Enhanced recovery for lower limb arthroplasty

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Enhanced recovery/fast-track surgery

Fast-track surgery or more appropriately named enhanced recovery refers to a multidisciplinary, evidence-based, and procedure-specific strategy to surgery. Early work on enhanced recovery was pioneered by Henrik Kehlet, a Danish surgeon in 1990. The strategy has four strands: improving preoperative care, reducing the physical stress of the operation, decreasing postoperative discomfort, and improving postoperative mobility.

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Patients must play an active role in their own enhanced recovery.

Audit and continued vigilance are required to maintain success in any multimodal multidisciplinary technique.

Key points
- Enhanced recovery is multidisciplinary
- Standardized perioperative care aimed at early mobility, discharge, and return to normal life with both reduced morbidity and potentially mortality.
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However, contrary to popular opinion, patient education has little effect on length of stay after arthroplasty, pain, or postoperative function. There is evidence that it may reduce patient anxiety in patient groups who require extra support or do not mobilize well. In these groups, it may improve recovery.

Optimization of anaemia before operation can reduce postoperative morbidity and mortality and this can be done in the general practice setting. Anaesthetic preoperative assessment is a growing specialty in its own right. The anaesthetists role is central to enhanced recovery with clear access to pre-, intra-, and postoperative care, which, if balanced, can allow early mobility.

Preoperative clinics are now working alongside general practice in some centres to identify anaemic patients, investigate, and treat them appropriately before surgery. Co-existing co-morbidities such as hypertension and diabetes can also be optimized in the community and perioperative plans established before admission. Good community relations are also required after operation with some centres using community-based enhanced recovery nurses to identify and treat postoperative complications.

### Patient admission

The majority of arthroplasty patients are admitted on the morning of surgery. Current studies indicate that enhanced recovery is most successful if carried out in designated areas or wards. Designated enhanced recovery areas aid standardized care, staff training, and a team approach. Premedication is given to all patients (Table 1). Premedication is given with a view to reducing the stress response of surgery, opioid requirements, and improving analgesia. In order to achieve this, multimodal analgesia is advocated, including the use of non-steroidal anti-inflammatory drugs (NSAIDs), paracetamol, and gabapentin. NSAIDs are used, provided that contraindications are not present (i.e. renal impairment, allergy, and gastrointestinal intolerance), prescribed for a short course only with regular review in the elderly population. Other premedicant agents target the reduction in the stress response to surgery, that is, clonidine (a central α2-agonist prescribed to patients who are not already taking β-blockers) and dexamethasone which has added advantage of reducing postoperative nausea and vomiting (PONV).

Minimizing fasting times and maintaining nutrition have been shown to reduce postoperative pain, nausea, perioperative insulin resistance, muscle catabolism, and in some small studies anxiety. The benefits of minimal starvation and the use of carbohydrate drinks are already well established in fast-track colorectal surgery.

### Anaesthetic technique

Traditionally, anaesthetic approaches to hip and knee arthroplasty have been varied with debate over the relative advantages of regional vs general anaesthesia. Consensus has been difficult with anaesthetic websites such as the PROSPECT group (http://www.postoppain.org/ accessed October 2012) (procedure-specific postoperative pain management) trying to produce evidence-based ‘best practice’ anaesthetic techniques for a range of common surgical procedures. Historically, analgesia was the primary outcome aim for most procedures for the anaesthetist with mobility a secondary outcome. Now there is increasing emphasis on more appropriate techniques to facilitate enhanced and early mobility. There are a number of techniques that can be used as part of an enhanced recovery programme both alone or in combination.

### Central neuraxial blocks

Spinal or epidural analgesia has commonly been used for joint arthroplasties. They can be used for anaesthesia alone (see below) or used with the addition of opioid either as a bolus or infusion for postoperative analgesia. Systematic reviews indicate that neuraxial and regional techniques can still confer reduced postoperative pain, morphine consumption, and nausea and vomiting while in the case of knee arthroplasty, potentially reduced length of stay.

While infiltration with or without a regional block can be used for postoperative analgesia, the patient will still require another form of anaesthesia for the procedure. Although general anaesthesia can

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### Table 1 CALEDonian technique (Clinical Attitude Leading to Early Discharge)

<table>
<thead>
<tr>
<th>Anaesthesia Type</th>
<th>Knee Arthroplasty</th>
<th>Hip Arthroplasty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anaesthetic technique</td>
<td>Central neuraxial block</td>
<td>Central neuraxial block</td>
</tr>
<tr>
<td>Intraoperative analgesia</td>
<td>Ketamine 25–50 mg i.v. intraop</td>
<td>Ketamine 25–50 mg i.v. intraop</td>
</tr>
<tr>
<td>Intraoperative fluid</td>
<td>500–1000 ml crystalloid</td>
<td>1000–1500 ml crystalloid</td>
</tr>
<tr>
<td>Local anaesthetic infiltration-surgery</td>
<td>Ropivacaine 2mg ml^-1 Catheter placed in posterior compartment of knee</td>
<td>Ropivacaine 2mg ml^-1 around hip joint</td>
</tr>
<tr>
<td>Postoperative analgesia</td>
<td>Ropivacaine 2 mg ml^-1 via wound catheter, 6h post surgery, 10a.m., 8 a.m. day 1 postop</td>
<td>No wound catheter</td>
</tr>
<tr>
<td>Oral postoperative multimodal analgesia</td>
<td>Oxycodone modified release 5–20 mg b.d. and p.r.n. for 24–48 h; oxycodone immediate release (oxynorm) p.r.n. for 24–48 h; gabapentin 300 mg b.d. 5 days; paracetamol 1 g q.d.s.; ibuprofen 400 mg t.d.s.</td>
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</tr>
<tr>
<td>Mobilization</td>
<td>Day 0: mobilize to toilet; day 1: full mobilization</td>
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</tbody>
</table>
be applied at our institution, a non-opioid low-dose spinal with an intraoperative target-controlled propofol infusion for sedation is used. Care must be taken to reduce PONV to a minimum with appropriate prophylaxis and treatment of high-risk groups.

**Postoperative analgesic techniques**

**Local infiltration**

A local infiltration technique, as described in Table 1, is used in our institution. The use of widespread local anaesthetic infiltration originally described by Kerr and Kohan is gaining popularity. Combined field and intra-articular infiltration is potentially an easier technical skill to acquire, with reduced risk of nerve injury and minimal motor block when compared with peripheral nerve block. Large volumes are used for knee replacement in order to ensure effective infiltration of all layers in the wound, namely the posterior capsule and femur, anterior capsule, quads, collaterals, anterior femur and subcutaneous tissues. Although limited data suggest that toxic plasma levels are not achieved, the anaesthetist must be constantly vigilant against the possibility of both the surgeon exceeding the maximum recommended dose and an accidental intravascular injection of local anaesthetic. If adrenaline is used with the local anaesthetic, accidental intravascular injection may result in tachycardia and hypertension. In the Kerr and Kohan paper, this dose was reduced to a maximum of 250 mg ropivacaine for patients <55 kg, >85 yr, ASA III–IV, or patients with previously reduced tolerance to local anaesthetics. One study looking at ropivacaine concentrations using an infiltration technique and a redivac drain found local anaesthetic concentrations below that which would be considered toxic, even after reinfusion of drain contents; however, further pharmacokinetic research in this setting is required. Chondrolysis has recently been reported in association with intra-articular injection but potential prothrombotic effects of tranexamic acid in trauma patients stresses the need for caution in high-risk groups. Tranexamic acid is an antifibrinolytic that has been shown to reduce blood loss in both cardiac and orthopaedic surgery. Reducing blood loss has obvious advantages including less postoperative anaemia and less need for postoperative drains which are all potential barriers to mobilization. Reduced transfusion requirements results in fewer associated complications including immunosuppression and infection. The dose of tranexamic acid used vary from 10 mg to 15 mg kg⁻¹ given before release of the tourniquet in TKR. A recent audit confirms that our transfusion rate with tranexamic acid for TKR and THR is 1% with only one patient in a consecutive series of 1089 patients requiring a blood transfusion. Recently, concern over potential prothrombotic effects of tranexamic acid in trauma patients stresses the need for caution in high-risk groups. However, although we have used tranexamic acid in nearly 5000 TKR and THR

**Infiltration analgesia with regional nerve block**

Some centres have adopted a combination of surgically placed posterior compartment local infiltration and a femoral nerve block for cases of knee arthroplasty. The concentration of local anaesthetic in the femoral nerve block has been reduced over time in an attempt to minimize motor block, with some studies achieving analgesia with concentrations as low as levobupivacaine 0.24 mg ml⁻¹. With any femoral nerve block, there exists the danger of motor block leading to delayed mobility or reduced proprioception leading to falls. The risks can be reduced with lower concentrations, physio-aided mobilization, and splints. Recent literature indicates that there is increasing interest in the use of single-shot or continuous femoral nerve blocks for TKR in particular with a view to short and potentially long-term functional mobility. While sciatic nerve block in combination with a femoral nerve block can provide excellent analgesia, the accompanying motor block and foot drop has excluded its use in an enhanced recovery setting.

**Intraoperative**

Once spinal anaesthesia and sedation is established, a single intraoperative dose of ketamine is given to reduce postoperative morphine consumption and PONV. In line with enabling early mobility, the use of urinary catheters is best avoided. With an opioid-free spinal anaesthetic, our catheterization rate is 7% in a series of more than 5000 joints. With the use of tranexamic acid, the need for surgical drains in TKR has also stopped, facilitating early mobilization.

**Tranexamic acid**

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patients with no increase in thromboembolic complications, further research is required.

**Recovery: the cryocuff**

In the recovery room, we apply a cryocuff to the operative leg (Fig. 1). A cryocuff is an ice-filled cuff that can be applied to the knee to provide both cold and pressure to the arthroplasty. Theoretically, this may provide cryoanalgesia, prevent local anaesthetic absorption, reduce inflammation or swelling, and finally, provide physical support to the joint. A prospective randomized study in TKR with or without compression bandages for the first 24 h indicated similar opiate requirements but reduced pain scores at rest and movement in the bandage group. On return to the ward, the patients are mobilized to and from the toilet as soon as possible with a physiotherapy visit on the day of surgery.

**Perioperative fluid management**

The debate over perioperative fluid balance continues with regard to type and amount. Inadequate fluid replacement may cause postural hypotension, renal impairment, and PONV while an excessively liberal use of fluids increases the risk of tissue oedema and in extreme cardiac failure and respiratory distress. Goal-directed therapy is well established in ERAS for colorectal surgery and is now a CQUIN target for some surgical procedures. It remains unclear whether it is necessary in lower limb arthroplasty. In TKR, fluid and blood losses are very low (operation under tourniquet and tranexamic acid). Further research to establish any benefits of cardiac output monitoring is required in an orthopaedic fast-track setting. An awake patient with a spinal anaesthetic would preclude techniques such as the oesophageal Doppler. Further interventions such as an arterial line would be required if arterial waveform cardiac output techniques such as LidCO is to be considered.

The drip stand is a major deterrent to mobility for elderly arthritic and frail patients, especially those with other co-morbidities. Kehlet advocates a restrictive fluid regime over the 24 h postoperative period (<2 litre) as opposed to a liberal regime (4–5 litre) in TKR but emphasizes the need not to dehydrate patients. THR patients lose more blood intraoperatively than TKR patients and therefore i.v. fluids are continued until the patient is able to drink adequate oral volumes.

**Failed analgesia or mobilization**

A motivated and successful ERAS team can achieve routine mobilization on the operative day. Multimodal postoperative analgesia is detailed in Table 1. Full commitment from all members of the enhanced recovery team including physiotherapists, ward nurses, doctors, and the patients is required; however, there are cases where this may not be possible. It is important with any enhanced recovery protocol to have a secondary plan if there is failure at any stage. At our centre, if patients experience pain despite local anaesthetic top-ups for TKR, a rescue femoral nerve block or an epidural is sited, provided there are no contraindications. In the case of failed local anaesthetic infiltration for a THR, an epidural is sited or rescue opioid analgesia given. Each centre will need to devise a ‘backup’ plan to identify and treat these patients promptly. Failure of one analgesic technique and conversion to another should not prevent attempts at early mobilization once comfortable. Postural hypotension is another barrier to mobilization in some groups; the incidence can be as high as 42% at 6 h after operation in THR; exact mechanisms and predictors remain unclear. However, it would seem sensible to exclude PONV, anaemia, dehydration, and cardiac causes after which 15–30 mg of oral ephedrine can be used pre-emptively before further attempts at mobilization.

**Audit**

With any new technique, it is of paramount importance to determine its efficacy, efficiency, and effectiveness. The ideal investigation is the prospective randomized controlled clinical trial, but this is difficult for many busy NHS units that do not have research facilities. However, centres should be encouraged to present any findings that may prove useful to the future development of ERAS programmes. With a multimodal multidisciplinary technique, there are numerous stages at which complications and failure may occur. Thus, carefully...
performed clinical audit also allows further modification and improvement to existing practice. Patient diaries detailing daily goals, progress, and feelings have proved useful not only for patient experience and feedback but as motivators.

**Declaration of interest**

None declared.

**References**


Please see multiple choice questions 1–4.