

Hip Fracture in the Elderly

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Clinical Medicine Insights: Geriatrics
Volume 10: 1–10
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DOI: 10.1177/1179553017703998



ABSTRACT: Hip fractures in elderly patients are the most severe form of fragility fractures. They can lead to significant morbidity and mortality; additionally, they have an enormous economic and social burden. Treatment of hip fractures in elderly patients should be based on a prompt initial evaluation, followed by surgical treatment without unnecessary delays under a collaborative effort of a multidisciplinary team. Postoperative care should be started immediately after surgery, and it must include an intensive rehabilitation, as well as treatment of osteoporosis and any other metabolic imbalance. This review incorporates current literature on initial evaluation and definitive management of hip fractures in the elderly and is intended to assist practitioners of different specialties treating these patients.

KEYWORDS: Hip fracture, orthogeriatrics, elderly patient

RECEIVED: November 11, 2016. **ACCEPTED:** March 17, 2017.

PEER REVIEW: Four peer reviewers contributed to the peer review report. Reviewers' reports totaled 1702 words, excluding any confidential comments to the academic editor.

TYPE: Review

FUNDING: The author(s) received no financial support for the research, authorship, and/or publication of this article.

DECLARATION OF CONFLICTING INTERESTS: The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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Introduction

Hip fractures are the most severe manifestations of so-called fragility fractures.¹ They not only can lead to significant morbidity² but also are associated with a high risk of mortality. In addition, they have an enormous economic burden.³

As the population continues to age, fragility fractures represent a growing epidemic worldwide. Therefore, the care of patients with these medical conditions has become a major topic of interest among not only orthopedic surgeons but also geriatric and internal medicine-related specialists as well as among public health authorities, and insurance systems.

Epidemiology

More than 200 000 hip fractures occur every year in the United States.^{4,5} Most of them affect older women. The estimated incidence of hip fractures is 957 and 414 per 100 000 inhabitants/year for women and men, respectively.⁴ With an aging population, the number on hip fractures is expected to increase significantly in the future, with an expected incidence of more than 500 000 cases per year by 2040.^{6,7}

Hip fracture is associated with a mortality rate of up to 30% within the first year^{8,9} and an increased risk of subsequent fractures.¹⁰ Even with prompt surgical treatment, patients with hip fracture might experience significant deterioration in their quality of life.¹¹ Almost half of the patients are unable to walk independently during the first year after surgery, and up to 80% of them experience limitations in some aspects of their life.¹² In addition, mortality is known to increase in older patients with a hip fracture. This is especially important in nonagenarians, who have a mortality rate as high as 51% in the first year.¹³

Initial Management

It is important to emphasize that treatment of elderly patients with a hip fracture begins in the emergency room (ER).

Furthermore, it is recommended that they be admitted to the hospital quickly. Critical steps in the initial management of these patients include early and continuous hydration with isotonic saline, effective pain control, and rapid consultation with orthopedic and internal medicine or geriatric specialists, especially for unstable patients who might require admission to a unit with a more intense form of monitoring such as a high-dependency, step-down, or intensive care unit.

Typically, a patient with an acute hip fracture is unable to mobilize and suffers from significant groin pain. Lower extremity deformity with shortening and external rotation can be seen if the fracture is displaced. It is important to determine the circumstances of the fall to rule out other factors that might be involved such as a stroke, syncope, or myocardial infarction. It is also necessary to inspect the patient for other injuries in the axial or appendicular skeleton, as nearly 5% of hip fracture patients present with another concomitant fracture or dislocation.¹⁴

The diagnosis of a hip fracture is usually performed using conventional radiographs. Anteroposterior (AP) x-ray of the pelvis and AP and lateral (cross-table) x-ray of the affected hip should be obtained. In most cases, a more advanced form of imaging is not necessary. In cases of a suspected hip fracture with negative plain radiographs, a computed tomographic image or magnetic resonance image could be obtained. Magnetic resonance imaging is usually the imaging modality of choice due to its high sensitivity and capacity to demonstrate other causes of hip pain than a fracture.^{15,16} However, the length of the examination and its availability are aspects to consider when planning to order an advanced image. Nevertheless, in the absence of a fracture, other causes of pain should be ruled out.

Pain management should be started without delay at the ER and should continue after surgery. A multimodal approach is



advisable, with a combination of acetaminophen and opioids. This combination usually allows for adequate pain management. Meperidine should be avoided, as it can increase the incidence of delirium.^{17,18} The use of traction has been abandoned, as it has demonstrated no benefit in pain management and is associated with a higher risk of pressure ulcers.¹⁹

Surgical Treatment

Surgical treatment of hip fractures is the standard of care for most of the patients.^{20,21} Nonoperative treatment is associated with a high rate of secondary displacement and increased mortality and medical complications related to bed rest such as pneumonia, urinary tract infection, and deep vein thrombosis (DVT). Therefore, nonoperative treatment is not a recommended option for medically fit patients.^{20,22} It might be indicated in patients who are too ill to undergo any type of anesthesia with a terminal illness with a life expectancy that is too short to benefit from surgery. A recent retrospective study compared medically unfit patients who were treated nonoperatively to surgically treated patients and showed no significant difference in mortality or mobility.²³ Nevertheless, insufficient power and no description make these results questionable.²⁴ Current recommendations cannot be changed unless new, higher quality studies are performed.

Surgical treatment of hip fractures in elderly patients involves an enormous expense for families and health care providers. However, a recent analysis by Gu et al²⁵ showed that the surgical treatment of displaced hip fractures in patients aged 65 years and older has societal benefits that exceed the direct medical costs, with savings of US \$65 000 to US \$68 000 per patient.

Surgical Timing

Early surgery has been associated with a lower risk of 30-day mortality, 1-year mortality, shorter length of stay, fewer postoperative complications, improved pain management, and greater return to independent living.^{26–31} Therefore, surgery within 48 hours of admission is the usual recommendation that is proposed by most medical societies.^{32,33} Delays are mainly due to operating room or personnel availability and acute medical illness that requires optimization or secondary referrals.²⁷

Preoperative Evaluation

The preoperative assessment is intended to address reversible medical problems and to prevent complications that are usually seen in elderly patients.¹ Patient-specific risk stratification allows for the provision of special care for high-risk patients and the adjustment of patient and family expectations. Multiple scores are available to determine patient risk and prognosis such as the Charlson comorbidity index,³⁴ Sernbo score,³⁵ and Nottingham Hip Fracture Score.³⁶ Interdisciplinary team efforts to manage these patients are mandatory to minimize unnecessary delays in surgery and to achieve better outcomes. This team-based approach has been referred to using different

terms such as orthogeriatric care or comanagement.³⁷ Such a team should involve orthopedic surgeons, geriatric or internal medicine specialists, anesthesiologists, and physical therapists. Several reports on orthogeriatric care in the management of frail patients with fragility fractures have described a positive effect on inpatient and long-term mortality, morbidity, and functional outcomes.³⁸

Cardiac evaluation should focus on allowing for early surgical treatment. Functional capacity, heart rate, and rhythm should be evaluated. In addition, an electrocardiography should be performed, and the results should be compared with previous ones, if available. Other preoperative tests such as an echocardiogram or nuclear medicine stress tests should be performed only when circumstances warrant them such as with patients with an acute cardiac condition or a functional capacity that is below 4 metabolic equivalents.^{37,39,40} Typically, β -blockers are continued in patients who undergo surgery who are using them for a cardiac condition. In other cases, the use of perioperative β -blockers in patients who are not under chronic treatment with this type of medication is controversial because current evidence shows a decrease in cardiac events but a worrisome increase in hypotension, stroke, and mortality.⁴¹

Patients with these conditions are at high risk of delirium. Therefore, personnel should be trained to recognize any type of cognitive dysfunction, as patients with a previous history of dementia are at higher risk of an acute alteration. The confusion assessment method is a useful tool to assess this status,⁴² and appropriate pain control, prompt admission, evaluation, and treatment are key elements to reduce its risks.

Laboratory Workup

Renal function decreases with age. Renal impairment is highly prevalent in elderly patients with a hip fracture with a combined etiology. Acute kidney injury might be explained by diminished hydration after the fall in addition to relative hypovolemia and anemia.

Coagulation tests (including prothrombin and partial thromboplastin times) should be checked, along with standard laboratory tests, including a metabolic profile and blood cell count.

Chest x-rays are also usually obtained to evaluate the risk of postoperative pulmonary complications.⁴³

In patients who are taking anticoagulants, an international normalized ratio above 1.5 should be managed, delaying the procedure, with vitamin K supplementation or fresh-frozen plasma, depending on the cause and urgency. The usage of new oral anticoagulants (ie, dabigatran, rivaroxaban) is becoming more common. Although the appropriate interval between the last dose and surgery is not clear, recent recommendations indicate that an interval of 48 hours is safe, considering the prolonged time in patients with renal impairment. One recent review of the literature on anesthesia and new oral anticoagulants recommended a 3-day interval for rivaroxaban and 4-day interval for dabigatran before considering neuraxial anesthesia.⁴⁴

Urinalysis should be performed, and symptomatic urinary tract infections should be treated prior to surgery to decrease the possibility of implant-related infections.⁴⁵ Controversy exists regarding the need for treatment of asymptomatic bacteriuria. Recent reports on elective lower extremity joint replacements have shown no benefit in association with screening and treating asymptomatic urinary tract colonization.^{46,47} Nevertheless, clinical conditions in elderly patients with hip fractures are different than those of patients who are undergoing elective surgery. Pain, opioid use, frequent urinary retention, and urinary catheterization could play a significant role, although it has not been determined. Prophylactic antibiotic that is adjusted according to bacterial sensitivity is recommended. Still, patients are often treated with antibiotics in the perioperative period.

Anesthesia

Currently, the primary anesthetic modalities in hip fracture surgery are either one of the different types of neuraxial anesthesia or general anesthesia. Recently, numerous publications have addressed this topic as well as the use of peripheral nerve blocks. In general, there is substantial evidence that supports similar outcomes for general or spinal anesthesia for hip fracture surgery^{33,48}; therefore, decisions among different techniques should be made on an individual basis and take into consideration the patient's medical condition and local preferences.

If neuraxial anesthesia is used, the patient's comorbidities and, in particular, the use of oral anticoagulants are important. Spinal hematomas are rare, but could be a serious preventable condition. A recent meta-analysis that included 36 448 patients who received general anesthesia and 33 952 patients who received regional anesthesia showed no difference in mortality or postoperative complications.⁴⁹ A 2016 Cochrane systematic review that compared neuraxial blocks to general anesthesia found no differences between the 2 techniques, with a 1-month mortality relative risk (RR) of 0.78 (95% confidence interval [CI]: 0.57-1.06). In addition, no significant differences were found in the risk of pneumonia (RR = 0.77; 95% CI: 0.45-1.31), myocardial infarction (RR = 0.89; 95% CI: 0.22-3.65), cerebrovascular accident (RR = 1.48; 95% CI: 0.46-4.83), or delirium (RR = 0.85; 95% CI: 0.51-1.40).⁵⁰ The review also found a lower rate of DVT in the absence of thromboprophylaxis in regional anesthesia compared with general anesthesia (RR = 0.57; 95% CI: 0.41-0.78); however, this difference disappeared if low-molecular-weight heparin (LMWH) was administered (RR = 0.98; 95% CI: 0.52-1.84).⁵⁰

The use of peripheral nerve blocks has improved pain management after hip fracture in a secure manner with numerous potential benefits, including lower objective pain scores compared with usual care and less need for opioid analgesia.⁵¹⁻⁵³ Many forms of peripheral nerve blocks have been reported, and their use can begin in the emergency department (ED) and continue until the postoperative period. Single-injection nerve

blocks have been used for acute pain management in the ED or preoperative period for patient positioning and anesthesia. Continuous infusion techniques have also been used for more prolonged analgesia. The most common ones are lumbar plexus blocks, femoral and triple nerve blocks (femoral, obturator, and sciatic nerves), and iliac fascia compartment blocks. Mouzopoulos et al⁵⁴ reported their results in a study of 207 patients who were randomly assigned to iliac fascia compartment block with bupivacaine or placebo. They showed that the iliac fascia block significantly prevented delirium in intermediate-risk patients but found no difference in those with a high risk of delirium at admission.

Surgical Treatment

The type of surgical treatment for hip fractures in the elderly is determined primarily by the fracture location, displacement, and stability. Femoral neck fractures are treated with internal fixation or arthroplasty, whereas intertrochanteric and subtrochanteric fractures are mainly treated with reduction and internal fixation.

Femoral Neck Fractures

Femoral neck fractures are treated according to the fracture displacement and patient functionality. Nondisplaced fractures are classically treated with internal fixation with either cannulated screws or a fixed-angle device. Nonsurgical treatment has been postulated to be an alternative to nondisplaced impacted femoral neck fractures in some patients.^{22,55,56} Raaymakers and colleagues^{55,56} reported a 1-year mortality rate of 19% in a prospective series with 319 patients who were treated nonoperatively. However, secondary instability was more frequent in older patients, with comorbidities and in patients with vertical fractures, with up to 83% instability when these factors are combined, making it a poor alternative for the elderly.

Cannulated screws are the most frequently used method to treat undisplaced femoral neck fractures in the elderly, with good results and a revision rate of approximately 10%.^{57,58} In an international survey of 442 surgeons, Bhandari et al⁵⁹ reported that 90% of surgeons preferred cancellous screws in this scenario. Fixed-angle devices such as sliding hip screws (SHS) are an alternative, with potential benefits including resisting bending and vertical shear loads, especially in basicervical or vertical shear fractures.^{60,61} Arthroplasty is a controversial option for treating undisplaced femoral neck fractures in the elderly. Although no prospective comparisons have been made, hemiarthroplasty could be associated with a lower revision rate but a higher mortality in this group.^{62,63}

For displaced fractures, ample evidence supports the performance of arthroplasty as the treatment of choice,⁴⁸ as it is associated with timelier rehabilitation, a reduced risk of implant failure and fewer reoperations.⁶⁴⁻⁶⁶ A hemiarthroplasty might be a more suitable option for lower demand patients due to its decreased operation time and blood loss and given that it does not have problems deriving from acetabular cup positioning. In

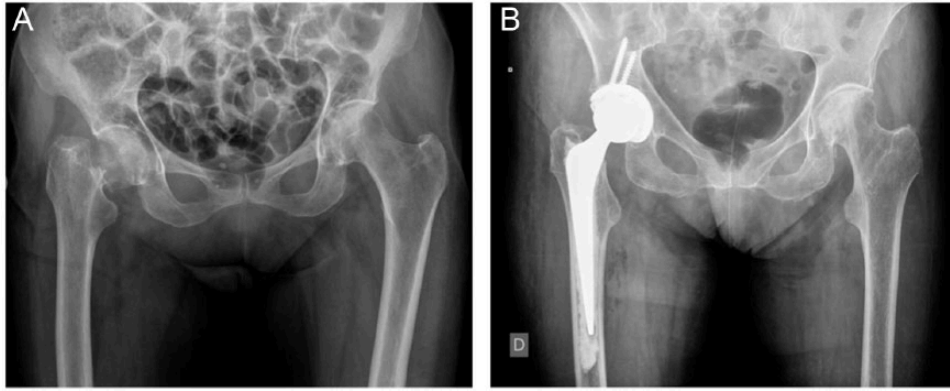


Figure 1. A highly functional 78-year-old women who suffered a left femoral neck fracture after a level fall. (A) Anteroposterior pelvic x-ray showing the displaced left femoral neck fracture. (B) Postoperative x-ray after a hybrid total hip arthroplasty.

the same way, a lower dislocation rate makes it a preferred alternative for patients with cognitive dysfunction or neurological impairment.⁶⁷ Higher demand patients, especially those with previous hip osteoarthritis, should be treated with a total hip replacement^{33,48} to avoid reoperations that are secondary to acetabular erosion and to assure better functional outcomes and less postoperative pain^{68–70} (Figure 1).

Bipolar hemiarthroplasty was introduced as an alternative that aimed to decrease the typical acetabular wear of traditional hemiarthroplasty. Although many studies have addressed this issue, it is still controversial whether there are benefits relating to function, reoperations, or mortality when comparing bipolar and unipolar arthroplasty in these patients.^{71,72} A recent systematic review by Jia et al⁷³ showed better results in association with performing bipolar hemiarthroplasties in terms of acetabular erosion at 1 year. However, no significant difference was observed at longer follow-up.

Finally, stem fixation has been another topic of debate. Randomized controlled trials have failed to demonstrate differences between cemented femoral stems and press-fit stems, except for a higher rate of periprosthetic fractures (PPFs) in the latter.⁷⁴ Cemented stems are associated with longer operation times, a higher learning curve, and the potential for embolization and hypotension at the time of cement insertion. Some national registers have shown a higher mortality rate in association with using cemented stems. Nevertheless, the reoperation rate was still lower than that associated with using uncemented stems (91% 5-year survival for uncemented versus 97% for cemented stems).⁷⁵

Intertrochanteric and Subtrochanteric Fractures

Inter- and subtrochanteric fractures are primarily treated with reduction and internal fixation. Alternatives to intertrochanteric fractures include SHS and cephalomedullary nails as the main options. For stable fractures, a recommendation was made by the American Academy of Orthopaedic Surgeons to treat them with either of those devices with similar results.⁴⁸ Ahrengart et al⁷⁶ showed no difference in functional outcomes, radiological outcomes, or complications for stable fractures,

although less blood loss was observed in the SHS group compared with the cephalomedullary nails group.

The recommendation to treat unstable intertrochanteric fractures such as those that involve a compromised lateral wall, multiple fragments, calcar disruption, or a subtrochanteric extension (AO 31-A2 and A3) is to use a cephalomedullary device. Such devices seem to have a lower reoperation rate,⁷⁷ especially AO 31-A3 fractures. Still, this topic is a matter of debate.⁷⁸ However, small differences have been found across different implants that are used to treat unstable intertrochanteric fractures without subtrochanteric extension (AO 31-A2). Cephalomedullary nail use is associated with slightly better functional outcomes and fewer blood transfusions.^{79,80}

Subtrochanteric fractures represent a challenging scenario, given their unique anatomic and mechanical characteristics. Many investigators have stated that SHS are not suitable for the treatment of these specific types of fractures (AO 31-A3), and different methods have been used to treat them instead.⁷⁷ In a prospective randomized trial that evaluated 39 patients with AO 31-A3 reverse or transverse inter- and subtrochanteric fractures, Sadowski et al compared the dynamic condylar screw to a cephalomedullary nail. Cephalomedullary nails were associated with shorter operation times, fewer blood transfusions, shorter hospital stays, and fewer implant failures and nonunions. These findings support the use of those implants to treat these types of fractures.⁸¹

Postoperative Care: Pain Management

A multimodal approach to treat pain should be continued in the postoperative period. The use of nonsteroidal anti-inflammatory drugs (NSAIDs) is a matter of concern. In the ER, the patient's renal status is usually unknown. In addition, elderly patients are at high risk of developing acute renal failure due to their basal renal function, dehydration, risk of rhabdomyolysis, and other factors. However, the cardiovascular and gastrointestinal bleeding risk should be considered and balanced, as NSAIDs are associated with an increased risk of adverse effects in these patients.⁸² Regarding fracture healing and the potential risk of delayed union, although animal

studies and clinical observational data have generated concerns regarding union rates when these drugs are used,⁸³ there is conflicting evidence. Therefore, higher quality studies are needed to assess this issue.⁸⁴ The 2015 Updated Beers Criteria for Potentially Inappropriate Medication Use in Older Adults⁸⁵ is a useful tool for selecting drugs for use with elderly patients.

In cases involving uncontrolled pain, a higher incidence of delirium, longer length of hospital stay, and delayed ambulation have been reported.¹⁷ In those cases and in patients with high cardiovascular risks, epidural pain management, or nerve blocks might play a role. Nevertheless, they require dedicated anesthesiologists or other trained physicians.⁸⁶ Pain assessment is difficult in the context of sensory impairment and delirium or dementia. In patients who are not able to describe their pain using a standard visual analog scale, several dedicated tools such as the Pain Assessment in Advanced Dementia (PAINAD) Scale and the Checklist of Nonverbal Pain Indicators (CNPI) are available and should be used.^{87–89}

Deep Venous Thrombosis and Hip Fractures

Elderly patients with a hip fracture are bedridden for periods of varying length. This factor and surgical treatment place them at high risk of DVT and pulmonary embolism. The rate of DVT has been estimated to be 1.6%, despite the use of prophylaxes. This rate appears to be higher in patients who are suffering from inter- and subtrochanteric fractures.⁹⁰ Furthermore, the risk for thromboembolic events increases with delayed consultation and prolonged preoperative periods, even in patients who receive a prophylaxis. Authors recommend DVT screening in every patient with a delayed consultation or prolonged hospital stay before surgery.⁹¹

The administration of an antithrombotic prophylaxis should be initiated soon after admission. Compared with LMWH, the use of unfractionated heparin (UH) is not associated with significant differences in terms of risk prevention and bleeding. Although the latter allows for easier administration, it has a higher cost. Mechanical prophylaxis can be useful in reducing the risk of DVT and pulmonary embolism. The benefit of compressive stockings should be balanced with the risk of skin lesions on the fragile skin of elderly patients and, consequently, they must be used with caution. There is no rationale for using a compressive stocking only on the uninjured extremity, as most cases of DVT occur on the fractured side.⁹² Pneumatic compression can also be used, but tethering the patient to the bed might increase the risk of falls and delirium. Therefore, further research is needed to inform a definitive recommendation.⁹³

A postoperative prophylaxis can be used with UH, LMWH, warfarin, or the newer factor Xa inhibitors. Studies have shown the benefits of using prolonged prophylaxis (5–7 weeks) after hip arthroplasty and hip fracture surgery. However, such benefits must be counterbalanced with the potential increased risk of bleeding.^{90,94} The American College of Chest Physicians' (ACCP) recommendation is to extend thromboprophylaxis for up to 35 days after the day of the surgery.⁹⁵

Aspirin has been included in the recommendations for DVT and pulmonary embolism prophylaxis after total joint replacement by the American Academy of Orthopaedic Surgeons and ACCP^{95,96} but not as the sole prophylaxis method (only in conjunction with compression devices as part of a multimodal approach).

Rehabilitation

Rehabilitation protocols should begin immediately after surgery, and it is recommended to implement a multidisciplinary protocol to obtain better outcomes. One systematic review reported a 16% lower rate of death or admission to a nursing home with multidisciplinary rehabilitation.⁹⁷ A recent Cochrane systematic review included conflicting results on this topic, which highlights the importance of missing evidence to allow for definitive conclusions.⁹⁸

It is important to emphasize that elderly patients' capacity to follow instructions relating to weight-bearing restrictions is likely to be altered, especially if cognitive impairment is present. Therefore, the decision-making process that is involved in choosing the type of surgery to perform should take into account that weight bearing should be permitted as tolerated.¹

Substantial evidence supports the use of intensive rehabilitation to improve function after a hip fracture in elderly patients. In addition, home-based exercise programs have been found to be an effective alternative,⁹⁹ with potential benefits of lower economic costs and need for professional assistance. There is still debate on the best rehabilitation protocol for these patients. Nevertheless, its aim should always focus on recovering prefracture status, and it should be intended to allow for rapid mobilization. Moreover, prolonged rehabilitation therapy could be performed in a subacute facility or on an ambulatory basis.

Nutritional assessment should be part of the perioperative management of every patient with a fragility fracture, given that malnutrition is highly prevalent in this population.¹⁰⁰ Poor nutritional status is related to poorer functionality and greater perioperative complications such as infection, nonunion, and falls.¹⁰¹ Furthermore, nutritional supplementation is believed to improve functional outcomes in selected patients.¹⁰² A recent Cochrane systematic review provided low-quality evidence that oral supplements might prevent complications within the first 12 months after hip fracture, with no clear effect on mortality.¹⁰³

Complications

Hip fractures in elderly patients might involve medical complications, including DVT, urinary tract infection, pneumonia, delirium, immobility, and overall functional impairment. In addition, surgical complications might also affect the clinical outcomes of these patients. Given that these patients are frail, surgical treatment should be intended to be a "single-shot surgery" to minimize the risk of reoperations. Nevertheless, physicians should be aware that complications can occur and that

readmissions are frequent, which can generate enormous expenses.^{104,105} However, the correct and prompt management of complications reduces their adverse effect on patients' outcomes.

There are general surgical complications and specific complications related to the particular surgical treatment that is chosen. Physicians should be aware that mortality and perioperative complications (including DVT, infection, and dislocation) are more common when treating patients with femoral neck fractures than patients who are undergoing elective hip arthroplasty¹⁰⁶:

1. *Surgical site infection.* The benefit of an adequate prophylaxis has been clearly identified. The best evidence that is available (1 dose of antibiotics preoperatively and 1-3 doses postoperatively) has demonstrated a risk reduction in surgical site infection and a decrease in urinary and respiratory tract infections.¹⁰⁷ Periprosthetic infection (PPI) is probably the most feared complication of hip arthroplasty, with a reported rate of 2.18%.¹⁰⁸ Modifiable risk factors such as uncontrolled diabetes, smoking, and obesity are not always controllable, given the need for early surgery. Delayed surgical intervention is recommended if an active urinary tract infection or another uncontrolled septic source is present. Although the diagnosis and specific treatment of PPI are beyond the scope of this review, the international consensus as reported by Parvizi et al¹⁰⁹ might be a useful guide.
2. *Implant failure.* As osteoporotic bone might not allow for a satisfactory implant purchase, these patients can exhibit early failures. In addition, implants might fail later in the case of delayed unions or nonunions. Adequate reduction and implant positioning are of paramount importance to reduce the risk of implant failure. If a failure occurs, treatment alternatives depend upon the patient's condition, location of the index fracture, and type of failure. If the articulation remains viable, new osteosynthesis might be attempted. Nevertheless, if the failure involves a cut-through or other intra-articular damage, conversion to a complex hip arthroplasty should be considered.
3. *Delayed union or nonunion.* Femoral neck nonunions are treated with conversion to an arthroplasty in this population (younger patients might be candidates for valgus osteotomy). Intertrochanteric and subtrochanteric nonunions represent a complex problem. Although some cases can be treated by changing the osteosynthesis method, others require a total arthroplasty with distal fixation stems.
4. *Avascular necrosis.* This complication occurs almost exclusively after femoral neck fractures, and reports of its occurring after intertrochanteric fractures are rare. In cases of severe pain, these patients might require conversion to a total hip arthroplasty.

5. *PPF.* This complication can occur during or after surgery and in the femur or the acetabulum, but it most commonly affects the femur. A Cochrane systematic review did not find differences in intraoperative femoral fracture rates when comparing cemented and uncemented stems.¹¹⁰ Nevertheless, more recent trials and analyses of national registries have shown that cemented stems are safer, result in fewer PPFs, and have lower rates of revision in this population.^{111,112}
6. *Dislocation.* This complication is a major concern after hip arthroplasty. A significant advantage of hemiarthroplasty over total arthroplasty is the reduction in the dislocation rate. The posterior approach has been described as a risk factor for dislocation and the need for revision in arthroplasty after hip fractures.¹¹³ Larger heads (36-40 mm) reduce the possibility of dislocation. In addition, dual-mobility cups and constrained liners might be used in high-risk populations.¹¹⁴⁻¹¹⁶

Secondary Osteoporosis Prevention in Elderly Patients with a Hip Fracture

It is of paramount importance to address bone density in elderly patients with a fragility fracture. Typically, patients with a hip fracture have suffered a previous fragility fracture without diagnosis or treatment for osteoporosis. Osteoporosis treatment improves function and quality of life and reduces the risk of new fractures. Furthermore, several studies have shown that it reduces mortality.^{117,118} Several guidelines propose that treatment should be started without delay, as it represents an opportunity that might be lost if the patient fails to have adequate follow-up¹¹⁹; however, there is concern about early bisphosphonate use and risk of nonunion, especially with femoral neck fractures treated with osteosynthesis. Although some authors have reported that bisphosphonates do not affect fracture healing in acute conditions,^{120,121} many orthopedic groups still have concerns about their early use. In this setting, a Fracture Liaison Service model is a proper way of achieving adequate follow-up and subsequent treatment on this segment of patients. Furthermore, suboptimal management is extremely frequent, and many patients are not sufficiently treated, with only 11% to 25% of them receiving pharmacologic treatment 3 months after a hip fracture in different settings.¹²² Recommendations regarding the drug, dose, and duration must be individualized,¹²³ and proper follow-up should be regularly performed. Several general recommendations are provided here.

Vitamin D Insufficiency and Deficiency

Although there is broad consensus that vitamin D deficiency (levels ≤ 20 ng/mL) requires supplementation, the upper range of normality and ideal levels are still a matter of debate.¹²⁴ Most current recommendations propose 30 ng/mL as the lower level of normalcy.^{125,126} Nevertheless, no real consensus has been reached on treatment goals. Vitamin D deficiency is

highly prevalent in elderly patients with hip fractures, and there is agreement on their treatment. However, there is no consensus on treating patients with higher levels.^{127–130}

Vitamin D Repletion Strategies

Numerous different repletion strategies have been reported, including a daily dose of 2000 IU, weekly dose of 30 000 to 50 000 IU for 6 to 24 weeks, and single doses of 250 000 IU¹³¹ and 500 000 IU of vitamin D.¹³² These strategies attempt to obtain levels above 30 ng/mL. This diversity in recommended treatments can be explained because trials have been conducted with patients with fractures, but others have been performed with elderly patients with a high fracture risk only. Nevertheless, higher dose repletion strategies must be employed with caution, as there have been reports of an increased risk of fractures and falls without any benefit to lower extremity function.^{132,133}

Calcium and Vitamin D Supplements

Calcium plus vitamin D supplementation reduces the overall risk of any fracture by 16% and the risk of hip fracture by 31%.¹³⁴ There is also evidence to support a reduction in mortality among elderly patients receiving calcium plus vitamin D supplementation but not for those receiving vitamin D alone.¹³⁵ Although calcium supplementation for risk fracture reduction is widely accepted, there is conflicting evidence suggesting an increased risk of myocardial infarction; therefore, cardiovascular risk should be considered.¹³⁶

Antiresorptives and Other Osteoporosis Treatment Drugs

Pharmacologic osteoporosis treatment should be initiated after a fragility fracture. Risk assessment is advisable to inform treatment decisions in patients without a fragility fracture. However, as the risk of a new fragility fracture is high after a prior fracture, treatment decisions do not require additional workup.

The most commonly used drugs are oral bisphosphonates. They are potent bone resorption inhibitors. They reduce osteoclast recruitment and increase their apoptosis. Alendronate, risedronate, and ibandronate are the most frequently used alternatives. Bisphosphonates' safety profile is favorable, with adverse gastrointestinal effects being the most common (as high as 91% in some reports).¹³⁷ Zoledronic acid (an intravenous bisphosphonate) can be used with patients who are unable to receive oral therapy or with high-risk patients. It reduces the risk of new fractures and mortality when given after a hip fracture.¹³⁸

Along with oral intravenous bisphosphonates, other drugs have been used. Denosumab is a fully human antibody against receptor-activated nuclear factor- κ B ligand. It prevents its interaction with the receptor-activated nuclear factor- κ B receptor. It reduced the incidence of new vertebral fractures by 68% and hip fractures by 40% over 3 years in patients with a vertebral fracture.¹³⁹ Teriparatide (recombinant human parathyroid hormone) is considered to be a bone anabolic, unlike all

the other treatment options that have been mentioned, which works by reducing bone resorption. It has been used with promising results.

Treatment response can be monitored with dual-energy x-ray absorptiometry and bone turnover markers, the latter of which shows changes more rapidly. There is an association between the bone marker short-term response and the risk of new fractures.¹⁴⁰ The duration of treatment depends upon the specific patient's risks and the drugs used. The provision of greater details on the pharmacologic treatment is beyond the scope of this review, but several osteoporosis treatment guidelines are available.¹⁴¹

Conclusions

As the population ages, fragility fractures will continue to increase in number and relevance. At this point, the management of hip fractures in elderly patients is a major topic of interest for both surgeons as well as geriatrics and internal medicine specialists. Many questions remain and generate discussion among the specialists who are treating these patients, including what is the most appropriate surgical treatment for particular types of lesions or the best metabolic management to reduce the risk of future fractures. It is important to treat these patients with a defined multidisciplinary protocol that is aimed at addressing underlying conditions to allow for prompt surgical management and with an immediate rehabilitation protocol with an emphasis on early mobilization and integrated postoperative care. Good treatment outcomes among these patients can only be achieved using collaborative management by a multidisciplinary team.

Author Contributions

Analysed the data: TZ, IK and JU. Wrote the first draft of the manuscript: TZ, IK. Contributed to the writing of the manuscript: TZ, IK and JU. Agree with manuscript results and conclusions: TZ, IK and JU. Jointly developed the structure and arguments for the paper: TZ, IK and JU. Made critical revisions and approved final version: TZ, IK and JU. All authors reviewed and approved of the final manuscript.

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