Anaesthesia for joint replacement surgery

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Abstract

Joint replacement, especially hip and knee, are increasingly common elective orthopaedic procedures. Patients who undergo these operations are usually elderly and may have multiple comorbidities requiring careful perioperative management. Specific issues include deep venous thromboembolism (DVT) prophylaxis and use of regional anaesthesia, potential blood loss and hypothermia, application of pneumatic tourniquet and use of bone cement, and postoperative mobilization. There is a trend for developing clinical pathways or protocols from preoperative assessment through postoperative pain management to improve outcomes and enhance recovery in these patients.

Keywords Arthroplasty; general anaesthesia; hip; joint replacement; knee; regional anaesthesia; shoulder

Royal College of Anaesthetists CPD Matrix: 3A08

Learning objectives

After reading this article, you should:

- understand the essentials of preoperative assessment for patients undergoing joint replacement
- be able to describe the intraoperative anaesthetic considerations and related complications of joint replacement surgery
- be able to discuss the options for postoperative analgesia

Introduction

The main aims of joint replacement surgery are pain relief and improvement of mobility. The 14th annual report from the National Joint Registry (NJR) shows that there were more than 200,000 hip and knee, around 7000 shoulder and approximately 1500 elbow and ankle joint replacement operations performed in England, Wales, Northern Ireland and the Isle of Man in 2016. More than 90% of lower limb joint replacements are due to osteoarthritis, whereas 31% of elbow joint replacement patients have rheumatoid arthritis. The average age of patients was almost 70 years old and multiple medical comorbidities are common, particularly those related to metabolic syndrome. Of those who had primary hip and knee replacement, 18% and 17%, respectively, were American Society of Anesthesiologists (ASA) grade 3 or worse, and these figures rose to 34% and 30% in revision procedures. The magnitude of surgery and patient demographics pose significant challenges. Thorough preoperative identification of risk factors and optimization of medical conditions are crucial.

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Preoperative considerations

Preoperative assessment should focus on age related physiological decline, medical morbidities, polypharmacy issues and underlying implications of arthritis. Many patients are overweight and their joint condition often exacerbates this by impeding exercise.

Cardiovascular system

Cardiovascular pathologies including hypertension, ischaemic heart disease, heart failure and arrhythmia are common. Echocardiogram provides quantitative assessment of heart structure and function. It should be performed in patients with known or suspected valvular heart disease to assess its severity. Severe valve lesions, particularly aortic stenosis, may need to be treated before arthroplasty. Preoperative evaluation of left ventricle (LV) function is indicated for patients with dyspnoea of unknown origin or those with worsening heart failure. Functional status assessment can be difficult due to arthritis-related limited mobility. Guidelines are available from the American College of Cardiology (ACC) and American Heart Association (AHA) or European Society of Cardiology and European Society (ESC) of Anaesthesiology (ESA) to assist assessment of patients in a stepwise-based approach. Orthopaedic surgery is classified as intermediate risk carrying a 1–5% reported perioperative cardiovascular death or myocardial infarction.

Respiratory system

Besides the usual deterioration in respiratory function secondary to age and/or smoking, pulmonary fibrosis and pleural effusion/nodules can be pulmonary manifestations of rheumatoid arthritis. Chest X-ray should not be performed routinely but is indicated if there are clinical signs of significant cardiopulmonary disease. Arterial blood gas analysis and lung function tests such as spirometry and diffusing capacity are seldom indicated unless in patients who are ASA grade 3 or 4 due to known or suspected respiratory disease. Increased body mass index (BMI) may be associated with obstructive sleep apnoea (OSA) and screening tools such as the STOP-Bang questionnaire or risk-stratification by polysomnography can be used if this is suspected.

Renal function

Glomerular filtration rate and tubular function decrease with age and may be further affected by diabetes mellitus, hypertension and drugs such as non-steroidal anti-inflammatories (NSAIDS).

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Musculoskeletal and airway

Painful joints and deformities have implications for surgical positioning and anaesthetic technique. Rheumatoid arthritis can lead to temporomandibular restriction, cricoarytenoid joint fixation and atlantoaxial instability. Detailed airway assessment and planning, cervical spine radiographs, cervical protection during airway manipulation and very careful head positioning are important. Where feasible, it can be useful to ask the patient to position themselves comfortably on the operating table with appropriate padding, prior to induction.

Anaemia

Preoperative anaemia was prevalent in approximately 25% of patients undergoing elective total hip or knee arthroplasty. Anaemia is associated with increased risk of many perioperative adverse outcomes, including infection, increased length of stay and mortality. Target haemoglobin concentration is >/= 13 g/L and anaemia should be investigated and corrected. Iron deficiency with or without anaemia should be treated with oral iron replacement 6–8 weeks before surgery while intravenous iron can be used in patients who do not tolerate or respond to the oral formulation.[1]

DVT prophylaxis

Major joint replacement increases the risk of venous thromboembolism (VTE) secondary to old age, obesity, immobility and the surgery itself.

Current guidelines established by the American College of Chest Physicians (ACCP) recommend dual VTE prophylaxis to patients undergoing THA or TKA with an antithrombotic agent and an intermittent pneumatic compression device (IPCD). Low molecular weight heparin (LMWH) is preferable to other pharmacological agents i.e. aspirin, adjusted-dose vitamin K antagonist (mainly warfarin), direct oral anticoagulants (apixaban, dabigatran, rivaroxaban), fondaparinux, low-dose unfractionated heparin (LDUH). The minimum duration of VTE prophylaxis is 10–14 days and up to 35 days. They recommend starting LMWH either 12 hours or more preoperatively or 12 hours or more postoperatively.

Perioperative anticoagulants need to be withheld for an adequate time interval before administering neuraxial or regional block (Table 1).

Intraoperative considerations

Monitoring

Aside from standard monitoring, consider arterial line and central venous pressure catheters in patients with significant cardiac comorbidities, or when major blood loss is anticipated as in revision surgery.

Anaesthetic techniques

Regional anaesthesia may be used for most joint replacements. There has been debate and conflicting evidence as to whether neuraxial or general anaesthesia is superior in hip or knee

Regional anaesthesia in patients receiving anticoagulants/ antiplatelets

Drug	Acceptable time after drug for block performance	Acceptable time after block performance or catheter removal for next drug dose
UFH sc prophylaxis	4 h or normal APTTR	1 h
UFH iv treatment	4 h or normal APTTR	4 h
LMWH sc prophylaxis	12 h	4 h
LMWH sc treatment	24 h	4 h
Fondaparinux prophylaxis	36–42 h (consider anti-Xa levels)	6–12 h
Fondaparinux treatment	Avoid (consider anti-Xa levels)	12 h
NSAIDS, aspirin	No additional precautions	No additional precautions
dipyridamole	No additional precautions	6 h
Clopidogrel, prasugrel	7 days	6 h
ticagrelor	5 days	6 h
Tirofiban, eptifibatide	8 h	6 h
Abciximab	48 h	6 h
Warfarin	INR = <1.4	After catheter removal
Rivaroxaban prophylaxis	18 h	6 h
Rivaroxaban treatment	48 h	6 h
Dabigatran prophylaxis/treatment	48–96 h depends on CrCl	6 h
Apixaban prophylaxis	24–48 h	6 h
Alteplase, anistreplase, reteplase, streptokinase	10 days	10 days

UFH, unfractionated heparin; sc, subcutaneous; APTTR, activated partial thromboplastin time ratio; iv, intravenous; LMWH, low molecular weight heparin, NSAIDs,non-steroidal anti-inflammatory drugs; INR, international normalized ratio; CrCl, creatinine clearance.

(Adapted from 2013 AAGBI guidelines).

Table 1

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