Fracture of the proximal femur

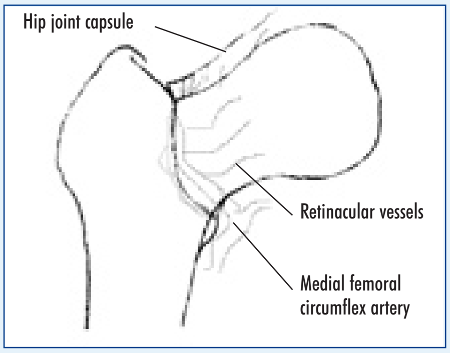
Anatomy and function

The proximal femur comprises the femoral head articulating with the acetabulum as the hip joint, the femoral neck, greater and lesser trochanters. It allows for the transmission of body weight from the upper body to the leg and moves the leg.

The region is divided into an intracapsular and extracapsular part. The hip joint capsule attaches to the pertrochanteric line anteriorly and half way up the femoral neck posteriorly. The blood supply to the femoral head is derived from an extracapsular arterial ring formed by a branch of the medial femoral circumflex artery. Ascending branches penetrate the capsule at the intertrochanteric line forming retinacular arteries. The proximity of these retinacular vessels to the femoral neck put them at risk in femoral neck fractures (*Figure 1*). Knowledge of the vascular supply in relation to fractures in this region is important as it helps in the prediction of associated complications, non-union and avascular necrosis. For practical purposes the femoral head is at significant risk of being rendered avascular by displaced fractures.

Mechanism of injury

Figure 1. Diagrammatic representation of the arterial supply to the femoral head.



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Fractures of the proximal femur (neck of femur fractures) are common in the elderly where the mechanism is from a simple low energy fall onto the affected hip. Less commonly fractures of the proximal femur can occur in a younger age group, these are the result of a high-energy trauma, a direct force along the femoral shaft, e.g. from a road traffic accident, or a fall from a height. The greater the force dissipation the more soft tissue stripping and comminution that occurs.

Clinical picture

The patient presents with pain in the affected groin or hip and has a shortened externally rotated lower limb. The latter deformity is a result of the direction of the muscle pull on the affected bone fragments.

Elderly patients who sustain proximal femoral fractures generally have significant comorbidity, which contributes to the fall. When taking a history from the patient it should be ascertained whether the patient sustained a mechanical fall or whether there was an underlying cardiac event or blackout that precipitated the patient's collapse and fall.

Young patients who present as a result of high-energy trauma should be assessed according to Advanced Trauma Life Support guidelines.

Investigations which are required to diagnose the fracture are appropriate radiographs – anteroposterior (AP) pelvis and a lateral radiograph of the affected hip. In some cases if symptoms and examination findings suggest a fracture, but it is not obvious on the initial radiographs, an AP view of the involved hip with the leg maximally internally rotated to eliminate femoral anteversion is required. In 10% of cases the diagnosis is delayed. In patients where a fracture is not obvious on plain radiographs further imaging with computed tomography or magnetic resonance imaging may be indicated. Patients with radiographic evidence of osteoarthritis are highly unlikely to have sustained an intracapsular fracture as a result of the underlying joint stiffness. These patients sustain extracapsular fractures or just exacerbate their arthritic symptoms following the fall.

Other investigations that should be requested are routine blood investigations (full blood count and blood biochemistry), a chest radiograph and electrocardiogram.

Classification

Fractures of the proximal femur are generally classified as either intracapsular or extracapsular. Intracapsular fractures (sometimes called subcapital fractures) are classified according to Garden (1961) (*Figure 2*). This is based on the displacement of the trabeculae within the femoral head in relation to those in the acetabulum:

I Undisplaced valgus impaction fracture, trabecular angle >160° (*Figure 3*)
II Undisplaced fracture with no impaction (the trabeculae maintain their normal alignment)
III Displaced fracture where the head rotates, trabecular angle <160° (*Figure 4*)

Figure 2. Diagrammatic representation of Garden's classification. (Lines superimposed on the proximal femur represent the bony trabeculae.)

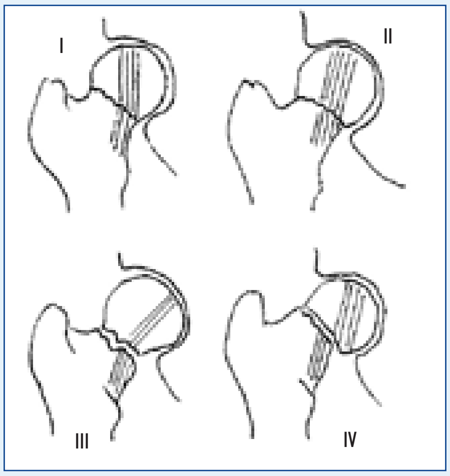


Figure 3. Anteroposterior pelvis radiograph showing Garden I fracture of the left neck of femur.

IV Displaced fracture with no cortical contact but no rotation to the head. Trabeculae maintain normal alignment (*Figure 5*).

For clinical purposes and management options the grading is simplified into either undisplaced (Garden I and II) or displaced (Garden III and IV).

Extracapsular (intertrochanteric) fractures were classified by Jensen and Michaelsen (1975) into the number of fracture parts (*Figure 6*).

- Type 1 Undisplaced two-part fracture
- Type 2 Displaced two-part fracture
- Type 3 Three-part fracture, with loss of posterolateral support
- Type 4 Three-part fracture, with loss of medial support (*Figure 7*)
- Type 5 Four-part fracture (*Figure 8*).

Initial management

Initial management of these injuries involves providing the patient with appropriate analgesia and intravenous fluids. Elderly patients have frequently been lying where they fell for several hours before being able to summon help, and are therefore in need of judicious fluid resuscitation. Usually bed rest is sufficient until definitive management is arranged. Occasionally application of skin traction with a 5 lb weight attached is required for help with pain relief.

Figure 4. Anteroposterior pelvis radiograph showing Garden III fracture of the left neck of femur.

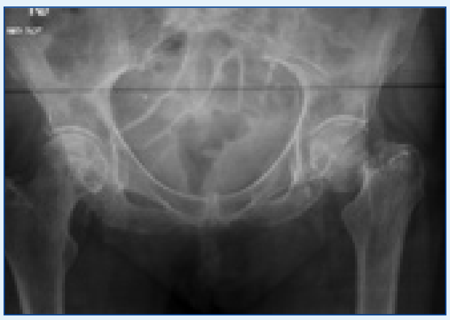
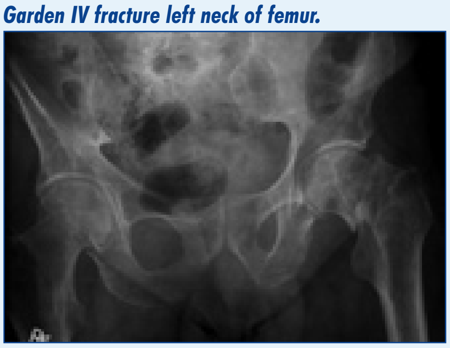


Figure 5. Anteroposterior pelvis radiograph showing Garden IV fracture left neck of femur.



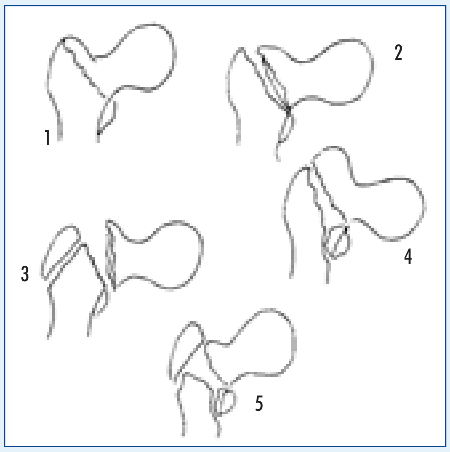


Figure 6. Jensen classification of extracapsular fractures.

Definitive management

Definitive care for these fractures is operative to allow early mobilization. In the elderly group care must be taken to optimize the patient's general medical status preoperatively.

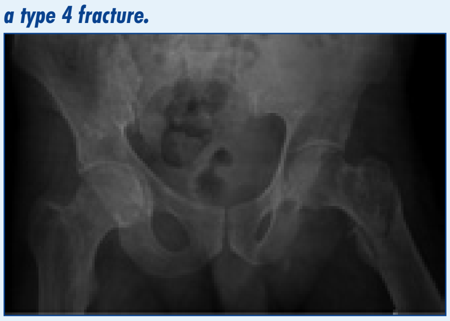
Undisplaced intracapsular fractures are fixed in situ to prevent fracture displacement. This can either be achieved with cannulated hip screws (*Figure 9*) placed in parallel or a sliding hip screw.

Displaced intracapsular fractures have a high risk of developing avascular necrosis of the femoral head secondary to disruption of the retinacular blood vessels. The treatment of these injuries in patients over 60 years of age tends to be based on the patient's physiological age as opposed to chronological age. Options are reduction and internal fixation or arthroplasty (either total, hemi or bipolar; *Figure 10*). Arthroplasty has been shown to reduce the risk of revision surgery but is associated with a greater mortality risk (Bhandari et al, 2003).

In the young age group who sustain an intracapsular fracture as a result of high-energy trauma the treatment, whether the fracture is undisplaced or displaced, is reduction and internal fixation. In the past this has been regarded as a surgical emergency with an aim to reduce and fix the displaced fracture as soon as possible following injury to reduce the risk of avascular necrosis developing. More recently literature has shown that although there is a decreased rate of radiographical signs of avascular necrosis, if displaced subcapital fractures are reduced and fixed within 12 hours it does not significantly affect the functional outcome (Jain et al, 2002).

Extracapsular fractures are treated by closed reduction of the fracture and fixation with a sliding hip screw (*Figure 11*) or intramedullary hip screw (*Figure 12*). The sliding nature of these devices allows the fracture to impact, with mobilization, and

Figure 7. Anteroposterior pelvis radiograph showing a type 4 fracture.



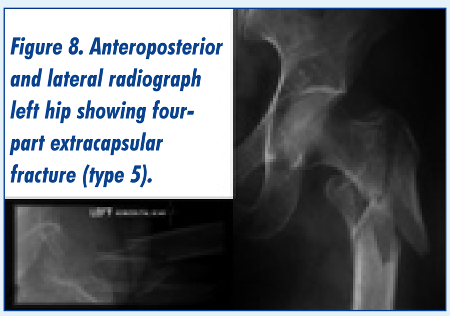


Figure 8. Anteroposterior and lateral radiograph left hip showing four-part extracapsular fracture (type 5).

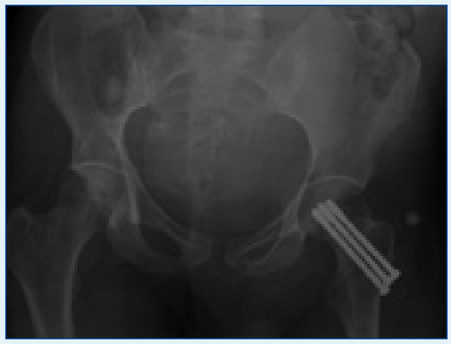


Figure 9. Anteroposterior pelvis radiograph showing internal fixation of left intracapsular fracture with parallel cannulated screws.

Figure 10. Anteroposterior pelvis radiograph showing right hip hemiarthroplasty.

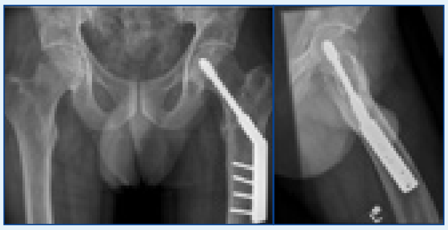


Figure 11. Anteroposterior pelvis and lateral radiograph showing sliding hip screw fixation of left extracapsular fracture.

achieve stability and union.

All methods of treatment allow for early mobilization of the patient thus preventing the complications associated with prolonged bed rest. BJHM

Conflict of interest: none.

Bhandari M, Devereaux PJ, Swiontkowski MF et al (2003) Internal fixation compared with arthroplasty for displaced fractures of the femoral neck. A meta analysis. *J Bone Joint Surg* **85-A:** 1673–81

Garden RS (1961) Low-angle fixation in fractures of the femoral neck. *J Bone Joint Surg* **43-B:** 647–63

Jain R, Koo M, Kreider HJ, Schemitsch EH, Davey JR, Mahomed NL (2002) Comparison of early and delayed fixation of subcapital hip fracture in patients sixty years of age or less. *J Bone Joint Surg* **84-A:** 1605–12

Jensen JS, Michaelsen M (1975) Trochanteric femoral fractures treated with McLaughlin osteosynthesis. *Acta Orthop Scand* **46:** 795–803

Further reading

Parker MJ, Pryor GA, Thorngren K (1997) *Handbook of Hip Fracture Surgery.* Butterworth Heinemann, Oxford

KEY POINTS

- Fractures of the neck of femur are common injuries in the elderly as a result of simple falls.
- Knowledge of the anatomy and blood supply to the proximal femur leads to a simple classification into intracapsular or extracapsular injuries, which then can lead to an algorithm for treatment options.
- Intracapsular fractures are fixed in situ if undisplaced or treated with an arthroplasty if displaced.
- Extracapsular fractures are reduced and fixed.

Figure 12. Anteroposterior radiograph of intramedullary hip screw fixation of pertrochanteric fracture.

RSM STUDENT MEMBERS' GROUP RESEARCH PRESENTATION

Concentration of circulating rhodopsin mRNA in diabetic retinopathy

The* British Journal of Hospital Medicine *is pleased to be publishing some abstracts from the Royal Society of Medicine's Student Members' Group Bicentenary Research Presentation. This is the winning poster. For information about entering this year's prize, please contact young.fellows@rsm.ac.uk

Abstract

Objectives

Diabetic retinopathy is the commonest complication of diabetes, and a major cause of registered blindness in the UK. No biochemical tests exist to determine the state and rate of change of the eyes in diabetics.

Method

In this study, using real-time polymerase chain reaction, mRNA encoding retina-specific pigment protein rhodopsin (RHO) was measured in the peripheral blood of healthy individuals (n=20) and diabetics (n=46) with and without retinopathy. β-actin mRNA was also assayed: results are expressed as a ratio of RHO to β-actin mRNA. Blood was taken by venepuncture and RNA extracted using Quiagen PAXgene Blood RNA extraction kits. Patients were divided into groups by severity of retinopathy assessed by fundoscopy: A = no retinopathy; B= background retinopathy; C = preproliferative retinopathy. Medians of the ratios between groups were compared.

Results

RHO mRNA was detected and quantified in peripheral blood in all healthy and diabetic groups, with levels significantly higher in diabetic patients than healthy controls (2.54×10^{-5} *vs* 1.29×10^{-5}, P=0.002). Additionally there were significantly lower RHO mRNA levels in healthy controls compared to diabetic groups A (2.52×10^{-5}, P=0.022), B (1.98×10^{-5}, P=0.028) and C (5.08×10^{-5}, P=0.002).

Discussion

The results suggest that there is an increase in circulatory mRNA with the severity of diabetic retinopathy.

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