Acta Orthop. Belg., 2016, **82**, 265-270

ORIGINAL STUDY

Postoperative pain relief and functional outcome following total knee arthroplasty – a prospective comparative audit of three analgesic regimes

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Pain control plays a key role in joint-replacement surgery. As a surgeon the challenge is to reduce pain to an acceptable level in the post-operative period. The aim of the study was to assess the efficacy of bolus local anaesthesia, infusion in to the surgical site and nerve blocks with femoral nerve catheter and its functional outcome.

A prospective audit of 114 patients undergoing total knee arthroplasty were carried out.The patients were divided in to three groups : Group 1 (n = 27) received a bolus injection of 20 ml 0.25% levobupivacaine + 10 ml 0.25%bupivacaine + adrenaline + 30 ml saline. Group 2 (n = 39) received a bolus injection as on group 1 with 240 ml 0.25% bupivacaine infusion and 5 ml/hour using a Pain Buster pump. Group 3 (n = 48) received 30 ml 0.125% levobupivacaine to femoral (3-in-1) block with 30 ml 0.25% levobupivacaine to sciatic nerve and introduction of a femoral nerve catheter. All patients were prescribed paracetamol 1 g QDS, Oxycontin 20 mg BD and Ibuprofen post operatively. Pain was assessed with a Visual Analog Scale (VAS). The incidence of PONV was measured by PONY intensity score.

The mean post-op VAS score for Group 3 was 4. The demand of oxynorm and NSAID were minimal in Group 3. The mean in patient stay for Group 3 was 3.1 days. The PONV intensity score was > 50 for 9 (36%) in Group 1, 15 (40%) in Group 2 and 9 (20%) in Group 3. There was loss of 20-30 degrees of flexion movements in Group 3 in the first 4 to 6 days post-op. Our study demonstrated that Regime 3 with the use of nerve blocks and femoral nerve catheter has given the maximum pain relief and good functional outcome following total knee replacement.

No benefits or funds were received in support of this study.
The authors report no conflict of interests.

Keywords : pain relief ; total knee replacement ; nerve blocks ; local infiltration ; pain buster ; functional outcomes.

INTRODUCTION

The patients undergoing total knee replacement will experience significant pain (*2,3*). As a surgeon the challenge is to reduce pain to an acceptable level in the post-operative period. It is the leading cause for delay of discharge from the hospital. Pain control plays a key role in joint-replacement patient's recovery (*23*). The patient's perception of pain most notably impacts the time it takes them to regain mobility.

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The use of local anaesthetic infiltration is commonly used in majority of all orthopaedic procedures (*8*). It involves infiltration of soft tissue with long acting local anaesthetic in combination with epinephrine supplemented with oral analgesiscs (*16*). There are studies in which an intra-articular local anaesthetic infusion has been used with varied results (*20*).

In the recent years the use of peripheral nerve blocks has been very prevalent in the practice of orthopaedic surgery, both in upper and lower limbs (*11*). Continuous three in one nerve blocks in the lower limb is sometimes more effective than epidural analgesia. They help with efficient rehabilitation, less requirement for narcotic analgesia and improved patient satisfaction outcomes. It also has got fewer side effects such as urinary retention, nausea and vomiting (*4,18,5,24,12*).

The mobilisation of the knee usually starts in the immediate postoperative period, for this adequate analgesia is very essential. The analgesia should not interfere with the mobilisation of the knee and at the same time provide with effective pain relief. The femoral nerve block has been reported to facilitate increase in knee flexion exercises with few side effects (*9*). In the past the degrees of knee flexion gained by the patient after total knee replacement is used as a criterion to assess the functional recovery and the efficacy of analgesia used (*6*). But recently the ability to mobilise from chair to standing and walking independently is a more reliable indicator of a good functional outcome after total knee replacement (*17*).

MATERIALS AND METHODS

A prospective comparative audit of three postoperative regimes for pain control was used. The patients received either a spinal anaesthetic (with hyperbaric bupivacaine 0.5% +/-intrathecal diamorphine 0.2-0.3 mg), or general anaesthesia as appropriate. Ondansetron 4mg (+/- dexamethasone 6.6 mg) was given intraoperatively.

Regime 1 : Bolus LA only

20 ml 0.25% levobupivacaine + 10 ml 0.25% bupivacaine + adrenaline + 30 ml saline

Regime 2 : Bolus LA + infusion into surgical site

20 ml 0.25% levobupivacaine + 10 ml 0.25% bupivacaine + adrenaline + 30 ml saline bolus (by surgeon) and 240 ml 0.25% levobupivacaine infusion at 5 ml/hr via Pain Buster (270 ml 5 ml/hr device filled aseptically)

Regime 3 : Nerve blocks + nerve catheter

30 ml levobupivacaine 0.125% to femoral (3-in-1) block and 30 ml levobupivacaine 0.25% to sciatic block Nerve catheter (femoral) to be topped up with 10 ml 0.25% levobupivacaine added to 10ml normal saline (i.e. 20 ml 0.125% levobupivacaine) 1-2 doses per day during "office hours" for 48 hours (i.e. up to 4 top-ups). If there is a motor block present, the top up should be delayed until it has resolved. All "top ups" will be prescribed on the drug cardex and carried out by the anaesthetist.

The regimes are suitable for patients whose body weight is 75 kg or more (equivalent to a max dose of bupivacaine 2 mg/kg) and for smaller patients the dose was reduced proportionately.

Post-Operative Regime

All patients were prescribed a postoperative regime of : Paracetamol 1 g QDS (if tolerated), and Oxycontin 20 mg BD (if elderly 10 mg BD) or PCA if required, Ibuprofen (max 1.6 g per day) is prescribed only if there are no contraindications such as bronchial asthma and chronic renal disease.

Data Collection

Each patient received a Patient Pain Diary to be completed during the first 3 days following surgery. This will record the patient's perception of pain score, nausea and vomiting and their ability to perform tasks.

In addition, a nominated person recorded, within the first 0-12 hours, 12-24 hrs and 24-48 hrs the :

a) Highest pain score recorded
b) Number of hours the pain score was above 5
c) Nausea/vomiting score
d) Ability to perform straight leg raise, mobilize with Zimmer frame, mobilise with crutches, and manage stairs.
e) Percentage of dressing soiled with clear or blood stained fluid
f) Record method of anticoagulation.

Table I. — Patient distribution in three Groups

Groups	No.
Group 1- Bolus LA only	27
Group 2- Bolus LA + infusion into surgical site	39
Group 3- Nerve blocks + nerve catheter	48

Table II. — Patient demographics in each Group

	Group 1	Group 2	Group 3
Sex (M/F)	16/11	21/18	28/20
Mean Age	73.5	72.8	71.9
Index side (R/L)	14/13	22/17	28/20

All patients included in the study had a four hourly observation for VAS pain and PONV inyensity scores for the first 72 hours. Patient's progress with the knee movements were documented daily by the specialist lower limb physiotherapist regarding active range of motion (ROM). They also measured the ROM with a short-arm goniometer. The average number of inpatient stay was monitored.

RESULTS

A total of 114 patients undergoing total knee replacement were included in the study. The patients were divided in to three groups depending on the postoperative regime they received. There were 27 patients in Group 1 who received regime 1. In group 2 there were 39 patients and in Group 3 there were 48 patients (Table 1). There were 56 males and 48 females. The index side was right in 54 and left in 60 patients. The mean age group was 72.7 (Range 68 to 78) Table 2.

The mean post-op VAS score for each regime, Group 1-5, Group 2-4.25, Group 3-4 (Fig. 1). The demand of oxynorm and NSAID were minimal in Group 3.

The PONV intensity score after 6 and 24 hours post surgery was > 50 for 9 (36%) in Group 1, 15 (40%) in Group 2 and 9 (20%) in Group 3 (Fig. 2).

The mean inpatient stay for Group 1 was 4.2 days, Group 2 was 3.8 days and in Group 3 was 3.1 days (Fig. 3). There was loss of 20-30 degrees of flexion movements in Group 3 in the first 4 to 6 days post-op. But at the end of 6 weeks review there was no significant difference in the post-operative flexion-extension between the three groups. There was no incidence of DVT in any of these groups. There was no evidence of post op wound drainage, haematoma or early infection in any of the groups. One patient in Group 3 had a fall on the first post-operative day and sustained an undisplaced fracture of the distal radius.

DISCUSSION

The infiltration of local anesthetics in to the peri-articular tissues can provide analgesia through several mechanisms. They directly block transmission of pain from nociceptive afferents from the wound surface and inhibit local inflammatory responses to injury by reducing the release of inflammatory mediators from neutrophils, preventing neutrophil adhesion to the endothelium and thereby leading to the decreased formation of free oxygen radicals and oedema formation (*14,15*).

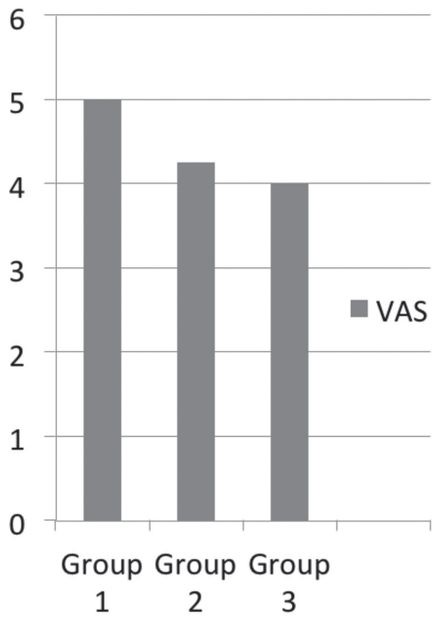

Fig. 1. — The bar graph showing the VAS for pain

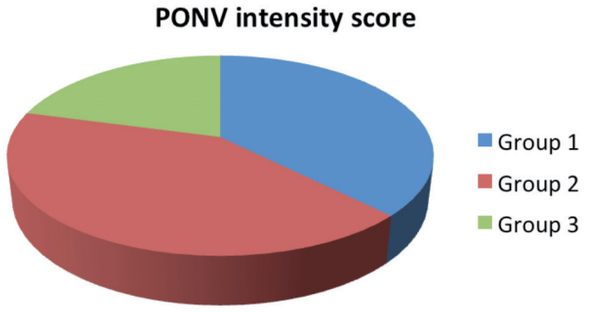

Fig. 2. — Pie chart showing the percentage of patients in each group with > 50 PONV score.

Kerr *et al* in their study in which they infiltrated local anaesthetics in the periarticular tissues during surgery has showed good results (*16*). This simpler technique achieved superior postoperative analgesia with minimal doses of opiods. This also helped in early patient mobilisation. Toftdahl *et al* in their comparative study of periarticular infiltration and continuous femoral nerve block showed good results with periarticular infiltration of local anaesthetics (*25*). This is in contrast to our study where femoral nerve blocks gave good quality analgesia with less use of opioids.

Bergman *et al* in their randomised double blind study comparing intraarticular and extra articular infusion of ropivacine after total knee replacement concluded that continuous infusion of ropivacaine intraarticulary did not improve postoperative analgesia at rest compared to extra articular infusion, but it appeared to reduce the incidence of high pain intensity during first exercises. This has helped to improve mobilization within 24 hours after total knee arthroplasty (*10*).

The three in one block for post-operative pain relief in total joint arthroplasty is an effective method of delivering analgesia.Continous infusion using a catheter in to the femoral nerve has shown to reduce the use of opioids and improves the range of movements in the immediate post-operative period (*12*). The placement of these catheters is very important in delivering the analgesic regime to the site. Capdevila *et al* in their study demonstrated that the tip of the catheter should be in the vicinity of the femoral nerve so that the pain medications can be effectively administered (*5*).

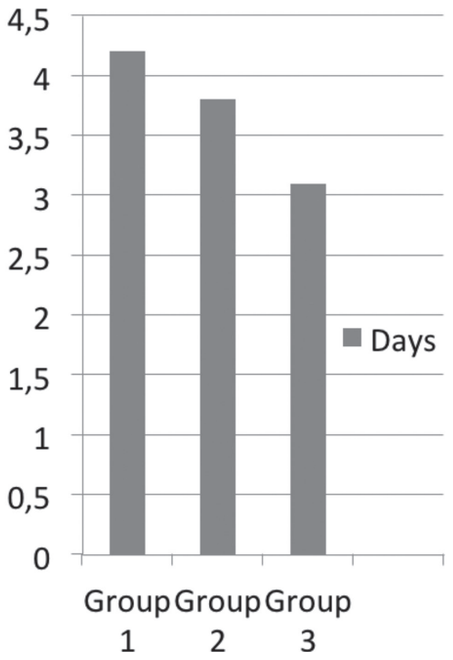

Fig. 3. — The bar graph showing the mean inpatient stay

The optimum concentration and infusion rates for the peripheral nerve blockade is not been established. Various studies have recommended infusion rates between 6 ml per hour to 12 ml per hour (*27*).

The efficacy of femoral nerve blocks alone is controversial since the sciatic nerve innervates the posterior and lateral aspect of the knee. While it is necessary to combine both femoral and sciatic nerve blocks for total knee arthroplasty anaesthesia, adequate postoperative analgesia is usually achieved with femoral nerve block. Dang *et al* in their studies have utilized a combination of continuous sciatic nerve block and femoral nerve block in patients undergoing total knee arthroplasty (*7*).

One study found minimal benefits of adding a sciatic nerve blocks to femoral nerve block. There were no differences in morphine consumption with femoral blocks and the combined sciatic-femoral block. The authors concluded that sciatic innervation of the posterior knee may be a minor contributor of post-operative pain following total knee arthroplasty (*1*). The benefit of blocking the obturator nerve in a psoas block is limited. There was only very little benefit in analgesic requirements in a pso-

as block and no difference in functional outcome when compared to femoral and sciatic blocks (*19*).

The nerve blocks above may be performed with a single injection of local anaesthetic or with a continuous infusion through an indwelling catheter. The benefits offered by a continuous infusion may include better analgesia through the second postoperative day ; however one study did not demonstrate a difference in length of hospital stay and functional recovery. The limitations of a continuous catheter include additional time, cost, and skills required to manage the catheter. There are also potential risks of infections and nerve injury with continuous catheters (*21*).

The use of peripheral nerve blocks is not devoid of side effects and complications. The clinicians must carefully evaluate the individual risk and benefit ratio of adding the sciatic block solely for postoperative analgesia. Sharma *et al* in their study of 709 femoral nerve blocks in total knee replacements using a single-injection technique into the femoral nerve sheath confirmed with nerve stimulation before induction has noticed few complications. Twelve patients (1.6%) sustained falls, three (0.4%) of whom underwent reoperations. Five patients had postoperative femoral neuritis, which may have been secondary to the block. One patient had new onset of atrial fibrillation (*22*). In our study one patient had a fall in the nerve block group and sustained a distal radius fracture.

The incidence of post-operative nausea and vomiting(PONV) varies from 20 to 30% for general anesthesia with no risk factors (*13*). In the past there were no reliable scales, indices or scoring systems available for PONV.We used the PONV intensity scoring system designed by Kakos *et al* to document and measure PONV after total knee repalcement.Clinically important PONV is defined as total score ≥ 50 at any time throughout the study period (*20*). In our study Group 1 and Group 2 had high PONV intensity scores.

The main limitation of our study is that it is an observational audit rather than a randomised trial. It was designed to ascertain whether the three analgesic regimes were safe for the patients and practical to use in an ordinary busy post-operative ward environment. The study was formulated initially to conduct a rapid enrolling of patients to each analgesic regime groups in a short space of time with a view to review the results quickly from patient records. It also focussed on the cost, time consumption and the feasibility to carry out the study in normal clinical settings. The results obtained in terms of pain, post-operative nausea and vomiting, hospital stay and functional outcomes suggest that a randomised clinical trial is justified to investigate whether the observed differences were clinically and statistically significant.

Our study demonstrated that Regime 3 with the use of Nerve blocks and femoral nerve catheter has given the maximum pain relief and good functional outcome following total knee arthroplasty. Opioids remain an integral part of most analgesic pathways but techniques and analgesic regimes that reduce opioid requirements typically improve pain control both at rest and with motion. It minimises opioid related side effects, and provide better patient satisfaction for pain control. It also reduces the incidence of long-term pain following surgery which will shorten the length of hospital stay with good functional outcomes for these patients.

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