Geriatric Preoperative Evaluation of the Older Adult

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Clinical Scenario

Ms. MN is an 89-year-old active older adult with obstructive jaundice and a surgically resectable mass in the head of her pancreas. She lives alone and is independently mobile, cognitively intact, and socially active. She has a history of hypertension and diet-controlled diabetes. She is independent with activities of daily living (ADLS) and instrumental activities of daily living (IADLS). She is able to walk two blocks without pause but has not really had the need to climb stairs and is unsure if she will have difficulty climbing them. On examination she is jaundiced and appears exhausted but comfortable. Her cardiac, pulmonary, abdominal, neurologic, and musculoskeletal exams are unremarkable. She takes less than 20 seconds on the timed up and go test which suggests good mobility. On admission, an electrocardiogram showed no acute changes. 2D ECHO, nuclear stress test, and chest x-ray were unremarkable. A complete blood count showed a mild normocytic anemia. A comprehensive metabolic panel demonstrated an obstructive pattern on the hepatic panel. A goal of care conversation was subsequently conducted with the patient and her family to discuss surgical resection of the mass. Given the patient's age and recent poor health, she was deemed to be at increased risk of post-operative complications and a prolonged, complicated post-surgical recovery period. The patient recognized that without the potentially curative surgical procedure, her life expectancy would be limited. Given her self-reported good quality of life, she felt that attempting the procedure, even if it led to further morbidity or death, was more acceptable to her than following a conservative approach. Although the medical and surgical teams and the patient's family expressed concerns regarding proceeding with surgery, they all acknowledged the patients view point and the goals of care she outlined. After finding no medical contraindications to surgery, the patient proceeded to have a pancreaticoduodenectomy.

10.1 Background

The geriatric preoperative assessment includes risk factor assessment with a focus on risk reduction of potential complications in the medical, social, functional, and neuropsychological domains. Recent comparative trials confirm that older adults who participate in a geriatric preoperative assessment have fewer complications, shorter hospitalizations, more frequent discharge to home, and fewer readmissions than a comparison group [1]. The geriatrician's role in a preoperative assessment goes beyond pre-procedure medical optimization by including additional plans for how to preserve the older adult's function, cognition, and social well-being. The geriatrician can prepare patients on what to expect during the post-operative recovery period, lay the groundwork for patients through transition planning, and explain settings for rehabilitation, short-stay skilled nursing facilities, or long-term acute care hospitals. Geriatric preoperative assessments also take into consideration the impact of aging on older adult's ability to tolerate surgery. The patient's ability to tolerate surgery rests not on the patient's physiologic reserve but also on environmental factors such as urgency of the surgery, nutrition, and social support. We have divided this chapter into a medical assessment organized around major relevant organ systems followed by functional, social, and psychological assessments relevant to a geriatric preoperative evaluation.

10.2 Medical Assessment

10.2.1 Cardiovascular System

An older adult's cardiovascular system has a reduced ability to compensate for stress. Changes in cardiac conduction also increase the risk of arrhythmia. Older patients are more prone to having perioperative cardiac adverse events [2]. We recommend calculating the revised cardiac risk index (RCRI), which is designed to predict post-operative complications such as myocardial infarction, pulmonary edema, ventricular fibrillation or cardiac arrest, and complete heart block. In patients with low risk by the RCRI, no further testing is indicated. In higher-risk patients, we recommend pursuing further cardiovascular testing if it will change clinical management [3]. An alternative to the RCRI is the American College of Surgeons National Surgical Quality Improvement Program (NSQIP) score which was designed to determine risk factors associated with intraoperative and post-operative myocardial infarction or cardiac arrest [4]. Routine 12-lead electrocardiogram testing is not recommended for everyone. Obtain an electrocardiogram only in patients with coronary heart disease, heart failure, significant arrhythmia, peripheral arterial disease, cerebrovascular disease, shortness of breath, or other significant structural heart disease, except in those undergoing low-risk surgeries. A 12-lead electrocardiogram may be considered in other asymptomatic patients who are undergoing higher-risk surgeries. Pursue an echocardiogram in patients with shortness of breath of unknown origin or any patient with previously documented left ventricular dysfunction with no assessment within the past year [3]. In patients with elevated cardiac risk and moderate or good functional capacity (more than 4 metabolic equivalent of task (MET)), no further testing is recommended. Examples of activities with METs greater than 4 include climbing a flight of stairs, walking up a hill, and walking on level ground at 4 mph [3].

In patients with elevated cardiac risk and unknown or poor functional capacity – less than 4 METs – pharmacologic stress testing is recommended if the results will change management [3]. Twenty-four-hour ambulatory monitoring is indicated primarily for patients with syncope or significant bradycardia or tachycardia if not previously evaluated. Preoperative angiography is recommended in patients with proven myocardial ischemia and unstable chest pain (Canadian Cardiovascular Society Class III–IV) despite adequate medical therapy who require non-urgent, non-cardiac

surgery. In patients with intermediate or high cardiovascular risk, a referral to a cardiologist for further evaluation may be indicated.

Heart failure (HF) The initial step in preoperative evaluation of patient with heart failure is assessment of functional status, symptoms and signs of heart failure, and comorbidities that may exacerbate the heart failure. In general, patients with a heart failure who are asymptomatic at the time of surgery should continue their current medical regimen. Patients with symptomatic heart failure should be medically optimized prior to surgery unless the surgery is emergent. Natriuretic peptides should be assessed as routine preoperative evaluation in patients with known cardiac dysfunction. In patients with arrhythmias, we recommend continuing oral antiarrhythmic drugs before surgery. Patients with permanent pacemaker (PPM)/automated implantable cardioverter-defibrillator (AICD) should undergo interrogation of the device prior to surgery [5].

Valvular heart disease In symptomatic patients with aortic stenosis, consider aortic valve replacement before non-cardiac surgery. Asymptomatic patients with aortic stenosis can proceed with elective surgeries. In asymptomatic patients with mitral stenosis if systolic pulmonary artery pressure is <50 mmHg and valve area is >1.5 cm^2, non-cardiac surgery can be performed. In symptomatic patients with mitral stenosis or in patients with systolic pulmonary artery pressure >50 mmHg, correct the mitral stenosis before non-cardiac surgery. In aortic or mitral regurgitation, non-cardiac surgery can be performed safely in asymptomatic patients. If a patient is symptomatic or has LV dysfunction, consider valve replacement [5]. New techniques and technology in minimally invasive surgery have broadened the eligibility of patients for various valve repairs and replacement. Transcatheter aortic valve replacement (TAVR) is an alternative for patients unable to undergo open heart surgery [6].

Prosthetic heart valves All mechanical valves require anticoagulation. When patients on anticoagulants are planned to have a surgical procedure with a high risk of bleeding, it may be necessary to stop their usual anticoagulant to reduce bleeding risk during the perioperative period. In patients with certain high-risk conditions, substituting an alternative anticoagulant with a short half-life while a patient's usual anticoagulant is held (a process known as "bridging") is recommended to minimize the risk of thrombotic events. Usually heparin or enoxaparin is used as a bridging agent. Of note, patients on direct-acting oral anticoagulants (DOACs) may not need to bridge since they have shorter half-lives and the duration that the patient is off of them is shorter. Bridging is indicated in patients with mechanical aortic valve plus additional clotting risk (atrial fibrillation, previous VTE, systolic heart failure with EF <30%, multiple mechanical valves, other hypercoagulable condition), older mechanical valve, and mechanical mitral or tricuspid valve (Table 10.1).

Table 10.1 Anticoagulation bridging therapy

Condition	When bridging is recommended
Atrial fibrillation	For patients with a CHADS2VASC > ≥5 *or* stroke within the last 3 months
Mechanical aortic valve	If additional stroke risk exists
Mechanical mitral valve	Always in major procedures where holding anticoagulation is necessary
DVT/PE	Occurred within the last 3 months prior to surgery
Thromboembolic stroke	Occurred within the last 3 months prior to surgery
Coronary stents	Recently placed – within 3 months prior to surgery

Resuming anticoagulation: Resumption of anticoagulation may vary depending on whether hemostasis has been achieved. Discussion with the surgeon performing the procedure is necessary to determine a safe time to resume anticoagulation. Generally, warfarin may be resumed within 24 hours of the procedure. Short-acting anticoagulants for post-operative bridging can be resumed after 24 hours, or later if there is higher risk.

Atrial fibrillation Anticoagulation bridging is beneficial if the patient has had a stroke within the past 6 months or if their CHADS2VASC score is ≥5 [7].

Guidelines for surgical delay after coronary revascularization Surgery should be delayed if possible after revascularization with coronary stenting. Ideally, anti-platelet agents (P2Y12 receptor inhibitors such as clopidogrel) should be continued, although the risks of bleeding vs. in-stent thrombosis must be weighed. If P2Y12 inhibitors must be discontinued, aspirin should be continued. Patients with high cardiac risk should be initiated on appropriate high-intensity statins [8].

Hypertension Anesthesia can lead to an increase in blood pressure in normotensive individuals. When hypertension is discovered in a preoperative evaluation, testing for target organ damage is recommended. In patients with blood pressure of 180/110 mmHg and above, the potential benefits of delaying surgery to optimize pharmacological therapy should be weighed against the risk of delaying the procedure. There is no clear evidence favoring one mode of antihypertensive therapy over another. There is no recommendation on whether diuretics should be discontinued prior to surgery. Beta blockers should be continued in the perioperative period and continued throughout the hospital stay. In patients with intermediate to high risk, it may be even reasonable to begin perioperative beta blockers; however, we do not recommend initiation of beta blocker on the day of surgery. Hold angiotensin-converting enzyme inhibitors/receptor blockers for a period of 24 hours

prior to surgery except in those with heart failure or with inadequately treated hypertension that cannot be improved before surgery [3].

Peripheral arterial disease When assessing an older adult for possible revascularization, functional status is among the most important things to consider. Revascularization is a high-risk surgery; thus, medical optimization and careful candidate selection is crucial for successful outcomes. Surgery is most likely to be beneficial to older adults as a means to preserve ambulation and independence. Studies have some good outcomes after revascularization both for chronic and critical limb ischemia, with upward of 70% of patients returning to live at home post-procedure [9].

10.2.2 Pulmonary System

Increasing age is an independent risk factor for post-operative pulmonary complications. Older adults develop an impaired ability to cough effectively over time (decreased respiratory muscle strength, increase chest wall stiffness), decreased mucociliary clearance, and greater ventilation-perfusion mismatch leading to an increased risk of pneumonia and hypoxia in the post-operative period [10]. Studies have shown a twofold risk for patients aged 60–69 and threefold for aged 70–79 for pulmonary complications. However, age may not be the strongest predictor of pulmonary complication. The type of surgery has been shown in one study to be a greater predictive factor. Proximity to the diaphragm and thoracic cavity increases pulmonary risk. This is thought to be due to pain, splinting, and inability to take deep breaths. Neurosurgery, neck surgery, aortic surgery, and other vascular surgeries also carry higher pulmonary risk [11]. Age ≥ 70 was only slightly higher risk than renal dysfunction, low albumin, and poor functional status. The American College of Physicians identifies the following risk factors to identify patients who require pulmonary evaluation: chronic obstructive pulmonary disease, age older than 60 years, American Society of Anesthesiologists (ASA) class II or greater, functionally dependent, and congestive heart failure. No specific models exist to predict pulmonary risk in older adults. A sample of commonly used risk assessment models for the general population is discussed below. While not aimed at older adults exclusively, these models can help guide discussion regarding the risk of post-operative complication, especially the possibility of longer-term intubation and tracheostomy which are important topics to explore with patients and families during the preoperative assessment. ARISCAT risk index [12] predicts the risk of any post-operative pulmonary complications, including respiratory infection, respiratory failure, bronchospasm, atelectasis, pleural effusion, pneumothorax, or aspiration pneumonitis. Arozullah respiratory failure index [13] predicts the likelihood of remaining on the ventilator 48 hours after surgery. Gupta calculator [14] predicts the likelihood of post-operative respiratory failure, definite specifically as the inability to come off a ventilator after 48 hours. The literature is not specific to geriatric patients; however, the following are reasonable guidelines to determine which patients may benefit from pulmonary function tests: those undergoing lung resection, coronary artery bypass grafting, pre-existing asthma or chronic obstructive pulmonary disease, and likely undiagnosed obstructive airway diseases. Routine chest x-ray is not recommended as part of a preoperative assessment for low-risk patients. Older adults are automatically considered at high risk by most assessment standards. Additionally, they have a higher prevalence of abnormal chest x-ray findings [15]. However, the clinical significance of abnormal chest x-ray is very low. A meta-analysis by Archer et al. demonstrated that abnormal chest x-ray that changed management occurred in only 0.1% of cases. Additionally, only 1.4% of these abnormal findings were "unexpected," meaning they would not have been predicted by history and exam [16]. A low serum albumin (<3.0) is correlated with a high likelihood of post-operative pulmonary complication. Nutrition status and other chronic diseases in older adults (cirrhosis, heart failure) may predispose to low albumin states. Elevated BUN increases risk of post-operative respiratory failure, though it is not as strong a predictor as albumin [17]. *Common conditions that affect pulmonary outcomes:* Functional status is a key component of a comprehensive geriatric assessment and has a significant impact on post-operative pulmonary complications. Partial dependence has 1.65 odds ratio of pulmonary complication; total dependence has 2.51 odds ratio of pulmonary complication; being categorized as ASA class II or higher is linked to increased risk of pulmonary complication and has an odds ratio of 4.8. Patients with cognitive impairment, prior stroke, gastroesophageal reflux disease, diabetes, dry mouth, and poor dentition are at increased risk for post-operative pneumonia. Smoking increases the incidence of pulmonary complications. Limited data exists on smoking cessation preoperatively, and no data is specific for older populations. In younger adults, smoking cessation more than 8 weeks prior to surgery has the greatest risk reduction. Chronic obstructive pulmonary disease increases risk of post-operative pulmonary complication, with an odds ratio of 1.79. Asthma has not been linked to increased pulmonary complication. Congestive heart failure significantly increases pulmonary complications, with an odds ratio of 2.93 [11]. *Venothrombolism:* The issue of anticoagulation in older adults is challenging. The benefit in terms of stroke prevention or treatment of deep vein thrombosis/pulmonary embolism must be weighed against the risk of bleeding. Several bleeding risk scores exist, including the HEMORR2HAGES risk index, HAS-BLED risk score, ATRIA, and OBRI. The HAS-BLED score has been shown to best predict clinically relevant bleeding, particularly intracranial hemorrhage [18]. Falls are a problem in older adults and often are cited as the reason for withholding anticoagulation. Subsequently we may be undertreating older adults. Evidence shows that patients with moderate to high risk of stroke still benefit from anticoagulation, even if they are at a high fall risk [19]. While bleeding is

a concern in older adults, rates of major bleeding have been found to be relatively low. A large study of 1500 patient found 2.4 major bleeding events for every 1000 patient-months. Insufficient education about bleeding risk and polypharmacy were the greatest risk factors for bleeding [20]. Stroke risk increases with age; therefore, there is increased benefit of oral anticoagulation with age. However, anti-platelets have been found to have decreased benefit for stroke prevention with age [21]. *Warfarin:* If there are 24 hours or more until surgery, give vitamin K to reverse the effect of warfarin [22]. There is no benefit to lower international normalized ratio (INR) goals with warfarin for preventing ischemic stroke in older adults. Tightly controlled INR with warfarin decreases risk of intracranial hemorrhage. The advantage of warfarin is that it is reversible but the disadvantage is the need for frequent monitoring. Direct-acting oral anticoagulants (DOACs) have a lower rate of intracranial hemorrhage than warfarin. *Dabigatran:* RE-LY trial found that at the 110 mg dose, dabigatran was noninferior to warfarin for stroke prevention but had a lower rate of bleeding [23]. Currently dabigatran is the only DOAC with an approved reversal agent: idarucizumab. *Rivaroxaban:* ROCKET-AF demonstrates non-inferiority to warfarin for stroke prevention. There were similar rates of bleeding but lower overall rates of intracranial hemorrhage [24]. *Apixaban:* ARISTOTLE trial showed that apixaban is superior to warfarin for stroke prevention, results in less bleeding, and has improved mortality [25]. Oral anticoagulants and antiplatelets are generally held prior to elective surgery. Discussion with the surgeon is necessary to determine which anticoagulants need to be held. Additional consultation with cardiology or hematology may be necessary in high-risk patients. For patients on anticoagulation receiving implantable cardiac defibrillator/pacemaker placement, continuing anticoagulation with warfarin has shown decreased rates of pocket hematoma than when bridging with heparin [26]. Known venous thromboembolism (VTE): The highest risk of recurrence of VTE is within 3 months of the event. Elective surgery should be delayed if possible to avoid this period [27].

VTE prophylaxis VTE prophylaxis should be used in patients with higher risk for DVT. Older adults have an increased risk of DVT. Other factors are prior DVT, malignancy, infection/inflammation, and stroke. Those who are immobile post-operative also are at increased risk and should have prophylaxis. Hip replacements carry a higher risk for DVT, as do abdominal/pelvic surgery in those with cancer [28].

10.2.3 Gastroenterology System

10.2.3.1 Liver Disease

Liver disease incurs a higher operative risk, even in younger patients. While there are surgical risk-prediction models for patients with cirrhosis and end-stage liver disease, including the Child-Pugh score and the MELD [29], neither of these were studied in older adults. *Coagulopathy in liver disease:* Valuating INR is reasonable to assess coagulopathy. Improvement in nutrition status may be beneficial in correcting INR. *Hepatic encephalopathy:* Hepatic encephalopathy predicts a poorer prognosis in patients with liver disease. Post-operatively, hepatic encephalopathy should be considered as a cause of altered mental status in cirrhotic patients. *Inflammatory bowel disease (IBD):* discussion with a gastroenterologist in patients with IBD is recommended prior to surgery, particularly if there is active disease or use of immune-modulating treatments. *Constipation:* Older adults are at risk of constipation in the post-operative setting for multiple reasons. The use of opiates for post-operative pain is a common cause, as is relative immobility. A good bowel regimen should include a motility-stimulating agent such as senna or a bisacodyl suppository. Docusate is generally ineffective for post-operative constipation in older adults. *Enteral feeding:* Temporary enteral feeding may be required post-operatively depending on the type of surgery and post-operative complications. The need for enteral feeding should be discussed with patients and families prior to surgery, with care to distinguish between temporary and long-term enteral feeding. For patients with advanced dementia, enteral feeding has not been shown to improve nutrition status or prolong survival nor does it decrease aspiration risk [30].

10.2.4 Renal System

Loss of kidney function with age increases acute kidney injury and renal failure risk. Changes in renal physiology also increase sensitivity to hypotension and increase the risk of acute kidney injury [31]. Renal function declines with age due to a multitude of physiologic changes. These changes also predispose to a higher risk of acute kidney injury and greater incidence of chronic kidney disease [32]. Similarly, the physiologic stresses created by surgery and anesthesia may be magnified. Patients with chronic kidney disease have at least doubled the likelihood of cardiovascular events and death after surgery as those with normal renal function [33]. The incidence of acute kidney injury after surgery is high. After cardiac surgery the rate can be up to 25% [34]. Additionally, a systemic review and meta-analysis found that those with acute kidney injury had a substantially increased risk of developing chronic kidney disease or end-stage renal disease, with a hazard ratio of 8.8 [35]. *Dialysis:* There is a higher post-operative mortality in hemodialysis patients [36]. A nephrologist should be involved in the preoperative screening process for any dialysis patients. A new dialysis requirement post-operatively is a poor prognostic factor. Older adults ≥75 years of age have a high 3-month mortality after starting dialysis, even in non-emergent settings [37]. Prior to any major surgery with a risk for AKI or renal failure, a thorough discussion of the risks and benefits of dialysis should be initiated with patients and their families/healthcare proxies. While there is no specific evidence to support this practice, it is generally recommended to hold diuretics on the day of surgery due to the theoretical risk for intraoperative hypotension [38].

Angiotensin-converting enzyme inhibitor/receptor blockers can be discontinued the evening before surgery, possibly 24 hours up to surgery. Increased incidence of intraoperative hypotension was found in patients who continued their angiotensin-converting enzyme inhibitor/receptor blockers on the morning of surgery [39]. Non-steroidal anti-inflammatory drugs: Discontinue prior to surgery to reduce acute kidney injury.

Dose adjustment and glomerular filtration rate (GFR) calculation Medications should always be dose-adjusted based upon renal function. The Crockoft-Gault formula, while widely used for calculation of creatinine clearance, should be used with caution in older adults as it is inaccurate and underestimates GFR (National Institute of Diabetes and Digestive and Kidney Diseases – NIDDK). Two alternatives being studied for calculating GFR are Chronic Kidney Disease Epidemiology Collaboration (CKD-EPI) and Modification of Diet in Renal Disease (MDRD) study. CKD-EPI may be more accurate for GFR calculations for patients ≥65 years old. Discussion with a pharmacist is recommended if there is concern about renal impairment. It should be noted that the Crockoft-Gault formula is used in studies that validate medications for approval with the FDA.

10.2.5 Endocrine System

Diabetes Preoperative glucose levels of >200 mg/dL has been found to be associated with deep wound infections [40]. For elective procedures, check HbA1C or have a glucometer diary, and if poorly controlled, surgery should be postponed. The American Diabetes Association (ADA) has endorsed a target glucose range of 80–180 mg/dL for the perioperative period. Patients on insulin should receive half their usual dose of intermediate-acting NPH insulin dose or full doses of a long-acting or pump basal insulin. Monitor blood glucose every 4–6 hours while NPO and correct with short-acting insulin if needed [41]. Basal insulin analogs and pump can be continued preoperatively and on the day of the surgery [42]. Oral hypoglycemic drugs or non-insulin injectable agents can be continued until the morning of surgery. They can be reinstated as soon as the patient is eating well. Consider cancelling non-emergent surgeries in patients with metabolic abnormalities (diabetic ketoacidosis, hyperosmolar hyperglycemia state) or blood glucose level above 400–500 mg/dL [43]. *Thyroid disease:* Myxedema coma is a potential risk in older adults with moderate to severe hypothyroidism undergoing surgery. If surgery is non-urgent, consider postponing until a euthyroid state is achieved. Patients with subclinical hypothyroidism may proceed with either urgent or elective surgeries. In severe hypothyroidism (myxedema coma; clinical symptoms such as altered mentation, pericardial effusion, or heart failure; or very low levels of T4), surgery should be postponed until hypothyroidism has been treated. If surgery is emergent, then start treating the patient as soon as the diagnosis is made [44]. Hyperthyroidism can result in thyroid storm with surgical stress. Treat hyperthyroidism before elective surgery. If surgery cannot be postponed, then initiate treatment as soon as possible. Hyperthyroid patients who require urgent surgery should be evaluated for possible cardiopulmonary disease such as arrhythmia, ischemia, and heart failure [45]. Thyroid medications (levothyroxine, propylthiouracil, etc.) should be continued in the perioperative period.

Adrenal insufficiency Adrenal insufficiency puts the patient at increased risk for perioperative cardiovascular collapse. Steroids at dose equivalent or greater to prednisone >20 mg/day for ≥3 weeks are considered to have iatrogenic suppression of the HPA axis and require stress dose steroids in the perioperative period. Consider adrenal insufficiency in patients on lower doses (5–20 mg/day) as well, and it is reasonable to give empiric corticosteroid coverage. Given the risk of stress-dose steroids (hyperglycemia, mania/psychosis, delirium), it is reasonable to perform testing to rule out adrenal insufficiency in those on lower doses to avoid unnecessary glucocorticoid use.

Morbid obesity Obstructive sleep apnea (OSA) and metabolic syndrome should be evaluated preoperatively. Perioperative continuous positive airway pressure in patients with OSA is recommended to decrease the chance for some of the post-operative pulmonary complications, such as atelectasis, pneumonia, and reintubation [46].

Nutrition Check for dietary preferences or restrictions to ensure an appropriate diet is ordered. Identify if the patient is having difficulty with loose fitting dentures or dental issues that need further evaluation, and assess if there are any signs of aspiration (coughing with eating, trouble swallowing). Record patient's weight, perform a brief nutritional assessment such as the mini nutritional assessment tool, and check for use of any supplements or vitamins [47].

Surgical mortality is higher in malnourished patients. Albumin has been traditionally used as a marker of poor nutrition, although this practice has become controversial. Regardless, there is a correlation between low albumin and poor surgical outcomes, including increased length of stay. Weight loss of ≥10% within 6 months prior to surgery is also a predictor of negative post-operative outcomes [47]. Older adults should undergo daily evaluation of their ability to take in adequate nutrition and risk of aspiration. Initiate dietary consultation and/or formal swallowing assessment if indicated. Patients who use dentures should have them easily available. Vision should also be assessed, as this can impair the ability to eat, and a patient's glasses should be easily accessible if needed. Patients should have an elevated head of bed and be sitting upright while eating and for 1 hour after completion of eating. Enteral feeding has to be started as early as possible [48].

10.3 Anesthesia

An anesthesia plan should be carefully tailored to each older adult undergoing surgery. This should include a prophylactic bowel regimen [49]. Scheduled acetaminophen is an appropriate first-line treatment option. In cases with contraindication to acetaminophen or if acetaminophen is insufficient to achieve pain control, then patients may require low-dose opiates or may benefit from local or regional pain management techniques [50]. Most studies examining elective surgery suggest no difference in post-operative delirium when regional and general anesthesia are compared [51]. Epidural anesthesia may provide benefits over general anesthesia in an older adult, including decreasing atelectasis, allowing for earlier extubation and reducing the length of ICU stays [52]. Post-anesthesia, slower recovery of psychomotor and neurocognitive function may be observed in older adults compared to younger populations, with cognition sometimes taking months to recover [53].

Review medications and evaluate for potential discontinuation of nonessential ones in the perioperative period. Inappropriate medication use in older patients before cancer surgery has been associated with increased incidence of postoperative delirium [54]. Consider potential for withdrawal, progression of disease with interruption of drug, and interactions with anesthetic agents as well [55]. For example medications such as rivastigmine or donepezil that are commonly prescribed for patients with dementia are associated with a prolonged effect of the anesthetic succinylcholine or the interaction between SSRI antidepressants with some of the serotonergic medications administered in the perioperative period may lead into serotonin syndrome. We also need to keep in mind that sometimes clinical depression or acute psychosis may develop following acute withdrawal of regular antidepressants or benzodiazepines. Always check for herbs or over-the-counter medication use. For example, ginkgo biloba may increase risk for bleeding during the surgery or Kava may increase sedative effect of anesthesia [56].

10.4 Psychological Assessment

Decision-making capacity The assessment of decision-making capacity generally is comprised of the ability of a patient to communicate a choice, understand health information, and appreciate the medical consequences of decisions and reasons about treatment options. Keep in mind that capacity is situation dependent. Patients with cognitive impairment may still retain the capacity to make certain decisions. In patients who do not have the capacity to make decisions, it is important to identify an alternate decision-maker. One such person may be the patient-appointed healthcare proxy. If no healthcare proxy has been appointed, next of kin and surrogacy laws generally determine the legal decision-maker. If no surrogates exist, then it may be necessary to seek legal guardianship [57].

Mental illness – schizophrenia This encompasses a wide spectrum of disease. Some individuals will still retain capacity to make decisions. *Depression:* This can affect decision-making capacity and can interfere with recovery from surgery. Depression should be screened for and treated appropriately prior to surgery. Antidepressants should be continued during the perioperative period. Stopping the antidepressant during the preoperative period may cause withdrawal (discontinuation syndrome). Symptoms of withdrawal include nausea, abdominal pain, diarrhea, affective symptoms, and insomnia [58]. Lithium: Kidney injury and changes in renal function can affect lithium levels during the preoperative period, risking lithium toxicity. Monitor renal function closely and adjust lithium doses as needed. Antipsychotics should be continued through the perioperative period. It should be noted that tramadol can interact with antipsychotics, SSRIs, and TCAs and lower the seizure threshold. Additionally, neuroleptic malignant syndrome and serotonin syndrome should be considered on the differential for altered mental status and fever for patients taking antidepressants or antipsychotics. *Substance abuse:* All patients should be screened for substance abuse prior to surgery. Withdrawal from alcohol may be deadly. While withdrawal from cocaine or heroin may not be fatal, it can be a cause of delirium post-operatively. Screening for prescription drug abuse is also important. Tobacco cessation should be recommended and a referral for treatment offered. *Preoperative cognitive status/dementia:* It is important to establish a baseline cognitive status on all patients undergoing surgery. Older adults should be screened for possible dementia or mild cognitive impairment. Two commonly used screening tools for dementia are the Folstein Mini Mental Status Exam (MMSE) and the Montreal Cognitive Assessment (MOCA). The MMSE and other screening tests are generally 70–90% sensitive and 80–90% specific for dementia [59].

Post-anesthesia cognitive dysfunction A large study of 1200 patients over the age of 60 found that about 25% had postoperative cognitive dysfunction. This generally improved, with only 10% reporting continued cognitive dysfunction after 3 months. However, about 1% of those patients had not returned to baseline after 2 years [60]. This phenomenon highlights the importance of baseline cognitive assessments, as well as establishing healthcare proxies and advanced directives. *Seizure:* Anesthesia and metabolic disturbances around surgery can cause seizures. Tramadol can interact with antipsychotics, SSRIs, and TCAs and lower the seizure threshold.

Cerebrovascular disease Patients at high risk of stroke should be medically optimized, controlling blood pressure, hyperlipidemia, diabetes, and hypo-/hyperthyroidism. Specialist referral would be appropriate if a patient has had a recent stroke. While there is some data on preoperative screening for carotid stenosis, there is no data to support this specifically in older adults. Symptomatic carotid stenosis (previous TIA or stroke) should be treated.

Post-operative delirium prevention Studies on pharmacologic therapy for delirium prevention and treatment are limited, with small studies and inconclusive data. Antipsychotics such as haloperidol and seroquel are commonly employed for treatment of agitation in delirium. There is no conclusive data on effectiveness or the superiority of one drug over another. Conservative measures for delirium prevention should be initiated in all older adults post-operatively. These include reducing tethers (lines, catheters, restraints), early mobilization, frequent reorientation, maintaining proper day/night cycles (ideally have the patient's bed near a window with the shades open), managing constipation, managing pain, ensuring proper vision and hearing devices are available if needed, and avoiding medications that cause or worsen delirium such as sedatives, anticholinergics, and antihistamines. While opiates may contribute to delirium, their use should be balanced against appropriate pain control (inadequate pain control can also cause delirium).

Antiepileptics These should be continued preoperatively, and levels monitored if indicated. Renal function should be closely monitored and medications dose-adjusted as appropriate.

Parkinson's medications These should be continued preoperatively. Stopping medications for Parkinson's disease can cause withdrawal or a flare of symptoms [61].

10.5 Functional Assessment

An assessment of an older adult's functional ability plays an important role in relation to post-surgical complications as well as transition planning options to a location other than a patient's home due to increased personal care needs. The preoperative period offers a unique period to assess and document baseline functional status and intervene through physical therapy, post-operative transition planning to subacute or acute rehabilitation or consideration for home physical therapy services. There is an increased interest in preoperative optimization via structure exercise programs with both aerobic and resistance exercise. Rehabilitation prior to surgery has not yet been sufficiently studied. Improving functional ability prior to surgery is appealing, as studies have shown in cancer patients that the inability to perform activities of daily living (ADLs) and instrumental activities of daily living (IADLs) is correlated with increased morbidity, mortality, and increased length of stay. We recommend documenting any history of falls in the past year, sensory impairments (hearing, vision, or swallowing), gait and mobility limitations, adaptive equipment needs (canes, walkers, wheelchair), and an assessment of ADLs, IADLs, and performance status during the preoperative evaluation [62]. Preoperative functional assessments such as the "Timed Up and Go" screening tool have shown to predict outcomes in elderly cancer patients as well as post-orthopedic surgery [63]. Patients who require more than 15 seconds to complete the Timed Up and Go test are at increased risk of falls. A significant change in functional status from baseline in a patient with preserved functional ability will influence transition planning to acute or subacute rehabilitation due to rehabilitation potential for return to baseline functional status.

Frailty This is the age-related decline in physiologic reserve and reduced ability to handle stressors. Frailty is a predictor of negative post-operative outcomes such as morbidity, mortality, increased length of stay, and discharge to facility. Frailty is common in older adults. There are multiple frailty assessment tools that include unintentional weight loss, generalized weakness, poor energy and endurance, low physical activity, and slow gait. The choice of frailty assessment instruments needs to be individualized based on evaluation time constraints and availability of objective measurement such as grip strength assessments or gait speed [64].

10.6 Social Assessment

Preoperative assessments should include current home address, type of abode if the patient lives in a private residence (i.e., elevator- or stair-accessible apartment), single-family home, assisted living, or long-term care facility, need to climb stairs in the home, and need for wheelchair access. Alternative living arrangements need to be explored if the patient is unable to safely function at home or has insufficient social supports or resources to meet their skilled (registered nurse) or unskilled needs (home health aide) during the post-operative recovery period. Identification of family members, formal and informal caretakers, health insurance information, prior use of Medicare rehabilitation days, ability to pay for private home health aides, or a private hire geriatric care manager to coordinate care are useful for post-surgical transition planning. Information on current services such as meals on wheels or certified home healthcare agency (CHHA) services is important to identify to resume or modify such services post-operatively. Working with interdisciplinary team members including social workers and case managers is highly valuable for navigating these assessments. *Advanced care planning and goals of care:* Geriatricians have an opportunity to ensure that the intended surgical procedure and anticipated outcome is in line with the patient's overall goals of care. This ensures that healthcare providers best meet patient expectations during the post-surgical recovery period and beyond. Delirium, prolonged or unexpected intubation, or other unexpected events leading to an inability to make decisions can lead to significant stress and conflict if appropriate preparations are not made. Ensure a clear alternate decision-maker has been designated (healthcare proxy, surrogate, guardian), and encourage patients to make their wishes known to this person prior to the operation. Advance care planning is the process which allows patient to voice the care they would want to receive if they were unable to communicate. Advance directives such as a

living will are the documentation of what patient's value, their beliefs, and treatment preferences. The process includes the opportunity to appoint a healthcare agent/proxy or identify surrogates/next of kin to allow for these individuals to participate in a discussion preoperatively. Non-emergent surgeries in particular offer an opportunity to explore what patient's value and ensure that anticipated surgical outcomes are in line with the patient's goals of care.

Case Conclusion

Ms. MN had a complicated post-operative course where she needed to be surgically re-explored for an anastomotic leak which was repaired. She developed post-operative delirium and renal failure requiring dialysis and needed prolonged mechanical ventilation and hemodynamic support in an intensive care unit. She ultimately died just over a month following the procedure due to ongoing multiorgan failure. The geriatric team met with the family to provide support and debrief following the patient's death. The patient's family, while grieving, recognized that the patient understood the surgical risks involved and was grateful that we honored her informed decision to pursue the surgery despite the risks and subsequent negative outcome.

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