Management of Proximal Femoral Fractures

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1. Introduction

Proximal femoral fractures present unique challenges for anaesthetic departments throughout Great Britain and Ireland, involving the perioperative care of large numbers of older patients with significant co-morbidities. Despite guidance since the early 1990s concerning best practice management for these vulnerable patients [1-6], there remains considerable variation in models of perioperative care, rehabilitation and orthogeriatric input.

Approximately 77,000 hip fractures occur in the United Kingdom annually, accounting for 1.5 million bed days, at an inpatient cost of £0.785bn. Approximately 65,000 of these occur in England, with a median post-operative length of stay of 23 days and a thirty day mortality that has remained consistently around 8-10% for the last two decades – although, again, there is considerable hospital variation in these figures [6, 7]. The majority (95%) of hip fractures occur in patients over the age of 60, 75% occurring in females. More than 98% of fractures are repaired surgically, for the purposes of analgesia and early rehabilitation. Approximately 25% of patients with hip fractures have at least moderate cognitive impairment (abbreviated mental test score less than seven), 20% are institutionalised, and 50% require walking aids or are immobile.

As a result of the inadequacies of the evidence base on which most guidance is founded, there is limited consensus on best practice anaesthetic management for hip fracture patients, which this document hopes to redress.

These guidelines will mainly focus on the acute hospital episode, particularly the pre-operative period, intra-operative management and immediate post-operative phase. Where evidence is limited, issues controversial or guidelines uninformative, the working party has provided pragmatic consensus opinions.

In addition, these guidelines will describe the logistics of providing a high quality service for these patients, together with the important relationships that must be developed between departments to ensure quality care.

This has been a multi-disciplinary collaboration, which has resulted in advice for anaesthetists, and other health care professionals on how to create, develop and manage a service for proximal femoral fracture.
2. Facilities and services required

Older patients with hip fracture are at risk of significant morbidity and mortality, both of which can be reduced by prompt surgical fixation of the fracture and early, effective rehabilitation. This section outlines the structures and processes required to expedite early surgery and achieve high quality rehabilitation.

The Department of Health has suggested the following targets for patients with hip fracture [8]:

- All patients to be admitted within 4 hours of arrival in the emergency department.
- Patients should be operated on by an experienced clinical team within 24 hours of a decision that the patient is fit for surgery.

In addition, the British Orthopaedic Association Standards for Trauma (BOAST) guidelines stipulate that [9]:

- Hip fracture patients should be admitted within 4 hours to an appropriate clinical ward area with nursing, orthogeriatric medicine and surgical expertise appropriate for this often frail patient group.
- Surgical fixation should not be delayed more than 48 hours from admission unless there are clear reversible medical conditions.

For many hospitals, achievement of these standards may require service re-organisation, incorporating the following:

Multidisciplinary hip Fracture management group
This involves a broad collective of stakeholder personnel who meet regularly in order to discuss and improve the quality and efficiency of hip fracture care appropriate to a particular trust. The group may include trauma co-ordinators, general practitioners, community/falls assessment nurses, emergency medicine staff, bed managers, orthopaedic nursing staff, orthopaedic surgeons, anaesthetists, orthogeriatricians, physiotherapists and occupational therapists, social workers and rehabilitation services.

Trauma co-ordinators have a pivotal role, in reducing pre-operative delays, facilitating interdisciplinary communication, and instituting early discharge planning.

Communication between the hip group and hospital theatre management group improves integration of system changes into general theatre service provision.

The fast-track admission pathway
Most patients with hip fracture are admitted via an emergency department, where a planned care package should be initiated promptly. The use of a care pathway pro forma focuses patient care and ensures basic quality standards are met; a number of these exist, which can be tailored to individual hospitals.

Continuous tracking/live data systems, which regularly update patient and logistical data, may improve patient management by identifying patient location, delays in treatment and relevant clinical information, and may be used to facilitate clinical audit and business planning.
Trauma lists
Specific trauma lists, separate from general emergency operating lists, improve the efficiency of trauma service provision. These should be provided daily, including weekends and bank holidays, and be staffed by appropriately experienced senior medical and theatre staff. Extra sessions should be made available flexibly in the evenings, when patient numbers exceed available operating space. Unless life or limb-threatening trauma intervenes, the working party suggests that hip fracture surgery is prioritised within operating lists, overriding the particular subspecialist interest of the surgeon assigned to the list.

Multidisciplinary trauma meetings
Daily multidisciplinary trauma meetings, prior to commencement of operating lists, offer excellent opportunities to communicate issues relating to recent admissions, to plan operative lists and equipment required for the day/next day, as well as providing regular teaching and feedback. Trauma meetings with the surgical staff may include involvement of surgeons and their junior trainees, theatre staff, anaesthetics, orthogeriatric medicine, orthopaedic nursing staff and physiotherapy. Members of the trauma team may change on a daily basis, so handover of information is a key element. Communication of clinical information should always involve accurate documentation in patients’ notes in addition to verbal handover.

A consultant-delivered service
Older patients with hip fracture experience some of the worst clinical outcomes among the hospital population. It is not acceptable for these patients to be anaesthetised solely by inappropriately experienced anaesthetists. Ideally, a consultant anaesthetist or SAS should anaesthetise hip fracture patients with similar clinical experience; furthermore, randomly allocated consultants should not anaesthetise such patients. Instead, a core group of consultant anaesthetists with relevant experience of anaesthetising unwell, older patients should provide the vast majority of the service; one consultant/SAS should assume overall clinical leadership for a hip fracture anaesthesia service.

Routine whole day list allocation of supernumerary trainee anaesthetists allows for greater continuity of care, pre-operative preparation, post-operative review and interdisciplinary communication, as well as providing training opportunities relating to orthogeriatric anaesthesia and regional/nerve blockade.

Similarly, patients should be operated on by an appropriately experienced surgeon, in order to minimise operation length and improve outcomes (for example, blood loss, dislocation rate and reoperation rate).

Operating department
Ideally, all trauma operations should be performed in a specific ‘trauma theatre’. This should be large enough to allow access for an image intensifier, traction table, and surgical equipment. Clean air systems, incorporating High Efficiency Particulate Air Filter (HEPA) and laminar airflow, reduce the risk of airborne infection transmission. Theatre temperature should be maintained between 20-23°C, and humidity between 50-60%, to reduce the risk of perioperative patient hypothermia.

The minimum theatre team should consist of an anaesthetic assistant, two scrub practitioners and a circulator. The theatre team leader must be experienced in both femoral reconstruction and replacement procedures, and scrub allocation should take account of both patient health and potential complications previously identified at a start of list team brief. Specialist education is crucial to building a functional team.
The allocation of a dedicated radiographer per trauma theatre reduces intra-operative delays.

Stock levels of surgical implants and consumables should anticipate expected patient numbers, and instrumentation needs should take into account reprocessing time.
3. Pre-operative management

**Mechanism**
Among the elderly, 90% of hip fractures occur after a fall. Most falls are multifactorial in nature and occur from a standing height or less in patients with osteoporotic bone [10].

Other important conditions that contribute to hip fracture include neuromuscular pathology, peripheral neuropathy, infection, dysrhythmia, postural hypotension, valvular heart disease and polypharmacy.

**Prehospital management**
Hip fractures are painful, particularly on movement. Ambulance transfer to hospital enables immobilisation, and the administration of opioid analgesia, intravenous fluid therapy and patient warming strategies.

**Emergency department treatment**
A number of hospitals have successfully introduced ‘fast-track’ triage systems that allow early clinical recognition of hip fracture (hip pain, inability to weight bear, shortened, externally rotated leg on affected side) with early radiography and diagnosis, enabling rapid ward admission, from where further medical input and investigations are carried out.

Close attention should be continued towards analgesia, intravenous fluid therapy, patient warming and pressure care during the stay in the emergency department, particularly if ward admission is delayed beyond four hours.

**Pain relief – initial**
Hip fracture is painful, and early fracture fixation provides the most effective analgesia.

In the interim, a formalised analgesia protocol should be followed. Simple analgesics, such as paracetamol, should routinely be prescribed on a regular basis, unless contraindicated [11].

Pain scores, visual analogue pain score (VAPS), at rest and on movement, should be recorded before and after the administration of analgesia. Other scoring systems may be used to assess pain relief in patients with cognitive dysfunction [12].

Approximately 40% of patients presenting with hip fracture have at least moderate renal dysfunction (eGFR <60 ml/min/1.73m²) on admission. Opioids should be used with caution and non-steroidal anti-inflammatory drugs are relatively contraindicated [13].
Single-shot/continuous nerve blocks (femoral/fascia iliaca [14]) may be successfully administered by appropriately trained emergency department, orthopaedic and anaesthetic medical staff [15].

**Pre-operative assessment**
A pre-operative visit by the anaesthetic team is mandatory. Often information can be exchanged at the trauma meeting but it is imperative that anaesthetists conduct a thorough history and examination.

**Role of the orthogeriatrician**
Traditionally, the pre-operative management of hip fracture patients has been performed by junior orthopaedic staff, with the role of geriatricians limited to post-operative rehabilitation planning and social placement on discharge from hospital.

More recently, it has become apparent that the increasing number of elderly, frail patients presenting with hip (and other fragility) fractures will benefit from earlier, more intensive orthogeriatric input, enabling:

- early identification of patients at increased risk of perioperative morbidity and mortality after hip fracture
- appropriate additional investigations, as indicated according to patient co-morbidities
- ‘preoptimisation’ of sicker patients prior to surgery
- early rehabilitation and discharge planning
• improved interdisciplinary communication between orthogeriatricians, surgeons and anaesthetists, reducing avoidable admission to operation delays

Patient characteristics

Co-morbidities
Approximately 70% of patients will be ASA 3 or ASA 4 [6,7].

Co-morbidity is common: 35% have one co-morbidity, 17% have two co-morbidities, and 7% have three or more co-morbidities [16]. The most common co-morbidities are: cardiovascular disease 35%, respiratory disease 14%, cerebrovascular disease 13%, diabetes 9%, malignancy 8%, and treated renal disease 3%.

Recently, a summative scoring system, the Nottingham Hip Fracture Score (see Appendix 1) [17], has been developed to accurately predict 30 day and one year post-operative mortality according to the number of co-morbidities and other factors (age, male sex, malignancy, pre-operative cognitive function, place of residence and anaemia). It provides the anaesthetist with information about outcome that may be discussed with the patient or their relatives.

The anaesthetist should also examine the patient pre-operatively with regard to: musculoskeletal abnormalities (osteoarthritis, kyphoscoliosis, fixed flexion deformities), skin condition and pressure areas, dentition, and hearing aids.

Polypharmacy
The over 60s consume 60% of the drugs prescribed in the UK; 20% of people aged over 70 take more than five medications [3]. Polypharmacy increases the likelihood of adverse drug reactions (ADRs), compounded by the limited physiological reserve of this population, 80% of which are potentially avoidable [18].

A current medication list should be reviewed carefully for inappropriate dosing and prescribing, and potential pharmacokinetic and pharmacodynamic interactions.

Routine pre-operative investigations
Full blood count, urea and electrolyte are routinely required prior to surgery. Coagulation studies are only indicated for clinical reasons.

Full blood count

Haemoglobin (Hb)
Pre-operative anaemia occurs in approximately 40% of patients, and can result from fracture-related haemorrhage, haemodilution, poor nutrition and/or chronic disease. Haemorrhage and haemodilution result in a fall in perioperative haemoglobin concentration equivalent to approximately 2.5 g/dl. Patients who are anaemic pre-operatively, are therefore likely to be very anaemic post-operatively, risking myocardial and cerebral ischaemia. It is has been suggested that older patients require a higher blood transfusion trigger than is generally used for patients undergoing elective surgery [19], to the extent that pre-operative transfusion should be considered if:
Hb is <9g/dl.
Hb is 9 – 9.9g/dl and there is a history of ischaemic heart disease.

If Hb is 10–12g/dl, two units of blood should be cross-matched. If Hb is within normal limits, a grouped sample is sufficient.

Revision surgery or peri-prosthetic fractures incur greater blood loss and require pre-operative cross matching according to local guidelines. Cell salvage should be considered for such procedures.

After transfusion, repeat Hb analysis (formal FBC or point-of-care) is mandatory.

**White cell count**
Leucocytosis and neutrophilia are common (45%, 60% respectively) at presentation, but may be a reactive response to trauma rather than indicative of infection. Marked leukocytosis > 17x10^9 cells/l may indicate infection (usually of the chest or urine).

**Platelet count**
A platelet count of 50–80 x 10^9/l is a relative contraindication to neuraxial anaesthesia [20]. A platelet count below 50 x 10^9/l will normally require pre-operative platelet transfusion.

**Urea and electrolytes**
Hypokalaemia is associated with new onset, rapid ventricular rate perioperative atrial fibrillation. Hyperkalaemia may indicate rhabdomyolysis if the patient was unable to call for help after falling.

Hyponatraemia on admission to hospital is common (17%), and may indicate infection, or result from medication (particularly diuretics).

**Electrocardiogram**
ALL elderly patients with hip fracture require pre-operative electrocardiography.

**Chest x-ray**
Routine chest x-rays on admission are not necessary, but may be useful in patients with newly diagnosed heart failure, or pneumonia.

**Special cases**
Given the underlying medical co-morbidities, medical causes of the fall are common and may be overlooked. A detailed history and examination are important.
Pre-operative assessment of the hip fracture patient by the anaesthetist is mandatory, allowing: planning of anaesthetic technique, assessment and communication of perioperative risk, and pre-optimisation of patient management.
In order to avoid patient cancellation on the day of surgery, a number of trusts have developed specific information leaflets for the benefit of orthogeriatricians and orthopaedic surgeons, identifying particular concerns of relevance to the anaesthetist. One particularly good example of this is ‘A-Z of anaesthesia for hip fracture patients’, compiled by Lucy White in Southampton.

**Alcohol dependence**
Alcohol dependence is common, under diagnosed and a risk factor for falls [21]. These patients are at risk of significant perioperative morbidity.
Atrial Fibrillation (AF)
All patients in AF should have a ventricular rate of less than 100. Factors that may lead to new or fast AF include hypokalaemia and hypomagnesaemia, hypovolaemia, sepsis, pain and hypoxaemia. If treatment of these is ineffective, acute ventricular rate control may be achieved using beta-blockers (metoprolol) or verapamil [22].

Anticoagulation
30% of patients presenting with hip fracture take aspirin regularly. There is a risk of significant bleeding if aspirin is taken in combination with other thromboprophylactic medication. Aspirin may be withheld during inpatient stay, unless indicated for unstable angina or recent/frequent transient ischaemic attacks.

4% of patients take clopidogrel (Plavix), which inhibits platelet function, and should alert the anaesthetist to the patient having myocardial ischaemia or cardiac stents. Clopidogrel is generally not stopped on admission, especially in patients with drug eluting coronary stents. Operation should not be delayed, nor platelets administered prophylactically, but marginally greater blood loss should be expected. Novel antiplatelet therapies include prasugrel, eptifibatide, abciximab, and tiroliban.

Low molecular weight heparin should be administered between 18:00 and 20:00, to minimise the bleeding risk of neuraxial anaesthesia during hip fracture repair on daytime trauma lists.

Warfarin is taken by approximately 5% of patients presenting with hip fracture. Trust guidelines concerning the perioperative management of patients taking warfarin should be followed; generally, the INR should be less than 2 for surgery and less than 1.5 for neuraxial anaesthesia. Small amounts of Vitamin K may be used to ‘reverse’ the effects of warfarin; supplemental perioperative anticoagulation with heparins are usually indicated. Prothrombin complex concentrates rapidly reverse the effects of warfarin but are expensive, and rarely indicated. Warfarin should be recommenced 24 hours after surgery, although some do restart on the same day as surgery.

The advice of haematologists should be sought if in doubt about the perioperative management of patients on chronic anticoagulant therapy.

Regular anticoagulant medication requires that the anaesthetist balance the attendant risks of neuraxial and lumbosacral plexus blockade (ie haemorrhage and neuropraxia) against the benefits of these procedures for the elderly.

Chest infection
Pre-operative chest infection requires prompt antibiotic administration, along with supplemental oxygen, intravenous fluid therapy and physiotherapy. Expedited surgery under regional anaesthesia is preferred, enabling early mobilisation, analgesia and improved cooperation with post-operative physiotherapy.

Diabetes
Approximately 9% of patients with hip fracture are diabetic. Trust guidelines concerning the perioperative management of diabetic patients should be followed. Hyperglycaemia is not a reason to delay surgery unless the patient is ketotic and/or dehydrated.

Dialysis
Dialysed patients may develop renal bone disease and anaemia. Although surgery is normally tailored around the patient’s dialysis, urgent surgery may necessitate heparin-free dialysis.
**Echocardiography**

Echocardiography may be indicated pre-operatively:

1. To investigate the severity of an ejection systolic murmur heard in the aortic area, particularly if significant aortic stenosis is suggested by two or more of: a history of angina on exertion, unexplained syncope or near syncope, a slow rising pulse, an absent 2nd heart sound, or left ventricular hypertrophy on the ECG without hypertension; Unrecognised aortic stenosis is an important cause of anaesthetic mortality. The major cause is calcific degeneration. One reason for failing to make a diagnosis is that the clinical signs can be difficult to interpret [23].

2. To establish left ventricular function if the patient is breathless at rest or on low-level exertion.

Some units already have a mobile echocardiography service. There is considerable debate concerning the postponement of surgery pending echocardiography. However, a majority of clinicians favour proceeding to surgery with modification of their technique towards general anaesthesia and invasive blood pressure monitoring. The patients should receive the investigation without delaying surgery.

**Implantable cardioverter defibrillators (ICD) and pacemakers**

Increasingly, ICDs are implanted to try and prevent sudden cardiac death from dangerous cardiac arrhythmias; they may also have a pacemaker function. As with pacemakers, there is a risk both of unipolar diathermy delivering an arrhythmogenic shock to the myocardium, and of perioperative device failure. Cardiology consultation is required prior to surgery to establish the type of device and a plan for theatre made pre-operative checks may be required, and patients should be referred urgently to cardiology.

**Pre-operative optimisation**

**Resuscitation**

All acute hospitals should develop a specific protocol for the resuscitation of patients with hip fracture, with particular regard to:

- Monitoring – SpO2, respiratory rate, ECG, NIBP, core temperature and pain score (static/dynamic)
- Cannulation and intravenous fluid therapy
- Analgesia
- Thermoregulation
- Pressure care

These protocols may be commenced during ambulance transfer, but are mandatory once the patient has been admitted to the hospital.

**Optimisation**

Subsequently, important co-morbidities should be recognised and treated without unnecessarily delaying surgery, in order to minimise that patient’s specific risks of surgery and anaesthesia. This is a multidisciplinary task, involving input from and communication between, orthogeriatricians, anaesthetists, surgeons, nursing staff and physiotherapists.

**The timing of surgery for hip fractures**
Ideally, surgery should be performed within 48 hours of hospital admission after hip fracture [2,9], with a new target of 36 hours having recently been introduced in England and Wales from April 2010. Currently, 80% of hospitals achieve a mean admission to operation time of less than 48 hours.

Meta-analyses [24,25] have found that delaying surgery beyond 48 hours from admission is associated with prolonged inpatient stay, increased morbidity (pressure sores, pneumonia, thromboembolic complications) and increased mortality (if delay is prolonged).

There is no evidence to suggest that outcome is improved by delaying surgery to allow pre-operative physiological stabilisation. However, the benefits of expedited surgery must be balanced against the risks of certain untreated conditions, and reasons to optimise within 48 hours of admission may include:

- Severe anaemia Hb <8g/dl
- Severe electrolyte imbalance, with plasma [sodium] < 120 or >150mmol/l and [potassium] < 2.8 or > 6.0 mmol/l.
- Uncontrolled diabetes
- Uncontrolled or acute onset left ventricular failure
- Correctable cardiac arrhythmia, with a ventricular rate greater than 120 beats per minute
- Chest infection with sepsis
- Reversible coagulopathy

The working party considers that unacceptable reasons for delaying surgery include:

- Lack of facilities or theatre space
- Awaiting echocardiography
- Unavailable surgical expertise
- Minor electrolyte abnormalities
4. Ethical considerations

A number of ethical considerations arise in the treatment of elderly patients with hip fracture.

Consent and mental capacity
Approximately 25% of hip fracture patients have moderate or severe cognitive impairment, and a further 15-25% have mild cognitive impairment. In order for the patient to consent to, or refuse, surgical repair of hip fracture, they must be able to do so voluntarily, based on a decision made on information about the procedure presented to them. The patient must have capacity to make a decision: that is they must be able to understand the information, remember it and use it to reach a decision. In this age group, the ability to assimilate information and communicate decisions may be impaired by poor vision, hearing or speech, and steps should be taken to overcome these problems.

If the patient lacks capacity, then treatment may be provided according to the Mental Capacity Act 2005 (MCA)[26], which applies to England and Wales. Essentially, it remains the doctors’ decision to administer treatment that is deemed to be both necessary and in the patient’s best interests; doctors should be prepared to justify their decisions to treat/deny/withdraw treatment to the courts if necessary. Decisions must not be biased by reference to the patient’s age. Doctors must consult relatives about treatment decisions but are not bound by relatives’ wishes. They should seek to ascertain whether the patient had previously written an advanced directive, or appointed a lasting power of attorney. The Courts may be consulted if there is uncertainty about a patient’s management or if there is dispute between clinical staff and relatives.

Rationing of health care
Implicit in the anti-discriminatory tenor of both the MCA and the Human Rights Act 1998 is the requirement to provide equal access to, and administration of, medical treatment (for example, high dependency unit facilities) to all patients, regardless of age and infirmity. This is at odds with common law, which appears to support the rationing of services within the NHS, and the issue remains unresolved in law. Doctors are not obliged to deliver treatment that they consider to be futile or not in the patient’s best interests.

Do not attempt resuscitation (DNAR) orders
A joint statement from the British Medical Association, the Resuscitation Council (UK) and the Royal College of Nursing provides the framework under which DNAR decisions are made and ratified [27].

DNAR orders are increasingly prevalent among the patient population with hip fracture, and may proscribe cardiopulmonary resuscitation in the event of arrest. Although DNAR orders are presumed not to apply during surgery and anaesthesia, resuscitation may not be in the patient’s best interests, or even desired by the patient. The AAGBI have recognised these potential difficulties, and issued guidance about DNAR orders in the perioperative period [28].

DNAR discussions should precede surgery, and anaesthetists must take steps to make themselves aware of the outcome of these discussions. If this decision is taken it must be clearly documented in the patient notes and on the anaesthetic record.
5. Intra-operative management

All appropriate pre-operative checks should be carried out prior to commencing surgery. This includes the WHO checklist.

Surgical considerations
A number of hip fracture classification systems exist. Generally, 50% of fractures are intracapsular, the remainder extracapsular.

Common sites of proximal femoral fractures. Arrows show the insertion of the joint capsule.

Intracapsular fractures
Intracapsular fractures include subcapital, transcervical and basicervical fractures, and may be displaced or undisplaced. Blood loss from an intracapsular fracture at the time of injury is minimal because of the poor vascular supply at the fracture site.

Occasionally conservative treatment may be used for undisplaced fractures, but there is a 30-50% risk of subsequent displacement. Current preference is for all undisplaced intracapsular fracture to be treated by internal fixation with multiple screws or a sliding hip screw.

Untreated, disruption to the capsular blood supply of the head of the femur by a displaced intracapsular fracture can lead to avascular necrosis of the bone, resulting in a painful hip of limited function. Therefore, surgical treatment involves hemiarthroplasty; even then, intracapsular fracture is associated with longer-term arthritis, and increasingly total hip arthroplasty is preferred for younger patients after fracture.

Compared to uncemented arthroplasty, cemented arthroplasty improves hip function and is associated with lower residual pain post-operatively.

Extracapsular fractures
These include intertrochanteric and subtrochanteric fractures, and can be further divided into groups related to the degree of comminution.

Blood loss from cancellous bone is greater, so that the total blood loss from an extracapsular fracture may exceed one litre; the greater the degree of comminution and larger size of the bone fragments, the greater the blood loss. In addition, greater periosteal disruption causes extracapsular fractures to be considerably more painful than an intracapsular fracture.

Extracapsular fractures can be treated conservatively, healing after six to eight weeks of traction and bed rest, but such management is associated with increased morbidity and mortality, and a considerably reduced chance of the patient returning home.

Invariably, extracapsular fractures are fixed surgically, using either a sliding hip screw (intertrochanteric fractures) or less commonly, a proximal femoral intramedullary nail (subtrochanteric fractures).
Anaesthetic considerations
Surgical anaesthesia of the hip joint requires blockade of the femoral, obturator and sciatic nerves as well as the lateral cutaneous nerve of the thigh, and can only be reliably achieved in the conscious patient with neuraxial blockade. General anaesthesia requires additional administration of post-operative analgesia, most commonly in the form of peripheral nerve blockade. Poor analgesia in the immediate post-operative period increases morbidity.

There is a minimal evidence base for determining the optimal anaesthetic technique for patients undergoing hip fracture surgery. Consequently, anaesthetists tend to adhere to a technique with which they are familiar, roughly half administering neuraxial anaesthesia and half, general anaesthesia. Furthermore, the wide range of drugs and dosages used obscures determination of the best technique using audit data.

Based on a 2004 Cochrane systematic review of anaesthesia for hip fracture surgery [29], which suggested that regional anaesthesia may reduce the incidence of post-operative confusion, the Scottish Intercollegiate Guidelines Network has produced the only recommendation concerning choice of anaesthetic technique, namely that ‘spinal/epidural anaesthesia should be considered for all patients undergoing hip fracture repair, unless contraindicated.’ [4]. Until such time as evidence is published that confirms regional anaesthesia superior to general anaesthesia or vice versa, the working party endorses this recommendation. This endorsement is supported by a recent meta-analysis suggesting regional anaesthesia ‘is the technique of choice (although) the limited evidence available does not permit a definitive conclusion to be drawn with regard to mortality or other outcomes’ [30].

Of greater importance, whichever technique is used, is that anaesthesia is sympathetic to the limited physiological reserve and co-morbidities of older patients [31].

The working party does not support the administration of opioid analgesics as the sole adjunct to anaesthesia for this patient group, due to the relatively greater risk of respiratory depression and post-operative confusion. Peripheral nerve blockade should always be considered; therefore, as an adjunct to spinal or general anaesthesia, to extend the period of post-operative non-opioid analgesia such as peripheral nerve blocks are pivotal in this group.
Neuraxial anaesthesia
The working party recommends that either spinal anaesthesia or general anaesthesia be administered, but not simultaneously, as this is associated with precipitous falls in intra-operative blood pressure.

Post-operative epidural anaesthesia (including combined spinal/epidural anaesthesia) provides good post-operative analgesia, but may limit early mobilisation after surgery, and for this reason is less commonly used in the UK.

Spinal (subarachnoid) anaesthesia is commonly used, with or without sedation. Spinal anaesthesia for hip fracture fixation in elderly patients is distinct from spinal anaesthesia for Caesarean section in younger patients. Lower doses of intrathecal bupivacaine (less than 10mg) appear to reduce associated hypotension [32, 33]. Lateralisation of subarachnoid anaesthesia using hyperbaric bupivacaine with the patient positioned affected hip down most may also ameliorate hypotension. Co-administration of intrathecal opioids prolongs post-operative analgesia; fentanyl is preferred to morphine/diamorphine, which is associated with greater respiratory and cognitive depression [34].

Sedation may be provided, but should be used with extreme caution in the older person. Midazolam and propofol are commonly used. Ketamine may be used, theoretically to counteract hypotension, but may be associated with post-operative confusion.

Oxygen saturation should always be monitored during spinal anaesthesia and supplementary oxygen given if the saturation falls below 95%.

General anaesthesia
Reduced doses of intravenous induction agents should be administered. Inhalational induction is well tolerated by the elderly, and allows for maintenance of spontaneous ventilation. Paralysis and intubation are associated with greater physiological derangement than spontaneous ventilation, and should be avoided unless specifically indicated. Intra-operative hypoxaemia is common, and higher inspired oxygen concentrations may be required.

Peripheral nerve blockade
Blockade of the femoral nerve, obturator nerve and lateral cutaneous nerve of the thigh is sufficient for peri-operative analgesia.

The only reliable method of blocking all three is the psoas compartment block, although this risks a degree of neuraxial blockade, and deep haematoma formation in recently anticoagulated patients.

Anterior approaches (femoral nerve block/fascia iliaca block) do not reliably block all three nerves, but reduce post-operative analgesia requirements, and are more amenable to ultrasound-guided placement and continuous catheter infusions post-operatively [15].

Wound infiltration with local anaesthetic is insufficiently analgesic. High volume, low concentration pericapsular/periosteal injection of local anaesthetic agents has not been assessed.

Peripheral nerve blockade can supplement both general and spinal anaesthesia.

Monitoring
Minimum standards for monitoring include the continual presence of the anaesthetist, oxygen saturation, capnography, electrocardiography and non-invasive blood pressure monitoring [35].

Core temperature measurements should be made to guide perioperative warming strategies.

Point of care [haemoglobin] analysers (e.g. Hemocue or similar) should be used routinely at the end of surgery to assess the degree of anaemia and guide blood transfusion.

Given the high incidence of significant co-morbidities in this population, there should be a low threshold for considering further monitoring equipment, which may include:

- Invasive blood pressure monitoring [36], particularly for patients with limited left ventricular function, or valvular heart disease.
- Central venous pressure monitoring, for patients with limited left ventricular function or undergoing revision/periprosthetic fracture surgery.
- Cardiac output monitoring. Transoesophageal Doppler guided fluid therapy may reduce hospital stay in patients undergoing general anaesthesia for hip fracture surgery. Transthoracic Doppler probes are becoming available for use in sedated or awake patients.
- Bioreactance technology (Cheetah NICOM), are non-invasive and are easy to use in awake patients.
- Dilution techniques (eg LiDCO) are increasingly accurate, and may be used in conjunction with invasive blood pressure monitoring.
- Bispectral index (BIS) monitors may be used to optimise the depth of anaesthesia and avoid potential cardiovascular depression. Initial BIS levels may be abnormally low in alcoholic and demented patients.
- Cerebral oxygen saturation [37]. The homeostatic regulation of cerebral blood flow is poor in older patients, and depressed further by anaesthesia. Detection of reduced cerebral oxygen saturation may be associated with reduced post-operative cognitive dysfunction.

**Supplemental pain relief**
Regular paracetamol administration should continue throughout the perioperative period. Non-steroidal anti-inflammatory drugs should be used with extreme caution in hip fracture patients, and are contraindicated in those with renal dysfunction. Similarly, opioids (and tramadol) should be used with caution in patients with renal dysfunction: oral opioids should be avoided, and intravenous doses should be halved and administered with a halved frequency. Codeine should not be administered, as it is constipating, emetic and associated with perioperative cognitive dysfunction.

**DVT prophylaxis**
DVT occurs in approximately 37% of patients with hip fracture, and pulmonary embolism in 6% [38].

These figures are for the research studies that have done venograms or VQ scans on all and is therefore the incidence of asymptomatic events. The actual clinical rate of deep vein thrombosis is 1-3% and that for pulmonary embolism of 0.5-3%.

LMWH are commonly prescribed and may impact on anaesthetic technique. Graduated compression elastic stockings or intermittent pneumatic compression devices should be
employed intra-operatively, in addition to ensuring the patient remains warm and well hydrated. Regional anaesthesia may reduce the perioperative risk of DVT.

The main measures to reduce the incidence of thromboembolic complications are:

- Early surgery
- Early mobilisation
- Regional anaesthesia
- Avoidance of over transfusion
- LMWH (low molecular weight heparin)

**Antibiotics**
Antibiotics should be administered before skin incision. Hospital antibiotic protocols should be followed.

**Pressure care**
Older patients are particularly susceptible to pressure damage. Patients should be positioned sympathetically during surgery, to avoid the development of pressure sores and/or neuropraxia.

The skin of older patients is thin and liable to be damaged by minimal trauma. Care should be taken when removing dressings or diathermy plates, and when moving the patient.

**Thermoregulation**
Older patients are susceptible to intra-operative hypothermia, particularly during longer procedures [39]. Active warming strategies should always be employed and continued post-operatively.

**Intravenous fluids**
Optimised perioperative fluid management reduces morbidity and hospital stay [40]. Many patients are hypovolaemic at the time of surgery. Every effort must be made to ensure that fluid is prescribed pre-operatively and that it is administered in the correct time frame. Try and avoid cannulation of the ante cubital fossa, this will slow down fluids when the arm is flexed. Colloids, targeted to cardiac output have been shown to reduce hospital stay and improve outcome [41]. A large French randomised controlled study, using Doppler guided fluid administration, reports next year and may give some more information.

**Bone cement implantation syndrome (BCIS)**
Hypoxia, hypotension or both characterise BCIS and/or unexpected loss of consciousness occurring around the time of cementation, prosthesis insertion, reduction of the joint or, occasionally, limb tourniquet deflation in a patient undergoing cemented bone surgery [42]. The incidence in hip fracture surgery is uncertain. Several mechanisms may contribute to a multimodal aetiology, including fat/platelet/fibrin/marrow emboli formation and stimulated release of vasoactive mediators. The risk of BCIS may be reduced by:

- Good surgical technique, including medullary lavage, good haemostasis before cement insertion, the use of a cement gun to enable retrograde cement insertion, venting of the femur, minimising the length of the prosthesis and reducing the force applied to the prosthesis during insertion.

- Good anaesthetic technique, including increasing the inspired oxygen concentration at the time of cementation, avoiding intravascular volume depletion, and using additional
haemodynamic monitoring in high-risk patients such as elderly unwell patients with compromised cardiorespiratory function.

The treatment of BCIS includes delivery of 100% inspired oxygen concentration, fluid resuscitation (guided by CVP measurement) and inotropic support.
6. Post-operative management

Hip fracture patients remain at relatively high risk of complications in the early post-operative phase, and may require a prolonged period of monitoring in the post anaesthesia care unit (PACU) or, less commonly, on HDU/ITU. There is recognition that some patients may not be nursed in the most appropriate place following hip fracture surgery. Standard ward care is often not enough and the working party recommends that these patients should go to a dedicated area where the ratio of nurses to patients is 1:4. These areas should have regular input from Medicine for Older Persons, as suggested in a recent NCEPOD report [3].

Analgesia
Peripheral nerve blockade is rarely effective beyond the first post-operative night. Analgesia requirements vary considerably after fracture fixation. Regular paracetamol administration should continue [11], augmented by carefully prescribed opioid analgesia, as indicated. Pain evaluation should be included as part of routine post-operative nursing observations. There will be requirements for analgesia to aid mobilisation. ‘Dynamic’ analgesia is more challenging than ‘static’ analgesia.

Oxygen
Older patients are at risk of post-operative hypoxia, and should be administered supplemental oxygen post-operatively for at least 24 hours. Oxygenation and respiratory function improve with mobilisation.

Fluid balance
Hypovolaemia is common. Early oral fluid intake should be encouraged, rather than routine prescription of intravenous fluids after surgery. Urinary catheters should be removed as soon as possible, to reduce the attendant risk of urinary tract infection.

Post-operative cognitive dysfunction (POCD)/acute confusional state
This is a common (25%) problem in patients with hip fracture, interrupting routine management and rehabilitation. Treatment involves multimodal optimisation of post-operative care, requiring adequate analgesia, nutrition, hydration, electrolyte balance and appropriate medication, bowel habit and mobilisation, in conjunction with identifying and treating complications, such as chest infection, silent myocardial ischaemia and urinary tract infection [43]. Drugs such as haloperidol or lorazepam should only be used to control symptoms in the short term. Cyclizine should be avoided in older persons because of the anticholinergic side effects.

Nutrition
Up to 60% of hip fracture patients are clinically malnourished on admission to hospital. The calorie and protein density of hospital food is often poor, and mortality (and possibly length of stay) may be reduced through the administration of nutritional supplementation and employment of dietetic assistants [44, 45].

Rehabilitation
The rehabilitation process constitutes the majority of a patient’s inpatient stay after hip fracture, and continues for some time after discharge.

Rehabilitation is ideally co-ordinated the multidisciplinary team, and is aimed at providing a patient-centred package of care that attempts to return the patient to levels of activity and residence similar to their pre-fracture status. To this end, the patients usually require input from
physiotherapists, occupational therapists, social workers, nursing staff and their own relatives. Secondary prevention of falls and osteoporosis should be actively considered in the early post-operative period, as subsequent fragility fracture or periprosthetic fracture is associated with particularly poor prognosis.

Anaesthetists may become involved in secondary surgical management (for example, wound debridement, prosthesis revision) or in the provision of longer-term analgesia or high-dependency facilities.

Printed information describing the typical care pathways for hip fracture patients should be available for patients, carers and relatives.

Outcomes
Outcomes vary considerably in the UK (excepting Scotland).

Mortality
Mortality after hip fracture has remained relatively unchanged for the last two decades. Currently, 7.7% of patients die within 30 days of surgery [6]. The NHFD figure is a bit lower than anticipated as it does not enjoy universal coverage as yet [6]. The Scottish Hip Fracture Audit (SHFA) had almost 100% coverage and gives a 30-day mortality of 9%. In summary the mortality at one month is between 8 and 9%.

However, it has been suggested that up to half of post-operative deaths are potentially preventable [46]. 30 day mortality is increased for older, sicker, male patients. 15-30% of patients die within one year of surgery.

Mean length of hospital stay
This is between eight and 30 days, with a mean of 20 days [6].

The only figure of relevance is total hospital stay. Acute ward stay is meaningless as just reflects how many patients are referred elsewhere.

SHFA figures are more accurate with median stay of 22 days and mean of 36 days. Both mean and medians are of relevance as they reflect how the good half of patients get home (median) and how you cope with the long stayers (mean).

Only 44% of patients admitted from home are discharged back to their own homes within 30 days of surgery. A further 22% are discharged to a residential or nursing home, and discharge may become prolonged in waiting for admission to these facilities.
7. Audit and research

Cochrane reviews have consistently recognised the relative dearth of evidence on which to base best practice guidance with regards to the clinical management of patients presenting with hip fracture. Consequently, practice varies widely across the country, as several audits have shown [6, 7], resulting in wide variations in patient outcome.

Clinical audit is fundamental to the process of improving the quality of patient care. Local audit enables physicians both to identify specific areas of care that could be improved, and to assess performance longitudinally. National audit enables trusts to compare performance against other trusts, and identify specific paragons of practice which may they may adopt.

A number of audit tools are available for anaesthetists:

**The Hip Fracture Perioperative Network**
The network was set up as an NHS Network under the auspices of the Age Anaesthesia Association, with the aim of improving evidence-based (anaesthetic) care for patients with hip fracture in the UK. It was originally called the Hip Fracture Anaesthesia Network (HIPFAN). Following a network meeting in 2011 the name was changed to the Hip Fracture Perioperative Network, reflecting the multidisciplinary nature of hip fracture care.

The network website [47] includes freely available database and annual report templates that anaesthetists may use to audit hip fracture care in their own hospitals, as well as ideas for research, specimen patient information leaflets, pre-operative care information for junior surgeons, and hip fracture care pathway proformas.

**The National Hip Fracture Database (NHFD)**
The National Hip Fracture Database (NHFD) [48] is a collaboration between the British Orthopaedic Association (BOA) and the British Geriatrics Society (BGS), the main aim of which is ‘to focus attention on hip fracture both locally and nationally, benchmark its care across the country, and use continuous comparative data to create a drive for sustained improvements in clinical standards and cost effectiveness.’ All eligible hospitals in the UK (except Scotland) are registered, with regular contributions of data from over 75% of eligible hospitals, concerning in excess of 100,000 patients (2010). The NHFD has recently begun to collect data about anaesthetic method used for hip fracture surgery.
8. Patient information

The provision of good quality information for patients is a key component of the ‘consent process’, and is fundamental to good practice as detailed by the General Medical Council (GMC) [49] and AAGBI [50].

We recommend that each department produce a written information leaflet or booklet. It is essential that patients are involved in the process. Typically, such information would include basic surgical information about the injury with more detailed information the anaesthetic considerations. Anaesthetic options, including intended benefits and risks should be explained clearly. An alternative to an anaesthetic information leaflet might be a more comprehensive document developed with multi-disciplinary input from nurses, surgeons, physiotherapist, occupational therapists etc. We recommend that, where possible, information should be evidence-based.

A specimen patient information sheet is freely available from the HIPFAN website (see chapter 7), and may be edited to apply to the hip fracture care pathway of specific trusts. Appendix 2 lists areas where information for patients can be found. The working party considers it to be essential to include patients and relatives in the editing process.
9. Training

The elderly patient with proximal femoral fracture offers multiple opportunities to learn and demonstrate specific core outcomes, knowledge and skills within ‘units of training’ set out in the Royal College of Anaesthetists’ 2010 curriculum [51].

The working party recommend that basic level trainees (CT1-2) participate in the multidisciplinary perioperative care of patients with hip fracture (for example, through participation in orthogeriatric and acute pain ward rounds, and pre-operative assessment), as well as receiving training in the theory of intra-operative care of the elderly and practical experience of relevant nerve block and regional anaesthetic techniques.

Intermediate level trainees (ST3-4) should be encouraged to become more independent in patient assessment, and should aim to manage the moderate to high-risk patient with indirect local support only.

Higher level trainees (ST5-7) should be encouraged to undertake independent trauma list planning, prioritisation and management with senior advice. This will, undoubtedly, reveal numerous potential management, teamwork and leadership opportunities; all essential domains of Common Competencies of Medical Practice. The trainee may also develop roles in teaching medical students and more junior trainees.

Advanced training/fellowship posts (ST6-7) undertaken in hospitals, for example, specialising in regional anaesthesia or anaesthesia for the elderly, may provide the potential for a trainee to develop a specific interest in the perioperative care of older trauma patients. Higher level trainees should be encouraged to participate in audit and research involving patients with hip fracture.

Competency goals appropriate to each level of training are listed in Appendix 3.
10. Ten maxims of hip fracture care

Ten ‘top tips for hips’

1. Protocol driven, fast-track admission through casualty
2. Multidisciplinary care, led by orthogeriatricians
3. Surgery is the best analgesic
4. Surgical repair within 48 hours of hospital admission
5. Damage-limiting surgery and anaesthesia by appropriately experienced surgeons and anaesthetists
6. High quality communication between clinicians and allied health professionals
7. Early mobilisation
8. Pre-operative discharge planning
9. Falls prevention
10. Continuous audit and targeted research
11. References


47. www.networks.nhs.uk/hipfractureanaesthesia

48. www.nhfd.co.uk


Appendix 1

Nottingham Hip Fracture Score
A score out of ten is derived by adding weighted scores for eight criteria. The total score may then be used to predict the risk of a patient dying within 30 days of hip fracture surgery, a figure which may be used to stratify the patient specific risk of surgery during the process of consent, and in order to identify patients who may benefit from more intensive levels of perioperative care. The score may also be used to predict one year post-operative mortality [52].

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<tr>
<td>Age 86 years or older</td>
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<tr>
<td>Male</td>
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</tr>
<tr>
<td>[Haemoglobin] less than or equal to 10g/dl on admission to hospital</td>
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</tr>
<tr>
<td>Abbreviated mental test score less than or equal to 6/10 on admission to hospital</td>
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<tr>
<td>Living in an institution</td>
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<tr>
<td>More than one co-morbidity</td>
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<tr>
<td>Active malignancy within last 20 years</td>
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<table>
<thead>
<tr>
<th>Score</th>
<th>Predicted 30 day post-operative mortality (%)</th>
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Appendix 2

Resources for patients and relatives

There is excellent guidance, with examples, available on how to develop and produce information leaflets from the following:

- RCoA website: navigate to the ‘For Patients’ section
  www.rcoa.ac.uk

The British Orthopaedic Association (BOA) Patient Information page:

  www.boa.ac.uk/en/patient-information/olderhip

- NHS Brand Guidelines: a general resource for producing written information for patients
  http://www.nhsidentity.nhs.uk/tools-and-resources/patient-information

- An example of a multidisciplinary booklet, entitled *information for Patients with a Fractured Neck of Femur (Broken Hip)*, can be found here:
Appendix 3

Suggested training targets in relation to hip fracture

By completion of CT2

Knowledge:
- understands issues relating to co-morbidity, frailty, physical and cognitive decline, and polypharmacy in older patients
- understands orthopaedic specific complications such as bone cement implantation syndrome and fat embolism
- understands issues relating to intra-operative patient positioning
- understands the benefits and disadvantages of general and neuraxial anaesthesia in individual patients with hip fracture
- understands the timing of surgery, and appropriate pre-operative investigations
- understands the surgical options for hip fracture repair
- blood conservation strategies and perioperative management of anaemia
- anatomical and pharmacological principles, and risks and benefits, of intrathecal anaesthesia (pertinent specifically to the elderly), and lower limb peripheral nerve blocks (lumbosacral plexus, fascia iliaca and femoral nerve blocks)
- understands (patho)pharmacology of sedation and use of opioid analgesia in older patients

Skills:
- demonstrates provision of perioperative care for the patient requiring internal fixation of the fractured proximal femur
- demonstrates sensitive handling of the patient with cognitive disturbance
- performs safe and effective spinal anaesthesia within a safe perioperative context and can recognise complications
- safely performs femoral nerve blocks while demonstrating appropriate consent process, checks and procedure
- recognises and manages local anaesthetic toxicity
- administers and monitors safe intravenous sedation for older patients, and recognises and manages the complications of sedation

By completion of ST4

Knowledge:
- describes issues relating to co-morbidity, frailty, physical and cognitive decline, and polypharmacy in older patients
- understands choice of local anaesthetic agents and additives, and the use of continuous peripheral nerve catheter techniques
- demonstrates in-depth understanding of the use of ultrasound in peripheral nerve blockade including sonoanatomy, techniques and effects/side-effects of local anaesthesia
- understands techniques and monitoring of sedation, and complexities of using multiple agents
- understands pharmacology and administration of continuous intravenous sedation/target-controlled infusion of sedative agents
understands physiology/pharmacology of hypotension and cardiac output monitoring in older patients

Skills:
- demonstrates ability to manage a trauma list with indirect senior supervision
- performs intrathecal/epidural/combined regional anaesthesia, and lumbosacral, fascia iliaca and femoral nerve blocks, using ultrasound appropriately
- manages complications of peripheral nerve blockade and provides appropriate follow up for any complication
- administers appropriate sedation safely

By completion of ST7

Knowledge:
- understands principles of continuous intrathecal/peripheral nerve blockade, an appropriate use of ultrasound for their insertion
- understands complexities of integrated perioperative management of older patients within context of general orthopaedic trauma

Skills:
- appropriate perioperative planning and management of trauma list while efficiently and safely implementing any peripheral nerve blockade appropriate under indirect supervision
- use of ultrasound to demonstrate contemporaneous circumferential spread of local anaesthetic around specified nerves
- teaching and supervision of junior trainees in regional anaesthesia
- teaching and supervision of junior trainees in a range of sedation techniques
- leads and conducts compassionate discussion with patients and family in relation to high risk anaesthesia, and critical care
- contributes to clinical discussion and decision-making involving the risks and benefits of surgery for complex, unwell patients
- contributes to audit of current practice and/or research