

Guidelines

Safety guideline: reducing the risk from cemented hemiarthroplasty for hip fracture 2015

Association of Anaesthetists of Great Britain and Ireland
British Orthopaedic Association
British Geriatric Society

Membership of the Working Party: R. Griffiths, S. M. White, I. K. Moppett, M. J. Parker,¹ T. J. S. Chesser,¹ M. L. Costa,¹ A. Johansen,² H. Wilson² and A. J. Timperley

1 British Orthopaedic Association

2 British Geriatric Society

Summary

Concise guidelines are presented for the preparation and conduct of anaesthesia and surgery in patients undergoing cemented hemiarthroplasty for hip fracture. The Working Party specifically considered recent publications highlighting complications occurring during the peri-operative period [1, 2]. The advice presented is based on previously published advice and clinical studies.

This is a consensus document produced by expert members of a Working Party established by the Association of Anaesthetists of Great Britain and Ireland, with representatives from the British Orthopaedic Association and British Geriatric Society. It has been seen and approved by the elected Boards/Councils/Committees of all three organisations.

All AAGBI guidelines are reviewed to ensure relevance/accuracy and are updated or archived when necessary. Date of review: 2020.

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- *What other guideline statements are available on this topic?*

The National Patient Safety Agency (NPSA) issued an alert in 2009, about the use of bone cement during hip arthroplasty [3]. Specialty-focused advice has been published by both anaesthetists [4] and surgeons [5].

- *Why was this guideline developed?*

The Anaesthesia Sprint Audit of Practice (ASAP) [1] collected prospective information on bone cement implantation syndrome (BCIS) [6]. The audit revealed evidence of cardiovascular compromise in some patients undergoing cemented hemiarthroplasty for hip fracture.

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- *How does this statement differ from existing guidelines?*
This document has been a collaborative effort by anaesthetists, surgeons and orthogeriatricians. It highlights the need for joint decision making, teamworking and attention to detail during the peri-operative period.
- *Why does this statement differ from existing guidelines?*
This is the first multidisciplinary clinical guidance on peri-operative management of this clinical problem.

Recommendations

There should be a three-stage process to reduce the incidence of problems in patients undergoing cemented hemiarthroplasty for hip fracture:

1. Identification of patients at high risk of cardiorespiratory compromise:
 - a) Increasing age;
 - b) Significant cardiopulmonary disease;
 - c) Diuretics;
 - d) Male sex.
2. Preparation of team(s) and identification of roles in case of severe reaction:
 - a) Pre-operative multidisciplinary discussion when appropriate;
 - b) Pre-list briefing and World Health Organization Safe Surgery checklist 'time-out'.
3. Specific intra-operative roles:
 - a) Surgeon:
 - Inform the anaesthetist that you are about to insert cement;
 - Thoroughly wash and dry the femoral canal;
 - Apply cement in retrograde fashion using the cement gun with a suction catheter and intramedullary plug in the femoral shaft;
 - Avoid vigorous pressurisation of cement in patients judged to be at risk of cardiovascular compromise (see below).
 - b) Anaesthetist:
 - Ensure adequate resuscitation pre- and intra-operatively;
 - Confirm to surgeon that you are aware that he/she is about to prepare/apply cement;

- Maintain vigilance for signs of cardiorespiratory compromise. Use either an arterial line or non-invasive automated blood pressure monitoring set on the 'stat' mode during/shortly after application of cement. Early warning of cardiovascular collapse may be heralded by a drop in systolic pressure. During general anaesthetic, a sudden drop in end-tidal pCO₂ may indicate right heart failure and/or catastrophic reduction in cardiac output;
- Aim for a systolic blood pressure within 20% of pre-induction value;
- Prepare vasopressors in case of cardiovascular collapse.

Introduction

This guidance is aimed at clinicians involved in the intra-operative management of patients undergoing cemented arthroplasty. The guidance does not include the consenting process, or the choice of surgical intervention, which is covered in existing national guidelines [7], although the Working Party acknowledges that these are vital parts of the process by which patients undergo such surgery, and that the usual requirements for individualised treatment and supplying patients with appropriate information must apply.

Bone cement implantation syndrome

Surgical instrumentation of the femoral canal has been associated with significant cardiovascular compromise [1, 5]. This phenomenon can occur with any such surgery, especially procedures that breach the femoral canal, such as intramedullary nailing and cemented and uncemented hip implants, but the risk has been particularly highlighted in frail patients undergoing cemented hemiarthroplasty following hip fracture.

During surgery, significant cardiovascular compromise can occur during preparation of the femoral canal, during insertion of the cement (if used for fixation) and/or prosthesis, and when the hip is reduced [6]. Compared with uncemented prostheses, the use of cemented prostheses for hip fracture surgery increases the likelihood of pain-free mobility after surgery [8], reduces the risk of re-operation and is associated with a lower mortality rate at 30 days [8–11]. However, an

Table 1 Incidence of adverse effects during arthroplasty using a cemented prosthesis [1, 2].

Grade 1	Arterial saturation < 94% or > 20% fall in systolic blood pressure	~20%
Grade 2	Arterial saturation < 88% or hypotension > 40% fall in systolic blood pressure or loss of consciousness	~3%
Grade 3	Cardiopulmonary resuscitation required	~1%

Table 2 Specific intra-operative surgical and anaesthetic roles for reducing the incidence and management of BCIS.

Conduct of surgery	<p>Ask the anaesthetist to confirm that he/she has heard your instruction to the theatre team that you are about to prepare the femoral canal for cement and prosthesis insertion</p> <p>Carefully prepare, wash and dry the femoral canal. Use of a pressurised lavage system is recommended to clean the endosteal bone of fat and marrow contents</p> <p>Use a distal suction catheter on top of an intramedullary plug. Insert the cement from a gun in retrograde fashion on top of the plug and pull the catheter out as soon as it is blocked with cement. Do not use excessive manual pressurisation or pressurisation devices in patients at higher risk of cardiovascular events (see above for risk factors)</p>
Conduct of anaesthesia	<p>Ensure that the patient is adequately hydrated before induction of and during anaesthesia</p> <p>Maintain vigilance for possible cardiovascular events once the femoral head is removed and the surgeon has verbally indicated his/her intent to instrument the femoral canal</p> <p>Confirm to the surgeon that you are aware of preparation of the femoral canal for cement and prosthesis insertion</p> <p>Aim to maintain the systolic blood pressure within 20% of pre-induction values throughout surgery, using vasopressors and/or fluids. Invasive blood pressure monitoring is indicated for patients at higher risk</p> <p>Be ready to give vasopressors, e.g. metaraminol/adrenaline in case of cardiovascular collapse</p>

adverse cardiovascular event has been associated with cemented hemiarthroplasty and this is sometimes referred to as ‘bone cement implantation syndrome’ (BCIS) [6].

Adverse cardiovascular events occur in approximately 20% of hip fracture operations in which a cemented prosthesis is used [1, 2]. The severity of the reaction is indicated in Table 1.

Certain patient factors are associated with an increased risk of severe cardiovascular events during cemented hemiarthroplasty, in particular increasing age, male sex, significant cardiopulmonary disease and use of diuretic medication [2, 11]. These factors are also associated with increased 30-day mortality, though the magnitude of the association is far greater for BCIS itself [2].

Administrative and human factor aspects

In patients with the above risk factors, discussion between surgeons, anaesthetists and orthogeriatricians should consider how best to minimise the early peri-

operative risks of mortality and morbidity, given the known benefits of surgical intervention [10]. Surgeons and anaesthetists can also modify peri-operative practice both to reduce the risk of cardiovascular events and to improve outcome in the event of such an event (Table 2) [11]. All hip fracture surgery should be undertaken or directly supervised by appropriately experienced anaesthetists and surgeons and on planned trauma lists [7].

All members of the theatre team should be aware of the problems associated with femoral instrumentation and the use of cemented prostheses. The potential for adverse events should be identified for each patient as part of both the pre-list briefing before starting a theatre list and at the World Health Organization Safe Surgery checklist ‘time-out’ immediately before surgery. In the event of a severe reaction or cardiopulmonary arrest, theatre staff should be aware of their defined roles in resuscitating the patient, as described in the Coventry ‘cement curfew’ and modified according to individual hospital operating procedures [12].

References

1. National Hip Fracture Database. Anaesthesia Sprint Audit of Practice, 2014. https://www.rcplondon.ac.uk/sites/default/files/national_hip_fracture_database_anaesthesia_sprint_audit_of_practice_asap.pdf (accessed 19/12/2014).
2. Olsen F, Kotyra M, Houltz E, Ricksten SE. Bone cement implantation syndrome in cemented hemiarthroplasty for femoral neck fracture: incidence, risk factors, and effect on outcome. *British Journal of Anaesthesia* 2014; **113**: 800–6.
3. National Patient Safety Agency. Mitigating surgical risk in patients undergoing hip arthroplasty for fractures of the proximal femur, 2009. <http://www.nrls.npsa.nhs.uk/alerts/?entryid45=59867> (accessed 19/12/2014).
4. Safe Anaesthesia Liaison Group. Patient Safety Update, 1 October 2011 to 31 December 2011. <http://www.rcoa.ac.uk/system/files/CSQ-PS-PSU-DEC2011.pdf> (accessed 19/12/2014).
5. Timperley AJ, Whitehouse SL. Mitigating surgical risk in patients undergoing hip arthroplasty for fractures of the proximal femur. *Journal of Bone and Joint Surgery [British]* 2009; **91-B**: 851–4.
6. Donaldson AJ, Thomson HE, Harper NJ, Kenny NW. Bone cement implantation syndrome. *British Journal of Anaesthesia* 2009; **103**: 12–22.
7. National Institute for Health and Care Excellence. Hip fracture: the management of hip fracture in adults, 2011. www.nice.org.uk/guidance/cg124 (accessed 19/12/2014).
8. Parker MJ, Gurusamy KS, Azegami S. Arthroplasties (with and without bone cement) for proximal femoral fractures in adults. *Cochrane Database of Systematic Reviews* 2010; **6**: CD001706.
9. Yli-Kyyny T, Sund R, Heinänen M, Venesmaa P, Kröger H. Cemented or uncemented hemiarthroplasty for the treatment of femoral neck fractures? *Acta Orthopaedica* 2014; **85**: 49–53.
10. Costain DJ, Whitehouse SL, Pratt NL, Graves SE, Ryan P, Crawford RW. Perioperative mortality after hemiarthroplasty fixation method. A study based on the Australian Orthopaedic Association National Joint Replacement Registry. *Acta Orthopaedica* 2011; **82**: 275–81.
11. Griffiths R, Parker M. Bone cement implantation syndrome and proximal femoral fracture. *British Journal of Anaesthesia* 2015; **114**: 6–7.
12. Scrase A, Horwood G, Sandys S. Coventry, “Cement Curfew”: team training for crisis. *Anaesthesia News* 2014; **327**: 8–9.