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Editorial

Bone cement and hip fractures

The use of bone cement for the fixation of arthroplasties for hip fracture surgery remains a controversial issue. The National Hip Fracture Database reports that in England, Wales and Northern Ireland, rates of cemented arthroplasty following hip fracture have risen from 74% in April 2012, to 92% in April 2020, but that in 2019 this figure still varied between 16% and 100% in different hospitals. [1] This variation in practice has been exacerbated by contentious newspaper headlines of 'killer cement' and 'poor science'. [2,3] The patient safety report of 2014 also highlighted the increasing incidence of such deaths. [4,5] NICE however gives very clear guidance on cement for hip fracture patients stating those with a displaced intracapsular fracture should receive a cement arthroplasty.[6] Where does this variance leave the practising surgeon?

The concern with bone cement in hip fracture patients centres on the complication of bone cement implantation syndrome. This syndrome results from the adverse effects of fat and bone marrow particle embolization during preparation of the femur for the prosthesis and following introduction of the polymethyl methacrylate component of the bone cement. Three grades of reaction have been defined and subsequent reports have given the incidence rates for hip fracture patients.[7–9]

- Grade 1. Arterial saturation < 94% or > 20% fall in systolic blood pressure. (Occurrence about 20% of patients)
- Grade 2. Arterial saturation < 88% or hypotension > 40% fall in systolic blood pressure or loss of consciousness. (Occurrence about 3-5%)
- Grade 3. Asystole or major cardiovascular collapse requiring cardiopulmonary resuscitation. (Occurrence about 0.5-1.7%).

The Grade 3 reaction invariably results in the death of the patient. [8,10,11] An intra-operative death rate of 0.3% following bone cement was reported from the Norwegian register study.[12] This devastating complication demands that we must have good evidence to justify the use of cement in this group of patients. This evidence principally comes from randomised trials and large database studies.

Mortality on day one will be increased for the cemented implants in comparison to the uncemented implants, but after day one, this increase is lost and thereafter there is a trend to a slightly lower mortality for the cemented implants.[12–18] This trend to a lower mortality may be related to the lower risk of implant related complications for the cemented prosthesis. [11,18–21] In particular, there is a lower risk of per-prosthetic fracture around the cemented implants. Reported revision rates are 0.6% versus 1.6% at 18 months,[19] 1.3% versus 3.0% at 3.8 years [20] and 3% versus 9% at five years [11] for the cemented versus uncemented implants. Additional benefits for the cemented implants are the improved regain of function and lower degrees of residual pain. These findings are readily apparent in comparisons against the older uncemented Austin Moore and Thompson implants, but less striking for the more modern uncemented stems. [13–17]

The use of cement therefore appears to be in the best interests of most patients, and it would be easy for clinicians to give too much weight to the patient safety argument. By analogy, antibiotics may carry a small risk of acute anaphylaxis, but this does not lead to anyone withholding them from patients with sepsis. However, there is possibly a small group of patients in whom cementing may not be appropriate. Those patients who have severe respiratory disease, such as those dependent on home oxygen and those who are cardiovascularly unstable with hypotension may be better treated with an uncemented prosthesis to avoid the risks of a bone cement reaction. Decisions in such high risk patients may need a discussion of risks and benefits between surgeon, anaesthetist, ortho-geriatrician, patient and relatives, to consider how to minimise the early perioperative risks. [22].

For the remaining patients a cemented prosthesis is appropriate, as recommended in the NICE guidance.[6] The ASAP study of 2014 resulted in a comprehensive safety alert produced by the UK Association of Anaesthetists and endorsed by the British Orthopaedic Association and the British Geriatric Society leading to the following approach being recommended to try and reduce the risk of a severe cement reaction. [9,22]

- These patients should be scheduled for surgery on a daytime trauma list with appropriately experienced anaesthetist and surgeon. [6]
- Ensure adequate resuscitation of the patient both pre- and intra-operatively with intravenous fluids.
- Preparation of teams and identification of roles of theatre staff using pre-list briefing and World Health Organization Safe Surgery checklist.
- The surgeon to inform the anaesthetist prior to cement insertion to check that the patient is stable and ensure a 'cement curfew' is undertaken.[22]
- Aim for a systolic blood pressure within 20% of pre-induction value at the time of cement insertion.
- Use an intramedullary plug in the femoral shaft to limit the distal spread of cement.
- Thoroughly wash and dry the femoral canal prior to cement insertion to reduce the extent of embolization of marrow contents.

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- Consider a suction catheter to reduce pressure in the intramedullary canal
- Apply the cement in the femur in a retrograde fashion using the cement gun.
- Avoid vigorous pressurisation of cement in patients judged to be at risk of cardiovascular compromise.

During general anaesthetic, a sudden drop in end-tidal pCO2 may indicate right heart failure and/or catastrophic reduction in cardiac output may be heralded by a drop in systolic blood pressure. At this stage surgery should stop, although there may be an argument for rapid removal of the cement if it is still pliable at this stage. The wound may need to be covered with a sterile dressing and the patient placed on their back to allow cardiac massage to commence. Prognosis for recover at this stage is however poor. [8,9,11]

Cost considerations are not a major issue for this topic. The surgical time for an uncemented prosthesis will be about eight minutes less [13] and there are no costs from the bone cement, cement restrictor and mixing system. However, the cost of a contemporary uncemented stem is invariably higher than a cemented stem and additional costs will be associated with the increased need for revision surgery with uncemented stems. The overall difference is likely to be only marginally in favour of the cemented implant. Using an older uncemented stem such as an Austin Moore would reduce this difference, but would be unacceptable due to the poorer regain of function and greater residual pain associated with these older stems. [13,14]

For the future, we need better studies to enable the identification of individual patients in which the risks of bone cement are too high. We also need the manufacturers of bone cement to evaluate whether a safer type of bone cement can be made for this group of patients. Analysis to date suggests there is no difference in the outcome of grade 3 cement reaction for different types of anaesthesia. [9] We need to determine if the methods taken to reduce the occurrence of a severe cement reaction are effective and this would only be possible if relevant information is integrated into national clinical audits and registries.

Declaration of Competing Interest

None of the authors has no conflict of interest related to this article.

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References

[1] National Hip Fracture Database; National report 2019. www.nhft.co.uk.
[2] Borland S. Alert over 'killer cement' used in hip replacements that has 'killed 41 patients in seven years. Mail Online 13.6.2014. https://www.dailymail.co.uk/health/article-2656762/Alert-killer-cement-used-hip-replacements-41-patients-die-operating-table-seven-years-warns-study.html.
[3] Boseley S. Hip implant deaths point to poor science, warns patient's family. The Guardian 18.9.2015. https://www.theguardian.com/science/2015/sep/18/hip-implant-deaths-point-to-poor-science-warns-patients-family.
[4] Cleary K. National Patient Safety Report NPSA/2009/RRR01; 2009.
[5] Rutter PD, Panesar SS, Darzi A, Donaldson LJ. What is the risk of death or severe harm due to bone cement implantation syndrome among patients undergoing hip hemiarthroplasty for fractured neck of femur? A patient safety surveillance study. BMJ Open 2014;4:004853.
[6] 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).
[7] Donaldson AJ, Thomson HE, Harper NJ, Kenny NW. Bone cement implantation syndrome. Br J Anaesth 2009;103:12–22.
[8] Olsen F, Kotyra M, Houltz E, Ricksten S-E. Bone cement implantation syndrome in cemented hemiarthroplasty for femoral neck fracture: incidence, risk factors, and effect on outcome. Br J Anaesth 2014;113:800–6.
[9] National Hip Fracture Database. Anaesthesia Sprint Audit of Practice, 2014. https://www.nhfd.co.uk/20/hipfractureR.nsf/vwContent/asapReport (accessed 27/10/2020).
[10] Talsnes O, Vinje T, Gjertsen JE, DSahl OE, Engesaeter LB, Baste V, Pripp AH, Reikeras O. Perioperative mortality in hip fracture patients treated with cemented and uncemented hemiprosthesis: a register study of 11,210 patients. Int Orthop 2013;37:1135–40.
[11] Gjertsen JE, Lie SA, Vinje T, Engesaeter LB, Hallan G, Matre K, Furnes O. More re-operations after uncemented than cemented hemiarthroplasties used in the treatment of displaced fractures of the femoral neck. J Bone Joint Surg Br 2012;94-B:1113–19.
[12] 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.
[13] Parker MJ, Gurusamy KS, Azegami S. Arthroplasties (with and without bone cement) for proximal femoral fractures in adults. Cochrane Database Syst Rev 2010;6:CD001706.
[14] Parker MJ, Pryor GA, Gurusamy K. Cemented versus uncemented hemiarthroplasty for intracapsular hip fractures; a randomised controlled trial in 400 participants. J Bone Joint Surg 2010;92-B:116–22.
[15] Parker MJ, Cawley S. Cemented or uncemented hemiarthroplasty for displaced intracapsular fractures of the hip: a randomized trial of 400 patients. Bone Joint J 2020;102-B:11–16.
[16] Moerman S, Mathijssen NMC, Niesten DD, et al. More complications in the uncemented compared to cemented hemiarthroplasty for displaced femoral neck fractures: a randomized controlled trial of 201 patients, with one year follow-up. BNC Musculoskelet Disord 2017;18:169.
[17] Talsnes O, Hjelmstedt F, Pripp AH, Reikeras O, Dahl OE. No difference in mortality between cemented and uncemented hemiprosthesis for elderly patients with cervical hip fracture. A prospective randomized study on 334 patients over 75 years. Arch Orthop Trauma Surg 2013;133:805–9.
[18] Yli-Kyyny T, Sund R, Heinanen M, Venesmaa P, Kroger H. Cemented or uncemented hemiarthroplasty for the treatment of femoral neck fractures? A Finnish database study of 25,174 patients. Acta Orthop 2014;85:49–53.
[19] Jameson SS, Jensen CD, Elson DW, Johnson A, Nachtsheim C, Rangan A, Muller SD, Reed MR. Cemented versus cementless hemiarthroplasty for intracapsular neck of femur fracture- A comparison of 60,848 matched patients using national data. Injury 2013;44:730–4.
[20] Okike K, Chan PH, Heather A, Prentice HA, Paxton EW, Burri RA. Association between uncemented vs cemented hemiarthroplasty and revision surgery among patients with hip fracture. JAMA 2020;323:1077–84. doi:10.1001/jama.2020.1067.
[21] Tanzer M, Graves SE, Peng A, Shimmin AJ. Is cemented or cementless femoral stem fixation more durable in patients older than 75 years of age? A comparison of the best-performing stems. Clin Orthop Relat Res 2018;476:1428–37.
[22] Griffiths R, White SM, Moppett IK, Parker MJ, Chesser TJS, Costa ML, Johansen A, Wilson H, Timperley AL. Association of Anaesthetists of Great Britain and Ireland Guideline: reducing the risk from cemented hemiarthroplasty for hip fracture. Anaesthesia 2015;70:623–6.