Trauma

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The management of displaced femoral neck fractures: a narrative review

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- This article serves to review the existing clinical guidelines, and highlight the most recent medical and surgical recommendations, for the management of displaced femoral neck fractures (FNFs). It stresses the need for multi-disciplinary intervention to potentially improve mortality rates, limit adverse events and prevent further economic liability.
- Globally, the incidence of FNFs continues to rise as the general population ages and becomes more active. The annual number of FNFs is expected to exceed six million by 2050. The increased burden of FNFs exacerbates the demand on all services associated with treating these injuries.
- The management of FNFs may serve as an indicator of the quality of care of the geriatric population. However, despite escalating health costs, a significant 30-day and one-year mortality rate, increased rate of peri-operative adverse events and sub-optimal functional clinical outcomes, continued controversy exists over optimal patient care.
- Much debate exists over the type of surgery, implant selection and peri-operative clinical care and rehabilitation. FNF care models, systematized clinical pathways, formal geriatrics consultation and specialized wards within an established interdisciplinary care framework may improve outcomes, mitigate adverse events and limit unnecessary costs.

Keywords: displaced neck of femur fracture; femoral neck fracture; review

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Introduction

Globally, approximately 1.3–2.2 million femoral neck fractures (FNFs) occur each year.[1–4] More than 50% of FNFs are intracapsular[5] and up to 80% are displaced.[6] The incidence is increasing and projected to be 3.9–7.3 million cases annually by 2050.[1–3,7–9] Numbers of annual hip fracture cases treated are: UK 100,000,[4] Germany 135,000[10] and Netherlands 18,500[11] respectively. This increase is linked to a growing ageing global population that is healthier and more active[8,12] and presents a major public healthcare issue.[13] Globally, the management of hip fractures may serve as an indicator of the quality of care of the geriatric population.[4]

FNFs are associated with high mortality, and associated disability results in a reduction in the quality of life and other health-related complications.[1,14] FNFs are within the leading 10 causes of disability globally in adults[14] and are the second leading cause of hospitalization in the elderly population.[6]

Cost

The increasing burden of FNFs is due to the morbidity, mortality and associated costs.[3] The FNF burden is a contributor to the global economic health crisis as treatment costs are three times higher than treating a patient without a fracture.[15] Peri-operative complications are common and can result in an increased length of stay, prolonged disability and resource utilization.[3] The associated annual healthcare costs in the UK amount to £2 billion.[4] The cost annually in Germany is €2–4 billion.[10] The mean total cost of treating a single patient at two years is €26,399.[9]

Risk factors

Advanced age is an independent risk factor for poor outcomes in FNFs.[10,16] Females account for 80% of patients, and have an 11.4% lifetime risk at 50 years of age of sustaining a FNF, which is comparable to breast cancer.[6] The mean age is 80 years old and less than 5% occur before the age of 60 years.[6] Patients are often on systemic glucocorticoids; treatment of more than three months, or at

a dose of prednisolone of 5 mg daily or more increases the risk of sustaining a fracture.[17] Globally there are currently over 36 million people living with human immunodeficiency virus (HIV),[18] the disease and antiretroviral therapies reduce bone mineral density.[19] There is a general increased fracture risk[19] which is five times in FNFs.[20] Alcohol consumption of more than 14 glasses per week in men aged 30–59 years increases the risk of sustaining a FNF.[21] Elderly patients fall, 30–50% suffer from at least one fall per year,[22] which increases the risk of sustaining a FNF.[17] A FNF in itself is a marker of systemic decline[23] and sub-clinical physiological changes which impair the body's response to the trauma of the injury.[22]

Management

Pre-operative assessment

FNFs constitute an orthopaedic emergency.[13] The pre-operative mortality is 2.1%.[24] The aim of pre-operative management is to ensure medical optimization and expedite surgical intervention. On admission, a thorough record of the patient's cognitive status,[2,25] pre-injury medical history, mobility and the use of walking aides must be taken to determine optimal operative intervention[25] and to predict patient outcomes.[26]

Intravenous fluids are essential as up to 500 ml blood loss and subsequent hypovolemia, resultant fluid shifts[27] and electrolyte imbalances[28] occur with this injury. Adequate prompt analgesia should be provided according to a pain management hierarchy throughout the patient hospital stay.[25] The pain itself can lead to delirium; however, caution should be taken in administering analgesia.[2]

Comprehensive, multi-disciplinary peri-operative care is essential.[29] As many as 50% of FNFs will be complicated by one or more grave and potentially avertible early complications such as venous thromboembolism (VTE),[7] delirium, pressure ulcers, cardiovascular events and infections such as urinary tract infections, surgical site infections and pneumonia. The orthogeriatric unit should assess the patient prior to surgery.[25] These patients suffer from a clustering of comorbidities[30] which have been shown in multiple studies to be a predictor of poor outcomes.[23,26,31]

Anaesthesiologists are fundamental to the multi-disciplinary approach.[2] The surgery should only be delayed if the benefits of additional medical treatment outweigh the risks of delaying surgery.[2] No evidence promoting general or regional anaesthesia exists. However, nerve blockade is recommended, irrespective of the type of anaesthesia administered.[2]

i) Non-operative treatment

Non-operative treatment of non-displaced FNFs leads to displacement in 14.1–55.7% and osteonecrosis at 2–3 years in 14% of patients.[32] This is an option in patients with significant pre-existing comorbidities, minimal baseline ambulation, and limited outcomes.[33] A systematic review reported worse mobility scores, pain scores and mortality rates in non-operative treatment.[32]

ii) Operative treatment

Optimal surgical management of displaced FNFs especially in the elderly is controversial.[1,14,34] Previously called the 'the unresolved fracture' the debate over treatment options has waged on since the 1930s.[35] Surgical options include open reduction internal fixation (ORIF), hemiarthroplasty (HA) and total hip arthroplasty (THA). The operative selection is based on fracture pattern, age, functional and mental status and medical comorbidities.[6] The Sernbo score is a four-component score (including age, social situation, mobility, and mental state) that was initially developed as a tool for decision making regarding treatment with either a THA or HA .The score is useful and can be promptly calculated in the acute setting to guide surgical intervention.[36]

Time to surgery

Prompt surgical intervention limits the pain and anxiety experienced by the patients and delays in surgery are associated with mortality, reduced return to mobility,[25] and increased complications.[10,28] The ideal time to surgery is contentious and various recommendations exist (see Table 1). In a meta-analysis of 257,367 hip fractures, Shiga et al[37] warned that delay of surgery beyond 48 hours after admission increased the risk of 30-day mortality and one-year mortality due to all causes by 41% and 32% respectively.

Surgical treatment options

i) Open reduction internal fixation (ORIF)

ORIF of FNFs is most suited for non-displaced, valgus impacted FNFs[12] and in young, active patients following high-speed trauma when a head-sparing technique is required.[6] However, poorer outcomes have been reported with ORIF in comparison to THA for displaced FNFs.[38] Reoperation rates are four times higher, functional performance is inferior and quality of life is ultimately worse in ORIF as opposed to arthroplasty surgery. Overall, the risk of failure of fixation for displaced FNFs is 39–43%,[7] mostly subsequent to osteonecrosis and nonunion.[6] THA and HA have higher initial costs, but with time they prove to be more cost-effective.[9] Overall, the selection of ORIF, particularly in the elderly, is declining.[12]

ii) Hemiarthroplasty (HA)

HA is currently the most reliable and widely used treatment option for displaced FNFs in geriatric patients[3] with

Table 1. Recommendations on time to surgery

Society/organization/guidelines	Recommendation
British Orthopaedic Association Standards for Trauma	Surgery should not be delayed by more than 48 hours unless early identified and reversible medical comorbidities present.[7]
National Institute for Health and Care Excellence (NICE) guidelines	Surgery to take place on the day, or day after admission.[25]
American Academy of Orthopaedic Surgeons	Moderate evidence supports hip fracture surgery within 48 hours of surgery[58].
Canada: the Health Quality Ontario & Ministry of health and long term care and the National fracture tool kit	Surgery not to be delayed of which should not exceed 48 hours.[4]
Australia and New Zealand Society for Geriatric Medicine	Early definitive surgery within 24 hours.[4]
National Services Scotland: Scottish Standards of Care for Hip Fracture Patients	Patients undergo surgical repair of their hip fracture within 36 hours of admission.[59]
Department of Trauma and Orthopaedics, Hospital Santa Maria delle Croci, Ravenna, Italy	Surgery within first 48 hours.[11]
Netherlands Society for Surgery	Undergo surgery on the day of admission or the following day.[11]
Spanish Society of Geriatrics and Spanish Society of Orthopaedics	Surgery within first 48 hours.[11]

low functional demands, poor cognitive function, significant medical comorbidities,[6] limited life expectancy[12] and no pre-existing acetabular wear.[3] However, it remains controversial for relatively healthy and active elderly patients.[3]

Monoblock and Bipolar HA are equivocal in terms of surgery time, blood loss, acetabular wear, stability, functional outcomes and re-operative rates.[13] However, bipolar HA is 2 to 5 times more expensive.[13]

Groin pain is the most common cause of patient dissatisfaction after HA due to acetabular erosion.[3] Conversion to THA from HA due to symptomatic acetabular erosion accounted for 4.6% of revisions in the Swedish register.[13] However, conversion THA has poorer outcomes than primary THA.[3] The advantages of HA are a reduction in dislocation rates, theatre time, blood loss and lower short-term costs.[1,3] The surgical time for HA is 59–82 minutes versus 80–102 minutes for THA.[6] THA on average results in 140 ml more blood loss[6] and 26% of THA lose more than 500 mls of blood versus 7% of HA.[7]

A meta-analysis found no difference in length of stay between HA and THA.[13] A higher rate of complications has been reported in HA,[5] > 66% being urinary tract and chest infections.[5] Dawson et al reported that the overall complication rate in HA was 45.6% as opposed to 8.7% in THA.[5] This difference is attributed to poorer pre-morbid physiology in patients undergoing HA,[5] older age and higher American Society of Anesthesiologists (ASA) scores.[3]

iii) Total hip arthroplasty

THA ostensibly allows superior post-operative rehabilitation,[6] better hip functional outcome scores[1,3,14,25] and superior quality of life.[39] The National Institute for Health and Care Excellence (NICE) guidelines dictate that clinical eligibility for THA in patients with a displaced, intracapsular FNFs includes independent ambulation outdoors with the use of no more than a stick, no cognitive impairment and medical fitness for anaesthesia and surgery.[5,25] THA is generally indicated in younger patients with longer life expectancy or those with pre-existing degenerative acetabular disease.[39] Subsequently, only 7.7% and 15% of cases in the USA and Australia respectively undergo THA for FNFs.[6]

Patients, their families and healthcare networks must be mindful that emergency THA for FNFs does not correspond with elective THA. Charette et al[40] compared 135,013 THA for osteoarthritis (OA) with 4622 THAs for FNFs and reported significantly increased 30-day mortality rates of 1.8% in FNF as opposed to 0.3% in OA. THA for FNFs, comparatively, had increased major adverse events, length of stay, reoperation rates and readmissions than for OA.[40]

Implant survivorship. The implant survivorship of THA in FNFs is comparable to implant survivorship in THA for other causes.[3] Meta-analyses have also shown that THA has lower revision rates compared to HA for FNFs.[1,3,14,25] Rogmark et al[35] showed that the revision rates for THA and HA where shown to be 2.5% and 20% respectively at a seven to ten-year follow up.

Functional outcomes. THA for FNFs have been shown to have superior functional outcomes and quality of life as opposed to HA.[6] This is apparent as early as the first month after surgery.[13] Two-thirds of patients with FNFs regain pre-morbid functioning subsequent to THA.[6] However, Tol et al showed no difference in functional outcomes between THA and HA in elderly active patients with an intracapsular FNF at a 12-year follow up.[34]

Dislocations. A FNF is a risk factor for instability.[13] Dislocation in THA for FNFs is five times more likely than in the setting of elective THA.[41] This increased incidence is due to the increased prevalence of soft tissue deficiency, abductor dysfunction and medical comorbidities such as Parkinson's disease, dementia and stroke in patients with FNF.[6] THA in comparison to HA have 2–3 times more post-operative dislocations.[41]

The use of DMC (dual mobility cups) has reduced the post-operative dislocation rate[42] in THA for FNFs[41] to

0–4.6%.[13] DMC have a smaller inner femoral head which is in keeping with Charnley's low-friction arthroplasty within a second articulation and larger polyethylene head which allows for a greater arc of motion,[43] increased 'jump distance' and head-to-neck ratio which increases stability and reduces dislocation.[44,45] DMC are a cost-effective adjunct in the management of FNFs.

Infections and peri-prosthetic joint infection (PJI). The peri-prosthetic joint infection (PJI) rate in FNF arthroplasty is 2–17%, and higher than in elective THA.[46] Older age, increased comorbidities and related inflammatory states secondary to trauma increase susceptibility.[47] Other nosocomial infections, most notably urinary tract and lower respiratory tract infections are more common in FNFs than in elective arthroplasty (1.7% vs. 0.3%).[39]

Thromboembolism and blood transfusion. Asymptomatic deep vein thrombosis (DVT) occurs in up to 50% of patients with hip fractures.[7] Incidence of peri-operative VTE is 1.4–7.5%[27] and fatal pulmonary embolism is 0.6%.[7] The blood transfusion requirements range between 19% and 69% in FNFs.[3] Tranexamic acid (TA) leads to reduced blood transfusion (42% vs. 60%) requirements with no increase in adverse thrombotic events.[7] However, there are significantly higher wound infection rates and numbers of urinary tract infections in patients with FNFs who undergo peri-operative blood transfusions.[3] Levi and Sandberg demonstrated 7.05% of transfused patients developed wound infection in comparison to 3.71% of non-transfused patients.[48] However, THA is associated with longer operative times,[6] increased blood loss[6] and blood transfusion requirements,[6] higher post-operative dislocation and infection rates,[3] and increased costs.[39]

Use of cemented prosthesis

Controversy exists regarding optimal femoral stem fixation in FNFs. The use of uncemented stems is suggested in known cardiac patients and young patients with good bone quality (medullary canal measurement of less than 16.5 mm).[7] They are associated with less blood loss and shorter surgical times.[13] However, uncemented stems are reported to have 20 times increased risk of peri-prosthetic fractures.[49] In osteoporosis, uncemented stems have an increased rate of early revision, higher pain scores and lower Harris Hip Scores.[50]

Cementing presents a risk for embolism,[13] peri-operative death (0.18%)[35] and increased 30-day mortality rates.[7] Protocols are recommended for prevention, detection and management of cement-associated complications.[2]

Cemented stems have decreased pain,[7] early weight bearing[50] and increased mobility.[34] Functional outcomes in cemented prostheses are controversial. Cemented prostheses have reports of increased functional outcomes at six weeks.[51] However, long-term outcome studies show equivocal results.[52,53] The review of the data favours a cemented femoral stem.[13]

Post-operative care

Aggressive pain management, multi-modal VTE prophylaxis and other multi-factorial interventions limit peri-operative delirium, reduce complications and promote successful care. The incidence of a new, contralateral hip fracture within two years of the initial fracture is 7–12%.[54,55] Additionally, a 2.5 times increased risk of non-hip-fragility fractures also exists.[55,56] Prevention of subsequent factures is mandatory and may be achieved by pharmacological and non-pharmacological methods.[54,55] There is support for routine prescription of bisphosphonates as first-line therapy as reports have shown a 35% decrease in secondary fractures and reduced the mortality rate by 20–28%.[54] However, there is concern that the incidence of hip fractures may only be reduced after three years of uninterrupted medication.[55,56]

FNF care models, systematized clinical pathways, formal geriatrics consultation and specialized wards within an established interdisciplinary care framework may improve outcomes, mitigate adverse events and limit unnecessary costs.

Prognosis

The one-year mortality of FNFs is 14–36%.[1,4,7] The 30-day mortality rate is 10%.[4] Mortality rates strongly correlate with age, living independence, mobility and mental status.[6] The ASA grading and patients' age are the strongest predictors of 30-day mortality.[4] A meta-analysis of randomized controlled studies indicates that there is no difference in the one-year mortality between HA and THA for FNFs.[3]

At one year post-operatively, 40% of patients cannot walk independently, 60% continue to struggle with one or more routine daily activities and 80% encounter difficulties with activities like driving and shopping.[57] Furthermore, 27% of patients are confined to a long-term care facility.[57]

Conclusion

The incidence of FNFs is increasing, while their subsequent management still remains controversial. The management requires a systematic and organized multi-disciplinary approach with clear institutional pathways formulated on evidence-based medicine. The literature confirms that this type of management leads to improved outcomes, decreased mortality results, limited adverse events and prevents further economic liability.

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