

Holistic Management of Older Patients With Hip Fractures

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As the silver tsunami hits the world, older patients with hip fractures are expected to increase to 6.3 million by the year 2050, of which the majority will occur in Asia. The estimated global cost of hip fractures in the year 2050 is estimated to reach U.S. \$130 billion. Hence, in addition to implementation of prevention strategies, it is important to develop an optimal model of care for older patients with hip fracture to minimize the huge medical and socioeconomic burden, especially in rapidly aging nations. This review summarizes the complications of hip fractures, importance of comprehensive geriatric assessment, and multidisciplinary rehabilitation, as well as predictors of rehabilitation outcome in older patients with hip fracture.

Introduction

Falls and falls-related injuries are common in older persons and cause significant health problems in a rapidly growing aging population. Between 20% and 33% of community-dwelling persons older than 65 years fell in the past 1 year, and the incidence increases considerably with age (Bergen, Stevens, & Burns, 2016; Peel, 2011; Tinetti, 2003; Tinetti, Speechley, & Ginter, 1988; Tripathy et al., 2015). Although most of the falls do not require medical attention, studies have reported that between 5% and 32% of falls result in serious injuries, including fractures, head injuries, subcutaneous tissues injuries, and even death (Kannus et al., 2005; Peel, 2011; Rubenstein, 2006; Sterling, O'Connor, & Bonadies, 2001; Tinetti & Williams, 1998). Falls are also associated with greater functional decline, higher risks of anxiety and depression, and increased usage of medical services (Choi et al., 2019; Faul et al., 2016; Hallford et al., 2016; Tinetti & Williams, 1998).

Although less than 1% of falls lead to hip fractures in older persons hip fractures are the leading cause of hospital admissions after falls and associated with serious consequences (Rockwood, Green, & Bucholz, 2010). In 2000, there was an estimated 1.6 million hip fractures worldwide, and this number is predicted to increase to 6.3 million by 2050 (Cooper et al., 2011). The most significant changes will occur in Asia where almost 50% of all patients with hip fracture will reside, due to population demographic changes, especially in China and India, which constitute approximately 37% of the world

population (Cheung, Ang, et al., 2018; Cooper, Campion, & Melton, 1992; Gullberg, Johnell, & Kanis, 1997). In Singapore, the number of hip fractures is projected to increase from 1,300 cases per year in 1998 to 9,000 in 2050 (International Osteoporosis Foundation, 2009). It is estimated that the total cost of hip fracture treatment in Singapore was U.S. \$17 million in 1998 and will reach U.S. \$145 million in 2050 (International Osteoporosis Foundation, 2009).

As such, there is an urgent need to develop an optimal model of care for older patients with hip fracture to reduce the substantial burden on limited healthcare resources.

Complications of Hip Fractures in Older Persons

Hip fractures are associated with significant mortality and major morbidities in older persons. The 1-year mortality rate of patients with hip fracture is reported to be up to 27%, and the overall mortality risk is three-fold higher in patients with hip fracture than the general population (Panula et al., 2011). This increased mortality risk is strongly associated with advanced age, male gender, low Parker mobility score, and a Charlson Comorbidity Index (CCI) of 4 or more (Schnell et al., 2010). For nursing home residents, the 6-month mortality rate is as high as 36% and is greatest among patients older than 90 years, those under conservative management, and those with CCI of 5 or greater (Neuman et al., 2014).

Medical complications of hip fractures are common, including change in cognition, cardiovascular adverse events, thromboembolism, infection, depression, social isolation, functional decline, institutionalization, pressure ulcer, and electrolyte and metabolic disorders (see Table 1). These complications lead to increased length

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TABLE 1. POTENTIAL COMPLICATIONS OF HIP FRACTURES IN OLDER PATIENTS

1. Cardiovascular adverse events
Deep venous thrombosis
Pulmonary embolism
Myocardial infarction
Congestive cardiac failure
Cerebrovascular accident
2. Infection
Pneumonia
Urinary tract infection
Surgical wound infection (superficial or deep wound infection)
3. Delirium
4. Pressure ulcers
5. Depression
6. Social Isolation
7. Functional decline
8. Institutionalization
9. Mortality

of hospitalization, poor functional outcomes, and increased mortality (Bateman et al., 2012; Beaupre et al., 2005; Dolan et al., 2000; Gustafson et al., 1988).

Delirium is extremely common in older patients with hip fracture, with the estimated prevalence ranges from 13% to as high as 61% during hospital admission (Dolan et al., 2000; Gustafson et al., 1988). Delirium is defined as an acute confusion state, characterized by an acute and fluctuating course with disturbance of consciousness, reduced attention, and a change in cognition (American Psychiatric Association Task Force on DSM-IV, 1994). The risk of developing postoperative delirium in patients with hip fracture is significantly higher in those with advanced age (80 years or older), those who reside in the nursing home, and those with underlying dementia (Smith et al., 2017). Patients with delirium have a higher risk of developing depressive symptoms as well as having poorer functional outcome over 24 months after hip fracture. Nonetheless, delirium on hospital admission is not a significant predictor of mortality after adjustment for confounding factors (Dolan et al., 2000). A multifactorial approach, comprising the use of regional anesthesia, adequate analgesia, minimizing use of sedatives and anticholinergic medications, and early mobilization, has been shown to reduce the risk of postoperative delirium (Dovjak et al., 2013; Papaioannou et al., 2005).

Deep venous thrombosis (DVT), pulmonary embolism, myocardial infarction, heart failure, and acute stroke are common cardiovascular adverse events in older patients with hip fracture. Without thromboembolism prophylaxis, the prevalence of proximal DVT is up to 27% in patients with hip fracture (Marsland, Mears, & Kates, 2010). The risk of fatal pulmonary embolism ranges from 0.4% to 7.5% in patients with hip fracture within 3 months of surgery (Falck-Ytter et al., 2012). Routine use of thromboembolism prophylaxis, includ-

ing pharmacological and/or mechanical methods, has been proven to reduce the risk of DVT by approximately 60% (Falck-Ytter et al., 2012). Although heart diseases, in particular heart failure, are shown to be significant causes of mortality after hip surgery, none of the studies have been able to identify consistent and specific interventions to reduce the perioperative heart disease-related burden (Cameron et al., 2010; Fahy et al., 2014; Fleisher et al., 2014). Nonetheless, there is a guideline suggestive of the use of epidural analgesia, which can decrease the incidence of perioperative cardiac events in patients with a hip fracture (Fleisher et al., 2014).

Infections, including pneumonia, urinary tract infection, surgical wound infection, are associated with an increased risk of delirium and mortality in patients with hip fracture (Cameron et al., 2010; Chong, Savage, & Lim, 2010; Smith et al., 2017). Recommendations to reduce risk of infection include early surgical intervention, prophylactic antibiotics, and early mobilization (Chong et al., 2010). Early detection, timely medical treatment, and accurate monitoring of infection are advisable when infection occurs in the perioperative period (Bateman et al., 2012; Chong et al., 2010).

Pressure ulcers result from an imbalance between external mechanical forces acting on skin and soft tissue, and the internal susceptibility of skin and its underlying soft tissue to injury. Risk factors of pressure ulcers include advanced age, malnutrition, history of smoking, and systemic illnesses (Bateman et al., 2012). The prevalence of pressure ulcers can range between 10% and 40% in patients with hip fracture and can lead to prolonged hospitalization (Beaupre et al., 2005). The use of foam or alternating pressure mattresses as well as good nutrition can help prevent the development of pressure ulcers (Beaupre et al., 2005).

Comprehensive Geriatric Assessment in Older Patients With Hip Fracture

The concept of comprehensive assessment was first initiated by Dr. Marjory Warren, the “Mother of British Geriatric Medicine,” in the 1930s.

Comprehensive geriatric assessment (CGA) is widely defined as a “multidimensional interdisciplinary diagnostic process focused on determining a frail older person’s medical, psychological and functional capability in order to develop a coordinated and integrated plan for treatment and long term follow up” (Rubenstein et al., 1991). It encompasses several domains: physical health, mental function, functional capacity, social, environmental, as well as economical resources. The goals of CGA are to provide interdisciplinary care plans, addressing physical and psychological and socioeconomic issues, improving survival rate, and establishing better quality of life (Rubenstein et al., 1991). Surgeons, geriatricians, anesthetists, specialized nurses, physiotherapists, occupational therapists, dietician, pharmacists, and podiatrists all play important roles in the multidisciplinary team.

Benefits of CGA in the management of older patients with hip fracture include improved mobility, greater

independence, better cognitive function, and reduced fear of falling (Prestmo et al., 2015). Published guidelines, including the Scottish Intercollegiate Guidelines Network (SIGN), the National Institute for Health and Care Excellence (NICE), and the American Academy of Orthopaedic Surgeons (AAOS), have all supported a multidisciplinary approach and stressed the inclusion of a geriatrician in the management of older patients with hip fracture (AAOS, 2014; NICE, 2011; SIGN, 2009). Application of CGA in older patients with hip fracture entails management of comorbidities, review of medications, nutrition, hydration status, elimination needs, osteoporosis, and fall prevention (British Orthopaedic Association, 2007). It also includes assessment of cognitive and physical function as well as social support. Early involvement of a geriatrician in a team not only promotes rapid optimization for surgery but also provides early individualized rehabilitation, maximize the patient's functional outcome and discharge planning, and ensure right siting of care (Riemen & Hutchison, 2016).

The British Geriatrics Society has defined key elements of good fracture services care, which are as follows (British Orthopaedic Association, 2007):

- Prompt admission to orthopaedic care;
- Rapid comprehensive assessment—medical, surgical, and anesthetic;
- Minimal delay to surgery;
- Accurate and well-performed surgery;
- Prompt mobilization;
- Early multidisciplinary rehabilitation;
- Early supported discharge and ongoing community rehabilitation; and
- Secondary prevention, combining bone protection and falls assessment.

As most older patients with hip fracture have complex medical, surgical, and rehabilitation needs, their care usually requires a systemic and well-organized multidisciplinary care. To date, none of the available studies are able to identify the best orthogeriatric model of care for patients with hip fracture (Grigoryan, Javedan, & Rudolph, 2014; Kammerlander et al., 2010; Mendelson & Friedman, 2014). However, there is an increasing direction toward an integrated approach, with close collaboration between different specialists and the involvement of a dedicated multidisciplinary team. This service allows better patient-centered care, where protocol-driven treatment and pathway are implemented under the shared decision-making process. Moreover, because of its complexity, the implementation of such a service requires good communication skills, considerable efforts, consistent administrative support, and strong physician leadership (Mendelson & Friedman, 2014). Table 2 provides a summary of the different orthogeriatric models of care for patients with hip fracture.

Multidisciplinary Rehabilitation in Patients With Hip Fracture

Despite an increase in allied health staffing to cope with higher workload in both acute and rehabilitation hospi-

TABLE 2. ORTHOGERIATRIC MODELS OF CARE

Models	Advantages
"Ad hoc" Geriatric Consultation: Patients with hip fracture are admitted to the orthopaedic ward. The geriatrician will provide medical consultative services when requested by the orthopaedic team.	No significant benefit over the usual care in terms of functional outcome, institutionalization, mortality, and readmission (Deschodt et al., 2011).
Routine Geriatric Consultation: Patients are admitted to the orthopaedic ward, with regular geriatric consultations provided for all older patients. The responsibility of the patient's care still lies with the orthopaedic surgeon.	Significant decrease in long-term mortality, inpatient mortality, and time to surgery (Grigoryan et al., 2014).
Geriatric Ward Service: Patients are admitted to the geriatric ward and their overall care is provided by the geriatric team. Orthopaedic surgeons will see the patient under consultation services and will provide surgical intervention when indicated.	Possible improvement in functional outcome, quality, and cost-effectiveness; reduction in 1-year mortality rate (Grigoryan et al., 2014).
Shared Care: A complex integrated model of care where patients are admitted to the orthopaedic ward, but both the orthopaedic surgeon and the geriatrician have equal responsibility in the patient's care.	Decreased length of hospital stay, 1-year mortality rate, risk of subsequent fracture; better functional outcome (Henderson et al., 2017).

tals as a result of multidisciplinary management, the effect of reduced length of stay (LOS) in both hospitals had resulted in significant savings of staffing cost per hip fracture case (Lau, Fang, & Leung, 2017). Significant cost savings had also been demonstrated in several different acute settings of multidisciplinary management as a result of reduced acute hospital LOS and reduced time to operating theater (Cheung, Shen, et al., 2018; Della Rocca et al., 2013; Ginsberg, Adunsky, & Rasooly, 2013; Kates, Mendelson, & Friedman, 2011; Mow, Lukeis, & Sutherland, 2017). A reduced time to operating theater had also been associated with a shorter rehabilitation LOS and greater Functional Independence Measure (FIM) efficiency (Tan & Saw, 2016). Rehabilitation LOS in a subacute rehabilitation hospital was also significantly shorter with its implementation of an integrated hip fracture care pathway (Chong et al., 2013). When treatment was provided by a board-certified rehabilitation physician, there were improvements in the mean FIM efficiency and mean LOS in older patients with hip fracture (Momosaki et al., 2016). Other advantages of multidisciplinary management include decreased mortality rate (during inpatient stay, at 30 days and 1 year post-hip fracture), decreased complication rate, higher osteoporosis treatment rate, reduced secondary fracture rate, improved discharge disposition, and better functional recovery (Cheung, Shen, et al., 2018; Doshi et al., 2014; Kammerlander et al., 2010; Lamb et al., 2017; Lau et al., 2017; Shigemoto et al., 2019).

In terms of rehabilitation outcomes, patients who received comprehensive geriatric care had significantly higher gait speed, less asymmetry, better gait control, and more efficient gait pattern (Thingstad et al., 2016). Parameters such as Timed-Up-and-Go test, elderly mobility scale, and fall risk screening also improved significantly in those who received multidisciplinary comprehensive care (Cheung, Shen, et al., 2018).

Intensive post-acute rehabilitation in the index hospital was associated with lower mortality compared with rehabilitation in an inpatient rehabilitation facility or no rehabilitation (Tedesco et al., 2018). Mortality was significantly lower in those who received hospital rehabilitation than among those who did not receive rehabilitation (Ireland, Kelly, & Cumming, 2016; Pitzul et al., 2016; Tedesco et al., 2018). Earlier studies have shown that those treated in inpatient rehabilitation facilities have better functional outcomes than those treated in skilled nursing facilities (Munin et al., 2005).

Predictors of Rehabilitation Outcome in Older Patients With Hip Fracture

Predictors of rehabilitation outcome in older patients with hip fracture include prefracture functional level, serum albumin at discharge, mental status, visual impairments, dyspnea at mild exertion, poststroke motor impairment, decreased serum folic acid, age, and site of hip fracture (see Table 3) (Cornwall et al., 2004; Fox et al., 1999; Gatot et al., 2016; Lieberman, Friger, & Lieberman, 2006; Semel et al., 2010).

Prefracture functional status is an important predictor of rehabilitation outcome in older patients with hip

fracture (Cecchi et al., 2018; Cree & Nade, 1999; Lieberman et al., 2006; Parker & Palmer, 1995; Semel et al., 2010). Prefracture mobility was predictive of a higher probability of discharging home (Cecchi et al., 2018; Parker & Palmer, 1995; Semel et al., 2010). Semel et al. (2010) reported that independent unaided ambulation prior to fracture was predictive of better LOS efficiency, shorter LOS, and a better probability of discharging home. Cecchi et al. (2018) found that patients who did not regain ambulatory ability had a significantly higher prefracture disability and disability in mobility. Lieberman et al. (2006) reported that prefracture FIM score was significantly and independently related to rehabilitation outcome. Cree and Nade (1999) concluded that low activities of daily living (ADL) score on admission was one of the negative predictors of successful return to community.

Serum albumin at discharge is significantly associated with rehabilitation outcome in older patients with hip fracture (Lieberman et al., 2006). A recent large retrospective cohort study found that hypoalbuminemia was a powerful independent risk factor for mortality after surgery for geriatric hip fracture (Bohl et al., 2017). Although albumin levels were not predictive of better total FIM scores upon discharge, albumin gain was a significant predictor for higher discharge FIM scores (Mizrahi et al., 2007, 2008).

Premorbid mental state is one of the significant factors in predicting outcome to continue to live at home and is associated with early recovery of functional mobility (Cree & Nade, 1999; Lee et al., 2014; Parker & Palmer, 1995). Impaired cognitive status at admission lowered the rehabilitation outcome and was directly associated with negative functional gain in older patients with hip fracture (Heruti et al., 1999; Lieberman et al., 2006). Although absolute motor gain appeared to be independent of cognitive status, relative motor gain depended on it (Heruti et al., 1999). Despite cognitive impairment contributing to poor outcomes, there was evidence to show that patients with cognitive impairment could still benefit from rehabilitation after hip fracture surgery to regain mobility (Huusko et al., 2000; McGilton et al., 2016; Mitchell et al., 2016; Seitz et al., 2016). Hence, it is essential to appropriately assess the cognitively impaired older patients with hip fractures for rehabilitation and devise suitable interventions to achieve feasible rehabilitation goals.

Visual impairment is a well-known risk factor for falls. The population-attributable risk of hip fractures due to visual impairment was 40% (Ivers et al., 2000). Visual impairment had a significant, independent negative effect on the absolute efficacy of rehabilitation in older patients with hip fracture (Lieberman, Friger, & Lieberman, 2004). This could be related to visual impairment possibly impacting the effectiveness of postoperative rehabilitation strategies (Marks, 2011). Visual impairment had also been demonstrated as one of the factors independently associated with a significantly increased risk of in-hospital hip fracture (Lichtenstein et al., 1994).

Mild exertional dyspnea and poststroke motor impairment are comorbidities that could affect functional recovery of older patients with hip fracture (Lieberman et al., 2006). Patients with hip fracture who had a

TABLE 3. PREDICTORS OF POOR OUTCOME IN OLDER PERSONS AFTER HIP FRACTURE

1. Prefracture functional level
Prefracture disability in ADL
Prefracture disability in mobility
2. Serum albumin
Hypoalbuminemia
Negative albumin gain
3. Premorbid mental state
Impaired cognitive status
4. Visual impairment
5. Comorbidities
Previous stroke
Exertional dyspnea
6. Folic acid
Low folic acid
7. Age
Older than 80 years
8. Site of hip fracture
Intertrochanteric fractures

Note. ADL = activities of daily living.

previous stroke did significantly worse in self-care, transfer, and locomotion on the FIM outcome scale, and those with congestive cardiac failure performed significantly worse in transfer and locomotion when compared with patients who did not have these comorbidities (Mathew, Hsu, & Young, 2013).

Folic acid is related to homocysteine levels; decreased folic acid level is associated with increased homocysteine level. Lieberman et al. (2006) found that decreased serum folic acid level had a negative effect on rehabilitation success following a hip fracture. This could be due to either low folic acid level directly affecting neuromuscular and sensorimotor system physiological processes as folic acid is involved in methylation processes of the neurological system or reduced folic acid level indirectly affecting strength, gait, and balance due to elevated homocysteine level (Ng et al., 2012). In addition, studies have shown that elevated homocysteine level is a predictive factor for hip fractures (McLean et al., 2004; van Meurs et al., 2004).

Several studies have shown that the very older patients with hip fractures have worse rehabilitation outcomes (Cree & Nade, 1999; Gatot et al., 2016; Lieberman et al., 2006; Magaziner et al., 1990; Parker & Palmer, 1995). Persons older than 85 years have an increased 30-day and 1-year mortality rate, longer hospital LOS, and a decreased likelihood of return to their pre-morbid place of residence after a hip fracture (Moon, Gray, & Deehan, 2011). Gatot et al. (2016) found those aged 80–89 years had poorer relative functional gain at 1 year post-hip fracture surgery than those aged 60–79 years. Although advanced age had adverse effects on absolute rehabilitation efficacy, successful return to community, and living alone, approximately half of a cohort aged 85 years and older admitted to a rehabilitation geriatric ward demonstrated significant functional improvements after rehabilitation and were independent in their ADL (Cree & Nade, 1999; Lieberman et al., 2006; Lieberman & Lieberman, 2002; Parker & Palmer, 1995). Hence, older patients with hip fractures should still be adequately optimized and evaluated for rehabilitation.

Patients with intertrochanteric fractures tend to perform functionally poorer than those with femoral neck fractures (Fox et al., 1999; Haentjens et al., 2007; Lee et al., 2014). Upon discharge, patients with intertrochanteric hip fracture have been shown to have a significantly increased mortality and greater disability on the Rapid Disability Rating Scale (Haentjens et al., 2007). A prospective study of 923 older patients with hip fractures showed that patients with intertrochanteric fracture were generally older and sicker and therefore recovery was more significantly affected (Fox et al., 1999).

Conclusion

With the rapidly aging population, hip fractures in older patients have emerged as a major public health concern due to its strong association with multiple medical complications and substantial healthcare cost and burden. A strong understanding of rehabilitation predictors and an early engagement of multidisciplinary rehabilitation team are the key elements for better functional outcome

and shorter length of hospital stay with lower economic cost in older patients with hip fracture. Various orthogeriatric models of care have been established, with the aim to streamline patient care, to minimize complications, as well as to improve short-term and long-term clinical and functional outcomes. However, the development and implementation of any orthogeriatric service should be based not only on the best available evidence but also on the availability of existing resources and the organization of the local healthcare system.

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ERRATUM

Obesity Treatment: A Focus on Pharmacotherapy of Weight Management: Erratum.

In the article by Khyati Patel entitled “Obesity Treatment: A Focus on Pharmacotherapy of Weight Management” in the March/April 2020 issue of the journal, there was an error.

In a statement under the subsection “Treatment Approach” on page 122, the following sentence read as follows:

“Addition of pharmacotherapy to lifestyle modifications is recommended for patients with BMI of 30 or more or BMI of 27 or more with two or more comorbidities (Apovian et al., 2015; Jensen et al., 2014).”

This sentence should have read as follows: “Addition of pharmacotherapy to lifestyle modifications is recommended for patients with BMI of 30 or more or BMI of 27 or more with one or more comorbidities (Apovian et al., 2015; Jensen et al., 2014).”

The number of comorbidities is one, not two.

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