness, has been found to occur particularly at later stages [34, 35]. Yet, sociocultural differences in perceptions of early cognitive decline and education may influence the informant's report. It has been reported that among African Americans, informants may underestimate mild cognitive changes as compared to their Caucasian counterparts. No differences were found between groups, when patients were at a dementia stage [36, 37]. One of the two studies attributed the difference to the informant's lower educational attainment, and we should always keep in mind that race serves as proxy for social determinants of health that often explain disparities, and may have not been explicitly described or assessed.

26.4 Causes of Dementia and Underlying Neuropathology

Dementias are classified clinically into syndromic categories which predict with different degrees of certainty the underlying neuropathology. Diagnostic criteria have been introduced and updated for Alzheimer's disease (AD) [17, 38, 39], dementia with Lewy bodies (DLB) [40], behavioral variant frontotemporal dementia (bvFTD) [41], primary progressive aphasia (PPA) [42], progressive supranuclear palsy (PSP) [43], corticobasal syndrome (CBS) [44], and prion disease [45, 46]. There is greater controversy regarding the criteria

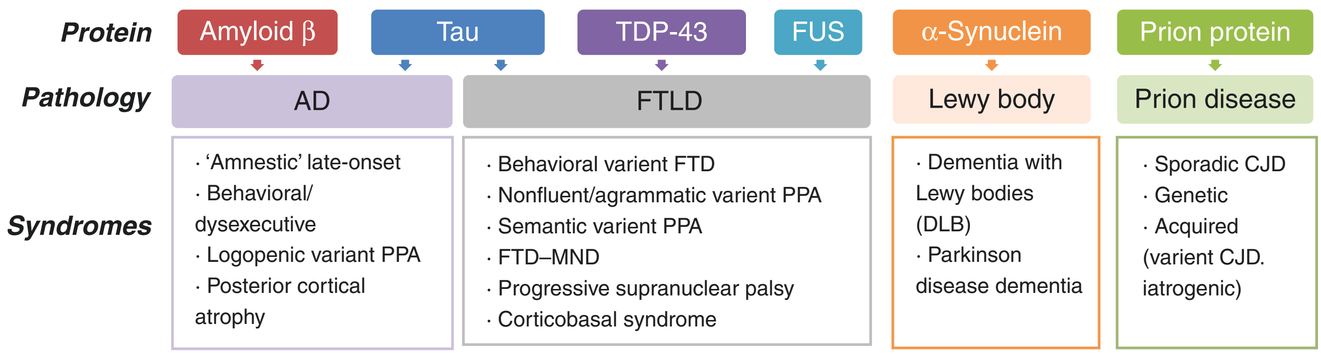

Fig. 26.1 Clinicopathological spectrum of neurodegenerative diseases. (Modified with permission from: Elahi and [49]). AD Alzheimer’s disease, CJD Creutzfeldt-Jakob disease, FTD frontotemporal dementia, FTD-MND FTD with motor neuron disease, FTLD frontotemporal lobar degeneration, PPA primary progressive aphasia

for vascular dementia, and it is well accepted that vascular dementia often coexists with Alzheimer’s disease and other degenerative conditions [47, 48]. The degenerative dementias can be categorized according to the pathological changes and the accumulation of abnormal protein aggregates in specific regions of the brain (Fig. 26.1) [49].

Typically, the process of protein aggregation precedes the appearance of clinical deficits by years. For example, with Alzheimer’s disease it is now accepted that amyloid deposition begins 20 years before the onset of symptoms [50]. Also, in the old and very old, autopsy studies show that people with or without dementia often have multiple comorbid pathologies [51–53]. How is it that some individuals develop symptoms while others do not? This brings up the concept of *cognitive reserve,* defined as the “adaptability of cognitive processes that helps to explain differential susceptibility of cognitive abilities or day-to-day function to brain aging, pathology, or insult.” Differences in cognitive reserve are determined by the interaction of innate individual differences (e.g., in utero, or genetically determined) and lifetime exposures (educational and occupational attainment, general cognitive ability or intelligence, and engagement in activities that are cognitively, socially, and physically stimulating) [54, 55]. The concept of cognitive reserve is critically important because if we could better understand the factors that allow an individual to resist the neurodegenerative process, it could help with the design of novel therapies.

26.5 Alzheimer’s Disease

Alzheimer’s disease (AD) is the most common form of dementia worldwide and makes up 60%–80% of all dementia cases [3, 14]. The neuropathological hallmark is the dual accumulation of extracellular aggregates of amyloid protein (neuritic plaques) and intracellular aggregates of hyperphosphorylated tau protein (neurofibrillary tangles) in the brain [49]. Some risk factors associated with developing AD include cerebrovascular disease, diabetes, smoking, obesity, traumatic brain injury, the presence of ApoE e4 allele, and having a first-degree relative with AD [3, 56]. Often, AD presents with an amnestic syndrome, characterized by progressive deficits in episodic memory (memories of events and their temporal-spatial relations). This can manifest with difficulty remembering recent conversations or events, repetitive questioning, or misplacing items frequently (see Table 26.1). Cognitive testing will show early weaknesses in delayed recall and category fluency (i.e., generating lists of animals) and as the disease progresses, difficulties in visuoconstruction and executive function [57]. Other presentations of AD are characterized by early changes in behavior or executive function (behavioral/dysexecutive AD) [58], language deficits, particularly with word retrieval (logopenic primary progressive aphasia (lvPPA)) [42] and visuospatial deficits (posterior cortical atrophy). The last two are more common in early-onset AD, meaning before age 65 [59].

Neuroimaging shows disproportionate atrophy of hippocampi, precuneus, and posterior cingulate cortex in classic amnestic AD syndrome and posterior-predominant atrophy (i.e., precuneus and posterior cingulate) is generally a feature across all AD syndromes [60, 61] (Fig. 26.2). The use of AD biomarkers for detection of tau and amyloid in positron emission tomography (PET) imaging is expensive and, therefore, currently it applies mainly to research. Cerebrospinal fluid (CSF) biomarkers are available for clinical use and can be used to rule in a diagnosis of AD. AD is characterized by low amyloid beta-42 and high tau in the CSF. Keeping in mind that roughly a third of cognitive normal older adults in their late 70s have amyloid positivity [50, 62]. New blood-based biomarkers for both amyloid and tau are emerging and also appear to have great promise for affirming the diagnosis of AD [63, 64].

Recently, a new disease entity that causes an amnestic syndrome in the oldest old has been described to cause a very similar presentation to AD, but with a different underlying pathology: Limbic-predominant age-related TDP-43 encephalopathy or “LATE” [65]. Currently, there is no way to confirm this diagnosis in vivo, but this should be considered by clinicians, since it is likely to have implications for treatment in the future.

Although older adults experience age-related *sleep changes* due to circadian rhythm disruptions (earlier bedtime and awakening times, inability to fall asleep or remain asleep), patients with neurodegenerative diseases frequently experi-

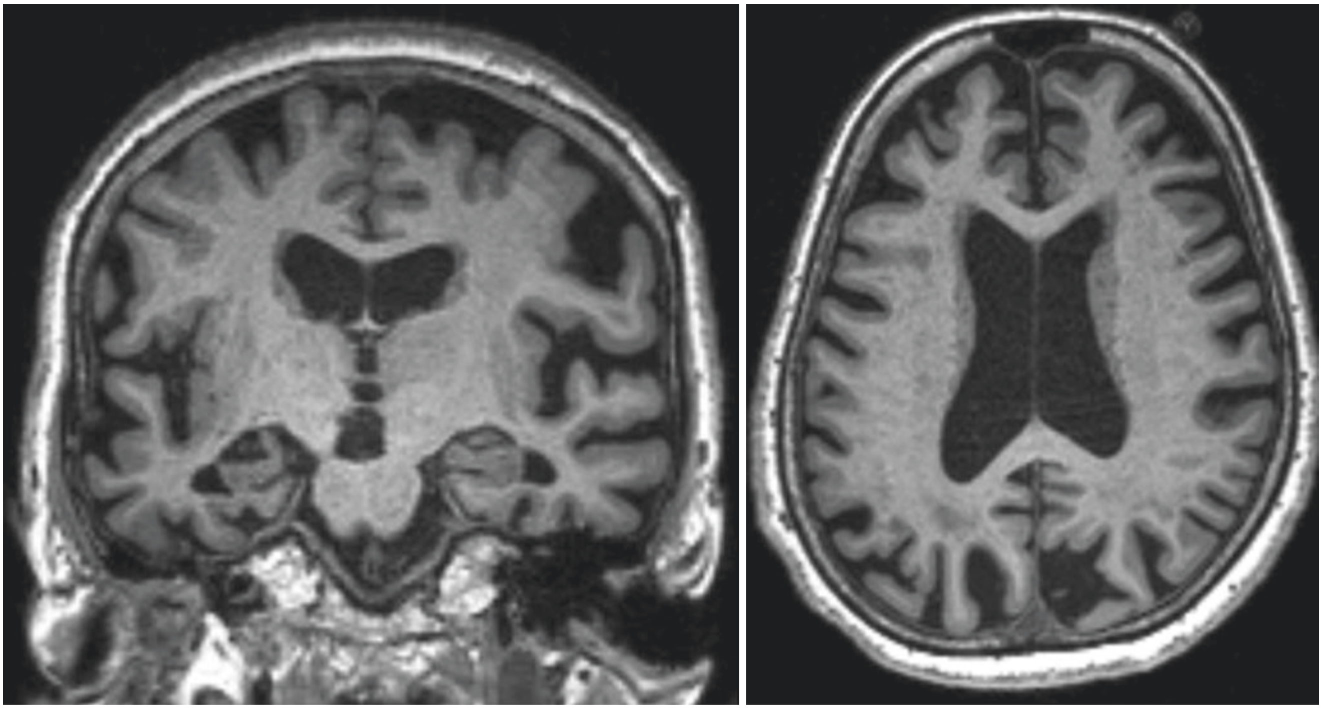

Fig. 26.2 Magnetic resonance imaging (MRI) of classic Alzheimer's disease (AD). MRI of a 74-year-old woman with 5 years of short-term memory loss, followed by navigational, planning, and organization difficulties. Predominant atrophy of dorsoparietal cortex, moderate atrophy of bilateral hippocampi, and mild dorsofrontal atrophy

ence more severe sleep disruptions. In AD, patients can present with an irregular sleep-wake rhythm disorder, with lack of a clear 24-hour sleep-wake pattern, usually with long periods of wakefulness during the night and irregular bouts of sleep throughout the day. This worsens as the disease progresses. Physiologically, wake-promoting neurons (WPNs) and sleep-promoting neurons compete for dominance through mutual inhibition, creating a systematic "switch" that results in either sleep or awake state. It has been found that tau protein accumulates in the brainstem and subcortical regions early in the disease trajectory of AD [66], where WPNs are located, and they have been found to be highly vulnerable in AD as compared to other neurodegenerative diseases [67, 68] which could explain the early sleep changes in AD.

It is well accepted that patients with underlying dementia have an increased risk of seizures, particularly in Alzheimer's disease [69, 70]. Often these seizures appear early in the course of illness and can even be the presenting sign of AD. Seizures are more common in the genetic forms of AD and with early age of onset [71–73]. The predominant seizure subtype in AD is a nonmotor complex partial seizure [74]. Fluctuations in awareness, cognition, or behavior may be the only clue that seizures are occurring. Given that its presence can hasten cognitive decline, the clinician should be aware of this correlation, to offer a timely diagnosis and treatment. When seizures are suspected, a 24-hour electroencephalogram (EEG) should be considered.

Box 26.2 Vignette

A 75-year-old-man with a history of hypothyroidism, obstructive sleep apnea (OSA), and depression and anxiety since his mid-40s, previously hypertensive now off medication due to orthostatic hypotension. He presented with 4 years of behavioral and cognitive changes. Family initially noted apathy, and he had decreased interest in playing golf and reading. He had progressive memory complaints that led to his retirement. He then developed increased irritability, anxiety, and new panic attacks. He had navigational problems and difficulty seeing things in front of him and described the appearance of shadowy figures just behind his field of view (extracampine hallucinations). His wife reported dream enactment behavior 2 years before his appearance in the clinic. On examination, he had signs of parkinsonism with decreased blink rate, axial rigidity, and mild bilateral upper extremity bradykinesia. Tremor was not present. Gait was wide based with decreased left arm swing and inability to do tandem walk. His MMSE was 18/30 with points deducted for orientation, world backward, delayed recall, pentagons, and repetition. A full neuropsychological battery revealed primarily visuospatial and executive function weaknesses.

26.6 Alpha-Synucleinopathies: Parkinson's Disease Dementia (PDD) and Dementia with Lewy Bodies

DLB and PDD lie along a clinicopathological spectrum, characterized by intracellular α-synuclein aggregates (Lewy bodies) in the brainstem, cortex, and substantia nigra, with the main difference between the two, the temporal relationship of parkinsonism relative to cognitive and neuropsychiatric changes. DLB should be diagnosed when dementia or visual hallucinations and fluctuation in attention occur before or within a year of appearance of parkinsonism [40]. DLB accounts for about 5% of all dementia cases in older adults [75]. DLB and PDD have a slightly increased male-to-female ratio [76, 77]. Having a first-degree relative with Parkinson's disease (PD) increases the risk, particularly if the family member had younger onset PD [77, 78]. Pesticide exposure is linked to PD and is a risk factor for PDD and DLB [49]. The core clinical features of DLB are recurrent visual hallucinations (typically of people or animals) [79], attentional fluctuations, rapid eye movement (REM), sleep behavior disorder (RBD), and parkinsonism. Supportive clinical features include autonomic dysfunction and neuropsychiatric symptoms like apathy, anxiety, and depression (refer to Table 26.4 for diagnostic criteria) [40]. Interestingly, like in the case of vignette 2, there has been some evidence that mood disorders presenting after age 45 might signal a neurodegenerative movement disorder [80]. The patient in the clinical vignette 2 clearly met the criteria for DLB and had a typical neuropsychological profile with disproportionate executive function, attentional, and visual processing deficits relative to memory and naming, as compared to AD [81], although memory deficits are usually evident with progression. Brain MRI of patients with DLB may not be diagnostically informative, as patients often have diffuse mild cortical atrophy with no distinct regional pattern; however, preservation of the medial temporal lobe can help differentiate from AD [61]. Clinicians can consider a polysomnography when the bed-partner reports dream enactment behavior, particularly if there is concern for obstructive sleep apnea (OSA), given that severe OSA can be a mimicker for RBD [82].

Table 26.4 Clinical diagnostic criteria for most common neurodegenerative disorders

Probable Alzheimer's disease dementia (Adapted from McKhann et al. [17]) Meets the criteria for dementia and has the following characteristics: A. Insidious onset (gradual over months to years). B. Clear-cut history of worsening of cognition by report or observation. C. Initial and most prominent cognitive deficits by history and examination in one of the following: (a) Amnestic: impairment in learning and recall of recently learned information. Deficits in other cognitive domains should be present. (b) Nonamnestic: (i) Language presentation: most prominent deficits are in word-finding, but deficits in other cognitive domains should be present. (ii) Visuospatial presentation: most prominent deficits are in spatial cognition, including object agnosia, impaired face recognition, simultanagnosia, and alexia. Deficits in other cognitive domains should be present. (iii) Executive dysfunction: most prominent deficits are impaired reasoning, judgment, and problem-solving. Deficits in other cognitive domains should be present. Possible diagnosis of Alzheimer's disease dementia Atypical course: has a sudden onset of cognitive impairment or demonstrates insufficient historical detail or objective cognitive documentation of progressive decline. Etiologically mixed presentation: evidence of (a) concomitant cerebrovascular disease, defined by a history of stroke temporally related to the onset or worsening of cognitive impairment; or the presence of multiple or extensive infarcts or severe white matter hyperintensity burden; or (b) features of Dementia with Lewy bodies other than the dementia itself; or (c) evidence for another neurological disease or a non-neurological medical comorbidity or medication use that could have a substantial effect on cognition.
Dementia with Lewy bodies (DLB) (Adapted from McKeith, et al. 2017) Meets criteria for dementia. Deficits on tests of attention, executive function, and visuoperceptual ability may be especially prominent and occur early. Prominent or persistent memory impairment may not necessarily occur in the early stages but is usually evident with progression. Core clinical features (probable DLB 2 or more; possible DLB 1 core feature) Fluctuating cognition with pronounced variations in attention and alertness Recurrent visual hallucinations that are typically well formed and detailed REM sleep behavior disorder, which may precede cognitive decline One or more spontaneous cardinal features of parkinsonism: bradykinesia, resting tremor, or rigidity. Supportive clinical features Severe sensitivity to antipsychotic agents; postural instability; repeated falls; syncope or other transient episodes of unresponsiveness; severe autonomic dysfunction (e.g., constipation, orthostatic hypotension, urinary incontinence); hypersomnia; hyposmia; hallucinations in other modalities; systematized delusions; apathy, anxiety, and depression. DLB should be diagnosed when dementia occurs before or concurrently with parkinsonism. The term Parkinson's disease dementia (PDD) should be used to describe dementia that occurs in the context of well-established Parkinson's disease. DLB is less likely, if parkinsonian features are the only core clinical feature and appear for the first time at a stage of severe dementia.

Table 26.4 (continued)

Behavioral variant frontotemporal dementia (bvFTD) (Adapted from Rascovsky et al. [41])

I. Neurodegenerative disease

Progressive deterioration of behavior and/or cognition by observation or history (as provided by a knowledgeable informant) must be present.

II. Possible bvFTD

At least three of the following features (symptoms must be persistent or recurrent, rather than single or rare events)

- A. Early[a] behavioral disinhibition [one of the following]:
  - A.1. Socially inappropriate behavior
  - A.2. Loss of manners or decorum
  - A.3. Impulsive, rash, or careless actions
- B. Early apathy or inertia
- C. Early loss of sympathy or empathy
  - C.1. Diminished response to other people's needs and feelings OR
  - C.2. Diminished social interest, interrelatedness, or personal warmth
- D. Early perseverative, stereotyped, or compulsive/ritualistic behavior [one of the following]:
  - D.1. Simple repetitive movements
  - D.2. Complex, compulsive, or ritualistic behaviors
  - D.3. Stereotypy of speech
- E. Hyperorality and dietary changes [one of the following]:
  - E.1. Altered food preferences
  - E.2. Binge eating, increased consumption of alcohol or cigarettes
  - E.3. Oral exploration or consumption of inedible objects
- F. Neuropsychological profile: executive/generation deficits with relative sparing of memory and visuospatial functions [all of the following]:
  - F.1. Deficits in executive tasks
  - F.2. Relative sparing of episodic memory
  - F.3. Relative sparing of visuospatial skills

III. Probable bvFTD

Possible bvFTD + significant functional decline + imaging supported

Frontal and/or anterior temporal atrophy OR hypoperfusion or hypometabolism on PET/SPECT

Exclusion criteria:

Deficits are better accounted for by other nondegenerative nervous system or medical disorders, or by a psychiatric diagnosis.

If biomarkers are strongly indicative of Alzheimer's disease or other neurodegenerative processes, can only be "possible bvFTD" and not probable.

[a]As a general guideline "early" refers to symptom presentation within the first 3 years

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Primary progressive aphasia (PPA) (Adapted from Gorno-Tempini et al. [42])

To meet the criteria for PPA, all of the following need to be present:

1. Difficulty with language is the most prominent clinical feature.
2. These deficits are the principal cause of impaired daily living activities.
3. Aphasia should be the most prominent deficit at symptom onset and for the initial phases of the disease.

Exclusion criteria:

Pattern of deficits is better accounted for by other nondegenerative nervous system or medical disorders, or by a psychiatric diagnosis

Prominent initial episodic memory, visual memory, and visuoperceptual impairments

Prominent, initial behavioral disturbance

Semantic variant PPA (svPPA)

1. Impaired confrontation naming AND
2. Impaired single-word comprehension

PLUS, three of the following:

1. Impaired object knowledge, particularly for low-frequency or low-familiarity items
2. Surface dyslexia or dysgraphia
3. Spared repetition
4. Spared speech production (grammar and motor speech)

Imaging-supported svPPA: predominant anterior temporal lobe atrophy

Nonfluent/agrammatic variant PPA (nfPPA)

1. Agrammatism in language production OR
2. Effortful, halting speech with inconsistent speech sound errors and distortions (apraxia of speech)

PLUS, two of the following:

1. Impaired comprehension of syntactically complex sentences
2. Spared single-word comprehension
3. Spared object knowledge

Imaging-supported nfPPA predominant left posterior fronto-insular atrophy

Logopenic variant PPA (lvPPA)

1. Impaired single-word retrieval in spontaneous speech and naming AND
2. Impaired repetition of sentences and phrases

PLUS, three of the following:

1. Speech (phonologic) errors in spontaneous speech and naming
2. Spared single-word comprehension and object knowledge
3. Spared motor speech
4. Absence of frank agrammatism

Imaging-supported lvPPA: predominant left posterior perisylvian or parietal atrophy

Box 26.3 Vignette

A 70-year-old woman presented with 4 years of behavioral and cognitive changes. Her family initially noticed social withdrawal, and she spent most of her time using her iPad or watching TV, instead of engaging with her grandchildren. Later on, when visiting her daughter who lived out of town, she seemed disinterested in activities she would have previously enjoyed and stayed at home and watched TV. Her daughter started to feel that she was not as interested in her life, and on one occasion during a time she was crying, the patient laughed.

She exhibited poor judgment and social disinhibition. She hit a parked car and left the scene of the accident and drove home. Her husband noticed a dent in the car, and when confronted, she answered "I hit somebody." At this point, the family insisted that she stop driving. She cut in line at the store and tried to take off her shirt in public when she became hot. On a few occasions, she walked out unexpectedly from a restaurant. She developed mental rigidity and obsessive behavior, becoming regimented in her routines and meal schedule. She insisted on eating the same food every day and watched the same episode of certain TV shows over and over again. She became obsessed about the weather, providing exact details about the forecast. She started *hoarding* cans of tomatoes. She became *disorganized*, which was very uncharacteristic of her. She had *difficulty balancing her checkbook*, missed payments, and could not calculate a tip at a restaurant. Later on, her family also noticed some *memory problems*, such as difficulty following a story line and remembering events. Her MMSE was 21/30, missing points for orientation (season, floor, and county), delayed recall, and spelling world backward (working memory). A full neuropsychological evaluation showed predominantly impairment in executive function, and working memory, although she also had poor verbal memory. During her examination, she showed poor insight into her deficits, and she was filing her nails during the interview. Her brain MRI showed out-of-proportion frontal atrophy and insula as well as mild degree of atrophy of the temporal and parietal lobes.

26.7 Frontotemporal Dementias

The frontotemporal dementias (FTDs) are a group of disorders characterized by predominant deficits in behavior and language. The three core syndromes are behavioral variant FTD (bvFTD) and two primary progressive aphasias (PPAs), nonfluent/agrammatic variant PPA (nfPPA) and semantic variant PPA (svPPA) [83, 84]. FTD is a leading cause of early-onset dementia, but it can also be seen in the geriatric population. Studies have reported that about one in four FTD cases has late-onset presentation (at age 65 or later) [85, 86]. Additionally, diagnosis is often made 2.5 years into the disease trajectory [87]. Almost 40% of patients have a significant family history of dementia. Nonetheless, heritability varies between FTD subtypes, including genes with autosomal dominant inheritance [88].

Progressive disturbance in personality, social comportment, and cognition is the hallmark of bvFTD [41], as seen in vignette 3. To meet diagnostic criteria, these features need to be present: behavioral disinhibition; apathy or inertia; loss of empathy or sympathy; perseverative, stereotyped, or compulsive/ritualistic behavior; hyperorality and dietary changes; and a neuropsychological profile that is primarily dysexecutive, sparing of memory and visuospatial skills (refer to Table 26.4). Not surprisingly, bvFTD is misdiagnosed as a psychiatric disease in up to 50% of cases [89]. Brain MRI can aid in diagnosis, if there is disproportionate atrophy of frontotemporal structures such as insula, anterior cingulate, anterior temporal lobes, striatum, amygdala, and thalamus [61, 90]. Although in advanced stages, the disease will affect areas of hippocampi and parietal lobes [91] (Fig. 26.3).

Language-predominant FTD syndromes include svPPA and nfPPA. Word-finding difficulties tend to be a common complaint in PPA, but a careful history and evaluation will show other problems as well. Patients with svPPA have problems with semantic memory (the organized knowledge we possess about words, objects, facts about the world, their meaning and referents, like a verbal and visual thesaurus essential for communication) and present with anomia and single-word comprehension deficits, initially for low-frequency words, for example they might have difficulty thinking of the difference between a slug and a snail. Although not part of the diagnostic criteria, oftentimes they have behavioral disturbances including compulsions and decreased empathy. Predominant anterior temporal lobe atrophy is characteristic on a brain MRI. In contrast, nfPPA presents with effortful speech (slow and labored speech production) and/or agrammatism (use of short, simple phrases and omissions of grammatical morphemes) in their written and verbal communication. Predominant left posterior fronto-insular atrophy on MRI is characteristic. A third type of PPA, mentioned earlier, "logopenic" is an atypical presentation of Alzheimer's disease, hence not part of FTD spectrum disorders (see Table 26.4 for diagnostic criteria). FTD-related syndromes that have motor predominant symptoms include progressive supranuclear palsy (PSP) syndrome [43] and corticobasal syndrome (CBS) [44, 92] (refer to Table 26.5 for more details).

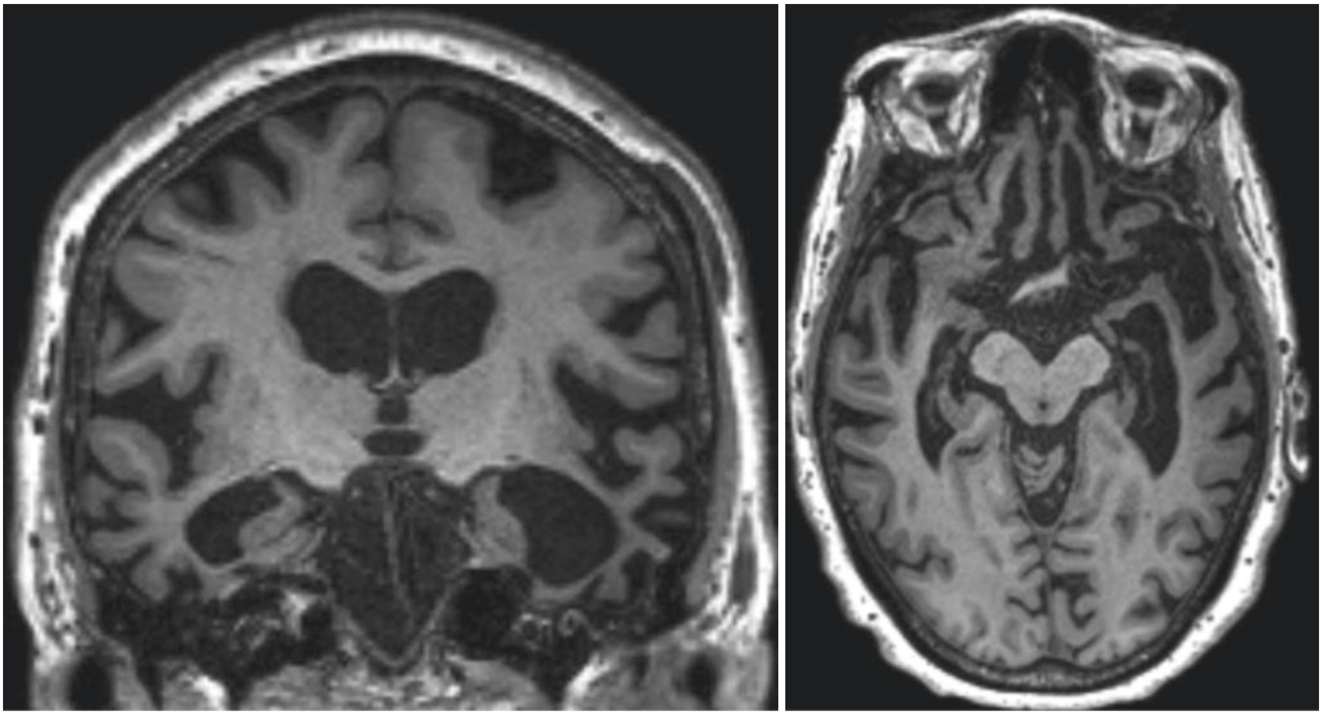

Fig. 26.3 Magnetic resonance imaging (MRI) of an 82-year-old patient with behavioral variant FTD. Predominant focal atrophy in the anterior and inferior temporal, orbitofrontal, and insular regions, right worse than left. Orientation is neurological (right-hand side of the figure is the right side of brain)

Table 26.5 FTD spectrum with prominent motor features

FTD-MND (1)	Overlap FTD + ALS Behavioral symptoms Upper motor neuron signs (hyperreflexia, spasticity, and slow speech) AND Lower motor neuron signs (fasciculations, muscle atrophy, and weakness) Frequently: pseudobulbar affect
PSP (2)	Postural instability (frequent falls) Oculomotor dysfunction Atypical parkinsonism Cognitive dysfunction Frequently: early dysphagia and dysarthria Behavioral symptoms: apathy, impulsivity, inattention, personality changes Depression is common Sleep disturbances: insomnia Brainstem atrophy
CBS (3)	Motor signs (limb dystonia, rigidity, akinesia, or myoclonus) AND Cortical signs (apraxia, cortical sensory loss, and alien limb phenomena).

FTD-MND frontotemporal dementia-motor neuron disease, *ALS* amyotrophic lateral sclerosis, *PSP* progressive supranuclear palsy, *CBS* corticobasal syndrome
(1) Lomen-Hoerth [139]; (2) Armstrong et al. [44]; (3) Höglinger et al. [43]

All of these clinical presentations belong to the frontotemporal lobar degeneration (FTLD) spectrum, a pathological entity characterized by neurodegeneration of cortical and subcortical structures within frontal and temporal regions of the brain, which have diverse molecular pathologies with the majority caused by intracellular aggregates of tau or TDP-43 protein [49] (Fig. 26.1).

26.8 Vascular Cognitive Impairment

Vascular cognitive impairment (VCI) encompasses MCI and dementia associated with cerebrovascular disease. Identifying a temporal relationship between a vascular event with the onset of cognitive deficits makes a diagnosis of VCI clearer, although it is not necessary. As long as there is evidence of vascular injury by neuroimaging, a diagnosis of possible VCI can be considered. In many occasions, mixed pathology contributes to the deficits with VCI [47]. Vascular dementia is the second most common cause of dementia. Studies have shown that up to 30% of patients develop a major neurocognitive impairment within 3 months after a stroke [4]. VCI can be caused not only by a large vessel disease (cortical infarcts), but also by a small vessel disease (subcortical), as well as ischemic and/or hemorrhagic etiologies [93], and it can be sporadic or occasionally inherited, with CADASIL syndrome being the most frequent within this category.

Small vessel disease (SVD) is the most common cause of VCI. Classical brain MRI features include white matter hyperintensities on T2FLAIR and lacunar infarcts (cavitating lesions typically in the white matter or subcortical gray matter on T1 sequence) [61]. White matter abnormalities of SVD typically affect frontostriatal circuits, correlating with observed deficits in attention, processing speed, and executive function [4]. Choosing an instrument that appropriately assesses these cognitive skills is an important consideration, and for this reason, the MMSE has been shown to be relatively insensitive in detecting VCI [94]. Hence, when administering only a brief assessment, the MoCA or another instrument that has more items of executive function is preferred. Noncognitive symptoms are often seen in patients with VCI, such as irritability, apathy, and depression. Clinical features that are supportive of VCI found during neurological examination include the presence of focal findings from a previous vascular insult, extrapyramidal signs "vascular parkinsonism," and motor deficits observed in gait [95].

26.9 Rapidly Progressive Dementia

Although there is no clear definition of rapidly progressive dementia (RPD), the term is accepted when dementia develops in less than 1 year from the onset of first symptom [96]. Confirming this timeframe after taking a careful history and ruling out delirium are key first steps. Also, it is important to perform a full review of symptoms and medications used. The vast majority of RPDs are nonprion neurodegenerative diseases; the second most common cause varies among studies reporting prion disease and secondary/reversible dementias [97–99]. Diagnostic accuracy is important given the possibility of a potentially treatable cause, such as immune-mediated disorders, infections, metabolic disorders, and malignancy [96, 100], but also for providing guidance to the family and patient, if the cause is deemed incurable. Prion disease or CJD (Creutzfeldt-Jakob disease) is a neurodegenerative disease with very poor prognosis. It is caused by the conversion of the normal prion protein into an abnormal form in the brain by three mechanisms: spontaneous (sporadic), genetic (familial), and acquired (transmitted). Sporadic CJD is the most common type, with a median age of presentation at 67 (55–75 years), and it has a mean survival of 6 months. Ninety percent of patients die within a year [101]. The classic clinical presentation involves not only cognitive/behavioral abnormalities, but also ataxia (usually gait), extrapyramidal features, and, eventually, myoclonus.

An initial RPD screen includes a routine work-up for cognitive impairment (complete blood count, comprehensive metabolic panel, TSH, vitamin B12 level, folate, as well as HIV and RPR) and neuroimaging. A brain MRI can help identify findings typical of CJD such as cortical ribboning and deep nuclei restricted diffusion (Fig. 26.4), or abnormalities consistent with encephalitis, vasculitis, infarcts, tumors, etc. The CSF analysis can provide clues to diagnosis by detecting pleocytosis, inflammation, or positive tests of rapid neuronal injury (total-tau). Particular tests can be ordered, depending on the clinical scenario, for example, EEG when seizures are suspected, RT-quIC in CSF if CJD is in the differential, or autoimmune encephalopathy panel in blood and serum, if an autoimmune encephalopathy is suspected (typically has a subacute onset ~3 months), among other toxic/metabolic and infectious workup depending on the clinical case [96, 102].

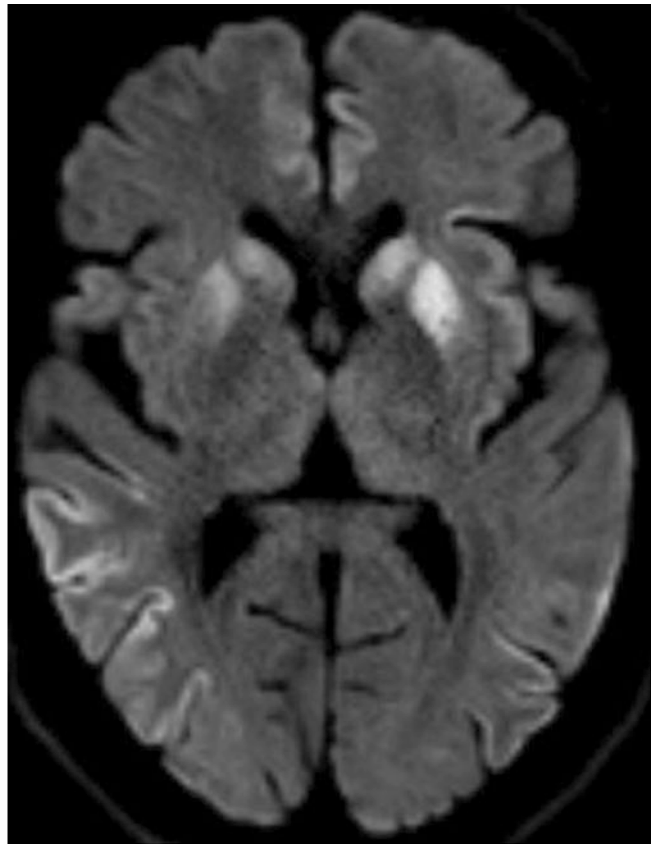

Fig. 26.4 Magnetic resonance imaging (MRI) of sporadic CJD. A 71-year-old woman with 1 year of memory loss, worsening executive dysfunction, and gait difficulties. Gait ataxia and mild parkinsonism on examination. DWI images show cortical ribboning of multiple cortical structures and hyperintensity of the deep nuclei bilaterally

26.10 Neuropsychiatric Symptoms of Dementia

Nearly all patients with dementia and more than 50% of patients with MCI have at least one neuropsychiatric symptom during the course of the disease [103, 104]. These include delusions, hallucinations, agitation/aggression, depression, anxiety, elation, apathy, disinhibition, irritability, aberrant motor behaviors, nighttime behavior, and changes in appetite/eating. These symptoms are associated with decreased quality of life, functional decline (independent of cognition), nursing home placement, increased caregiver burden as well as caregiver stress, regardless of patient's residence [105–107].

Although agitation/aggression is highly prevalent in patients with dementia [104, 108], apathy is the most common neuropsychiatric symptom across different forms and stages of dementia [109, 110]. Depression and apathy are the most frequent symptoms in both MCI and dementia and are often confused. Apathy is characterized by diminished motivation in self-initiated goal-directed behavior (like in vignettes 2 and 3), cognitive goal-directed behavior (paucity of ideas and curiosity), or emotional goal-directed behavior. Approach to neuropsychiatric symptoms will be discussed in the next section.

26.11 Prevention and Management of Cognitive Impairment

It is estimated that approximately 40% of worldwide dementias could be prevented or delayed by addressing 12 modifiable risk factors during a person's life-course. Forty percent! These risks include less education, hearing impairment, hypertension, obesity, excessive alcohol consumption (>21 units/week, equivalent to 12 standard drinks/week, since 1 unit = 8 g of pure alcohol), traumatic brain injury (TBI), air pollution, low physical inactivity, social isolation, smoking, diabetes, and depression [111]. Modifying the last six risk factors even after age 65 can have a positive impact. Starting with physical activity, the WHO recommends at least 150 minutes of moderate-intensity aerobic exercise throughout the week and a Mediterranean-like diet to adults with normal cognition and MCI to reduce the risk of cognitive decline. We recommend this goal, but patients can try to be as active as physical ability allows. Additionally, appropriate management of vascular risk factors is always recommended to promote brain health and decrease further decline. Doing a good review of medications and discontinuing any that could be contributing to cognitive deficits is important. Common offenders are first-generation antihistamines that have an anticholinergic effect, like diphenhydramine or sedating medications like benzodiazepines.

Patients with cognitive impairment often live with multimorbidity and have difficulty managing their health and navigating the health-care system, eventually relying on their caregivers for these responsibilities. For this reason, care in the continuum of cognitive impairment requires a holistic and multidisciplinary approach that addresses medical and psychosocial needs of the patient to optimize health and well-being, as well as providing support to caregivers [112]. The prototypical Comprehensive Geriatric Assessment (CGA) can be particularly useful in dementia, given that a multidimensional evaluation process identifies the needs of the patient, followed by multidisciplinary interventions that foster a personalized care plan, incorporating the patient's circumstances and caregiver's support [113, 114].

In terms of disease-specific medications, currently there are no disease-modifying treatments that can be offered to patients with a neurodegenerative disease, but extensive research efforts continue. Medical management has focused on symptomatic treatment that is FDA approved for patients with Alzheimer's dementia. Cholinesterase inhibitors, like donepezil and rivastigmine, boost levels of the neurotransmitter acetylcholine and have small benefits for cognitive function, activities of daily living, and clinician-rated global clinical state at all stages of the disease [115–117]. Significant benefits have also been observed in patients with DLB and Parkinson's disease dementia with positive impact on behavioral disturbances and cognitive function (particularly with attention) [118–120]. In our experience, we always recommend this medication when AD and DLB is in the differential diagnosis, unless the patient has intolerable side effects. Some of the side effects include gastrointestinal (nausea, diarrhea), vivid dreams, and bradycardia. Rivastigmine should be given as a patch rather than a pill, due to less gastroinstestinal side effects in this form. Memantine, an NMDA-receptor antagonist, reduces clinical deterioration in moderate-to-severe AD [121], and there is some evidence that it has some benefit in diminishing behavioral disturbances in AD [122]. In FTD, cholinesterase inhibitors have been mostly associated with worsening of cognitive and behavioral symptoms, and memantine has shown no benefit [123, 124].

Treatment of behavioral disturbances can be the most challenging, and the first-line approach should be a nonpharmacological intervention, except when the risk of harm to patients or caregivers is present. In behaviors that are severe and have a risk for injury, we start with an atypical antipsychotic in parallel with nonpharmacological strategies. The first step is to understand the behavior in question and possible triggers by doing a good semiology of the symptom. Following the DICE approach can be very helpful [106], this acronym stands for Describe, Investigate, Create, and Evaluate. A good example is "agitation" which can mean a myriad of things for people. Understanding the behavior by asking the questions who, what, when, and where can be enlightening. Careful history-taking and observation is key as it allows the provider to identify possible modifiable causes that might be related to patient (pain, illness, medication changes, etc.), caregiver (i.e., communication styles, unrealistic expectations), and/or environment (i.e., over- or understimulating environment). Knowing the level of distress of caregivers and patients will also guide the plan. For example, if low levels of distress are associated with a symptom like nonbothersome hallucinations, no further intervention is needed other than reassurance. A personalized plan for each dyad (patient-caregiver) should be created to address the particular behavior and follow-up should happen soon after to evaluate if it was beneficial or further interventions are needed. In general, caregiver education and referral to support groups are always warranted, as well as ensuring that the patient has a schedule that provides engaging activities.

When medications for behavior are needed, antidepressant SSRIs have been associated with a reduction in symptoms of agitation, when compared to placebo [125]. These studies have included sertraline and citalopram. Empirically, escitalopram is likely to provide the same benefit as citalopram, with likely a safer cardiac profile. The FDA has a maximum recommended dose of citalopram of 20 mg/day for people older than 60 years of age due to the risk of QT interval prolongation, which may limit its use. There is currently a clinical trial to evaluate the safety and efficacy of escitalopram for agitation. As mentioned earlier, atypical antipsychotics are sometimes necessary; however, it is important to discuss with families their side effect profile, including somnolence and risk of gait problems, and that they carry a FDA black box warning of increased risk of death and cerebrovascular adverse events [126, 127]. Some of the drugs commonly used in this group, include risperidone, olanzapine, and quetiapine. Compared to quetiapine, risperidone has more extrapyramidal symptoms, hence it should be used judiciously or avoided in patients with DLB. Trying the lowest dose possible with the desired benefit is highly recommended [128].

Sleep disturbances are also common, and it is important to first rule out and treat other causes that could be contributing, like nocturia or obstructive sleep apnea, as well as implementing known recommendations for sleep hygiene. Use of melatonin is controversial, but generally considered innocuous. Hence, it can be tried, and if sleep difficulties continue to be problematic, low-dose trazodone should be considered [129]. One of the advantages of trazodone is that it does not interfere with deep sleep which is the time when memories are consolidated and when tau and amyloid are cleared from the brain. Benzodiazepines and nonbenzodiazepine hypnotic "Z drugs," such as zolpidem, should be avoided, as they are in the Beers criteria for potentially inappropriate medication in older adults and interfere with deep sleep [130].

It is important to discuss with the patient and their family safety measures and advance care planning. As part of a safety assessment, providers should inquire about wandering behavior and risk of getting lost, cooking and fire hazard, driving adequacy [131], use of heavy machinery or appliances that could cause harm, and access to firearms [132]. Screening for social isolation and loneliness (perceived isolation) is important in this patient population, due to its association with poor outcomes. If present, interventions to increase social support, such as referral to available community resources, are recommended [133, 134]. Unfortunately, patients with cognitive impairment are vulnerable to financial scams, and implementing measures to protect their assets by educating them and their caregivers is necessary, so that they can be proactive about financial planning. Lastly, advance care planning should always be discussed with patients and their families. Due to the progressive nature of neurodegenerative diseases, patients will lose their cognitive capabilities and with time will be less able to communicate their wishes. Hence, the earlier this discussion takes place, the better [9]. Prognosis varies depending on the type of neurodegenerative disease and the clinical severity [85, 87, 135, 136] (refer to Table 26.6), and universally, patients with dementia eventually develop swallowing difficulties. It is well accepted that tube feeding in persons with advanced dementia does not offer any benefits. Hence, it is not recommended [137]. Estimating survival in advanced dementia is difficult; however, a study that included nursing home patients with dementia showed that the presence of pneumonia, febrile episodes, and eating problems were associated with high 6-month mortality [138]. When available, patients with advanced dementia who have a life expectancy of 6 months or less can be offered hospice services. The provider can use the functional assessment staging tool (FAST) to have a sense of the clinical severity of the illness. Some of the benefits that have been observed with use of hospice include lower risk of dying in the hospital or being hospitalized in the last 30 days of life. Also, this approach is associated with a higher frequency of treatment for pain and dyspnea, and families report have greater satisfaction with patient care [137].

Table 26.6 Survival estimates of neurodegenerative diseases from symptoms' onset

Alzheimer's disease	6.6 years[a] (age dependent)
Dementia with Lewy bodies	6.1[a]
Behavioral variant FTD	8.7[a]
Semantic variant PPA	11.9[a]
Nonfluent/agrammatic variant PPA	9.4[a]
FTD-MND	3 years[a]
PSP	5.1 years[b]
CBS	6.8 years[b]
Sporadic CJD	6 months[b] (4–17 months)

FTD frontotemporal dementia, *PPA* primary progressive aphasia, *PSP* progressive supranuclear palsy, *FTD-MND* frontotemporal dementia-motor neuron disease, *CBS* corticobasal syndrome, *CJD* Creutzfeldt-Jakob disease

[a]Median; [b]Mean

References: Wolfson et al. [135]; Mueller et al. [136]; Johnson et al. [85]; Coyle-Gilchrist et al. [87]; Geschwind [101]

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27 Geriatric Dermatology

Justin Endo, J. Klint Peebles, and Rita Lloyd

27.1 Overview

We define an older or geriatric person as being at least 65 years of age in accordance with the National Institute on Aging [1]. At least one-third of dermatology outpatient visits in the United States were with older patients, and this number has been rising with the aging of the population [2–4].

One of the challenges and joys of caring for older patients is addressing the unique psychosocial and medical needs of this heterogeneous population [5, 6]. However, studies have shown many medical schools do not require a geriatrics clerkship [7]. Dermatology residency programs also likely have formal curricular gaps in preparing physicians in geriatric care [8]. Without structured and deliberate geriatric training, dermatologists might be less prepared to provide nuanced care for older adults [9]. The goal of this chapter is to provide evidence-based and expert-recommended content to help fill these gaps.

We will first present conceptual frameworks for approaching geriatric dermatology patients and contrast it with that of younger adults. Next, we will review special considerations for safely prescribing medications and age-related physiologic changes in the skin and immune system. Then, we will discuss selected subpopulations, including ethnic skin, homeless, and LGBTQI individuals. The rest of the chapter will cover conditions more common in older adults and practical management tips.

Case 1: An 89-year-old female with mild cognitive impairment, coronary artery disease, chronic lymphocytic leukemia, and severe hand and shoulder osteoarthritis presents with diffuse actinic keratoses on her face, arms, hands, and chest. She has a history of two squamous cell skin cancers (the most recent was 2 years ago). You coincidentally note a 3 mm pearly papule on the right cheek, which has not been symptomatic (Fig 27.1). The family thinks it has been present for a year but has not been bothering her or rapidly growing. She has been unintentionally losing weight, having difficulty swallowing food and pills, and is falling more frequently. The patient's family says she has an upcoming appointment with her hematologist for "abnormal blood tests." She has been living alone, but the family is thinking about transitioning her to an assisted living facility. She also complains of an itchy back without rash.

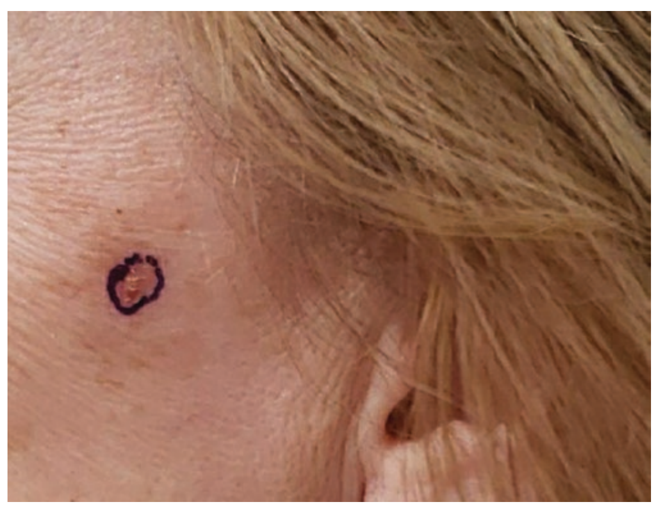

Fig. 27.1 Case 1: Basal cell carcinoma

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27.2 Frameworks for Approaching Geriatric Patients with Skin Conditions

In a landmark and thought-provoking article, Linos et al. challenged the assumption that geriatric dermatology – managing skin conditions in older adult patients – is the same as "plain dermatology" [10]. The current author [JE] would agree with Dr. Linos and colleagues. As life expectancy has increased in some countries, the medical complexity of older adults has followed suit [11]. General medical knowledge, the armamentarium of diagnostics and therapeutic options, and healthcare system costs have also increased over time [12]. However, healthcare providers are under increasing productivity pressures [13]. How are we to reconcile these challenges and do what is best for our older patients?

Linos et al. adapted existing best practices of geriatric care from internal medicine and geriatrics to dermatology [10, 14–16]. Their framework provides a suggested approach to older adults, which might differ from younger adults. See Table 27.1 for these geriatric dermatology principles. Best prescribing practices will be discussed in a separate section below.

Table 27.1 Geriatric dermatology principles

Geriatric dermatology principle	Examples
Consider *life expectancy* over chronological age	Some patients in their 60s or 70s might have multiple comorbidities or lifestyles that reduce their life expectancy more than otherwise healthy 80-year-old people
Weigh the *lag time* of intervention to probable benefit	When screening or treating a patient, the clinician should consider whether the patient is likely to live long enough to reap benefits from the intervention
Follow *best prescribing practices*	Older adults might take more medications and have physiologic changes that alter pharmacokinetics and pharmacodynamics
Cognitive status	Most older adults do not have dementia [233]. But when patients have significant memory impairment, the clinician must consider not only their capacity for informed consent but also whether the patient is likely to *cooperate* with a treatment plan or procedure
Functional ability/mobility	Potential for falls in phototherapy units Challenges in applying topical medications or with dressing changes due to arthritis
Caregivers	Although most older adults are community dwelling, some rely on families or social support networks for transportation and/or treatment plan discussions and adherence
Integrate *patient preferences* into care plans	The dermatologic management plan should consider the patient's big picture and integrate, when possible, their values and priorities in their current stage of life ("What matters most") [16]

Adapted from Linos et al. [10]

27.2.1 Life Expectancy and Lag Time to Benefit

The first two principles in Table 27.1 overlap somewhat and will therefore be discussed together here.

Many factors contribute to life expectancy including comorbidities, sex, age, and frailty [17]. However, age is but one factor. The clinician should be on guard to avoid ageism – "a process of systematic stereotyping of and discrimination against people because they are old…and subtly [ceasing] to identify with their elders as human beings" [18]. There are several calculators available which provide relatively accurate life expectancy estimates, including eprognosis.ucsf.edu.

The concept of lag time to probable benefit has been well characterized in low-grade prostate cancers. When patients have relatively indolent tumors that do not impact quality of life toward the end of life expectancy, the potential risks and associated costs might outweigh the theoretical benefits of treating such cancers in older adults [10].

Case 1 highlights two dilemmas of management decisions for basal cell carcinoma and actinic keratoses given the patient's somewhat guarded prognosis and life expectancy due to nondermatological comorbidities. Basal cell carcinomas (BCCs) are common and generally slow-growing tumors that rarely metastasize or cause death [19, 20]. Linos et al. have noted the increasing number of diagnosed and treated BCCs over time and questions whether treating *some* of these tumors in older adults toward the end of life might offer diminishing returns [21]. It is important to emphasize that rapidly growing, symptomatic, or cosmetically sensitive tumors should still be considered for treatment [15].

Actinic keratoses (AKs) are thought to be a precursor (or at least a marker of overall risk) of squamous cell carcinoma (SCC). The rate of progression cited in the literature is quite broad, but is probably fairly low in the current author's opinion [JE] [22]. In about one-fourth of cases, thin AKs might self-resolve [23]. In this scenario, the clinician should thoughtfully consider these factors when counseling patients and suggesting treatment options. Chronological age should not be the ultimate deciding factor in management.

27.2.2 Cognitive Status

There are two important aspects of a patient's cognition. The first is the patient's ability to engage in an informed consent discussion for treatment and procedures. The second is the patient's ability to tolerate and adhere to them. It is important to point out that an individual's ability to have decision-making capacity might depend on the complexity, context, and stakes of the decision [24]. Moreover, if a patient understands and articulates treatment options but declines medical advice, this action does not constitute lack of capacity [25].

There are several published best practices for obtaining informed consent, which are beyond the scope of this chapter [26, 27]. We will highlight potential pitfalls with older dermatology patients. One common medicolegal pitfall is a misunderstanding about healthcare decision proxies. In the US ambulatory setting, a healthcare power of attorney (HCPOA) is a commonly encountered term. While there are variations across legal jurisdictions, the primary purpose of this document is to assign healthcare decision-making authority to another individual. However, this document is only "activated" when the patient has been deemed incapacitated by healthcare providers. Not uncommonly, medical trainees, patients, and their families might assume the presence of the document – without verifying whether it has been activated – serves as the ability to bypass the patient in decision-making. Another point of confusion is the difference between a financial power of attorney and the HCPOA. These are two separate legal documents. Therefore, the dermatologist should confirm whether a reference to a "power of attorney" is, in fact, for healthcare; and whether the document has been activated. Partnering with the primary care provider or a social worker can be helpful to address capacity concerns. In some cases, an ethics committee might need to be involved [28].

A common scenario in a busy dermatology clinic is bypassing the patient for decision-making – particularly if an outspoken caregiver is present or if the patient has presbycusis. While caregivers have an important perspective and can be involved in discussions, exercise caution to ensure the patient is also included in a noncoercive way.

Patients with dementia have several unique issues that must be considered beyond the obvious challenges of gathering history from collateral sources or determining capacity for consent. One example is a patient's ability to follow commands during procedures. Some patients with dementia might feel discomfort or fear. They may startle easily or have difficulty verbally expressing their needs. In turn, they might exhibit aggressive behavior or become agitated. The clinician must be attuned to nonverbal gestures (e.g., tense body posture and restlessness), which might be surrogates for expressing pain or other forms of discomfort (e.g., needing to use the restroom). See Table 27.2 for other suggestions.

Table 27.2 Optimizing dermatological procedures in adults who have dementia

Consider scheduling longer procedures in the morning to avoid sundowning (increased agitation in the late afternoon and evening hours) [30]
Recommend timed toileting before procedures
Pay attention to nonverbal expressions
Have a family member or familiar caregiver present, when possible
Minimize surgical suite traffic
Communicate using simple, concrete terms and sentences – particularly before noxious stimuli such as anesthetic injection or cauterization
Use nonpharmacological management of dementia behavioral symptoms whenever possible (e.g., music and other distraction techniques) [30]. Pharmacological and physical restraints can increase the risk of respiratory depression, paradoxical worsening agitation, or confusion

Best practices adapted from Whitely et al., 2003, except where indicated [29]

27.2.3 Functional Ability and Mobility

The below section on best prescribing practices highlights several practical considerations of how comorbidities and functional status can impact treatment plans or disease risk. A few additional common examples will be provided here. A common scenario is a patient with a dermatological condition for whom you might consider phototherapy. It is important to look for obvious gait instability during the examination and inquire about falls risk factors (e.g., history of frequent falls, gait imbalance, grip strength weakness, benzodiazepine use, and severe cognitive impairment) because full body phototherapy might not be a safe choice [31]. Another example is a patient who might need assistance (either from clinic staff or a willing neighbor) to help with postprocedural wound care. Immobilized patients might be at risk for developing pressure injury.

27.2.4 Caregivers

The above sections on cognitive status and functional ability describe how caregivers serve important roles in patients with physical or cognitive limitations. Another example is some older adults might rely on others for transportation to appointments, so scheduling might require careful coordination with a third party.

27.2.5 Integrating Patient Preferences

When synthesizing all the above principles, it is critical to frame treatment plans and counselling in terms of "what matters most" to the patient [14, 16]. The current author [JE] contends the patient's autonomy must be balanced with the patient's desired health outcome goals and preferences. Rather than giving an exhaustive list of management options and deferring to the patient to decide, the provider should thoughtfully present viable options that address the patient's care goals and standard of care – including the risks and benefits of no treatment. It is equally important to guard against making ageist assumptions (e.g., a patient beyond a chronological age not being concerned about scars or wanting aggressive treatment). This step is particularly critical toward the end of life. In Case 1, the provider should clarify the patient and family's overall care goals before administering dozens of cryotherapy treatments and/or prescribing field therapy [10]. If some lesions were symptomatic or functionally problematic, treatment might focus on those.

Case 2: A 77-year-old patient with a decade of psoriasis complains of ongoing flares and pruritus despite trying many "salves" that he received from his primary care doctor and you. The patient cannot remember the names of the topical medications, and it sounds like he randomly applies them on an inconsistent basis. Some of the medications were too expensive for him to refill consistently. He has not seen you for over a year, and he is frustrated with poorly controlled skin disease. The patient has about 9% body surface area involvement with thick scale and excoriations. He is somewhat thin. There is severe xerosis throughout the body. Past medical history includes type II diabetes that is well controlled with oral medication and lifestyle modification, hypertension, history of myocardial infarction with symptomatic severe systolic heart failure, hyperlipidemia, and benign prostatic hypertrophy. He estimates taking at least two dozen oral and topical medications for his various conditions. Serum creatinine is at upper limits of normal.

27.2.6 Best Prescribing Practices

There are several age-related physiologic changes that affect pharmacokinetics and pharmacodynamics (see below section). Older adults tend to consume more medications and have about a two- to threefold increased risk of hospitalization for untoward drug events compared to children and younger adults. Many of these costly hospitalizations are thought to be preventable with thoughtful prescribing and "deprescribing" approaches [32, 33]. Thus, the astute dermatologist should be aware of key geriatrics prescribing principles that differ from managing other age groups. We will review a systems-based and patient-centered approach called the "Geriatric Dermatology Prescription Cycle" that synthesizes best prescribing practices from the geriatrics literature, as it pertains to dermatologists [34].

The geriatric dermatology prescription cycle consists of eight steps that we recommend periodically performing with older adult patients (see Fig. 27.2). In order to make these steps practical, we recommend a team-based approach for medication reconciliation. Several of the proposed tasks can be delegated to clinic staff or pharmacist, thus freeing the busy clinician.

The first step is to review interim health status or medication changes. For example, if the patient was diagnosed with a terminal illness or has started medications that could interact with dermatologic prescriptions, they should be noted. The "brown bag" method for medication reconciliation can be helpful [35]. The patient or caregiver is asked to bring all dermatologic medications to visits. A staff member verifies what the patient is taking and how they are doing it, to help identify medications that might be obsolete, inappropriately used, or newly prescribed by another provider. In other cases, a staff member might need to contact the patient's pharmacies to determine which medications were dispensed and when. Both of these techniques might be helpful in reconciling medications for Case 2.

The second step might seem paradoxical. Stopping or tapering medications is just as important as knowing what medication to prescribe. The number of prescriptions increases the likelihood of adverse drug events independent of age [36]. Several factors can predispose older adults to take unnecessary or redundant medications. It is not uncommon for older adults to see multiple prescribing specialists, and treatments may not necessarily be coordinated. In fact, approximately 40% of patients identify a specialist as being their predominant care provider [37, 38]. Furthermore, it is not uncommon that management plans change over time but patients might continue using obsolete prescriptions [39]. Duplicative prescribing can also unintentionally occur when patients confuse generic and trade names [40]. In Case 2, the patient likely requires most of his nondermatologic medications because of his multiple comorbidities. But his topical regimen can probably be simplified to improve adherence, reduce waste and financial concerns.

Another example is when patients have been prescribed a medication intended for a short course (e.g., antihistamine), but additional refill requests – either from the patient or an automated message from the pharmacy – unwittingly cue the provider to continue the medication. If the patient is benefiting from a medicine and not having untoward side effects, it is appropriate to continue. But patients who might be at high risk for common geriatric syndromes (e.g., falls) or medication adherence challenges like polypharmacy (taking multiple medications) might benefit from stopping unnecessary medicines, particularly for certain medications that are known to have a higher side effect profile in older adults (refer to Table 27.3). In other cases, a skin condition might have improved to the point that the medication could be stopped or tapered to find the lowest possible therapeutic dose.

The third step is to determine whether a new systemic therapy has a high potential for causing adverse drug events (ADEs) in older adults. For instance, a first-generation sedating antihistamine would increase the risk of falls and urinary retention in Cases 1 and 2, respectively. If feasible, a topical regimen with a lower side effect profile might be a safer option. Another common scenario is postprocedural pain control. An ice pack or acetaminophen might be more appropriate rather than an opioid [41]. The Beers list (see Chap. 6) is one commonly cited evidence-based set of medi-

Fig. 27.2 Geriatric dermatology prescribing cycle. Adapted from Lai and Endo [34]

cations that have a higher risk for ADEs in the older population.

The fourth step is to determine whether there might be potential medication interactions. Table 27.3 lists common examples, which include warfarin. If there are no alternative treatment options, coordinate with the other prescribing provider to ensure that appropriate monitoring or dose adjustment is attempted to reduce the likelihood of an ADE. Some electronic medical record systems will provide automated alerts. Alternatively, a drug interaction tool such as ePocrates, Lexicomp, or MicroMEDEX can be used.

The fifth step is to determine whether the patient can adhere to the medication regimen. In Case 1, the patient will probably be unable to apply a topical medication that comes in a small tube that would be difficult to open with hand arthritis. Furthermore, it would be impossible for the patient to reach behind the back to apply it without some assistance or an assistive device (e.g., back lotion applicator). Another simple technique to facilitate applying topicals to the posterior body is securely taping plastic wrap to a wall, applying the topical medicament to the plastic wrap, and then leaning while rubbing against the surface. Some pharmacies can package medications in arthritis-friendly containers. Pill organizers can be helpful for patients who take multiple medications throughout the day. For older Americans who live on a fixed income or lack prescription insurance coverage, cost can be a significant barrier. Approximately 20% of older adults have difficulty affording their medication [42]. Many pharmaceutical company-sponsored medication discount programs exclude patients on Medicare [43]. However, some retail pharmacies or programs such as goodrx.com provide cash discounts for medications that are not covered by insurance. Case 1 highlights the challenges of patients who are unable to swallow whole pills. If there is a question about whether a patient can swallow medications, consider referring the patient for a swallow study. Some patients might be able to better tolerate pills that are crushed (if the medication and formulation allow) or are in liquid form.

The sixth step is to ensure clear communication of the treatment plan with the patient and caregivers. It is important to articulate the rationale for medications, realistic treatment expectations, and therapeutic endpoints (e.g., stop the prescription steroid whether rash clears and resume as necessary). Sometimes sensory impairment (e.g., presbycusis or

Table 27.3 Common dermatologic medications that might require dose adjustment, interact with other common medications, or have other potentially adverse effects in older adult patients

Medication	Renal dose adjustment	Cytochrome P450 metabolism	Pharmacokinetic notes	Example of medication interaction	Potential consequences in older patients
Acyclovir	Y				Delirium and nephrotoxicity
H1-antagonists (particularly first-generation antihistamines)		Diphenhydramine is potent [a]CYP2D6 inhibitor	Hydroxyzine is very lipophilic and has prolonged half-life in older patients	Counteracts cholinesterase inhibitors (might aggravate dementia)	Constipation and delirium
H2-antagonists	Y			Increases warfarin levels	Risk of mental status changes at creatinine clearance <50[b]
Azathioprine	Y			Decreases warfarin levels	
Benzodiazepines					Excessive sedation, falls, delirium, and fractures
Cephalosporins	Cephalexin			Many cephalosporins increase warfarin levels	
Cetirizine	Y				
Chloroquine	Y				Unknown if older patients, especially with existing macular degeneration or renal insufficiency, are at higher risk than younger healthy adults for ocular toxicity
Ciprofloxacin	Y	[a]CYP1A2 inhibitor		If taken with systemic corticosteroids, increases tendon rupture risk Increases warfarin levels	Prolonged QTc, delirium, and tendon rupture (especially if taken with systemic corticosteroids)
Colchicine	Y				Risk of gastrointestinal, neuromuscular, and bone marrow adverse events[b]
Cyclosporine	Y	[a]Metabolized by CYP3A3/3A4 Increases digoxin levels			Nephrotoxicity risk
Dapsone		[a]Metabolized by CYP3A3/3A4			May cause hemolytic anemia, which might not be tolerated in patients with cardiopulmonary disease or baseline anemia
Dicloxacillin				Decreases warfarin levels	
Doxepin					Anticholinergic effects and risk of delirium Theoretical concern for systemic absorption of topical form
Erythromycin		[a]CYP3A4/3A5 inhibitor		Increases warfarin levels	
Famciclovir	Y			Increases warfarin levels	
Fluconazole	Y	[a]CYP2C9 inhibitor		Increases warfarin levels	
Gabapentinoids (e.g., gabapentin and pregabalin)	Y		Taper rather than abruptly stop to prevent withdrawal	Avoid use with opioids or benzodiazepines[b]	Consider initiating at 100 mg QHS with slow titration to prevent ataxia and somnolence Older adults and those with respiratory comorbidities (e.g., chronic obstructive pulmonary disease) are at increased risk for respiratory depression[c]

(continued)

Table 27.3 (continued)

Medication	Renal dose adjustment	Cytochrome P450 metabolism	Pharmacokinetic notes	Example of medication interaction	Potential consequences in older patients
Griseofulvin		[a]Weak/moderate CYP1A2/2C9/3A4 inducer		Decreases warfarin levels	
Itraconazole and ketoconazole (oral forms)		[a]CYP3A4/3A5 inhibitor		Increases digoxin levels	FDA warning issued to avoid using ketoconazole in treating nonfatal skin and nail fungal infections due to risk of hepatotoxicity and adrenal insufficiency[d]
Macrolides (except azithromycin)				Increases warfarin levels (except for azithromycin) Increases digoxin levels	
Methotrexate	Y			Caution with trimethoprim, penicillins, and nonsteroid anti-inflammatory drugs (NSAIDs)	
Metronidazole (oral)				Increases warfarin levels	May cause dysgeusia and aggravate anorexia in frail patients
Nafcillin				Decreases warfarin levels	
Opioids			Many are hepatically metabolized	Increased risk of sedation with benzodiazepines, gabepentinoids, and other sedating medications[b]	Delirium, falls, fractures, sedation, and constipation. Use low dose and carefully titrate. Recommend scheduled bowel regimen
Prednisone		[a]Weak/moderate CYP2C19/3A4 inducer			Hypertension, hyperglycemia, osteoporosis, delirium, psychosis, heart failure exacerbation, dysrhythmias, and myopathy. Peptic ulcer risk increased 15-fold with concomitant nonsteroidal anti-inflammatory drug (NSAID)
Rifampin		[a]Potent inducer of many CYPs		Decreases warfarin levels	
Spironolactone	Y			Caution with potassium-sparing antihypertensives	Increased risk of hyperkalemia
Terbinafine	Y	[a]CYP2D6 inhibitor			May cause dysgeusia and aggravate anorexia in frail patients
Tetracycline	Y			Increases digoxin levels	
Tricyclic antidepressants (e.g., amitriptyline, and doxepin >6 mg/day)			Taper rather than abruptly stop to prevent withdrawal	Exacerbates dementia by counteracting cholineresterase inhibitors	Delirium, orthostatic hypotension, and constipation
Trimethoprim – sulfamethoxazole	Y	[a]CYP2C9 inhibitor		Increased risk for hyperkalemia with concomitant use of angiotensin-converting enzyme inhibitors (ACEi) or receptor blockers (ARB)[b]	May cause hemolytic anemia, which might not be tolerated in patients with cardiopulmonary disease or baseline anemia

(continued)

Table 27.3 (continued)

Medication	Renal dose adjustment	Cytochrome P450 metabolism	Pharmacokinetic notes	Example of medication interaction	Potential consequences in older patients
Tumor necrosis factor (TNF) inhibitors					Contraindicated in patients with severe symptomatic heart failure
Valacyclovir	Y				

Updated and adapted from Lai and Endo [34]

[a]Examples of cytochrome (CYP) substrate medications in geriatric patients include CYP2C9 (e.g., carvedilol, celecoxib, glipizide, losartan, and irbesartan), CYP2C19 (e.g., omeprazole), CYP2D6 (e.g., carvedilol, *donepezil*, and metoprolol), and CYP3A4/CYP3A5 (e.g., amlodipine, atorvastatin, cyclosporine, dapsone, estradiol, simvastatin, sildenafil, verapamil, and zolpidem)

[b]The American Geriatrics Society Beers Criteria® Update Expert Panel [234]

[c]Federal Drug Agency [235]

[d]Federal Drug Agency [236]

visual impairment) can be confused for cognitive impairment. Speaking in a slow, low tone while facing the patient directly can help patients who are hard of hearing. For older adults with visual impairment, consider printing instructions in a 12-point font or larger with high color contrast between the paper and print. It is also best to avoid using all capital letters [44]. Being specific about what specific anatomic sites to apply topical medications is also important (e.g., apply to scalp) because electronic medical record systems might default to say “apply to affected areas” [45]. To verify if the patient and caregivers understand the treatment, using the “teach back” method can be an effective way to avoid misunderstanding without significantly prolonging the visit [46]. The dermatologist could state: “I would like to make sure I explained the plan clearly. In your own words, can you please summarize what you understood?” Avoiding miscommunication is important to prevent subsequent phone calls with questions, ADEs, and treatment “failure.” In Case 2, a printed list of medicines to be started, stopped, continued, or modified might help the patient keep track of the regimen.

The seventh step is to titrate the medication to mitigate the risk of ADEs. Aging and/or comorbidities often reduce renal function [47, 48]. In frail older adults, serum creatinine can overestimate actual renal function due to decreased muscle mass [49]. The Cockroft-Gault (CG) equation adjusts for age and body weight and was used in drug studies to develop dose recommendations. It can be used to estimate renal function in older adults. The Modification of Diet in Renal Disease (MDRD) equation has limitations for older patients and should only be used for medications appropriately measured during development of drug doses. Even when using the C-G estimate of renal function, follow the geriatrician’s prescribing adage for systemic therapy to “start low [dose], go slow [to uptitrate].” It is also important to clearly set realistic *a priori* therapeutic endpoints with the patient to avoid overmedicating (e.g., reduce itch by about 50%). These might need to be renegotiated as the patient’s circumstances change (e.g., new or worsening comorbidities) [43, 50].

The final step is to help coordinate care and scheduling strategic follow up. The current author [JE] believes dermatologists play a critical role in managing noncosmetic conditions and can play a critical role as part of the healthcare team for older adult patients. It is important to consistently demonstrate our value to patients and other healthcare providers because the public’s perception of the importance of dermatologists is somewhat negatively skewed [51]. How might we demonstrate our contribution and engagement with the healthcare system?

When systemic medications are changed, the dermatologist can avoid patient safety problems or miscommunication by notifying the primary care provider or other relevant specialists. One critical patient safety example is when there is a potential medication interaction (e.g., oral antibiotic and warfarin) or risk for adverse events that might require monitoring (e.g., systemic glucocorticosteroids). In some cases, a patient might be so medically complex or psychosocially challenged that the dermatologist might consider referral to a geriatrics specialist or request the assistance of the primary care provider for case management.

Scheduling strategic follow-up calls or visits of sufficient length are also important in improving adherence and treatment outcomes [52]. For instance, if a complicated treatment regimen must be prescribed (when no feasible alternative exists), consider having the clinical staff follow up with a call or schedule a follow-up visit in a shorter timeframe to anticipate questions and reinforce the treatment plan. The patient in Case 2 might benefit from more frequent follow up or check-ins with clinic staff.

27.3 Barrier Function and Immunologic Changes in Skin Aging

The stereotype of “old skin” might conjure an image of an older person with thin, dry, and wrinkled skin, lentigines, solar purpura, poor wound healing, and overall skin fragility. Skin aging refers to the physiologic and histologic changes that lead to the characteristics of "old skin" [19]. It has been historically categorized into extrinsic and intrinsic causes, although both are presumably involved for all people. Extrinsic skin aging refers to environmental factors that accelerate skin aging beyond intrinsic aging, such as tobacco use, pollution, and lifetime sun exposure [38]. Intrinsic aging is "normal" and chronologic that presumably occurs in all individuals with non-sun-exposed skin. The phenotype of "old skin" is likely a combination of both factors for most individuals. We will review the clinically relevant changes in skin barrier function and immunity that help explain dermatologic conditions of older adults, which is collectively referred to as immunosenescence [53]. These immunologic derangements are thought to explain the increased risk for skin infection, dermatitis, Grover's disease, autoimmune skin conditions, and skin cancers in older adults [53, 54].

Aging is associated with several structural skin changes that explain the phenotype of "old skin." Most of these changes are presumably from telomere shortening and impaired cellular replication. There are decreased amounts of elastin and collagen. Dermal fibroblasts shrink and the subcutaneous fat layer becomes thinner. Epidermal pH increases after age 70, which is associated with reduced lipid and protein production and negatively impacts barrier integrity and repair. These changes lead to increased transepidermal water loss and dryness, increased permeability to antigens and allergens, as well as proinflammatory repair cytokines [53–55]. Therefore, low pH skin products are generally recommended and might help the patient in Case 2 [56]. There are limited data indicating differences in the skin microbiome of older, nondiseased skin compared to that of younger adults [57, 58]. The pathophysiologic relevance and cause remain somewhat unclear.

There are also several key immunologic changes in effector cells. Paradoxically, some of these changes inhibit certain inflammatory pathways while others promote inflammation (known as "inflammaging"). Langerhans cells, which are important antigen-presenting cells, are reduced in number, express less antimicrobial peptides, and exhibit less migration. There also appears to be an increased proportion of T-regulatory cells in the skin, which reduces not only inflammatory responses to antigens but is also positively correlated with several skin tumors. Some data suggest that skin-resident CD4+ and CD8+ cells have reduced functional capacity due to increased PD-1 expression. On the other hand, accumulation of senescent macrophages and fibroblasts (e.g., from UV damage) is thought to increase reactive oxidative stress, damage stroma, and increase inflammatory mediator expression [54]. Circulating T cells in older adults seem to favor Th2 over Th1 without apparent change in Th17 activity [53].

One pitfall to avoid, particularly in older adults, is routinely ordering serologic studies for autoimmunity. Older adults who are otherwise healthy appear to have a higher prevalence of circulating autoantibodies compared to younger populations. One study showed approximately one-third of patients without apparent lupus had circulating antinuclear antibodies (ANA) [59]. Thus, the prudent clinician should avoid ordering unnecessary or potentially misleading antibody tests, particularly ANA, in patients with low pretest probability for systemic lupus. A weakly (<1:160 or <80 IU/mL) or false-positive ANA can lead to potential harms of patient angst or the attribution bias of any patient symptom being presumed to be caused by systemic lupus [60, 61]. There are mixed data as to whether older adults without clinical evidence of autoimmune blistering disease have detectable serum pemphigoid-associated antibodies (i.e., BP180 and BP230), which are presumably nonpathogenic [59, 62, 63].

27.3.1 Special Populations

There are layered issues of socioeconomics and cultural factors that compound access and affordability for people of color relative to White individuals. A comprehensive review of the intersection between dermatologic care and all permutations of racial, socioeconomic, religious, geographic, housing, political refugee, and minority statuses is beyond the scope of this chapter. We will instead highlight considerations for selected subpopulations of older adult patients and how these might impact care. An important caveat is to be cautious of stereotyping and acknowledging individual differences.

Many common skin conditions such as dermatitis, alopecia, and fungal infections overlap in American ethnic minority patients [64, 65]. However, few studies specifically compare skin conditions of older adults with different skin types. While there are generally fewer skin cancers in patients with darker skin, there is increased mortality compared to White patients. Possible explanations include delayed diagnosis, low healthcare literacy, and barriers to healthcare access [66–70]. Notably, patients with darker skin tend to have inconspicuously located acral or mucosal melanomas [70]. There are opportunities to educate older adults about their skin health and offer screening. A survey found one-third of older African-Americans did not believe people of darker skin type should be concerned about skin cancer [71]. Other interventions that might reduce healthcare disparities include offering professional (rather than a friend or family) interpreter, partnering with community resources or patient navigators, and obtaining cultural competency training [72]. The current author (JE) also suggests taking an actively antiracist approach to evaluating existing workflows and points of patient contact.

Some traditional medicine or cultural practices are associated with dermatologic findings. For example, coining and

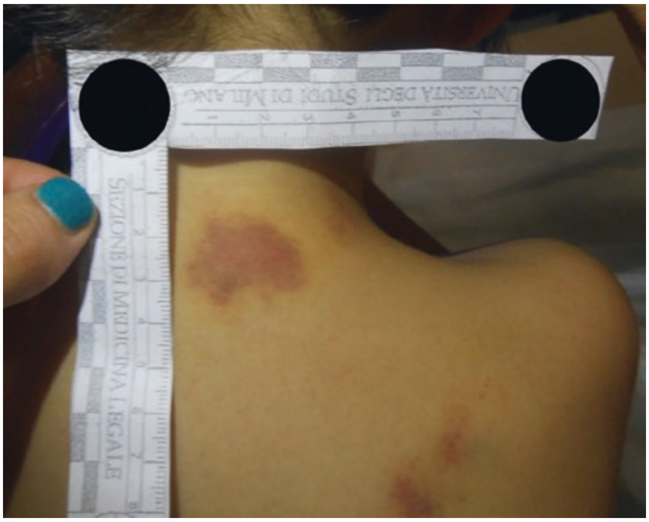

Fig. 27.3 The appearance of bruises on the neck and shoulders in a "Gua-Sha" case. (From Viero et al. [73]; https://link.springer.com/content/pdf/10.1007/s12024-019-00115-4.pdf)

moxibustion are practiced by some Asians and result in geometric violaceous, purpuric, erythematous, or hyperpigmented patches and plaques (see Fig. 27.3). These findings can be misconstrued as physical abuse [73]. Certain hair styling practices, such as tight braids or rows, might be associated with scarring alopecia.

There is a paucity of data about dermatologic care of older homeless patients. They have similar skin conditions as those who are not homeless, but the prevalence may be higher [74]. Special challenges for this patient population include limitations of resources, including finances, transportation, bathing and personal hygiene products, and privacy to apply topical medications [75].

27.3.2 Sexual and Gender Minority Older Adults (SGMOA)

The US population is aging with projections that people over the age of 65 will double to over 80 million by 2050 [76]. While this population shares many challenges in healthcare and other services, older adults are not monolithic in their experiences. A combination of factors can be associated with unique forms of discrimination and health disparities within the framework of intersectionality [77]. Among these, sexual and gender minority (SGM) identity in older adults has received little attention despite the fact that more than 2.7 million SGM adults aged 50 or older are living in the United States [78]. Many barriers exist to research on the aging SGM populations. Not only have SGM older adults (SGMOA) been historically marginalized but also major public health surveys, questionnaires, and mainstream research efforts have failed to account for this population by often excluding sexual orientation or gender identity from demographic data [78] and limiting longitudinal studies of this population to understand the needs of SGMOA as they evolve over the lifespan [79].

27.3.3 Background and Terminology

It is necessary to define basic terminology prior to a discussion of dermatologic concerns in the SGMOA population. SGM people encompass identities based on sexual orientation, gender identity, gender expression, attraction and behavior, all of which are distinct concepts. For instance, individuals who engage in same-sex sexual behavior or who are attracted to individuals of the same sex may not openly self-identify as such and may choose not to disclose that information in the healthcare setting [79]. Sexual orientation refers to how a person characterizes their sexual attraction to others while gender identity captures a person's sense of being a man, woman, other gender, or no gender at all. Transgender describes a person whose gender identity or expression does not align with their sex assigned at birth. SGMOA may identify as lesbian, gay, bisexual, transgender, queer (LGBTQ), asexual, Two-Spirit, or as a host of other identities indicating that their sexual orientation, gender identity, gender expression, and/or behaviors may vary from traditional societal or cultural norms [80, 81]. There is no universal definition of SGM or LGBTQ older adults. While many sources define SGMOA as those aged 60–65 years and over, some include those as young as age 45 [79].

Significant generational differences exist within the SGMOA population [78]. Those who lived through the Great Depression and World War II came of age during a time with sparse recognition of SGM people and their concerns. Subsequent generations experienced increased visibility and growing resistance, including outright social and political discrimination, and criminalization of self-expression. The youngest older generation saw the birth of the gay rights movement concurrent with efforts to achieve social equality for women and people of color. Most SGMOA individuals saw the AIDS crisis of the 1980s, which continues to be a source of trauma [78, 79]. Other characteristics compound the adverse experiences and health outcomes within SGMOA, including disparities linked to race and ethnicity.

The challenges faced by SGMOA are (1) structural, interpersonal, and intrapersonal discrimination across the lifespan; (2) loss of family support and reliance on chosen family; and (3) lack of culturally competent healthcare and health disparities [79]. Social determinants of health for SGMOA individuals factor into each of these domains [82]. For example, all SGM people are more likely to live in poverty and lack affordable housing. While federal housing protections prohibit discrimination in federally funded housing on the basis of sexual orientation and gender identity, many states do not have similar prohibitions and half of older same-sex couples experience housing discrimination [80]. This is compounded by SGMOA experiencing a lifetime of employment discrimination [83, 84]. Only in June 2020 did the Supreme Court of the United States rule that sex discrimination under Title VII of the Civil Rights Act applied to sexual orientation and gender identity [85]. This decision has little impact on SGMOA who may have already left the workforce. And while federal marriage equality has existed since 2015, many SGMOA whose partners died prior to 2015 are unable to access survivor benefits including social security spousal survivor benefits, inheritance and tax benefits, pensions, and veterans benefits [79, 86].

Lifelong discrimination often results in poverty and isolation. A third of SGMOA live at or below 200% of the federal poverty level. This number includes almost half of transgender older adults and 40% of both African American and Hispanic LGBTQ older adults [87]. Lack of full legislative equality and systemic ageism amplifies the isolation of SGMOA. Isolation and marginalization create vulnerability to abuse and exploitation, and research suggests that SGMOA incur high rates of elder abuse [88–90].

27.3.4 SGMOA Health and Dermatology

Shifting to healthcare, understanding the minority stress model is imperative. Minority stress is a cumulative result of interpersonal and structural discrimination, which may provoke intrapersonal conflict and result in health disparities [91]. The healthcare space presents barriers to SGMOA as experiences of harassment and discrimination are reported by these individuals when interfacing with the healthcare system [92].

Many SGMOA are veterans and warrant attention by the VA health system. Estimates suggest that there are 130,000 transgender veterans. Over half of respondents age 75 or over to a large transgender survey in the United States reported being a veteran [79, 82]. Care in nursing homes for SGMOA patients may create apprehension and choices may be limited due to a dependency on chosen family and loss of partners [93]. Some SGMOA report discrimination and abuse in these facilities, prompting many to "go back in the closet," concealing their sexual orientation or gender identity rather than face discrimination. As a result, high rates of psychological distress are observed in the SGMOA population [79, 94, 95].

The dermatologic concerns of SGMOA are understudied with little research on this population. In general, ensuring a safe space for SGMOA is critical for a therapeutic relationship and disclosure of important health information. Patient-preferred language should be elicited, and assumptions about identity and behavior should be avoided. Clinicians should ask for a patient's name and pronouns and avoid assumptions about the gender(s) of partners, parents, and relationship status. Recognize that terminology used by younger generations may differ from that of SGMOA. For example, the term "queer" has been reclaimed as validating by younger SGM individuals but may be considered disparaging by SGMOA. In contrast, "homosexual," which has fallen out of favor in younger people, may still be used by SGMOA [80].

Specific challenges are faced by SGMOA living with HIV. In 2016, nearly half of people in the United States living with HIV were aged 50 and older with 1 in 6 new HIV diagnoses in 2017 in this group [96]. Thus, it is important to integrate HIV care into geriatric training programs. Now that life expectancy of those living with HIV is similar to the general population, healthcare providers must be skilled in comanagement of chronic diseases, multiple medications, and changes in physical and cognitive capacity [79].

HIV and HPV infection disproportionately impact MSM (men who have sex with men) and transgender women including SGMOA [97]. High-risk HPV anal infection exists in 74% of HIV-positive and 37% of HIV-negative MSM [98]. The incidence of anal squamous cell carcinoma (SCCA), due to HPV, is rising yearly. From 2001 to 2015, SCCA incidence increased 2.7% per year with pronounced increases in individuals aged 50 years and older [98]. While antiretroviral therapy has improved survival, overall outcomes, and quality of life in individuals living with HIV infection, anal cancer rates continue to rise [99]. As SGMOA living with HIV continue to age, anal cancer rates are expected to rise further, necessitating routine anogenital skin exams. It is less likely that SGMOA will be immunized against HPV as evidence of the benefit of vaccination in older individuals is lacking [100]. Consequently, there are no standard recommendations for immunization in this age group.

There is evidence that skin cancer is likely to be more common among MSM relative to their heterosexual counterparts. Survey data show that gay and bisexual men are twice as likely as heterosexual men to report having had nonmelanoma skin cancers, and this may be related to an increased frequency of indoor tanning among this population, though more research is needed [100, 101].

Little is known about the dermatologic concerns of aging gender-diverse and transgender population. As this population ages, research will be needed to assess the impact of gender-affirming hormone therapy on the skin. Though data are scant, there are reports of an association between atopic dermatitis and feminizing hormone therapy in transgender women [102]. Additionally, there are several reports of trans-feminine women on feminizing hormone therapy developing cutaneous autoimmune connective tissue disease, including systemic sclerosis and lupus erythematosus [103–105]. There are no studies on the incidence of autoimmune disease in the transgender population. In limited reports, patient profiles, including clinical features and autoantibody serologies, are heterogeneous. Estrogens influence lymphocyte maturation, cytokine release, increase autoantibody production, and can upregulate the activity of antigen-presenting cells [105]. However, the immunomodulatory effects of gender-affirming therapy and its possible role in the development of autoimmune disease remains speculative, requiring further study of how this may impact the aging transgender population [105].

Gender-diverse and transgender individuals who have undergone gender-affirming surgeries may also be at risk for some malignancies and dermatoses [97]. Case reports document carcinomas of the neovagina in transfeminine women possibly due to HPV infection or scarring and chronic inflammation [106–108]. Similarly, anogenital lichen sclerosus was reported in a transgender woman in her 60s, successfully treated with topical steroids [109]. As more gender-diverse individuals undergo medical and surgical affirmation and as these individuals age, skin examinations for cutaneous malignancy become more important. Dermatologists should develop comfort and competency in the care of the gender-diverse population and routinely assess the organ inventories of these patients in order to appropriately screen for concerning lesions.

In summary, much like other aspects of healthcare, the well-being of SGMOA is inextricably linked to social determinants, particularly those that ensure successful aging of an otherwise vulnerable population. Along with high-quality care, financial security and a firm social support structure are critical for these individuals and may markedly differ from their non-SGMOA peers. While the past experiences of marginalization sustained by SGMOA cannot be altered, their current and future health concerns must be a priority for the medical community as it works to dismantle structural disparities.

27.4 Selected Skin Conditions of Older Adults

27.4.1 Psoriasis

Psoriasis is a common inflammatory skin disease of the general population. There are limited and somewhat conflicting studies about the prevalence and impact of psoriasis with respect to aging. The age of onset appears to be bimodal in young adulthood and between the fifth and sixth decade [110]. Some studies have shown psoriasis is just as common, if not more common, in older ages compared to younger age groups [111–113]. However, the incidence of older-age onset psoriasis is not known [114]. It is possible that disease burden diminishes with aging or there might be less disease reporting, although there have been mixed results [111, 112, 115].

27.4.1.1 Is Psoriasis Different in Older Adults?

Some data suggest the morphologies and comorbidities might differ compared to younger adults. The morphologies can vary in older adults and can include nummular type. Notably, two studies showed plaque psoriasis was somewhat less common in older adults [112, 116]. A few studies found a higher association of metabolic syndrome in older adult inpatients with psoriasis. Interestingly, those patients appeared to have a later age of onset but longer duration of psoriasis [116, 117]. Compared to younger populations, there does not appear to be a significant difference in comorbid psoriatic arthritis in older people [116, 118]. One prospective observational study in Italy compared younger and older adult psoriasis patients [113]. They did not find a statistically significant difference in lesional gene expression of Th1- and Th17-type cytokines.

27.4.1.2 What Is an Evidence-Based Approach for Treating Psoriasis in Older Patients?

Case 2 highlights the challenge of treatment decision-making for older adults with psoriasis. The data supporting the safety and efficacy of psoriasis treatments are limited because many clinical trials have historically excluded older patients or those with multiple comorbidities [119]. The best available evidence and expert opinions from landmark articles will be synthesized here [114, 120, 121]. For limited skin involvement, first-line therapy is topicals: steroids, vitamin D derivatives, tar, and retinoids. These regimens are generally cheaper than the alternatives, and the most practical in certain countries or insurance contexts [114]. The only study that compared topical efficacy in younger versus older adults was betamethasone dipropionate/calcipotriol [120, 122]. However, high-potency steroids should be used with caution because older skin tends to be thinner and at higher risk for atrophy. There is no strong evidence for which vehicle is best for older adults [114]. It is the current author's opinion [JE] that caution should be exercised with ointments, since they are more occlusive; and, if used on the feet, might increase the risk for falls if the patient walks barefoot.

For more extensive disease, the National Psoriasis Foundation recommends phototherapy and systemic agents (except cyclosporine) as first-line agents. While broadband ultraviolet B was the only phototherapy studied in older adults, the expert recommendations also included narrowband ultraviolet B or psoralen with ultraviolet A [120]. There are very limited data to determine the safety of acitretin for older adults, but a small retrospective, uncontrolled study suggested it might be effective at relatively low doses (approximately 25 mg daily) [123]. The risk of hyperlipidemia is not necessarily a contraindication, since it can be monitored and treated. Furthermore, the cardiovascular risk associated with hyperlipidemia has a long time horizon and might not be as relevant to older individuals. Acitretin might theoretically aggravate xerosis [124].

Methotrexate can be carefully considered in older adults without severe renal impairment or significant risk factors for cirrhosis. However, there are two important caveats about prescribing methotrexate in older adults. First, normal aging is associated with reduced renal function and older adults might be at higher risk for myelosuppression [125–127] (see also Sect. 27.2.6, step 7). A small study suggested older adults might require doses as low as 2.5 mg/week, particularly those older than 80 years [128]. Second, older adults with psoriasis are 70% more likely to develop nonalcoholic fatty liver disease compared to those without comorbid psoriasis [129].

Apremilast is a novel phosphodiesterase-4 inhibitor that does not appear to increase the risk of malignancy or infection compared to placebo [130]. Di Lernia and Goldust have suggested that the relative safety profile makes it a reasonable consideration after failing phototherapy, particularly in patients with multiple comorbidities [131]. A lower dose of 30 mg daily is recommended when patients have an estimated glomerular filtration rate of less than 30 mL/min [132].

Cyclosporine should be used cautiously, if at all, in older adults. There is a 1.6-fold relative risk of creatinine increase (defined as 25% over baseline) [133]. Cyclosporine can interact with several medications via cytochrome P450 pathways and can potentially aggravate hypertension or gout [134]. A retrospective multicenter Italian study found the risk of adverse events to be fourfold higher in cyclosporine compared with methotrexate [135].

There has been trepidation about using biologics in older patients due to (particularly anti-TNF agents) warnings of increased risk for infection or malignancy [121]. Limited studies suggest some biologics can be used in selected older adults. In a relatively large multicentered retrospective study out of Italy, the prevalence of infections was under 5% [136]. The studied medications were adalimumab, ustekinumab, infliximab, secukinumab, infliximab, golimumab, and certolizumab. The mean baseline PASI score was 16.5. Approximately 60% achieved PASI 75 and over 40% achieved PASI 90 by week 28, although the dropout rate by week 52 was 9%. In another study, adverse effects for adalimumab included elevated cholesterol, triglycerides, elevated transaminase, and other nonmalignant and noninfectious phenomena that are not strongly associated with the medication in the general population – or have known associations with psoriasis itself [135].

There are very limited data regarding malignancy in older patients. The Italian study found only three cases of nonmelanoma skin cancer and one vocal cord carcinoma. Regarding patients with a history of cancers, expert opinion is to generally avoid immunosuppressants in patients who had malignancy within 5 years [124, 137]. This timeframe was largely based on the exclusion criteria of clinical trials. Some data suggest anti-TNF agents might have a somewhat higher associated risk for malignancy compared with methotrexate and ustekinumab [138]. In refractory disease, a discussion with the patient and oncologist might be warranted to weigh the risks versus benefits of immunosuppression.

Going back to Case 2, the clinician might begin with topical medication reconciliation to simplify the regimen and reduce costs. If the patient failed an optimized topical regimen, phototherapy could be considered, if there were no fall risks and the patient had access to visits. The dosing and titration might need to be reduced, if the patient is taking photosensitizing medications (anti-hypertensives are a common example). Failing that, cautious use and monitoring of low-dose methotrexate or acitretin might be discussed with the patient. However, the patient's age and comorbidities might increase the risk of adverse events. If biologics were considered, anti-TNF agents should be avoided due to symptomatic heart failure. However, other biologics or apremilast might be considered. Review the patient's history to determine if a vaccine might be needed prior to therapy (e.g., live vaccines cannot be used while receiving biologics). Cyclosporine would be best avoided in this patient, unless the patient had a severe erythrodermic flare in which the potential benefits might outweigh risks.

27.4.2 Contact Dermatitis in Older Adults

Contact dermatitis is divided into irritant contact dermatitis (ICD) and allergic contact dermatitis (ACD). ICD is nonimmunologic in etiology; ACD is immunologic. It is widely quoted in the literature that irritant contact dermatitis accounts for 80% of contact dermatitis, and allergic contact dermatitis only 20%. These data come from records regarding frequency of contact dermatitis in occupational cases, as this is the most robust source of data for incidence and prevalence of contact dermatitis. Though there are reports that challenge the 80/20% dogma, it is still a useful approximation of the relative occurrence of each type of contact dermatitis [139, 140]. Though ICD is more common, we will focus most on ACD because the information on ICD is more generally agreed upon and less complex to analyze.

Irritant contact dermatitis is a result of often cumulative "insults" to the skin with agents that decrease skin moisture, or have a direct, nonimmunologic mechanism of skin injury (such as especially high or low pH, or physical disturbance of the stratum corneum and keratinocytes, for instance). Examples of irritant exposures include cleansers, chemicals such as industrial solvents, fabrics such as wool, materials such as fiberglass, plants such as nettles, topical medications such as retinoids.

There is general agreement that irritant contact dermatitis is less common in older adults [140–142]. This is true even though the older individual have drier skin at baseline than younger individuals and defects in the skin barrier, with greater time required for injury repair [142–144]. The decreased frequency of ICD may be due to fewer older people working in jobs that require frequent exposure to irritants, given that repeat exposure to the item is important in generating the dermatitis. In most cases, irritant dermatitis responds to avoidance of or protection from irritants, and frequent use of emollients.

Allergic contact dermatitis, which is a Th1 delayed hypersensitivity reaction to haptens that bind to skin proteins, has a prevalence of about 20% in the population [145]. The ability of the skin to become sensitized to a hapten is present from infancy, and with more years of exposure to potential allergens, and maturation of the immune system, the incidence of allergic contact dermatitis is higher in adults than children [145, 146].

There are several factors influencing whether allergic contact dermatitis is more, less, or just as common in older individuals. Older people have decreased lipids in the stratum corneum (more barrier dysfunction and penetration of haptens), greater number of chemical exposures through time, a slower turnover of keratinocytes in the epidermis (less sloughing of haptens bound to skin), and medical comorbidities (stasis dermatitis and ulcerations); these factors all tend to predict greater ability to develop and express ACD. Importantly, the decreased density of Langerhans cells [142, 147, 148] and decreased cytokine production [147, 149, 150] would predict less ACD in older people.

Evaluating frequency of ACD in older patients is even more complicated, in that one can break this down into parts: ability to become newly sensitized, ability to react to a previously identified hapten, and changes in intensity of a reaction to a hapten as well as time between exposure and rash. Additionally, there are potential differences in which haptens are more important at older ages.

It is not surprising, therefore, that there is variation in the literature regarding ACD in older people. A 1995 review article illustrates this nicely [146]. One study cited showed decreased sensitivity to bruised poison ivy leaves with older age (14% in ages 61–70 years; 58% in ages 21–30 years). Other cited studies with Rhus antigens showed milder and later reactions in old age. Other investigators repatch testing previously positive individuals noted that 14% now had negative tests and 27% had diminished responses. Several investigators tried to sensitize to dinitrochlorobenzene (DNCB); in one study, they were able to sensitize only 69% of those 70 years and older, compared to 96% of those younger than 70. Another group was able to sensitize only 23% of those over 65, and 96% of those between 20 and 40. Smaller studies, with fewer subjects, found no age difference.

One retrospective review noted that the peak age for positive reactions was 30–49 years for females, and 70–79 years for males [151]. They also noted more older individuals with multiple allergens.

In an excellent 2010 review of age and contact dermatitis in later life, there were 14 publications which analyzed age and ACD in different ways [141]. Of these 14 publications, 7 noted a decrease in ACD in older patients, 3 noted an increase, 2 noted no overall change, and 2 noted different allergens of importance, and this qualitative difference in allergens was also noted within several other publications.

To summarize, there is a preponderance of evidence that older people become newly sensitized to contact allergens at a decreased frequency compared to younger adults, may show less intense reactions to items to which they have known positive patch tests, may take longer from exposure to develop a rash or positive patch test, and will have increased frequency of reaction to some haptens (fragrances and medicaments), with decrease or no change in the frequency of others (metal and others). Some of the variability may have to do with the fact that not all haptens are alike, and the immunology behind sensitization and elicitation of contact allergies to metal, for instance, may not be exactly the same as contact allergy to other haptens such as fragrance. Additionally, the frequency of exposure to certain chemicals likely changes over time. For instance, the increase in number of reactions to fragrance is thought to be due to the presence of balsam of Peru (a fragrance from a plant with numerous components) being present in topical medicaments that may be used on stasis ulcers, for instance, not due to increased use of fragranced products.

Patch testing is required to ascertain the chemicals that must be avoided to prevent the rash, which is eczematous in nature, and shows spongiotic dermatitis on biopsy. An individual with eczematous dermatitis who does not respond to therapy, and does not have a history of atopic dermatitis, is someone for whom patch testing should be considered, regardless of age. For accurate patch testing, one must have a robust set of haptens to test, have the patches for 48 hours, and do a delayed reading 96 hours (5 days) to 168 hours (7 days) after the patches are placed. These are general rules; it may be important to do a second delayed reading in older people, related to the longer time to see reactions, and it may be reasonable to counsel avoidance of weak, questionably positive reactions in this age group due to the demonstrated milder response to haptens with aging.

Allergen avoidance is necessary to clear allergic contact dermatitis, as desensitization to contact allergens is not possible. Counseling patients on how to avoid contact allergens requires understanding by the provider where the allergen might be and how to avoid it. Specific instructions on label reading, or other advice if the allergen is not on a label (e.g., allergens in items of clothing), are necessary. Providing written information that reinforces counseling is necessary, but written information alone is never enough.

Many older individuals will be as able to comprehend and follow through with allergen avoidance advice as younger individuals, but the concepts and follow through are not easy. Those with cognitive or memory deficit will need assistance. A study to assess how well individuals recalled their test results showed no difference in the ability to recall allergens at 6 months when comparing age less than 40 to age greater than 40 years [152]. Some of the most complete tools that assist in being able to avoid allergens involve computers or smart phone apps, which may not be used by some older individuals. Additionally, the print on product labels, where one would look for the problem chemical(s), is often quite small and difficult to read.

One way to help someone with incomplete understanding of how to avoid an allergen in a product is to generate a "safe" list for you, the provider, to search through and pick out a soap, a shampoo, a moisturizer, a sunscreen that is widely available, and "prescribe" the exact names of products for purchase. If it is possible for a family member or friend to assist with the purchase of the new products and go through the patient's products at home and remove the problem items, this can be a great help. In the current author's experience (RL) many will not want to "waste" products and will continue to use them until gone, even if this perpetuates the dermatitis. Asking a patient to bring in products they are using for you to examine is also useful. Patients of all ages default to buying products marketed as "hypoallergenic," "for sensitive skin," "unscented," and "all natural." Education is necessary regarding that these are, in fact, marketing terms that have no relevance to whether the product may contain their allergen.

In sum, contact dermatitis (ICD and ACD) is present in older individuals, though perhaps less frequently than in younger age groups. There are many factors influencing the development and expression of contact dermatitis. The immunologic and barrier changes in the skin that occur with aging, and comorbidities, change the "substrate" upon which the potential allergens are placed, and the number and type of allergens older patients are exposed to may differ from younger individuals. Patch testing and allergen avoidance in the case of ACD, and decreased frequency of exposure to irritants with emollients for barrier restoration in the case of ICD, will assist in returning the skin to normal.

27.4.3 Vulvar Lichen Sclerosus

There are several genital dermatoses of older patients, but we will focus on lichen sclerosus (LS) because it can be misdiagnosed. The delay in diagnosis in one study was approximately 5 years. LS is an inflammatory condition, usually of the genitals, that is much more common in older women than men. The prevalence is about 3% of older women, although it is the current author's opinion that the actual figure is probably higher [153]. A proposed hypothesis is that the anatomic structures in women cause the anogenital skin to be subjected to more chronic urinary irritation [154]. It is also posited that the hypoestrogenic state of menopause and anti-extracellular matrix protein 1 might have pathophysiologic roles [155, 156]. The latter observation might explain why 8% of LS cases might be associated with other autoimmune diseases, such as Hashimoto's thyroiditis, alopecia areata, rheumatoid arthritis, and type I diabetes mellitus [157].

The classic LS presentation is a "strawberries and cream" pink-white atrophy without secondary change in patches or plaques (see Fig. 27.4). There can be purpura and telangiectasias, which can be mistaken for sexual abuse. Unlike males, females usually have both perianal and vulvar involvement in a "figure of 8" configuration – but sparing the vaginal mucosa [157–159]. LS is described as being pruritic, but one series found about 40% of newly diagnosed LS patients were asymptomatic [160]. However, there can be superimposed erosions, fissures, or lichenification from scratching. Pigmented lesions sometimes can be found in association with LS: lentigines, nevi, and rarely melanoma [161, 162]. When there is a melanocytic process, it can be difficult to distinguish between the interface dermatitis changes in LS versus regression of a melanocytic process [162].

Some argue that LS and morphea might exist on a clinical and histologic spectrum, while others assert they are two distinct entities [163]. In either case, there is a well-established association. One prospective study found that over one-third of morphea patients also had LS [164]. Another large retrospective study found LS coexists with morphea (particularly generalized and plaque types) at a higher-than-expected rate compared to the general population. The temporal relationship of the two diagnoses can vary; morphea can precede LS by years or be found simultaneously [157]. An important clinical pearl is to offer a full skin check in patients with either morphea or LS to ensure appropriate management.

There are three important sequelae of untreated LS. First, progressive scarring can obstruct urinary flow or cause sexual dysfunction. Once there is extensive scarring and functional impairment, procedural intervention is generally necessary. Second, the estimated lifetime risk of vulvar LS patients developing squamous cell carcinoma is approximately 5% [165]. The pathogenesis is thought to be related to mutations in p53 expression rather than human papilloma virus (HPV) [159]. It is unknown whether treating LS reduces the malignant transformation risk [166]. Finally, unchecked disease can lead to dyspareunia and embarrassment [159].

Fig. 27.4 A 41-year-old woman with asymmetric vulvar lichen sclerosus limited to the upper part of the right labium minus and the interlabial sulcus: depigmentation, hyperpigmentation, and sclerosis leading to circumscribed retraction of the right labium minus. (From Fistarol and Itin [167])

The differential diagnosis of LS includes graft-versus-host disease, plasma cell vulvitis, inverse psoriasis or lichen planus, vitiligo, atrophic vaginitis, and contact dermatitis. A helpful diagnostic clue of LS is vulvar asymmetry or agglutination of the labia minora and majora [167] (Fig. 27.4). The presence of ulcers, papules, or nodules should raise the question of malignancy or superimposed infection (especially candida or HSV). In such cases, consider obtaining wound cultures for bacteria and HSV and possible biopsy. A careful history should exclude allergens or irritants, such as wet wipes, feminine hygiene products, and topical medicaments [159]. Patch testing might be appropriate in cases of refractory itch or worsening symptoms despite topical steroids.

The goals of medical management are to reduce symptoms and prevent further scarring. It is critical to manage itch not only to improve quality of life but also to reduce scratching and the Koebner phenomenon [165]. First-line therapy is typically potent-to-ultrapotent topical steroids such as clobetasol or mometasone. There are insufficient data about which vehicle is best. Most studies used creams or ointments, although some prefer gels [168]. Some recommend topical calcineurin inhibitors (e.g., pimecrolimus and tacrolimus) for treatment and/or maintenance. However, data are limited regarding efficacy and long-term safety, and the burning sensation might reduce adherence [159, 168]. In refractory cases, very limited data suggest second-line therapy with topical calcipotriol, topical retinoids, intralesional steroid injection, methotrexate, sulfasalazine, vitamin D, oral cyclosporine, or phototherapy. Since there is often sebaceous destruction, many patients complain of dryness and itch. Limited data suggest that emollients might provide relief after inflammation is controlled with topical steroids [159]. Data do not support use of topical vitamin E, cyclosporine, estrogen cream, hydroxychloroquine, or photodynamic therapy.

Periodic examination is important to monitor inflammatory activity and malignant change, given the large number of patients who might be asymptomatic.

27.4.4 Itch

Itch (pruritus) is a common condition in older adults that negatively impacts quality of life and sleep. Patients have the unpleasant sensation and desire to scratch the skin [169]. The prevalence of itch varies widely among studies, anywhere from 3% to 40%, depending on the setting. Most studies support an increasing prevalence of itch with age and a male preponderance [170]. The pathophysiology of itch appears to be a complex interplay of age-related changes in keratinocytes and the neurologic and immune systems [171] (see Sect. 27.3). Several chemical mediators have been described that might have therapeutic implications, including neurokinins, opioid receptors, and IL-31 [172–174].

To simplify the categorization and management of itch, Yosipovitch et al. have proposed a practical framework [175]. The first step is to determine the presence or absence of xerosis or intact primary lesion of an underlying inflammatory skin disease. In one cross-sectional series, xerosis was associated with over two-thirds of older itchy patients – a statistically significant difference compared to patients without itch [176]. Counsel the patient to avoid hot water and vigorous skin scrubbing as well as to consistently apply thick emollients. It is important to clarify the brand of soap patients are using because the patients' subjective definition of a sensitive soap might not be ideal. In the author's experience, some patients assume that "natural" or "organic" soaps are better than synthetic detergents. However, these soaps can increase skin pH and cause barrier dysfunction. Low pH products are preferable [177, 178]. Returning to Case 2, the patient's xerosis might be partially responsible for the poorly controlled psoriasis.

The clinician should also look for evidence of underlying inflammatory or infectious causes such as nummular eczema, psoriasis, mycosis fungoides, scabies, tinea, contact dermatitis, or autoimmune blistering condition such as bullous pemphigoid (especially the nonbullous variant). When a patient insists on a rash that is not present, one clinical pearl is to check for dermatographism [19]. Obtain history on living arrangement (e.g., scabies risk), alcohol intake, substance use (e.g., alcoholic liver disease or formication from illicit substance use), and sexual history. HIV is probably underdiagnosed in older adults and is another cause of itch [179, 180]. Skin biopsies or scrapings and possibly serologic studies (see Sect. 27.4.5) might be appropriate to exclude treatable causes.

If no xerosis or primary skin lesion is found, the clinician should consider systemic, neuropathic, or psychogenic causes [175]. Examples of systemic causes include chronic kidney or liver disease, metabolic derangements, or nutritional deficiencies. A population-based study by Fett et al. suggests that malignancy is not a common cause of itch in patients without primary lesion. Their study found hematologic and bile duct malignancies were associated with itch, and suggest that malignancy workup in the absence of focalizing symptoms or physical exam abnormalities is of low yield [181]. In the current author's opinion [JE], initial tier lab testing could include a complete metabolic panel and thyroid function. The clinician might also consider nutritional work up, depending on history or examination findings. Any identified systemic condition should be managed accordingly.

Neuropathic causes of itch include notalgia paresthetica, brachioradial pruritus, trigeminal trophic syndrome, pruritus ani, diabetic neuropathy, itch within scars, and poststroke pruritus. Itch is often localized. A history about prior injury or degenerative arthritis or disc disease (or regional nature of itch) might suggest a nerve impingement that requires imaging or physical therapy referral.

Treating refractory systemic, idiopathic, or neuropathic itch can be challenging. Topical treatment options might include menthol, capsaicin (skin irritation is often limiting), lidocaine-prilocaine, pramoxine, doxepin, or compounded ketamine 0.5% and amitriptyline 1% [175, 182]. Exercise caution with the latter four medications if used on large body surfaces due to risk of systemic absorption and side effects. Narrowband ultraviolet B (UVB) phototherapy can be effective for widespread itching. First-generation antihistamines should be avoided due to modest efficacy and potential harm in older adults, and second-generation antihistamines reserved for those with urticaria [183, 184]. It is the author's opinion that the next tier of therapy might include cautious use of naltrexone 50–100 mg orally, selective serotonin receptor inhibitors (SSRIs), the antidepressant mirtazapine 7.5 mg orally, or low to intermediate doses of gabapentin. Tricyclic antidepressants should generally be avoided due to anticholinergic side effects. There are limited data suggesting that immunosuppressants such as azathioprine or mycophenolate mofetil, thalidomide, or aprepitant might help intractable cases, although the potential risks and costs should be carefully weighed against potential benefits for chronic pruritus [175, 185–187].

Psychogenic causes should also be considered after other organic etiologies have been excluded. Itch has been associated with depression, anxiety, and delusions of parasitosis. The dermatologist should partner with a mental health specialist or primary care provider when underlying mood order is thought to be contributing. Patients with delusions of parasitosis are very challenging since they have fixed beliefs and might reject psychiatric evaluation or medications. A review of this topic is beyond the scope of this chapter, but the bibliography contains practical references [188–191]

Notably, medication-induced itch can present with or without rash. A comprehensive review of culprit medications is beyond the scope of this chapter, but a few points are worth noting. Drug-induced itch without rash can be caused by several classes of antihypertensives, antimalarials, anxiolytics, and opioids. The itching usually starts within a few days or weeks of starting the medicine, but can sometimes last over 6 weeks after discontinuation [192]. Statins and diuretics have been associated with generalized xerosis and itch [193]. Calcium channel blockers have been implicated in chronic eczematous eruptions in older people [194, 195].

Returning to Case 1, localized itch without rash suggests a noninflammatory etiology. Dermatographism and non-bullous pemphigoid should be excluded. Use emollients to optimize barrier function. Although phototherapy is a relatively safe and ideal modality, the patient's gait instability would be a contraindication. If the patient has assistants, topical treatments might be the next best option. If refractory, consider discussing cautious use of systemic treatments using the aforementioned best prescribing practices.

27.4.5 Pemphigoid

Pemphigoid is a family of autoimmune blistering conditions that are caused by pathogenic antibodies that attack various targets within the basement membrane zone (BMZ). The specific pemphigoid disease is defined with respect to the target antigen. Here, we will focus mostly on bullous pemphigoid (BP), which is associated with antibodies directed against BP180 (type XVII collagen) and BP230. The former antibody has stronger evidence implicating its pathogenicity [196]. The increasing incidence might be explained by older adults living longer and age-related immunologic changes that were outlined above (see Sect. 27.3) [197].

The classic presentation of bullous pemphigoid is typically pruritic, tense bullae on the torso, and extremities with surrounding urticaria-like plaques. Mucosal surfaces can be involved, so it is important to ask about symptoms and inspect these areas. Peripheral eosinophilia is reported in up to 50% and might be associated with more extensive disease [198].

The differential diagnosis should also include other autoimmune blistering diseases (e.g., epidermolysis bullosa acquisita [EBA] and linear IgA bullous dermatosis), bullous diabeticorum, coma blisters, bullous tinea, and bullous arthropod. It is also important to take a careful medication history because some cases are potentially reversible if the offending medication is discontinued. One retrospective study suggested that almost 13% of medication-induced pemphigoid cases are missed [199]. Over 50 medications have been associated with pemphigoid, including, but not limited to, antihypertensives, dipeptidyl peptidase IV inhibitors (“gliptins”), vancomycin, and PD1/L checkpoint inhibitors [200–202].

Several studies have found an association of neurologic diseases, including multiple sclerosis and various dementias. The exact pathophysiologic relationship remains elusive, and it is possible the medications used to treat these neurologic conditions might be contributing [203]. Studies have shown low-level expression of BP180 in central nervous tissue. Some patients with neurologic diseases have circulating antibodies against BP180, but these antibodies appear to target different epitopes than those in BP patients [204].

27.4.5.1 Atypical Presentations of Pemphigoid Not to Miss

Atypical, nonblistering presentations of pemphigoid can occur in 20% of patients [205]. In one series, the mean delay to diagnosis of nonbullous pemphigoid was 29 months, during which period, patients suffered from significant symptoms [206]. This condition should be considered in older patients with sudden, intractable, and unexplained urticaria-like lesions lasting more than 24 hours. Other atypical pemphigoid presentations include pruritus, prurigo nodules, atypical dermatitis, dyshidrosis, vegetative plaques, hyperkeratotic papules with keratoderma, toxic epidermolytic necrosis (TEN-like), or even erythroderma [19, 207].

27.4.5.2 Diagnosis

Histopathology (H&E) of an intact vesicle or the edge of a larger blister is often done. While the findings may *suggest* pemphigoid, this test alone is unable to diagnose pemphigoid. There are several potential pitfalls in interpreting H&E results of suspected pemphigoid. Blisters can re-epithelialize within 48 hours, creating the appearance of an intraepidermal blister. Older blisters can also develop epidermal necrosis, which could lead to clinical-pathological confusion [208].

Direct immunofluorescence (DIF) is the gold standard for diagnosis. The specimen should be taken less than 1 cm away from a relatively new blister but not within the blister itself. If only urticarial or eczematous lesions are present, the biopsy can be taken within inflamed areas of intact skin. Biopsies from the lower legs might have a lower diagnostic yield, and some advocate for taking biopsies from other anatomic sites, when possible [209]. Fresher blisters are preferable, since they are less likely to become secondarily infected and result in false negatives [208]. Some laboratories report salt split skin on the patient’s DIF specimen or serration patterns to differentiate between bullous pemphigoid and other blistering conditions. However, these practices have not been widely adopted [210, 211].

In many cases, the clinical picture and a positive DIF support the diagnosis [208]. However, serologic studies such as enzyme-linked immunosorbent assay (ELISA) and indirect immunofluorescence (IIF) can provide important data. Anecdotally, some practitioners assert serologic studies should be done in all cases of suspected pemphigoid to confirm the diagnosis and guide therapy. For example, EBA is a relatively rare disease that also favors older adults [212]. There are some data suggesting EBA might be associated with hematologic dyscrasias, autoimmune, or inflammatory bowel disease [213]. EBA has a dermal staining pattern on DIF and would not be expected to have circulating BP180 and BP230 antibodies. Two other examples in which ELISA and IIF can be helpful adjuncts to DIF are nonbullous pemphigoid (no visible blisters can be biopsied) and the p200/laminin-ϒ1 pemphigoid variant, which typically shows a dermal staining pattern. These typically do not have circulating BP180/230 antibodies [214].

27.4.5.3 Management Pearls

Topical high-potency steroids are a relatively safe first-line therapy (except for the face) and are associated with fewer side effects than systemic steroids [215]. Notably, the topical clobetasol regimen described by Joly was at least 4 months long [216]. However, it is not uncommon in the United States that prescription insurance limits the steroid potency and/or quantity that can be dispensed. Another common challenge is some patients might not be able to apply the medication to all affected areas without assistance. There are weaker data supporting the topical calcineurin inhibitors [217].

Wound care should consist of antiseptic washes. Extensive debridement is not recommended. Large or symptomatic blisters may be carefully drained [217].

In cases of seemingly refractory disease or sudden flares, it is important to confirm that there is no superimposed infection or alternative cause such as drug-induced pemphigoid. In the current author's experience (JE), impetigo, herpes simplex virus (HSV), or even bullous tinea can complicate the clinical picture by causing blisters, erythema, ulcers, or itch. There are also reports of bullous scabies causing false-positive DIF results [218]. Appropriate testing for these organisms can avoid unnecessarily escalating immunosuppression and iatrogenesis.

Once confounding factors have been excluded, extensive and refractory disease requires systemic therapy. Systemic corticosteroids provide relatively rapid improvement at prednisone dose equivalents between 0.5 and 1 mg/kg, although older adults are at risk for significant adverse reactions. Lower doses might not be effective, but the current author (JE) generally recommends a "start low, go slow" approach to avoid complications [217]. Steroid-sparing agents should be considered to reduce systemic corticosteroid exposure and side effects. There are some data supporting dapsone, tetracycline antibiotics with nicotinamide (syn. niacinamide), methotrexate, mycophenolate, intravenous immunoglobulin (IVIg), azathioprine, omalizumab, and rituximab. The choice depends on patient comorbidities, formulary coverage, and access to infusion centers [217, 219].

27.5 Gaps and Future Opportunities in Geriatric Dermatology

One in five Americans will be over the age of 65 years by 2030, and many countries are seeing a significant expansion in their older populations [220, 221]. Historically, clinical trials often excluded older adults or those with multimorbidity [222]. There is a great need and opportunity for research to include older adults and address relevant clinical conditions of aging, such as pruritus and pemphigoid. Better evidence-based studies will, in turn, inform clinical practice and training of the future generation of dermatologists.

Another challenge will be ensuring adequate care delivery as the patient population ages and practicing Baby Boomer dermatologists retire. Physician extenders (e.g., nurse practitioners and physician assistants) are expected to only partially fill this gap [223–226]. At the time of writing this chapter, a novel coronavirus causing severe acute respiratory illness (COVID-19) is disrupting how medicine is practiced. There will be an exciting opportunity for telemedicine to expand and help older adults. Telemedicine has slowly expanded over the preceding years due to several technological and financial barriers. There are a handful of studies focusing on store-and-forward teledermatology in geriatric patients. One study out of Italy found reasonable diagnostic agreement between teledermatology and an in-person visit [227]. Studies in the Veterans Affairs (VA) system comparing teledermatology and face-to-face visits found comparable to somewhat lower costs and similar patient satisfaction, with about 50% of teledermatology visits requiring subsequent in-person visits [228–230]. Telemedicine might also facilitate preoperative consultations for Mohs micrographic surgery [231]. However, it is important to point out that these settings typically included standardized history gathering and photography by individuals with healthcare training. There are legitimate concerns whether older adults have access to and are comfortable with teledermatology platforms with direct-to-consumer models [232]. Furthermore, the accuracy of some existing commercial teledermatology services or smart device apps has been called into question.

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