AAGBI SAFETY GUIDELINE

Management of Proximal Femoral Fractures 2011

Published by
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June 2012

This guideline was originally published in *Anaesthesia*. If you wish to refer to this guideline, please use the following reference:

Association of Anaesthetists of Great Britain and Ireland. Management of proximal femoral fractures 2011. *Anaesthesia* 2012; **67:** pages 85-98. This guideline can be viewed online via the following URL: http://onlinelibrary.wiley.com/doi/10.1111/j.1365-2044.2011.06957.x/abstract

The following bodies have endorsed this guideline:

Age Anaesthesia Association

The Association for Perioperative Practice

British Orthopaedic Association

The College of Emergency Medicine

Guidelines

Management of proximal femoral fractures 2011

Association of Anaesthetists of Great Britain and Ireland

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Summary

1. There should be protocol-driven, fast-track admission of patients with hip fractures through the emergency department.
2. Patients with hip fractures require multidisciplinary care, led by orthogeriatricians.
3. Surgery is the best analgesic for hip fractures.
4. Surgical repair of hip fractures should occur within 48 hours of hospital admission.
5. Surgery and anaesthesia must be undertaken by appropriately experienced surgeons and anaesthetists.
6. There must be high-quality communication between clinicians and allied health professionals.

7. Early mobilisation is a key part of the management of patients with hip fractures.
8. Pre-operative management should include consideration of planning for discharge from hospital.
9. Measures should be taken to prevent secondary falls.
10. Continuous audit and targeted research is required in order to inform and improve the management of patients with hip fracture.

This is a consensus document produced by expert members of a Working Party established by the Association of Anaesthetists of Great Britain and Ireland (AAGBI). It has been seen and approved by the AAGBI Council.
** This article is accompanied by an Editorial. See page 2 of this issue.*
Accepted: 11 September 2011

- *What other guideline statements are available on this topic?*
  A number of guidelines concerning best practice management of hip fracture have recently been published [1–6].
- *Why was this guideline developed?*
  However, existing guidelines are inconclusive about either the involvement of anaesthetists or the provision of anaesthesia for patients sustaining hip fracture.
- *How and why does this statement differ from existing guidelines?*
  This guidance is intended specifically to help anaesthetists manage patients with hip fracture.

In common with other guidelines, this guideline reviews current evidence regarding best practice anaeathesia. Crucially, however, this guideline also recommends best practice in the numerous circumstances where evidence is controversial or incomplete, based on expert consensus opinion.

Proximal femoral fractures present unique challenges for anaesthetic departments throughout Great Britain and Ireland, involving the peri-operative 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 peri-operative care, rehabilitation and orthogeriatric input.

Approximately 77 000 hip fractures occur in the UK annually, accounting for 1.5 million bed days, at an inpatient cost of £0.785 billion.

Approximately 65 000 of these occur in England, with a median postoperative length of stay of 23 days and a 30-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. Among the elderly, 90% of hip fractures occur after a simple, mechanical fall from standing height in patients with osteoporotic bone (Fig. 1) [8]. Other important causes of hip fracture include neuromuscular pathology, peripheral neuropathy, infection, arrhythmia, postural hypotension, valvular heart disease and polypharmacy. 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 < 7), 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.

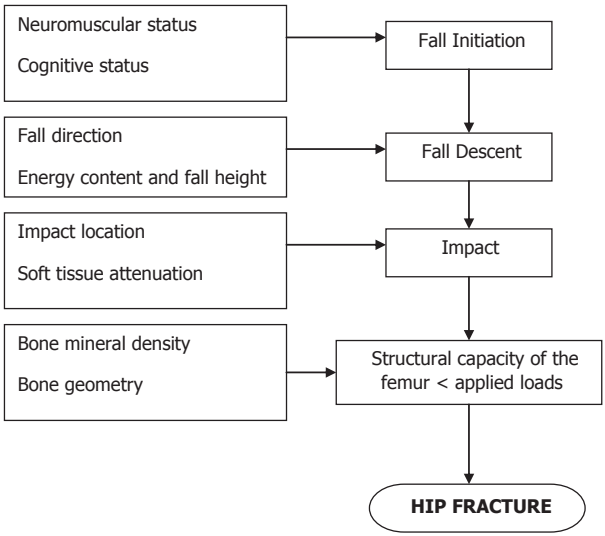

Figure 1 Mechanical factors leading to a hip fracture.

These guidelines will mainly focus on the acute hospital episode, particularly the pre-operative period, intra-operative management and immediate postoperative 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 multidisciplinary collaboration that has resulted in advice for anaesthetists and other health-care professionals on how to create, develop and manage a service for patients with proximal femoral fracture.

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 [9]: (i) all patients should be admitted within 4 h of arrival in the emergency department; and (ii) patients should be operated on by an experienced clinical team within 24 h of a decision that the patient is fit for surgery. In addition, the British Orthopaedic Association Standards for Trauma (BOAST) guidelines [10] stipulate that within 4 h of hospital arrival, hip fracture patients should be admitted to an appropriate clinical ward area with nursing, orthogeriatric medicine and surgical expertise appropriate for this often frail patient group; further, that surgical fixation should not be delayed more than 48 h from admission unless there are clear reversible medical conditions (see below).

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

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 hospital. The group may include trauma co-ordinators, general practitioners, community/falls assessment

nurses, emergency staff, bed managers, orthopaedic nursing staff and surgeons, anaesthetists, orthogeriatricians, physio- 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 this group and the hospital's theatre management group improves integration of system changes into general theatre service provision.

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 proforma 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 that regularly update patient and logistical data may improve management by identifying patients' location, delays in treatment and relevant clinical information, and may be used to facilitate clinical audit and business planning.

Trauma lists

Protected 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. 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 senior surgeon assigned to the list.

Multidisciplinary trauma meetings

Daily multidisciplinary trauma meetings, convened before the start of operating lists, offer excellent opportunities to communicate issues relating to recent admissions and to plan operative lists and equipment required for the day/next day, as well as providing regular teaching and feedback. Trauma meetings may involve the same staff as above, including their trainees. 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.

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 by inappropriately experienced trainees. Ideally, such patients should be anaesthetised by a consultant or specialist with similar clinical experience. Furthermore, a core group of consultants with relevant experience of anaesthetising unwell, older patients should provide the vast majority of the service, rather than randomly-allocated consultants; one consultant/specialist should assume overall clinical leadership for a hip fracture anaesthesia service.

Routine allocation of supernumerary trainee anaesthetists to whole-day lists allows for greater continuity of care including pre-operative preparation, postoperative 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 operative time and surgical outcomes (e.g. blood loss, and rate of dislocation/re-operation).

Operating department

Ideally, all trauma operations should be performed in a specific 'trauma theatre', 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 air flow, reduce the risk of airborne infection. Theatre temperature should be maintained at 20–23 °C and humidity at 50–60%, to reduce the risk of peri-operative hypothermia.

The minimum theatre team should consist of an operating department practitioner, 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 the patient's health and potential complications previously identified at the 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 processing time.

Pre-operative management

Initial 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.

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, warming and pressure care during patients' stay in the emergency department, particularly if ward admission is delayed beyond 4 h.

Early fracture fixation provides the most effective analgesia. In the interim, a formalised analgesia protocol should be followed. Pain scores, 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 [11]. Simple analgesics, such as paracetamol, should routinely be prescribed on a regular basis, unless contraindicated [12]. Approximately 40% of patients presenting with hip fracture have at least moderate renal dysfunction (estimated glomerular filtration rate < 60 $ml.min^{-1}.1.73m^{-2}$) on admission. Opioids should be used with caution until urea and electrolyte biochemistry results have been reviewed, and non-steroidal anti-inflammatory analgesia is 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

Traditionally, the pre-operative management of patients with hip fracture has been by junior orthopaedic staff, with the role of geriatricians limited to postoperative 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 may benefit from earlier, more intensive orthogeriatric input (Table 1).

Table 1 Benefits of early, intensive orthogeriatric input into management of patients with hip fracture.

- Early identification of patients at increased risk of peri-operative morbidity and mortality.
- Appropriate additional investigation, indicated by patients' co-morbidities.
- 'Pre-optimisation' of less fit patients before surgery.
- Early rehabilitation and discharge planning.
- Improved interdisciplinary communication between orthogeriatricians, surgeons and anaesthetists, reducing avoidable admission-to-operation delays.

Pre-operative assessment by the anaesthetist is mandatory, allowing planning of anaesthetic technique, assessment and communication of peri-operative risk, and pre-optimisation. In order to avoid cancellation on the day of surgery, a number of hospitals have developed specific information leaflets for the benefit of orthogeriatricians and orthopaedic surgeons, identifying particular concerns of relevance to the anaesthetist.

Co-morbidities

The preponderance of elderly patients has been noted above. Approximately 70% of patients will be of ASA physical status 3–4 [6, 7]: 35% have one co-morbidity; 17% have two; and 7% have three or more [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 (Appendix 1) [17], has been developed to predict postoperative mortality according to the number of co-morbidities and other factors (age, male sex, malignancy, pre-operative cognitive function, place of residence and anaemia), and provides the anaesthetist with information about outcome that may be discussed with the patient or their relatives.

In addition to assessment of the major systems, the anaesthetist should also assess the patient 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, which may be

compounded by the limited physiological reserve of this population, and of which 80% 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 and urea and electrolyte analyses are required routinely before surgery. Coagulation studies and chest radiography are required only if clinically indicated.

Full blood count. 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 may result in a fall in peri-operative haemoglobin concentration (Hb) equivalent to approximately 2.5 $g.dl^{-1}$. Therefore, patients who are anaemic pre-operatively are likely to be very anaemic postoperatively, 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 < 9 $g.dl^{-1}$, or Hb is < 10 $g.dl^{-1}$ with a history of ischaemic heart disease. If Hb is 10–12 $g.dl^{-1}$, two units of blood should be crossmatched. If Hb is within normal limits, a grouped sample is sufficient. Revision surgery or periprosthetic fractures incur greater blood loss and require pre-operative crossmatching according to local guidelines. Cell salvage should be considered for such procedures. After transfusion, repeat Hb analysis (formal full blood count or point-of-care) is strongly recommended.

Leucocytosis and neutrophilia are common (45% and 60%, respectively) at presentation, but may be a reactive response to trauma rather than indicative of infection. Leukocytosis $> 17 \times 10^9.l^{-1}$ may indicate infection (commonly of the chest or urine).

A platelet count of $50–80 \times 10^9.l^{-1}$ is a relative contraindication to neuraxial anaesthesia [20]. A platelet count is below $50 \times 10^9.l^{-1}$ will normally require pre-operative platelet transfusion.

Urea and electrolytes. Hypokalaemia is associated with new onset, rapid ventricular rate atrial fibrillation (AF) peri-operatively. Hyperkalaemia may indicate rhabdomyolysis if the patient was immobilised and unable to call for help after falling.

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

Electrocardiogram (ECG). This is required in all elderly patients with hip fracture.

Chest radiograph. Routine chest radiographs on admission are not necessary, but may be useful in patients with newly diagnosed heart failure or pneumonia.

Special cases

A number of clinical situations merit specific comment since they are commonly encountered in this group of patients.

Alcohol dependence. Alcohol dependence is common, under-diagnosed and a risk factor for falls [21]. Patients are at risk of significant peri-operative morbidity.

Atrial fibrillation. All patients in AF should have a ventricular rate $< 100.\text{min}^{-1}$. 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. A third 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. About 4% of patients take clopidogrel, which inhibits platelet function, and this should alert the anaesthetist to myocardial ischaemia or cardiac stents. Clopidogrel is generally not stopped on admission, especially in patients with drug-eluting coronary stents. Surgery should not be delayed, nor platelets administered prophylactically, but marginally greater blood loss should be expected. Novel antiplatelet therapies include prasugrel, eptifibatide, abciximab and tirofiban.

Warfarin is taken by approximately 5% of patients presenting with hip fracture. Hospital guidelines concerning the peri-operative management of

patients taking warfarin should be followed; in general, the International Normalised Ratio (INR) should be < 2 for surgery and < 1.5 for neuraxial anaesthesia. Small amounts of vitamin K may be used to 'reverse' the effects of warfarin; supplemental peri-operative anticoagulation with heparins is usually indicated. Prothrombin complex concentrates rapidly reverse the effects of warfarin but are expensive and rarely indicated. Warfarin should be recommenced 24 h after surgery, although some departments recommence it later on the day of surgery.

The advice of haematologists should be sought if in doubt about the peri-operative 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 therapy, along with supplemental oxygen, intravenous fluids and physiotherapy. Expedited surgery under regional anaesthesia is preferred, enabling early mobilisation, analgesia and improved co-operation with postoperative physiotherapy.

Diabetes. Approximately 9% of patients with hip fracture are diabetic. Hospital guidelines concerning the peri-operative 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.

Heart murmur. Unrecognised calcific aortic stenosis is an important cause of anaesthesia-related mortality. There is considerable debate concerning the postponement of surgery pending echocardiography, but a majority of clinicians favour proceeding to surgery with modification of their technique towards general anaesthesia and invasive blood pressure monitoring, with the proviso that patients should undergo echocardiography in the early postoperative period.

Echocardiography may be indicated: (i) to establish left ventricular function if the patient is breathless at rest or on low level exertion; or (ii) 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 second heart sound; or left ventricular hypertrophy on the ECG without hypertension (although clinical signs of aortic stenosis can be difficult to elicit [23]).

Implantable cardioverter defribrillators (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's delivering an arrhythmogenic shock to the myocardium, and of peri-operative failure of the device. Early pre-operative consultation with a cardiologist is required, both to establish the type of device and to develop a plan for intra-operative management of patients.

Pre-operative optimisation

All acute hospitals should develop a specific protocol for the resuscitation of patients with hip fracture, with particular regard to: monitoring (pulse oximetry, respiratory rate, ECG, non-invasive blood pressure measurement, core temperature and static/dynamic pain scores); cannulation and intravenous fluid therapy; analgesia; thermoregulation; and pressure care. These protocols may be commenced during ambulance transfer, but are mandatory once the patient has been admitted to the hospital.

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.

Timing of surgery

Ideally, surgery should be performed within 48 h of hospital admission after hip fracture [2, 9], with a new target of 36 h having been introduced in England and Wales in April, 2010. Currently, 80% of hospitals achieve a mean admission to operation time of less than 48 h [6].

Meta-analyses [24, 25] indicate that delaying surgery beyond 48 h 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 (Table 2).

Ethical considerations

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

Consent and mental capacity

Approximately 25% of patients with hip fracture have moderate or severe cognitive impairment, and a further 15–25% have mild cognitive impairment. In order for patients 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, he/she 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 [26] (MCA) (in Scotland, the Adults with Incapacity (Scotland) Act 2000). Essentially, it remains the

Table 2 Reasons for delaying surgery for hip fracture that the Working Party considers acceptable and unacceptable.

Acceptable	Unacceptable
• Haemoglobin concentration < 8 $g.dl^{-1}$.	• Lack of facilities or theatre space.
• Plasma sodium concentration < 120 or > 150 $mmol.l^{-1}$ and potassium concentration < 2.8 or > 6.0 $mmol.l^{-1}$.	• Awaiting echocardiography.
• Uncontrolled diabetes.	• Unavailable surgical expertise.
• Uncontrolled or acute onset left ventricular failure.	• Minor electrolyte abnormalities.
• Correctable cardiac arrhythmia with a ventricular rate > 120 $.min^{-1}$.	
• Chest infection with sepsis.	
• Reversible coagulopathy.	

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, and 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 healthcare

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 (HDU) care) 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) decisions

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].

Do not attempt resuscitation decisions are increasingly prevalent among the patient population with hip fracture, and may proscribe cardiopulmonary resuscitation in the event of arrest. Although DNAR decisions 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 has recognised these potential difficulties, and issued guidance [28].

Discussions about DNAR should precede surgery, and anaesthetists must take steps to make themselves aware of the outcome of these discussions.

Intra-operative management

Surgical considerations

A number of hip fracture classification systems exist. Generally, 50% of fractures are intracapsular, the remainder extracapsular (Fig. 2).

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 and tamponade effected by the capsule.

Occasionally, undisplaced fractures may be treated conservatively, 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.

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

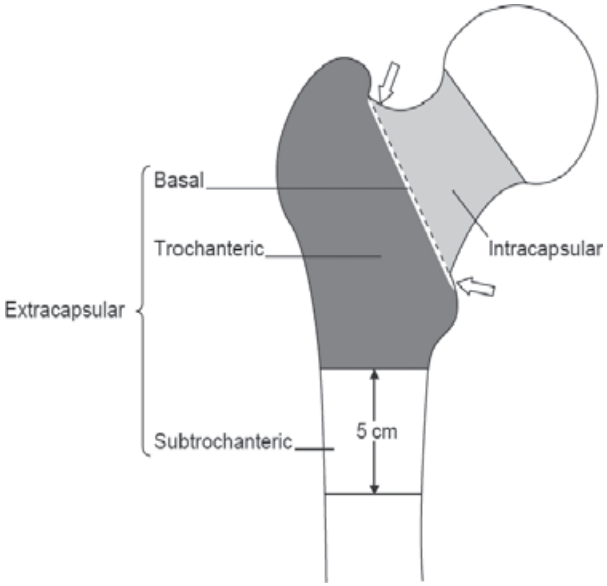

Figure 2 Common sites of proximal femoral fractures. Arrows show the insertion of the joint capsule.

Extracapsular fractures

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

Blood loss from cancelleous bone is greater, such that the total blood loss from an extracapsular fracture may exceed one litre; the greater the degree of comminution and the larger 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 6–8 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

Regional anaesthesia for hip fracture surgery requires blockade of the lateral cutaneous nerve of the thigh and femoral, obturator, sciatic and lower subcostal nerves, and can only be reliably achieved in the conscious patient with neuraxial blockade. General anaesthesia requires additional administration of postoperative analgesia, most commonly in the form of peripheral nerve blockade. Poor analgesia in the immediate postoperative 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 the remainder 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], that suggested that regional anaesthesia may reduce the incidence of postoperative 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.*' [1]. Until such time as evidence is published that confirms regional anaesthesia is superior to general anaesthesia or vice versa, the Working Party endorses this recommendation. This endorsement is supported by a recent

meta-analysis suggesting that regional anaesthesia '*is the technique of choice (although) the limited evidence available do(es) 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 postoperative confusion. Peripheral nerve blockade should always be considered, therefore, as an adjunct to spinal or general anaesthesia, to extend the period of postoperative non-opioid analgesia.

Neuraxial anaesthesia

The Working Party recommends that *either* spinal anaesthesia *or* general anaesthesia is administered, as simultaneous administration is associated with precipitous falls in intra-operative blood pressure [32].

Postoperative epidural analgesia (including combined spinal-epidural anaesthesia) provides good postoperative 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. Conceptually, spinal anaesthesia for hip fracture fixation in elderly patients should be viewed distinctly from spinal anaesthesia for caesarean section in younger patients. Lower doses of intrathecal bupivacaine (< 10 mg) appear to reduce associated hypotension [32, 33]. Attempted lateralisation of subarachnoid anaesthesia using hyperbaric bupivacaine with the patient positioned laterally (with the fractured hip inferior) may ameliorate hypotension. Co-administration of intrathecal opioids prolongs postoperative analgesia; fentanyl is preferred to morphine or diamorphine, which are associated with greater respiratory and cognitive depression [34].

Sedation may be provided, but should be used cautiously in the very elderly. Midazolam and propofol are commonly used. Ketamine may be used, theoretically to counteract hypotension, but may be associated with postoperative confusion.

Supplemental oxygen should always be provided during spinal anaesthesia.

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. There remains debate about whether mechanical ventilation is preferred to spontaneous ventilation. Paralysis and tracheal intubation are associated with greater physiological derangement than spontaneous ventilation, but proponents argue that mechanical ventilation reduces the risk of peri-operative aspiration and allows greater control of arterial carbon dioxide levels. Intra-operative hypoxaemia is common, and higher inspired oxygen concentrations may be required.

Peripheral nerve blockade

Blockade of the femoral, obturator and lateral cutaneous nerve of the thigh may be sufficient for peri-operative analgesia. The most reliable method of blocking all three is the psoas compartment block, although this risks a degree of neuraxial blockade and formation of a deep haematoma in recently anticoagulated patients.

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

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

Pre- or postoperative peripheral nerve blockade may be used to supplement either general or spinal anaesthesia.

Monitoring

Minimum standards for monitoring include the continual presence of the anaesthetist, pulse oximetry, capnography, ECG and non-invasive blood pressure monitoring [35]. Core temperature monitoring should be used routinely. Point-of-care Hb 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 (CVP) 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. Dilution techniques (e.g. 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 patients and patients with dementia.
- 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 postoperative cognitive dysfunction.

Supplemental pain relief

Regular paracetamol administration should continue throughout the peri-operative 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 both dose and frequency of intravenous opioids should be reduced (e.g. halved). Codeine should not be administered, as it is constipating, emetic and associated with peri-operative cognitive dysfunction.

Thromboprophylaxis

Venogram and ventilation/perfusion studies have shown a prevalence of 37% for deep vein thrombosis (DVT) and 6% for PE (pulmonary embolism) [38], although clinical symptoms are only seen in 1–3% of DVTs and 0.5–3% of PEs in patients with hip fracture. Fondaparinux or low molecular weight heparins are commonly prescribed and may impact on the anaesthetic technique: low molecular weight heparin should be administered between 18:00 and 20:00 to minimise the risk of bleeding related to neuraxial anaesthesia during hip surgery on daytime trauma lists. Thromboembolism stockings or intermittent compression devices should be employed intra-operatively, in addition to ensuring the

patient remains warm and well-hydrated. Expedited surgery and mobilisation, and regional anaesthesia, may reduce the risk of DVT further.

Antibiotics
Antibiotics should be administered within one hour of 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. Excessive flexion and internal rotation of the non-operative hip should be resisted during dynamic hip screw insertion.

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 postoperatively.

Intravenous fluids
Optimised peri-operative fluid management reduces morbidity and hospital stay [40]. Many patients become hypovolaemic before surgery, and pre-operative fluid therapy should be prescribed routinely. Cardiac output-guided fluid administration appears to reduce hospital stay and improve outcome [41].

Bone cement implantation syndrome (BCIS)
This is characterised by hypoxia, hypotension, or both, and/or unexpected loss of consciousness, 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 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, use of a cement gun to enable retrograde cement insertion, venting of the femur, minimising the length of the prosthesis and minimising the force applied to it during insertion) and 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).

The treatment of BCIS includes delivery of 100% oxygen, fluid resuscitation (guided by CVP measurement) and vasoactive/inotropic support.

Postoperative management

Patients with hip fracture remain at relatively high risk of complications in the early postoperative phase, and may require a prolonged period of monitoring in the anaesthetic recovery unit or, less commonly, the HDU/ICU. There is recognition that some patients may not be nursed in the most appropriate place following hip fracture surgery. The Working Party recommends that hip fracture patients should receive ward care with a nurse:patient ratio of 1:4, with regular input from physicians specialised in medicine for the elderly [4].

Analgesia

Peripheral nerve blockade is rarely effective beyond the first postoperative night. Analgesia requirements vary considerably after fracture fixation, particularly during remobilisation. Regular paracetamol administration should continue [11], augmented by carefully prescribed opioid analgesia, as indicated. Pain evaluation should be included as part of routine postoperative nursing observations.

Oxygen

Older patients are at risk of postoperative hypoxia, and supplemental oxygen should be administered postoperatively for at least 24 h. 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. Urinary catheters should be removed as soon as possible, to reduce the attendant risk of urinary tract infection.

Postoperative cognitive dysfunction/acute confusional state

This is common (25%) in patients with hip fracture, interrupting routine management and rehabilitation. Treatment involves multimodal optimisation of postoperative care requiring adequate analgesia, nutrition, hydration, electrolyte balance, 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 used with caution in older persons, due to its antimuscarinic side effects.

Nutrition

Up to 60% of patients with hip fracture 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 by orthogeriatricians, 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, 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 postoperative period, as subsequent fragility fracture or periprosthetic fracture is associated with a particularly poor prognosis.

Anaesthetists may become involved in secondary surgical management (e.g. wound debridement, prosthesis revision) or in the provision of longer-term analgesia or HDU 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.

Mortality

Mortality after hip fracture has remained relatively unchanged for the last two decades. Currently, 8.4% of patients die within 30 days of surgery [6]. However, it has been suggested that up to half of postoperative deaths are potentially preventable [46]. Thirty-day mortality is increased for older, sicker, male patients. Up to 15–30% of patients die within a year of surgery.

Length of acute inpatient stay

This is between eight and 30 days, with a mean of 16 days [6].

Discharge destination

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.

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 hospitals to compare performance against other hospitals, and identify specific paragons of practice that may they might adopt. A number of audit tools are available for anaesthetists:

Hip Fracture Perioperative Network (HFPN)

This is an NHS-sponsored network developed 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. The HFPN 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, preoperative care information for junior surgeons, and hip fracture care pathway proformas.

National Hip Fracture Database (NHFD)

The NHFD is a collaboration between the British Orthopaedic Association and the British Geriatrics Society, with the main aim '*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*' [48]. 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 130 000 patients (2011). The NHFD has recently begun to collect data about anaesthetic methods used for hip fracture surgery.

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 [49] and AAGBI [50].

The Working Party recommends that each department produce a written information leaflet or booklet. It is essential that patients and relatives 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 multidisciplinary input from nurses, surgeons, physiotherapist, occupational therapists, etc. The Working Party recommends that, where possible, information should be evidence-based.

A specimen patient information sheet is freely available from the HFPN website [47], and may be edited to apply to the hip fracture care pathway of specific hospitals.

Appendix 2 lists areas where information for patients can be found.

Training

The elderly patient with a 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 recommends that basic level trainees (CT1-2) participate in the multidisciplinary peri-operative care of patients with hip fracture (e.g. 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, undoubtabley, 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 for develop a specific interest in the peri-operative care of older trauma patients. Higher level trainees should be encouraged to participate in audit and research involving patients with hip fracture.

Acknowledgement

The Working Party acknowledges the assistance of Prof. Opinder Sahota and Dr Iain Moppett, Queen's Medical Centre, Nottingham.

Competing interests

RG and SW have advised both the National Institute for Health and Clinical Excellence (during development of Clinical Guideline 124 (The management of hip fracture in adults)) and the NHFD, and are respectively, Lead Clinician and Research Co-ordinator for the HFPN. MJP has received honoraria from a number of commercial companies for giving lectures on different aspects of hip fracture treatment and advising on hip fracture treatments, and he has received royalties from BBraun Ltd related to the design and development of an implant used for the internal fixation of intracapsular hip fractures.

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Appendix 1

Nottingham Hip Fracture Score

A score out of ten is derived by adding weighted scores for eight criteria (a). The total score may then be used to predict the risk of a patient dying within 30 days of hip fracture surgery (b), a figure that may be used to stratify patient-specific surgical risk during the process of consent, and in order to identify patients who may benefit from more intensive levels of peri-operative care. The score may also be used to predict 1-year postoperative mortality [52].

(a) Derivation of score.

Variable	Points
Age 66–85 years	3
Age 86 ≥ older	4
Male	1
Haemoglobin concentration ≤ 10 $g.dl^{-1}$ on admission to hospital	1
Abbreviated mental test score ≤ 6/10 on admission to hospital	1
Living in an institution	1
More than one co-morbidity	1
Active malignancy within last 20 years	1

(b) Predicted 30-day mortality.

Score	Predicted 30-day postoperative mortality
0	0
1	1%
2	2%
3	4%
4	6%
5	10%
6	15%
7	23%
8	22%
9	45%
10	57%

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:

- Royal College of Anaesthetists (http://www.rcoa.ac.uk/index.asp?PageID=69): *You and your anaesthetic*; *Anaesthesia explained.*
- British Orthopaedic Association (http://www.boa.ac.uk/en/patient-information/olderhip): *Guidance for older patients with hip fractures.*
- NHS Brand Guidelines (http://www.nhsidentity.nhs.uk/tools-and-resources/patient-information): *Patient information*: a general resource for producing written information for patients.

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