



Local infiltration analgesia in hip and knee arthroplasty : An emerging technique

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The optimal form of post-operative analgesia in hip and knee arthroplasty is still debated. Traditionally, patient-controlled analgesia and epidural anaesthesia were used. Potential side-effects such as nausea, confusion, urinary retention, hypotension and immobility have resulted in the emergence of newer techniques that limit opioid use. Peripheral nerve blockade provides excellent analgesia but limits patient ability to ambulate in the immediate post-operative period. Local infiltrative analgesia (LIA) is an emerging technique that has shown to provide superior analgesia, higher patient satisfaction and earlier discharge from hospital when compared to some of the more traditional methods. This review article highlights the advantages of LIA in hip and knee arthroplasty surgery. We describe the technique used, including additional measures that aid early ambulation and discharge from hospital in this cohort of patients.

Keywords : hip arthroplasty ; knee arthroplasty ; local infiltrative analgesia.

Total joint arthroplasty of the hip and knee is arguably one of the most successful medical interventions of the 20th century. The success of this surgery in improving quality of life and achieving relief of pain is well documented (2,18,23). Total hip arthroplasty has been shown to be one of the most cost-effective surgical interventions in terms of increased quality-adjusted life expectancy and of cost per quality-adjusted life year gained (4). Technological advances in prosthesis and instrument design, as well as the use of less invasive tech-

niques and navigation systems, have resulted in a less severe physiological insult to the patient (25). Improvement in both the anaesthetic and operative treatment of the patient has led to a quicker recovery, higher satisfaction, earlier discharge and a faster return to independent ambulation (3,17).

The role of early mobilisation in achieving a good clinical outcome is paramount. A recently published randomized clinical trial demonstrated a reduced hospital stay with a quicker return to independent walking when rehabilitation was commenced within the first 24 hours following surgery (16). Early mobilisation also reduces the potential risks of deep vein thrombosis as well as respiratory infections that may be associated with immobilisation (12). A shorter hospital admission will help reduce the incidence of nosocomial infection and will help provide a more cost-effective management of health services. One of the most significant factors in achieving early mobilisation is

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adequate pain control. Advances in pain management techniques in the past decade have affected the manner in which we perform hip and knee arthroplasty. While there is still considerable debate on the optimal form of post operative analgesia in hip and knee arthroplasty, it is clear that each method has its limitations and that there is no one gold standard. The ideal anaesthesia for lower extremity ambulatory surgery should be easy to carry out, have a rapid onset, provide good operating conditions, allow for early mobilisation, provide good post-operative pain relief and have minimal side effects.

It has been previously reported that a significant number of patients undergoing hip and knee arthroplasty may receive inadequate pain control in the post-operative period (8). Traditionally, the mainstay of post-operative analgesia following total joint arthroplasty has been either intravenous patient-controlled analgesia (PCA) or epidural analgesia. The use of opioids has significant side-effects such as nausea and vomiting, confusion, constipation, urinary retention, sedation, respiratory depression and pruritus. These side-effects limit early mobilisation and impede patient recovery. Additionally, opioids do not reliably provide adequate pain relief (11). Epidural anaesthesia, while providing effective analgesia, has the potential drawbacks of hypotension, urinary retention, risk of spinal haematoma and motor block which again may prevent early mobilisation (5).

As the need for analgesic regimes to minimise the use of opioids became apparent, newer techniques such as peripheral nerve blocks emerged. These can be given as both single-dose and continuous blockades and have been used with success in the setting of total joint arthroplasty (10). Lower extremity blocks can have a variable success rate depending on operator experience and method of nerve localisation. Additionally, their use has worryingly been associated with increased falls in the post-operative period due to quadriceps weakness and an inability of the patient to achieve stance-phase stability (13).

In recent years, local infiltrative analgesia (LIA) has emerged as an effective means of providing post-operative analgesia in total joint arthroplasty

with limited side effects. Thorsell *et al* performed a prospective study comparing LIA and epidural anaesthesia in controlling pain after total knee arthroplasty. Although a reduction in post-operative morphine requirements was not demonstrated, patients treated with LIA were independently mobile one day earlier when compared to epidural anaesthesia and patients were more satisfied with the procedure (26). In a randomised, double-blind study, LIA was shown to reduce morphine consumption following total knee arthroplasty resulting again in higher patient satisfaction and a trend of shorter hospital admission (7). In this study the LIA treated patients had a lower incidence of nausea and sedation with no reported side effects from this treatment. Mullaji *et al* performed a prospective, randomised trial on 40 patients undergoing simultaneous bilateral total knee replacement surgery and injected only one knee with a mixture of bupivacaine, fentanyl and methylprednisolone (20). A significant lower pain score, greater active flexion up to 4 weeks and superior quadriceps recovery up to 2 weeks following surgery was demonstrated. The use of fentanyl instead of morphine in this study was felt to be significant as fentanyl has more analgesic potency when compared to morphine. It was also postulated that the more sustained effect of the LIA at up to four weeks was due to the addition of the methylprednisolone.

We have been using LIA in both primary and revision joint arthroplasty in our unit for the past six years. We have found it to provide reliable pain relief with limited use of narcotic analgesia and minimal side effects. Importantly, our patients mobilise under supervision within a few hours of surgery and approximately 50% of our patients undergoing primary hip and knee replacement surgery are discharged home on the first post-operative day once the discharge criteria as outlined below, are met. The following describes our technique of LIA and additional measures we feel help during the post-operative period.

Technique

The injection technique is similar to the technique popularized by Kerr and Kohan (14). The injection

mixture consisted of Ropivacaine HCl (Naropin ; AstraZeneca Pty. Ltd., Sydney, Australia), 2.0 mg/mL in a 200 ml bag mixed with 30 mg ketorolac trometamol (Ketoral ; Aspen Pharmacare Australia Pty Ltd, Australia), 4 mg dexamethasone and 1mg adrenaline, with occasional variations if the patient was unusually small (< 55 kg), very elderly (> 85 years), multiple co-morbidities (American Society of Anaesthesiologists class 3 or 4), renal impairment or the presence of an intolerance to any of the agents in the injection mixture. All infiltration was done using 25-mL syringes and 10-cm-long 19-G spinal needles.

Catheter

Prior to wound closure a catheter is inserted into the joint as described in the following sections. This allows a further injection mixture on the morning of the first post-operative day. We used a 16-G Tuohy needle, an 18-G epidural catheter (Portex, Smiths Medical International Ltd. Hythe, Kent, UK), and a 0.22- μ m high-performance antibacterial flat epidural filter (SIMSPortex Co., Hythe, Kent, UK).

Injection technique in total knee replacement

Following skin incision, 50 ml of plain 0.2% naropin is injected proximally as a block of the intermediate and medial cutaneous nerves of the thigh, and in areas of fat deep to the deep fascia using a “moving needle” technique. The skin flaps are not injected. Following bony resections and prior to cementing the implants, the posterior aspect of the joint is exposed by bending the knee to 90° and opening the interval with a laminar spreader ; 50 ml of the injection mixture is injected into the posterior capsule on each side. The needle is pointed along the posterior aspect on the distal femur to avoid injecting the common peroneal nerve on the lateral side. Following cementing of the implants, a further 60-70 ml of injection mixture is injected into the synovium, medial and lateral retinaculum, anterior capsule and quadriceps. Prior to closure, a wound catheter is tunnelled in from medial to the incision, through the skin, quadriceps and medial capsule to lie along the medial femoral condyle.

The knee is then flexed and the catheter passed medially into the posterior aspect of the joint. The hub and bacterial filter is connected to the catheter and a small amount of mixture is flushed through the catheter to confirm patency of the catheter prior to wound closure.

Injection technique in total hip replacement

We perform our hip replacements through a mini-posterior approach. Fifty milliliters of plain naropin is injected into the subcutaneous tissues following the skin incision. Following acetabular exposure and preparation, 60-70 mls of injection mixture is injected into the superior, anterior and inferior capsule and peri-capsular tissues. Again this is performed using a “moving needle” technique. Towards the end of the procedure when the hip is reduced and the posterior capsule and external rotators have been repaired, a further 40 mls of mixture is injected into the posterior capsule, quadratus femoris and gluteus maximus prior to closure. A wound catheter is passed through the skin and deep fascia anterior to the skin incision. It is then passed under the trochanteric bursa and over the piriformis and directly into the joint. The hub and bacterial filter is connected to the catheter and a small amount of mixture is flushed through the catheter to confirm patency of the catheter prior to wound closure.

We do not use drains in standard hip and knee arthroplasty. All patients have a compression dressing applied prior to leaving the operating theatre. Patients undergoing total knee replacements have a wool and crepe dressing from the toes to the level of the upper thigh. This is further re-enforced with a flexible cohesive bandage (Co-plus ; BSN Medical, Hamburg, Germany). Patients have ice-packs applied to the wound in recovery.

Post-operative analgesia

We have attempted to standardise our prescription of post-operative medications to ensure good post-operative analgesia. We routinely prescribe paracetamol 1 g PO/IV 6 hourly, Celebrex® (celecoxib) 200 mg bd for three days changing to 200 mg

od for three weeks, Norspan patch (buprenorphine transdermal patch) 5 mg in recovery and tramadol 50-100 mg orally 6 hourly as required. If a patient has tramadol intolerance or is on a SSRI, then we prescribe endone (oxycodone) for the first 24 hours. We routinely prescribe cefazolin for our antibiotic prophylaxis and aspirin 150 mg od for thromboprophylaxis. Additionally, we advise aggressive mobilisation and expect all our patients to mobilise under supervision 3-4 hours following surgery.

Re-injection of anaesthetic mixture

On the early morning round of the first-post-operative day, each patient receives a top up injection of anaesthetic measure through the catheter. The mixture consists of 50 ml of 0.2% naropin, ketoral 30 mg, adrenaline 0.5 mg and dexamethasone 4 mg. Half of the mixture is injected into the posterior aspect of the joint and the remainder as the catheter is withdrawn to ensure a more even dispersion of the mixture throughout the joint.

Discharge criteria

When considering whether a patient is suitable for discharge, we have formulated discharge criteria, which enables us to determine if early discharge is appropriate. The criteria are as follows :

1. Adequate pain control (typically a pain score of 1-2)
2. Discharge medications and analgesia ready for the patient
3. Independently mobile with crutches
4. Haemoglobin > 80 or preferably > 100 g/L if over 80 years of age
5. No uncontrolled co-morbidities
6. Appropriate patient attitude
7. Suitable home environment with another person in the house
8. Suitable transport arrangements
9. Rescue plan in place if any problems arise

While we felt that LIA is an integral component of management of our arthroplasty patients, we have also modified other aspects of our practice to optimize patient recovery and outcome. We believe

that patient education prior to surgery is important in not only informing patients about the surgery and post-operative period, but dealing with the expectations and anxieties of both the patient and his/her family. While there has been conflicting data in the literature on the beneficial effects of pre-admission educational programmes, a recent study by Yoon *et al* demonstrated a shorter hospital stay in patients undergoing hip and knee arthroplasty who had participated in a pre-operative education program (6,19,28). We routinely explain to the patient our method of LIA and the potential benefits or early mobilisation and discharge from hospital. We explain the importance of mobilisation on the day of surgery. We have found it to be a very important factor in achieving patient co-operation and improving patient determination in the post-operative period.

We no longer use a tourniquet when performing routine knee replacements. Reperfusion of a limb is associated with both local and systemic pro-inflammatory responses which can adversely affect patient outcome. Restoration of blood flow to a limb initiates a cascade of cellular and biochemical events that result in muscle oedema and impaired muscle function (22). While every attempt is made to keep tourniquet time to less than 90 minutes, Wakai *et al* have demonstrated enhanced neutrophil transendothelial migration that has the potential for tissue injury with tourniquet use of less than thirty minutes in young healthy males undergoing knee arthroscopy (27). Knee arthroplasty patients are typically older with multiple co-morbidities and less able to tolerate the physiological insult that may be associated with tourniquet use. Additionally, the reperfusion pain that is associated with tourniquet deflation is also eliminated which in turn limits patient's pain in the immediate post-operative period.

A further advantage of not using a tourniquet is the accurate control of haemostasis that one is forced to achieve. The bleeding vessels have to be meticulously cauterised to improve visualisation and allow the surgery to be performed safely. This limits post-operative swelling, which improves patients' postoperative recovery and reduces pain (9). An additional method of limiting lower limb swelling in the immediate post-operative peri-

od is the application of a compression bandage from the toes to the level of the proximal thigh. We routinely perform this on all our knee replacements and have found that patients are more comfortable in the immediate post-operative period. This is in keeping with the findings of Andersen *et al* who demonstrated improved pain relief with LIA when used with a compression bandage in total knee arthroplasty (1).

Another aspect of our practice that we feel has improved patient recovery following knee and hip arthroplasty is the use of smaller incisions and less invasive surgical exposures. Modern instrumentation allows sufficient exposure to perform the surgery safely and effectively while minimising injury to the surrounding musculature and soft tissues. Proponents of minimally invasive surgery have demonstrated a shortened hospital stay and reduced post-operative pain with this form of surgery (3, 15,21). We also use patient specific cutting jigs that are custom made for each patient based on pre-operative MRI. This negates violation of the intramedullary canal during total knee arthroplasty which can be a significant source of bleeding during the procedure (24).

In conclusion, a collaborative approach between the orthopaedic surgeon and anaesthetist is required to achieve optimal pain relief for patients following hip and knee arthroplasty to allow early mobilisation. While we acknowledge that anaesthesia in this cohort has to be tailored to each patient, it has been our experience that LIA is well tolerated and allows early ambulation with good pain control.

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