Medical Management

12

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Introduction

Proximal femur fractures, and their associated morbidity and mortality, raise a significant public health concern in the United States. The annual incidence of such fractures ranges from approximately 400/100,000 for men to almost 1,000/100,000 for women [1]. While the incidence of hip fractures has steadily declined over the last decade in parallel with increased bisphosphonate use, the 1-year mortality from this disease has not decreased and remains approximately 30% [2]. Additionally, there is a significant reduction in the patient's quality of life due to loss of independence, financial burden, and associated morbidity. The role for medical management of hip fractures includes optimizing patients preoperatively, attending to immediate postoperative complications, and coordinating long-term follow-up for evaluation and treatment of associated comorbidities.

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Medical management of hip fractures involves the following aspects of care:

(a) Pain control
(b) Optimizing medical comorbidities prior to surgery
(c) Postoperative complications:
    1. Infections
    2. Venous thromboembolism
    3. Delirium
    4. Pressure ulcers
    5. Anemia
(d) Early mobilization, rehabilitation, and falls prevention
(e) Nutritional support
(f) Secondary prevention with osteoporosis treatment
(g) Long-term cognitive outcomes

Pain Control

While provision of patient comfort is a fundamental obligation of healthcare providers, recent data shows that pain is inadequately treated in the perioperative period [3]. Barriers include cognitive impairment leading to inability to report pain reliably, reliance on primitive pain scoring tools, and lack of evidence-based recommendations. Inadequate pain control not only leads to suffering, but also contributes to delirium and suboptimal rehabilitation which may lead to slower

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recovery, pressure sores [4], and longer hospital lengths of stay.

Nonverbal clues such as restlessness, agitation, and facial expressions as well as physiologic signs such as tachycardia, tachypnea, or hypertension should be carefully evaluated in the elderly patient and especially in those with cognitive impairment—a population in whom hip fracture is exceedingly common.

Both opiod medications and regional nerve blocks are therapeutic options to control pain in patients with hip fracture. The sensory innervation of the proximal femur and a portion of the intracapsular femoral neck arise from the femoral nerve; hence femoral nerve block (FNB) is a therapeutic option in such patients. Additionally, FNB plays a unique role in the elderly patient with multiple comorbidities who may be unable to tolerate the cardiorespiratory side effects of systemic opiods. FNB results in a reduction of the quantity of systemic analgesia required [5]. Ultrasound-guided FNB has been shown to be superior to the traditional nerve stimulation-guided method and provides faster, longer pain relief with a smaller volume of anesthetic use [6].

Systemic opiods play a complementary role to FNB but should be used with caution until cardiorespiratory and metabolic parameters have been reviewed. Early fracture fixation provides the most effective pain control [7]. Most importantly, a standard pain control protocol should be adopted. Initiation of a pain control program using preoperative FNB as well as utilization of a systematic approach to nutrition, fluid, and oxygen therapy; and avoidance of urinary retention led to reduction in postoperative complications (including delirium, confusion, urinary tract infection) as well as a reduction in mortality in certain patients [8].

Optimizing Medical Comorbidities Prior to Surgery

Studies show that early surgery—within 24–48 h of hospitalization—leads to lower incidences of delirium, fatal pulmonary embolism, and pressure sores and is associated with a lower 1-year mortality [9]. There are, however, certain scenarios where the benefits of early surgery are outweighed by the risks of delaying surgery while medical comorbidities are optimized.

Advanced age is not an independent risk factor for complications after surgery, but the geriatric population is predisposed to having concurrent medical conditions. Patients with active high-risk cardiac conditions such as acute coronary syndromes, severe valvulopathy, or decompensated heart failure [10] should undergo medical optimization prior to surgery. Cardiopulmonary status and metabolic parameters should be carefully assessed. Major abnormalities such as significant hypotension, active infection, decompensated heart failure, acute coronary syndrome, coagulopathy, severe respiratory failure, and significant metabolic abnormalities have all been shown to be independent risk factors for the development of postoperative complications [11]. Hence, these risk factors should be addressed prior to surgery.

ASA classification can also be used to risk stratify patients undergoing surgery. ASA III and IV (moderate to severe systemic disease that impacts the patient's function and severe systemic life-threatening disease, respectively) have nine times higher 1-year mortality rates compared to ASA I and II (normal, healthy patients and mild systemic disease with no functional limitations) [12].

The elderly population is often exposed to polypharmacy which increases the likelihood of adverse drug reactions. Meticulous attention should be paid to the patient's medication list in the perioperative period in order to minimize pharmacokinetic and pharmacodynamic interactions.

Preoperative testing should routinely include a full blood count, a basic chemistry panel, and an electrocardiogram. Other studies are indicated based on the patient's underlying comorbidities. Operative blood loss is expected; hence preoperative transfusion should be considered if the Hb is <9–10 g/dL. Dyselectrolytemias predispose to cardiac arrhythmias and should be corrected preoperatively. Special attention should be paid to the patient's underlying cardiac rhythm, since the incidence of atrial fibrillation is very common in the elderly. For patients who are chronically

anticoagulated prior to admission, a recent trial showed that forgoing bridging anticoagulation in patients with atrial fibrillation who were on warfarin was noninferior to perioperative bridging with low-molecular-weight heparin, with lower risk of major bleeding [13]. Cardiac consultation should be considered in patients with indwelling cardiac stents, implantable cardiac defibrillators, and pacemakers.

Managing Postoperative Complications

Postoperative complications are common, add to the morbidity and mortality of hip fracture surgery, and require a high degree of vigilance in elderly patients to detect. Common postoperative complications are listed in Table 12.1. Studies have shown that most of the common postoperative complications are independently associated with increased 30-day and 1-year mortality [14].

Between 14 and 20% of patients will have postoperative complications after hip surgery [14], the most common being respiratory infection (9%), heart failure (5%), and urosepsis (4%). Patients with preexisting comorbidities are, predictably, more likely to develop complications and require even closer attention in the postoperative periods.

Infections

Surgical site infections (SSI), chest infections, and urinary tract infections make up the majority of infectious complications. The typical onset of an SSI is between day 3 and day 8 postsurgery

Table 12.1 Frequent postoperative complications

Complication	Incidence (%)	Prevention
Surgical site infections	1.6–22.7	Preoperative medical optimization
		Prophylactic antibiotics
		Intraoperative sterility
		Glycemic control
Chest infections	Unknown	Handwashing
		Early extubation and remobilization
		Avoidance of PPI
		Avoidance of sedation
Urinary tract infections	38	Early catheter removal
		Antibiotics in patients with positive urinary culture, regardless of symptoms
Delirium	10–65	Daily screening for hyperactive and hypoactive delirium
		Pain control
		Avoidance of polypharmacy
Venous thromboembolism	1.0–4.3	Anticoagulant therapy
		Early mobilization
Delirium	61	Pain control
		Oxygen, fluids, nutrition
		Environmental stimulation
Constipation		
Pressure ulcers	10–40	Foam mattress
		Mobilization
		Nutritional support
Anemia	80	Avoid unnecessary phlebotomy
		Transfuse to goal Hb > 8 g/dL
Secondary fractures	Unknown	Falls prevention
		Vitamin D

and is reduced by active surveillance, hand hygiene, attention to nutritional status, glycemic control, and perioperative antibiotic prophylaxis [15].

Chest infections are common and are associated with increased length of stay, worsening morbidity, and increased mortality. Age-related immunosenescence, age-related changes to the lung epithelium, silent aspiration of oropharyngeal secretions, reduced alertness and gag reflex, and immobility all contribute to the development of chest infections in the elderly postoperative patient [16]. Vigilance is key because the elderly patient often will not mount the classical signs of infection such as fever or leukocytosis.

Chest infections are sometimes grouped under the broader category of postoperative pulmonary complications (PPCs), which include atelectasis, pneumonia, respiratory failure, and venous thromboembolism (VTE). VTE will be discussed in more detail separately; however, atelectasis and respiratory failure deserve special mention here.

Atelectasis is common, and postoperative orthopedic patients are prone to this because of immobility, inadequate pain control, body habitus, and preexisting cardiopulmonary disease. Regular pulmonary toilet, incentive spirometry, early extubation, and ambulation must be stressed upon in the postoperative period. Hypercapnic respiratory failure is common as well, most commonly from excessive administration or reduced excretion of centrally acting medications or from undiagnosed sleep apnea. Hypoxic respiratory failure is often multifactorial and can occur from fluid overload, aspiration, atelectasis, venous thromboembolism, and pneumonia.

Venous Thromboembolism (VTE)

VTE is a serious and common complication following hip fracture surgery [11] which significantly contributes to worse outcomes in terms of morbidity and mortality. Without prophylaxis, the incidence of VTE is as high as 46–75% [17] with a fatal pulmonary embolism (PE) rate of 4% [18]. Delay in presentation to the hospital or delay in time to surgery increases the risk for developing VTE by almost ten times. Patients are at risk for VTE soon after the time of injury and not after surgical repair; therefore prophylactic anticoagulation should be initiated immediately.

The incidence of VTE can be substantially reduced by the use of appropriate and timely VTE prophylaxis. Mechanical VTE prophylaxis such as intermittent pneumatic compression devices (IPCD) has been shown to reduce deep venous thromboses rates [19]. The American College of Chest Physicians, in its 2012 guidelines, recommends the use of only portable, battery-powered devices that are capable of recording and reporting wear time; additionally, it advises at least 18 h/day of daily compliance [20].

Chemical prophylaxis is key in preventing VTE in patients following hip fractures. Options include heparinoids (unfractionated heparin, low-molecular-weight heparin (LMWH)), fondaparinux, direct oral anticoagulants (DOAC, apixaban, rivaroxaban, dabigatran), vitamin K antagonists (warfarin), and aspirin. Using an agent such as LMWH reduces symptomatic VTE rates to <2% in the first 5 weeks postsurgery. LMWH should be used in preference to other agents, irrespective of the use of IPCD, unless there is a contraindication to doing so. Thromboprophylaxis should be extended to 35 days postoperatively since the risk of VTE is highest during these first 5 weeks. There is no established role for routine prophylactic inferior vena caval filter insertion or Doppler screening for DVT in asymptomatic patients [20].

Because of the high incidence of VTE, a high index of suspicion for PE must be maintained in the perioperative course. Traditional Wells' criteria for diagnosing PE does not perform well in this population [21], and coexisting pulmonary pathologies such as atelectasis, aspiration, and opiod-induced hypercapnia makes hypoxia an extremely nonspecific finding. [Bedside ultrasonography and the use of end-tidal CO_2 monitoring are exciting tools to use in differentiating the etiology of cardiorespiratory failure in this setting. Lower extremity Doppler examination, biomarkers for right ventricular strain such as troponins and beta-natriuretic peptide, echocar-

diogram, and imaging such as a CT angiogram or a ventilation/perfusion scan are modalities in the workup for possible PE.]

Treatment largely depends on the cardiopulmonary effects of PE. Non-massive PE and low-risk sub-massive PE are usually treated with anticoagulation alone (either heparinoids or vitamin K antagonists or direct oral anticoagulants), while patients with high-risk sub-massive PE may be candidates for thrombectomy or catheter-directed thrombolysis. IVC filters are reserved for patients in whom anticoagulation is contraindicated or has failed, while systemic thrombolysis is usually a salvage measure for massive PE.

Delirium

Delirium is common in elderly patients, and its incidence is significantly increased in patients who are hospitalized. There is a large overlap among patients with delirium and those with hip fractures. Common risk factors include age, polypharmacy, gait instability and coexisting dementia, and other medical comorbidities. The incidence of perioperative delirium after hip fracture is high as 60% [22]. At 6 months, patients with delirium were found to have increased hospital length of stay, increased postoperative complications such as urinary incontinence and decubitus ulcers, and an increased chance of dying or being placed in a nursing home.

Factors predisposing patients to delirium include the use of centrally acting medications, especially benzodiazepines and opiods, poor nutritional status, hypoxia, sepsis, and preexisting dementia [23].

A high level of suspicion for delirium should be maintained in the perioperative setting. Hypoactive delirium may be as common as hyperactive delirium but is more difficult to diagnose. Risk factors for developing delirium should be minimized. Delirium can be prevented in one-third of at-risk patients and can be minimized in the others. If the underlying cause of delirium cannot be corrected and the patient's behavioral symptoms cannot otherwise safely be controlled, antipsychotics can be considered. Their toxicity, especially cardiac arrhythmias and extrapyramidal side effects, however, should be carefully monitored. Efforts should be taken to institute a multidisciplinary stepwise approach to assess and treat patients who are at high risk for developing delirium.

Pressure Ulcers

Pressure sores are common after hip fractures with reported incidence rates of 10–40% [24] and have significant effects such as an increase in pain scores, length of stay, costs of care, medical complications, and mortality [25]. Of note, hospital-acquired pressure ulcers are considered a "never event," and the Centers for Medicare and Medicaid Services does not reimburse hospitals for the cost of their treatment.

Older patients with hip fractures are at high risk for developing pressure ulcers. Predisposing factors include immobility, poor nutritional status, incontinence, and the presence of coexisting diseases such as diabetes and anemia [24, 25]. Pressure sore prevention is crucial and involves minimizing surgical delay, pressure-relieving mattresses, good skin care, rehabilitation, and regular assessment of the patient's nutritional status [26].

Pressure ulcers are particularly difficult to heal. Treatment principles include careful assessment of severity, releif of pressure and friction, moist wound healing, removal of debris, and management of bacterial contamination [26]. Severe complications of pressure sores can include osteomyelitis and bacteremia.

The mere presence of a pressure ulcer is a prognostic sign. Only about 10% of ulcers heal by the time of hospital discharge, and as many as two-thirds of patients with pressure ulcers die during acute hospitalization. Patients whose pressure sores heal do significantly better than those in whom the sores persist. Though pressure sores themselves are not causally related to poor outcomes, their existence marks a patient who may have significant risk factors for developing perioperative complications leading to increased mortality and morbidity [27].

Anemia

The incidence of preoperative and postoperative anemia following hip fracture is high and is associated with increased length of hospitalization and increased 6-month and 12-month mortality [28]. While approximately 40% of patients are anemic on admission, intraoperative blood loss leads to postoperative anemia in almost all patients with hip fractures [29].

A large, well-designed, randomized controlled trial has helped determine optimal transfusion thresholds in patients following hip surgery [30]. In this trial, more than 2000 high-risk patients (as defined by history of or risk factors for cardiovascular disease) were randomized to a liberal transfusion strategy (hemoglobin threshold of 10 g/dL) or a restrictive transfusion strategy (symptomatic anemia or a hemoglobin threshold of 8 g/dL). There was no difference among the two groups in terms of mortality or functional capacity at 60 days; neither were there any differences in in-hospital myocardial infarction or unstable angina.

Early Mobilization and Rehabilitation

While early mobilization of the elderly patient with a recent hip fracture can be challenging, there is robust evidence to support aggressive early mobilization following hip fracture surgery. Increased immobility leads to worsening morbidity and mortality [31] and predisposes to postoperative complications such as pressure ulcers, urinary retention, ileus, and VTE. Studies show that early ambulation (first walk on postoperative day 1 or 2) accelerates functional recovery and reduces the need for high-level care compared to delayed ambulation [32]. Processes should be in place to facilitate early mobilization. These include aggressive and timely pain control, removal of indwelling catheters, minimizing sedative medications, and an early assessment by the rehabilitation team.

Nutritional Support

More than half of hip fracture patients are malnourished [33]. Nutritional deficiency is strongly implicated in the pathogenesis of hip fractures [34], as they accelerate bone loss, predispose to gait instability, and are associated with higher comorbid indices [35]. Therefore it is imperative to pay close attention to the nutritional status of elderly patients to (a) prevent hip fractures, (b) enhance recovery, and (c) prevent recurrence.

Calcium and vitamin D supplementation in elderly patients has been shown to increase bone density and reduce the incidence of hip fractures and is a cost-effective way of managing high-risk patients [36]. Among patients who have developed a hip fracture, macronutrients and micronutrients must be replenished. Macronutrient deficiencies such as low protein intake play a detrimental role in recovery, and replacement aids in reducing complication rates and hospital length of stay. In general, hyperproteic nutritional supplements are recommended in the inpatient care of elderly patients with hip fractures. Micronutrients that play a pathogenic role in the disease process include vitamin D, vitamin K, and calcium, and efforts should be made to replete their deficiencies.

Secondary Prevention and Management of Osteoporosis

The occurrence of a second hip fracture is approximately 10%, and care should be taken to avoid such recurrence. Risk factors include age, female gender, obesity, coexisting illnesses such as diabetes, hypertension, as well as the prolonged use of analgesics and anti-inflammatory medications [37]. Guidelines clearly state that osteoporosis treatment is necessary to prevent recurrence of hip fractures [38]. Vitamin D supplementation suppresses parathyroid hormone and increased bone mineral density. It also helps to prevent falls after hip fracture [39].

Bisphosphonates are key in preventing the loss of bone mass and help reduce vertebral and non-vertebral fractures [40]. Of all the bisphosphonates available, special attention should be given to zoledronic acid. A large randomized controlled trial showed that an annual infusion of zoledronic acid within 90 days after repair of a low-trauma hip fracture reduced the rate of clinical fractures and improved survival [41]. Hip protectors may reduce the risk of hip fractures, although compliance is low secondary to discomfort and practicality [42].

Long-Term Cognitive Outcomes

Cognitive impairment is common in all older hospitalized patients and is multiplicated in patients suffering hip fractures, with incidence rates approaching 60% in this group [43]. Hip fracture patients who suffer from cognitive problems have increased hospital lengths of stay, higher risk of death, and poorer functional recovery. Risk factors for such cognitive impairment include preexisting dementia, coexisting comorbidities, inadequate pain control, effects of anesthesia, as well as sleep and sensory deprivation in the hospital. In elderly hip surgery patients without a preoperative diagnosis of cognitive impairment, patients who develop postoperative delirium have nearly double the risk of being subsequently diagnosed with dementia compared to at-risk patients who do not develop delirium.

Efforts should be made to prevent and treat delirium, especially since the risk of dementia in patients developing delirium is extremely high [44]. Screening for underlying delirium and cognitive impairment is vital, and well-validated tools such as CAM-ICU should be routinely used.

Conclusions

Hip fractures are a common condition in the elderly and significantly contribute to increased mortality and morbidity in this population. Evidence-based medical care improves clinical outcomes, and systems should be in place to address the common perioperative complications, as well as facilitate early rehabilitation and nutritional support in these patients. Long-term consequences of hip fracture include cognitive impairment, fracture recurrence, and functional disability. A coordinated multidisciplinary team approach involving orthopedic surgeons, internists, geriatricians, nurses, physical and occupational therapists, nutritionists, dieticians, and social workers has been shown to decrease complications and improve outcomes in this population [43].

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