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ANAESTHESIA FOR HIP ARTHROPLASTY ANAESTHESIA TUTORIAL OF THE WEEK 62

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SELF ASSESSMENT

Before reading this tutorial please attempt the following questions relating to total hip replacement

1. With regard to total hip replacement surgery:
 - a) Patients are often elderly
 - b) Exercise tolerance is a good indicator of fitness for surgery
 - c) All patients should be cross matched 4 units pre-operatively
 - d) Patients often have associated medical conditions

2. Regional anaesthesia as compared with general anaesthesia results in:
 - a) Reduced mortality
 - b) Reduced blood loss
 - c) Increased risk of deep venous thrombosis (DVT)
 - d) Increased requirement for urinary catheterisation

3. With regard to spinal anaesthesia:
 - a) 2 mls 0.5% plain bupivacaine is a reasonable dose for most patients.
 - b) It may be combined with general anaesthesia
 - c) Addition of diamorphine gives prolonged analgesia up to 20 hours
 - d) Strict aseptic precautions are required

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4. Concerning the post operative recovery period:

- a) Femoral nerve block gives as effective analgesia as lumbar plexus block
- b) Epidural analgesia is indicated in most cases
- c) Patients are not usually mobilised until at least 48hrs post op.
- d) Further blood loss is likely to be minimal

5. With regard to cement reactions

- a) Fat embolization is the most likely cause
- b) Suction applied to bone cavity by surgeon is unlikely to reduce the risk
- c) Hypotension and hypoxia are the most common effects
- d) Cardiac arrest may occur.

6. With regard to venous thromboembolism

- a) Incidence of DVT post op is 1% even when prophylactic measures have been taken
- b) All patients should receive mechanical prophylaxis
- c) All patients should receive low dose anticoagulant prophylaxis.
- d) Risk factors include previous history of DVT and positive family history.

Key points

- Use regional anaesthesia where possible
- Prevention of venous thromboembolism is of key importance.
- Be aware of cement problems

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Introduction

Total hip replacement is a common orthopaedic operation generally performed in elderly patients, with a high success rate.

Surgery

The hip joint is a ball and socket joint. The ball is formed by the head of the femur, and the socket by part of the pelvis called the acetabulum. The ends of the bones are covered with a layer of cartilage, which allows smooth movement. When the cartilage is damaged by arthritis, joints become stiff and painful. Most patients have degenerative joint disease, commonly osteoarthritis (OA). Other conditions requiring hip replacement include rheumatoid arthritis (RA), infection, congenital dislocation and avascular necrosis of the femoral head.

Joint replacement is performed to relieve pain and improve mobility. Total hip replacement involves:

- Dislocation and removal of the femoral head
- Reaming of the acetabulum and insertion of a prosthetic plastic or ceramic cup
- Reaming of the femur with insertion of a femoral component (metal or ceramic head, metal stem) into the femoral shaft, with or without cement.

Hip resurfacing is an alternative procedure which is gaining popularity for younger more active patients. The surfaces of the head of the femur and acetabulum are relined with metal coverings, without using cement. The joint produced is closer to normal anatomy and therefore has potential for improved function. Also more of the patient's own bone is conserved, making any future revision easier.

Preoperative assessment

Patients are usually elderly and commonly have associated problems such as hypertension, ischaemic heart disease, chronic obstructive pulmonary disease and renal impairment. They may also have other problems relating to the underlying orthopaedic condition, particularly in rheumatoid arthritis. Therefore careful preoperative evaluation is essential to identify risk factors and ensure that the patient is as fit as possible for surgery.

Cardiopulmonary reserve is often difficult to assess as exercise tolerance is usually limited by hip disease in these patients. If untreated ischaemic heart disease, valvular dysfunction or arrhythmias are detected then further investigation may be required to start treatment prior to elective hip surgery. Echocardiography can be used to assess left ventricular function and valvular abnormalities. A resting ECG may show silent ischaemia or previous MI, but is more often normal in patients with ischaemic heart disease. However these tests only provide information about the cardiovascular system in the resting state. Tests of dynamic function

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such as cardiopulmonary exercise testing (which can be performed using an arm ergometer) or pharmacological stress tests provide greater information but are not readily available.

Renal function may be impaired due to age, hypertension or chronic use of non-steroidal anti-inflammatory drugs

Musculoskeletal - other joint involvement is common. This may have implications for positioning for regional anaesthesia and surgery. Obesity may be present as a cause or result of degenerative joint disease. In RA the cervical spine and temporo-mandibular joint (TMJ) may be involved. Atlanto-axial subluxation occurs in approximately 25% of patients with severe RA. Excessive movement during anaesthesia can result in cervical cord compression. Unless certain that the cervical spine is stable treat as unstable neck – this may involve neck stabilization during intubation, or awake intubation. TMJ involvement may result in restricted mouth opening. Regional anaesthesia may be the best option in these patients to avoid airway manipulation.

Drugs - Patients may be taking drugs which have implications for regional anaesthesia such as warfarin, aspirin or clopidogrel. Many elderly patients are on cardiovascular treatments such as beta blockers and ACE inhibitors. Beta blockers should be continued perioperatively; ACE inhibitors may be stopped particularly if a regional technique is selected. Enquire about antibiotic allergies.

General – Consider other important factors which may influence choice of anaesthesia – patient weight and shape of back, whether the patient will tolerate being awake and patient choice.

Investigations – all patients should have:

- Full blood count
- Urea, creatinine and electrolytes
- ECG if aged over 60 or any other clinical indication
- Group and save or crossmatch 2 units of packed cells
- Other tests as indicated – e.g. coagulation, and chest X-ray

Choice of anaesthetic

Total hip replacement can be performed under general, spinal or epidural anaesthesia, and often a combination of techniques is used. There is no evidence of a difference in mortality between the techniques. However regional anaesthesia has significant advantages over general anaesthesia.

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Advantages of regional anaesthesia

- Reduced blood loss during surgery , reducing the need for blood transfusion
- Decreased bleeding at the operative site, improved cement bonding and shorter surgical time
- Reduced incidence of deep venous thrombosis (DVT) and pulmonary embolism (PE)
- Avoids the effects of general anaesthesia on pulmonary function
- Provides good early post operative analgesia
- Lower cost

The reduced blood loss seen with spinal anaesthesia, as compared with general anaesthesia is due to the reduction in arterial and venous pressure resulting from sympathetic blockade, which gives rise to less arterial, and notably less venous oozing of blood from the surgical area.

Advantages of general anaesthesia

- Better for patients who are unable to lie flat
- Safer for patients with fixed cardiac output conditions such as aortic stenosis.
- Patient preference
- Less likely to require urinary catheter

Most anaesthetists believe that regional anaesthesia has proven benefits over general anaesthesia. However, the choice of technique for a particular patient will depend on a number of factors including patient preference, the skills of the anaesthetist, the facilities, funds available and location of the hospital.

Anaesthesia

Monitoring – all patients should be monitored with blood pressure (usually non-invasive), ECG and pulse oximetry. Capnography, inspired oxygen, volatile agent analysis and airway pressure monitoring are indicated for general anaesthetic.

IV lines –14-16g cannula. For patients undergoing surgery in the lateral position placement in the lower arm has the advantage of keeping the upper arm free for blood pressure cuff.

Temperature – keep patients warm – use forced air warmer if available and warmed IV fluids. Actively warming the patient reduces intra-operative blood loss. In addition hypothermia may cause poor wound healing, infection and cardiovascular dysfunction.

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Blood pressure – aim to maintain blood pressure at an adequate level based on preoperative readings: hypotension is not indicated.

Ensure **adequate volume filling** prior to cementing.

Antibiotic prophylaxis is required.

Position – most surgery takes place in the lateral position. There is a risk of excessive lateral neck flexion and pressure in the dependent limbs. Also care must be taken to ensure that the anterior stabilising post used to hold the patient in the lateral position does not compress the femoral triangle.

Spinal anaesthesia

- Check for any contraindication to spinal anaesthesia.
- Preload with IV fluid before performing spinal.
- Monitor blood pressure closely.
- For a single-shot spinal use 2.5 – 3.5 mls 0.5% plain bupivacaine depending on patient's size. Opiate may be added for more prolonged analgesia and to cover longer surgery (up to 3 hours). There is a potential risk of delayed respiratory depression postoperatively.

Opioid	Dose	Duration of action
Diamorphine	250 mcg	10-20 hrs
Morphine (preservative free)	100-200mcg	8-24 hrs
Fentanyl	25mcg	1-4 hrs

Sedation is often desirable due to the length of the operation, intraoperative noise and patient request. Patients in the lateral position may become restless and uncomfortable because of pain arising from the dependant shoulder. Target controlled infusion of propofol, 0.5-3 mcg/ml, gives smooth, titratable sedation. Intermittent boluses of midazolam, 0.5-1mg can be used, but may cause disorientation resulting in patient movement. Facemask oxygen should be administered throughout the operative period. Occasionally general anaesthesia is required using a laryngeal mask airway (LMA).

For longer cases (e.g. complex primary hip replacement) consider combined spinal and epidural. **General anaesthesia**

Spontaneous ventilation with a laryngeal mask airway or ventilation via an endotracheal tube are appropriate. Analgesia may be supplemented by the use of a peripheral nerve block enabling reduced opioid use. Epidural analgesia may be considered for longer, more complex surgery but is not usually required for post operative analgesic requirements for uncomplicated primary hip replacement. Use of epidural analgesia postoperatively necessitates insertion of a urinary catheter in most patients, which is best done at the time of surgery.

Peripheral nerve blocks for total hip replacement

The hip joint is innervated by the femoral, sciatic and obturator nerves with skin and superficial tissues receiving branches from the lower thoracic nerves. Consequently no single peripheral nerve block is sufficient for hip replacement. Lumbar plexus block provides effective analgesia which extends into the postoperative period. However this block should only be performed after appropriate training. The femoral 3 in 1 block, which is technically easier with fewer complications, may be used with the intention of blocking the lumbar plexus via the anterior route, but is less effective.

Post operative

Position – the surgeon usually prefers patients to be placed on their bed in the supine position with the legs abducted using a pillow to prevent dislocation of the prosthesis.

Analgesia – patients are generally mobilised within 24 hours, and simple IM or oral opioids with regular paracetamol and non-steroidal anti-inflammatory drugs (NSAIDs) are usually sufficient. The benefits of epidural analgesia may be limited to the early post op period (up to 6 hours) and longer term use may delay mobilisation.

Fluid balance – blood loss may double in the first 24 hours and is poorly tolerated in elderly patients, therefore careful fluid balance monitoring is essential.

Check haemoglobin (Hb) 24 hours post operatively and transfuse or treat with iron as appropriate.

Oxygen therapy for 24 hours is advisable in most patients, continued up to 72 hours in those at high risk of myocardial ischaemia.

Complications

Blood loss. This varies significantly. It is also affected by the anaesthetic technique. The average loss is 300-500mls (reduced by centroneuraxial techniques). A similar amount may be lost in the drain and tissues postoperatively. In patients with an adequate preoperative Hb it is relatively uncommon for blood transfusion to be required in theatre. Group and saved serum is adequate as long as cross matched blood is available within 30 minutes.

Venous thromboembolism. DVT is the most common complication, occurring in at least 1% of patients even when prophylactic measures have been taken. Patients at high risk should be identified. Risk factors include a history of DVT or PE, malignant disease, positive family history, dehydration and likelihood of prolonged immobility or poor mobilisation. Strategies to minimise the risk include regional anaesthesia, intermittent leg-compression devices and graduated compression stockings. There is strong evidence for the effectiveness of low dose heparin, low molecular weight heparin (LMWH), warfarin, or the selective factor Xa inhibitor, fondaparinux in reducing DVT, but there is also concern about possible bleeding complications which may put surgical wound, implant or patient at risk. Local policies should be in place, but recent evidence based guidelines advise that all patients should be offered mechanical prophylaxis plus LMWH or fondaparinux.

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If using central neuraxial block, ensure that the final preoperative dose is timed appropriately. Bleeding and compression neuropraxia is a potential complication in patients who are anticoagulated or with clotting abnormalities. Recommendations allow a 12 hour interval between low molecular weight heparin and epidural/spinal injection. This also applies to removal of an epidural catheter.

Cement reactions. Use of cement to fix the prostheses in place may lead to bone cement implantation syndrome. Methylmethacrylate is an acrylic polymer that has been used extensively in orthopaedic surgery for 30 years. Its use is associated with the potential for hypoxia, hypotension and cardiovascular collapse including cardiac arrest. The most likely cause is fat embolization resulting from raised intramedullary pressure due to the cement expanding as it hardens. Direct toxic effects of the cement are also possible. Problems typically occur soon after cement insertion, but may not occur until the end of the operation when the hip is relocated and emboli are dislodged from a previously obstructed femoral vein.

Prevention and treatment

- Increased inspired oxygen concentration prior to cementing
- Measure blood pressure frequently at this time
- Ensure adequate blood volume prior to cementing
- Stop N₂O
- Alpha agonists (e.g. methoxamine) to treat hypotension

Suction applied to the bone cavity by the surgeon to evacuate air and fat during cement insertion dramatically reduces the incidence of complications.

It may be appropriate to avoid the use of cement in patients with severe cardiac disease, and this should be discussed with the surgeon beforehand.

Revision of total hip replacement

Revision surgery involves re-operation on a previously performed hip replacement which has failed or become loose. Part or all of the implant is removed and replaced with a new one. The principles are the same as for total hip replacement, except for the following points:

- The operation takes longer (2-3 hours or more)
- Blood loss can be significant (often over 1 litre)
- Patients are often older and usually have more medical problems.

The complexity of surgery is very variable, therefore pre-operative discussion with the surgeon is essential.

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Anaesthesia

- Discuss with surgeon to know extent and length of surgery.
- Generally as for total hip replacement, including a urinary catheter.
- Invasive monitoring with arterial and CVP lines may be indicated depending on the cardiovascular status of the patient and anticipated blood loss,
- The anaesthetic technique should be planned on the length of surgery and patient factors. A single- shot spinal is not appropriate, and for complex revisions ventilation via an endotracheal tube and epidural supplementation may be most appropriate.
- Blood transfusion is often required, and blood loss can be substantial. Two units of crossmatched blood should be available with the ability to obtain more within 30 minutes. Cell salvage should be used where possible.
- Postoperative pain can be significant - consider an epidural infusion or PCA.

Answers to self assessment

1. TFFT 2. FTFT 3. FTTT 4. FFFF 5. TFFT 6. TTTT

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