

- In the presence of pre-existing cardiopulmonary dysfunction, avoid bilateral hip replacements with cemented prostheses and use non-cemented prostheses.
- Prior to cementing, if the patient's mean arterial pressure

Surgical Techniques

- Maintain normovolemia, particularly at the time of cementing and prosthesis insertion.
- Increase inspired oxygen concentration by administering 100% oxygen during the procedure.
- When using general anesthesia, decrease the concentration of volatile agent prior to prosthesis insertion.
- Use invasive hemodynamic monitoring when pre-existing cardiopulmonary problems exist and during cementing.
- Use central intravenous access to provide drug administration.

Anesthetic Techniques

- During preoperative and preanesthetic assessments, identify risk factors, particularly the patient's cardiopulmonary reserve, and use this information to choose the prosthesis, surgical procedure, and techniques most likely to avoid cardiopulmonary complications.
- If medically feasible, defer surgery until the patient's medical and cardiovascular status can be maximized.

Patient Assessment

Surgeons and anesthesiologists can use reported interventions to reduce the risk of BCIS, including the following:

Reported Risk Reduction Strategies

- Use a cement restrictor combined with other methods to reduce intramedullary pressures (e.g., a venting hole). However, for some high-risk patients, the surgeon may wish to avoid increased femoral pressurization that might occur with the sole use of a restrictor.
 - During preinsertion, work the cement to remove volatile vasodilator compounds.
 - Mix bone cement in a vacuum.
 - Use low viscosity cement to reduce intramedullary canal pressures.
- Insertion**
- Use the retrograde cement gun technique.
 - Slowly introduce the prosthesis stem into the cemented femoral canal.
 - Use vacuum along the linea aspera to drain the proximal femur, which reduces high intramedullary pressure during cement and prosthesis insertion.
- Cement Preparation**
- Use a cement restrictor/Plug
 - For long-stem prostheses, use a venting hole in the distal femur. However, drilling a venting hole may reduce the prosthesis stability or increase the risk of fracture.
- Venting Hole**
- Use thorough, pulsatile, high pressure, high-volume lavage and brushing and drying of the intramedullary canal of the femoral shaft.
- Lavage**
- decreases by 20 to 30% below baseline during canal reaming or plugging, change the technique from cemented to uncemented prostheses.

Reported Risk Factors

Patient-Related

- Advanced age
- Severe osteoporosis
- Intertrochanteric or pathologic fracture
- Severe underlying cardiovascular disease/limited cardiopulmonary reserve
- ASA Class 3 or 4
- Fixed heart rate
 - pacemakers
 - sympathetic blockade of epidural anesthesia
- Hypotension
- Hypovolemia/inadequate volume replacement
- Large femoral canals — 21mm or more
- Femoral tumors or cancer
- Hemodynamic instability
- Patent foramen ovale

Technique-Related

- Long stem femoral components
- Revision surgery
- Volatile anesthesia
- Cemented hip arthroplasty



Risk Factors and Reduction Strategies for Bone Cement Implantation Syndrome (BCIS)

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