Bone cement implantation syndrome and proximal femoral fracture

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The report from Olsen and colleagues1 on bone cement implantation syndrome (BCIS) in this edition of the British Journal of Anaesthesia coincides with the recent publication of the Anaesthesia Sprint Audit of Practice (ASAP).2 BCIS has been reported for many years and it is perhaps surprising that it took until 2009 for a full explanation and classification of BCIS to emerge.3 Olsen and colleagues looked back on over 1000 cemented hemi-arthroplasties, inserted after a proximal femoral fracture. The incidence of BCIS was over 20% and the incidence of a severe reaction resulting in cardiovascular collapse was 1.7%. It is worth comparing the data from Sweden with other studies from Northern Europe. The ASAP study observed the development of BCIS in a population of over 3500 cemented hemi-arthroplasties. BCIS was observed in 19% of cases with grade 2 or 3 occurring in 2.7% and 0.5%, respectively; the corresponding figures from this study are 5.1% and 1.7%. A study from Norway4 reported an incidence of intraoperative cardiovascular collapse or death (grade 3) of 0.5%, identical to the ASAP study. Although all these studies are observational and rely on single arterial pressure measurements and oxygen saturation data charted on anaesthesia records, the figures are comparative and do show that BCIS is a problem in those patients who have suffered a proximal femoral fracture.

Perhaps this is not surprising as soon as bone cement was used for hip surgery, reports started to emerge of problems.3 The National Patient Safety Agency (NPSA) issued a rapid response report following a series of deaths in 2009.5 It is beyond the scope of this editorial to discuss the aetiology of BCIS, but the data from Olsen and colleagues have identified some of those who are most likely to be affected, which gives those treating these patients some guidance on what type of fixation should be used.

There are four important factors to consider for BCIS, the patient, the surgeon, the anaesthetist, and the theatre team involved in the operation. The NPSA warning in 20095 highlighted that patients with poor cardiorespiratory reserve were at risk. The analysis from the paper by Olsen and colleagues1 has confirmed these findings. Independent predictors of severe BCIS were high ASA grade, the presence of pre-existing chronic obstructive pulmonary disease, and medication with diuretics or warfarin. The outcome for the patients who develop grade 2 and 3 BCIS was poor, and they accounted for 95% of those patients who died within 2 days of surgery in the present study. An analysis of mortality from the National Hip Fracture Database (NHFD)6 has revealed an increase in deaths from cemented compared with uncemented prostheses at 24 h, which does appear to tie in with the incidence of BCIS from ASAP and the observational studies that have emerged from Scandinavia.1 4

Another question to ask is whether BCIS is a problem in elective hip arthroplasty surgery. A rate of intraoperative mortality for elective total hip arthroplasty of about 0.1% has been reported.3 7 The number of patients having primary hip arthroplasties with an ASA score of III or IV was 15%, this has increased to 22% for NHS hospitals by 2012.7 The 90 day mortality for elective hip arthroplasty is 0.29%8 and has decreased steadily, despite the increasing age and complexity of patients. This lower incidence is due to the elective cases being younger and medically fitter with less cardiovascular disease in comparison with those patients with a hip fracture.

The advantages of a cemented arthroplasty for hip fracture cases have been summarized in the NICE guidelines on this topic.9 The cemented arthroplasty, in comparison with the uncemented designs, lead to a hip that has less residual pain and better regain of mobility.9 10 11 The need for revision arthroplasty is also reduced for the cemented implants.4 9 10 12 This increased re-operation rate is due to implant loosening causing pain and a larger risk of re-fracture around the implant. While the 1 day mortality is increased for the cemented prosthesis, mortality thereafter shows no difference and by 1 yr, there is even a trend to a lower mortality for those with the cemented prosthesis.10

Anaesthetists should increase their vigilance during a cemented procedure. There are a number of crucial factors that can make the likelihood of BCIS more common, apart from patient selection. Maintenance of arterial pressure during surgery and adequate circulating volume should be in place before cement insertion. In those patients who have cardiovascular compromise, the insertion of an arterial line will give immediate notice of alterations in arterial pressure. End-tidal carbon dioxide measurement may decrease and this is a useful monitor in those receiving general anaesthesia, which is about 50% in England, Wales, and Northern Ireland.13 For the surgeon, the femur needs to be carefully prepared and dried. A cement gun must be used and for the frailest patients, pressurization of the cement should be avoided.14
Perhaps, if a cemented technique is going to be used, this should be discussed during the various stages of the World Healthcare Organization safer surgical checklist. A novel team approach has developed in Coventry, where a consultant anaesthetist and member of the NHS Hip Fracture Perioperative Network has come up with a ‘Cement Curfew’ protocol to reduce the likelihood of BCIS. This involves all members of the theatre team involved in the operation having specific roles and full concentration around the time of prosthesis insertion. The team in Coventry has already included the cement curfew as part of the team brief.

Patient selection appears crucial to trying to reduce the burden of BCIS in hip fracture surgery. The surgeon treating the hip fracture has to decide which method of fixation is optimal for each patient. They should consider the physical fitness or co-morbidity of the patients before deciding which prosthesis to choose? There are some important multidisciplinary educational issues that could go some way to making sure that the right patient has the right operation. Surgery, orthogeriatrics, and anaesthesia must ensure that the patients are well informed and all the team members should make the decision about the type of fixation with the best interests of the patient paramount.

All hospitals need to have an alternative procedure available for those who are considered to be at too high a risk to justify a cemented prosthesis. This may be an uncemented prosthesis. The old Austin Moore or Thompson prosthesis can be used without cement, but these implants lead to a hip that caused more residual pain and poorer function than the cemented prosthesis. The use of such a prosthesis is therefore declining and should be consigned to the implant museum. A more modern uncemented prosthesis can be used, with a design similar to that used for elective arthroplasty. These implants tend to be more expensive and to date there are few published reports of their effectiveness for hip fracture surgery. An alternative for the hip fracture patient is for internal fixation of fracture. This is indirectly related to the development of an implant used for the internal fixation of intracapsular hip fractures. This is indirectly related to the subject of this article.

**References**


**Declaration of interest**

M.P. has received expenses and honorarium from a number of commercial companies and organizations for giving lectures on different aspects of hip fracture treatment. He has also received royalties from B. Braun Ltd related to the design and development of an implant used for the internal fixation of intracapsular hip fractures. This is indirectly related to the subject of this article.