Hip Fractures and Alzheimer's Disease

People with Alzheimer's disease have a higher incidence of hip fractures than other elderly people. Unfortunately, patients with dementia are also less likely to recover their previous functional status following a hip fracture, are more likely to require institutionalization, and have a higher mortality rate.

By Susan Freter, MSc, MD, FRCPC; and Kata Koller, MD, FRCPC

Hip fractures are common and often devastating in the elderly population. Annually, there are more than 35,000 hip fractures in Canada and more than 270,000 in the United States, and most occur in individuals older than 60 years. Overall incidence is anticipated to double by the year 2040.[1,2] In Canada alone, the current annual cost of hip fractures has been estimated at $650 million and is expected to increase to $2.4 billion by 2041. Lifetime incidence of hip fracture at age 50 is 17% to 22% for women, and 6% to 11% for men.[3] Amongst Caucasian women, one in six will suffer a hip fracture in her lifetime.[4]

Susan Freter, MSc, MD, FRCPC
Attending Geriatrician,
Queen Elizabeth II Health Sciences Centre
Associate Professor of Medicine,
Dalhousie University
Halifax, Nova Scotia

Kata Koller, MD, FRCPC
Fellow in Geriatric Medicine,
Dalhousie University,
Special interest in Palliative Care
Halifax, Nova Scotia

Classification of Hip Fractures

Hip fractures can be classified by the location of the fracture line along the femur, into intracapsular or extracapsular. Intracapsular fractures include femoral head and neck fractures, and extracapsular fractures can be subdivided into intertrochanteric or subtrochanteric. The femoral neck is the most common location for a hip fracture, accounting for 45% to 53%. Approximately 38% to 49% of hip fractures are intertrochanteric, and 5% to 15% are subtrochanteric.[7] Most of the blood supply to the femoral head is supplied by the posteromedial and lateral femoral circumflex arteries, which wrap around the neck of the femur. Intracapsular fractures can cause disruption of this arterial system, potentially resulting in avascular necrosis of the femoral head and/or nonunion.[5,6] One large study followed more than 900 elderly inpatients with hip fractures and found that patients with intertrochanteric fractures tended to be older and had a poorer health status. They had decreased functional recovery at two and six months, as well as longer hospital stays.[8]

Outcomes After Hip Fracture

Hip fractures in older adults have potentially serious consequences, resulting in increased morbidity, mortality, functional impairment, and healthcare costs.[3] By global estimates, there were 1.31 million new hip fractures in 1990 and the prevalence of individuals with hip-fracture-related disability was 4.48 million with 1.75 million disability-adjusted life-years (DALYs) lost.[9] The mortality rate associated with hip fracture is estimated at 10% at one month, 20% at four months, and 30% one year after.[10] Complications relating to restricted mobility, such as pneumonia, deep vein thrombosis, pulmonary embolism, deconditioning and poor rehabilitation outcomes correlate with increased mortality rates postoperatively.[2]

Functional decline commonly follows hip fracture, with rates of

increased dependence in activities of daily living (ADLs) approaching 50%.[10] By six months post-fracture, only 50% of patients will have recovered their prefracture walking ability. By one year post-fracture, less than 50% of patients can walk without aids and only 40% are independent in all ADLs. Hip fractures are associated with subsequent institutionalization in 10% to 20% of individuals.[11] Several studies have shown that delay in surgery is correlated with higher mortality, longer hospital stays and a higher complication rate.[12] In one large study, a significant increase in short-term and one-year mortality was seen in patients who waited for surgery more than four days, when compared to those who had surgery within two days.[13]

For those patients who survive their hip fracture and regain some independence in ambulation, there is an increased risk of suffering a second hip fracture. Older age and a low body mass index (BMI) are predictive of a second hip fracture, as is having regained a higher functional status after the first hip fracture, presumably because of increased opportunities for suffering a second devastating fall. Whereas the risk of death following an initial hip fracture is around 16%, the one-year mortality following a second hip fracture is 24%.[14]

Risk Factors

The two principle determinants of hip-fracture risk are low bone mineral density (BMD) and falls.[15] It is generally accepted that the vast majority of hip fractures in the geriatric population are "fragility fractures," occurring in the setting of underlying bone weakness stressed to a breaking point.[3] History of either vertebral compression fracture or distal radial fracture doubles the risk of hip fracture. History of previous hip fracture increases the risk for second hip fracture by six-fold.[16] There is an exponential risk increase with age, particularly after age 70.[17] This likely relates to the age-associated decline in BMD, as well as an increase in number of comorbid conditions and risk of falls.[4]

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Falls are the causal mechanism for 95% of all hip fractures. One in every three individuals older than 65 sustains a fall each year. Individuals in residential and long-term care facilities have a three-fold risk of hip fracture, as compared to the general population. Having sustained one fall increases the probability of having another fall by three-fold.[3] In elderly women, approximately 1% of falls will result in hip fracture. Aside from bone quality, the likelihood that a fall will result in fracture depends on the point of impact and the energy of the fall. Elderly individuals tend to fall with relatively low velocity, but directly onto their hips and without putting their arms out to slow their fall.[4]

The multifactorial nature of hip-fracture risk is reflective of general frailty, fall risk and bone fragility.[5,18] Table 1 organizes risk factors for hip fracture by factors associated with osteoporosis and those raising the risk of falls.

Hip Fractures and Alzheimer's Disease (AD)

People with AD have a higher incidence of hip fractures than other elderly people. Unfortunately, patients with dementia are also less likely to recover their previous functional status following a hip fracture, and are more likely to require institutionalization, and have a higher mortality rate. One study found that institutionalized patients with AD were approximately twice as likely to have sustained a hip fracture over a 12 month period as nursing-home residents without dementia.[19] There may be a number of reasons for this association, including a higher rate of falls and osteoporosis in patients with AD. Weller et al found that there is a relationship between AD and fractures which is independent of falls and osteoporosis. They suggest that low BMI, weight loss, decreased muscle mass, nutritional deficien-

cies, and sideways direction of falling may be more common in patients with AD and might help explain the increased risk of sustaining a hip fracture.[19]

Community-dwelling people with dementia who are prescribed antipsychotic drugs are at an increased risk of having a hip fracture, and this association holds for atypical and conventional antipsychotics.[20] Interestingly, apolipoprotein E4, which is associated with a higher risk of developing AD, may also be a marker for hip-fracture risk.[21] The relationship between AD and hip fracture needs further exploration, as in some instances the onset of AD follows the hip fracture, implying that either the hip fracture brought the patient's cognitive deficits to medical attention or that the hip fracture and surgery may have precipitated the cognitive decline.

Hospitalization for hip fracture is costly, and the cost goes up with longer length of stay and comorbidities. Average cost increases with the number of comorbid illnesses, but the specific type of associated illness has also been found to be important, with dementia topping the list by adding the largest amount to total costs.[22] Cost-containment solutions could include efforts at reducing length of stay, by reducing wait times before surgery, and further exploring how dementia contributes to length of stay and cost.

Concerns about quality of hospital care for patients with AD and hip fractures have been raised, in part because of the greater odds of death during index hospitalization, compared to individuals without AD.[23] The situation is more complex in patients from chronic-care facilities. Although patients from chronic-care settings generally have lower pre-fracture function, the decline in level of functioning and mobility after a hip fracture is much greater than in their community-dwelling counterparts.[24] It is concerning that this post-fracture decline in ambulation and functioning is actually associated with a shorter length of hospital stay, reflecting a tendency to send these patients back to their nursing homes as soon as they are medically stable, rather than having access to inpatient rehabilitation.

Individuals with dementia are at greater risk of developing delirium during hospitalization for hip fracture, with published incidences ranging from 15% to 60%, depending on the specific criteria used. Hip-fracture patients with delirium have worse outcomes, including longer hospitalizations, decreased recovery of functional abilities and ambulation, and increased risk of institutionalization and death. Cognitive impairment and dementia have been cited as the best predictors of post-orthopedic surgery delirium.[25-27] As delirium can potentially be prevented and treated,[28,29] this may be an important starting point for improving the care

Table 1
Risk Factors for Hip Fractures

Osteoporosis-associated	Increased Risk of Falls		Both
Low bone mineral density (BMD)	Polypharmacy	Diabetes	Age
High bone turnover	Sedative medication use	Peripheral neuropathy	Frailty
Calcium deficiency	Orthostatic hypotension	Sensory impairment	Previous falls/fractures
Low body mass index (BMI)	Deconditioning	Balance problems	Vitamin D deficiency
Weight loss	Dementia	Foot disorders	Physical inactivity
European or Asian ancestry	Parkinson's disease	Urinary urgency	Anticonvulsant use
Female gender	Stroke	Environmental hazards	Thyroid disorders
Caffeine intake	Arthritis		Alcohol intake
Cigarette smoking			Certain medications
Family history			

of elderly dementia patients with hip fractures. Targeting patients who are at greatest risk of developing postoperative delirium with delirium-prevention strategies may help to improve quality of care and postoperative outcomes, and reduce costs. More research on delirium prevention and management is needed in this population, as many research trials have excluded patients with dementia.

Improving Care of Hip Fracture In Patients with Dementia (Table 2)

Delirium Prevention and Management. Having sustained a hip fracture is an independent risk factor for developing delirium and this risk is increased several-fold in patients with pre-existing dementia.[27] There may be ways to improve the perioperative care of frail elderly hip-fracture patients, with the goal of decreasing the incidence of delirium. Work by Marcantonio[28] has demonstrated that combined medical and nursing interventions, augmented by proactive geriatric consultation, can potentially reduce the incidence and severity of delirium complicating postoperative hip-fracture care. Another intervention study, involving systematic cognitive screening, regularly scheduled pain medications, and education of nursing staff, resulted in decreased severity and shorter duration of delirium in hip-fracture patients.[36] Routine cognitive screening on admission can be helpful in establishing baseline cognitive functioning, against which later cognitive changes can be compared.

Uncontrolled pain is itself a risk factor for developing delirium, in addition to being inhumane. Pain medications are frequently prescribed on an as-needed basis, but patients with cognitive impairment may not be able to effectively communicate their needs. This increases the likelihood of relatively severe postoperative hip pain, which may then result in the administration of higher opioid doses. Regular administration of non-narcotic analgesics, such as acetaminophen, may help to reduce uncontrolled severe pain and the total amount of opioid that is needed.[5,28]

Unfortunately, environmental strategies, such as limiting changes in staff and involving relatives in re-orientation, are frequently overlooked.[31] Delirium-prevention studies have, by and large, been fully funded research studies in tertiary referral centres and it is unclear whether their results can be replicated in everyday practice. A challenge in delirium research is to discover ways in which good practice can be disseminated widely, so that permanent improvements in quality of care for vulnerable elderly people can be achieved and appropriate interventions become part of routine care.

Nutrition. Malnutrition is common amongst elderly hip-fracture patients. This, in addition to the catabolic response to surgery, can contribute to muscle wasting and weakness and may contribute to poor rehabilitation outcomes. Undernutrition may also contribute to delayed wound healing and impaired functioning of the immune system. Early medical complications and dementia have been shown to be major risk factors for inadequate postoperative nutritional intake.[32] Strategies to improve nutrition in high risk groups may include reducing fasting time preoperatively, reducing opioid load, and nutritional supports. Patients with dementia who are at increased risk of complications may benefit from further intensification of nutritional support.[32] Another innovative approach may include providing one-on-one attention from dietary assistants, in high-risk patients, to help with meal choices and actual food consumption, if needed.[33]

Rehabilitation. A multidisciplinary approach to rehabilitation after hip fracture can help to optimize recovery of mobility and functional capacity.[34,35] Rehabilitation in patients with dementia can be more challenging and may require specialized geriatric rehabilitation teams. However, research has shown that pre-morbid ambulatory status is more important than the presence or absence of dementia at predicting who will reach motor independence and safe gait, following rehabilitation efforts.[36,37] Functional status at discharge from rehabilitation after hip fracture does depend, to some extent, on pre-operative cognitive status and functional ability, but nonetheless, the ability to perform functional activities is

Table 2
Improving Care of Hip Fracture Patients with Dementia

Perioperative Care
Multidisciplinary team approach
Education of healthcare team
Routine cognitive screening
Delirium prevention strategies
Regularly scheduled non-opioid analgesia
Nutritional support
Geriatric rehabilitation
Prevention Strategies
Fall prevention
Exercise programs in the community and nursing home
Osteoporosis treatments

improved by the rehabilitation process in cognitively impaired patients.[38,39] Indeed, the greatest benefit by specialized geriatric rehabilitation programs may be derived by hip-fracture patients with mild-to-moderate dementia.[40,41]

Taking this one step further, it may be beneficial to introduce a multidisciplinary approach even earlier in the postoperative course. In one study, a multidisciplinary, multi-factorial intervention program was implemented in the acute-care and rehabilitation phases of hip-fracture patients, resulting in a significant reduction in falls during the inpatient stay, related at least in part to a reduction in postoperative delirium in the intervention group. Dementia patients, who are at highest risk of delirium and further falls after hip-fracture surgery, seemed to benefit the most from this intervention program.[42] Future directions in hip fracture rehabilitation may include home-based rehabilitation programs,[43] and body-weight-supported treadmill techniques, which may be useful in more severe dementia.[44]

Prevention. Hip-fracture prevention starts with efforts at fall prevention, for which multifactorial programs in certain settings may be effective. Not all falls, of course, can be prevented. There has been some interest in hip-protector use to prevent fractures resulting from falls. Meta-analysis on this question is inconclusive, but there may be a small reduction in rates of hip fracture in care homes with the use of hip protectors.[45]

There is good evidence for the pharmacologic treatment of osteoporosis, with outcomes including fracture reduction in postmenopausal women, including those with a previous fracture history.[3,46,47] Risedronate has been found to reduce the risk of hip fracture in elderly women with AD.[48] Dietary intake of calcium and sun exposure are unpredictable in nursing-home populations. A number of studies have found that oral calcium and vitamin D supplementation reduced falls and fractures in nursing-home patients.[45] However, a subsequent study failed to replicate these findings,[49] so the jury is still out on this issue.

Patients with dementia may be less likely to engage in regular exercise, which can contribute to muscle weakness from deconditioning, and may increase their risk of falls and fractures. Rolland et al[50] implemented a twice-weekly exercise program in nursing-home patients with dementia. Over the course of a year, they noted an increase in walking speed and significantly less decline in ADLs in the exercise group. There were too few fractures in either group to allow any insight into fracture prevention, but it is thought-provoking that it was possible to implement a regular exercise program in this population. Preliminary work in people with dementia living in the community showed that it is possible to successfully train caregivers to implement a home exercise program, which may have a persistent effect on physical health and functioning .[51]

Conclusions

As the population ages, the prevalence of Alzheimer's disease and other dementias, as well as the incidence of hip fractures, will continue to rise. Outcomes after hip fracture

tend to be poor in patients with dementia, and much can be done to improve the care of this group. Health care providers from all disciplines will have to become comfortable with managing frail elderly patients, with or without cognitive impairment, in the perioperative period, which will include delirium recognition and management, as well as a multifactorial approach to optimizing outcomes.

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