



A Prospective Comparative Study of Post Total Knee Arthroplasty Pain Management by Epidural vs Local Infiltration

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ABSTRACT

In a randomized controlled trial, we compared whether local infiltration analgesia would result in better pain management after total knee arthroplasty (TKA) than epidural analgesia (EA). Two groups were made with 30 patients each. Group local infiltration analgesia (LIA) with a total of 30 patients (mean age of 65 years) received LIA with a periarticular injection of a mixture of ropivacaine, adrenaline, and ketorolac that was prepared under strict sterile conditions. In group EA, 30 patients (mean age of 67 years) were given EA. There was no statistically significant difference of pain at rest. The mean opioid consumption was higher in those receiving local infiltration. Most secondary outcomes were similar, but EA patients had lower pain scores when walking and during continuous passive movement. If EA is not readily available, local infiltration provides similar length of stay and similar pain scores at rest following TKA.

Keywords: Epidural analgesia, Local infiltration analgesia, Pain management, Total knee replacement, Visual analog scale.

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INTRODUCTION

Total knee arthroplasty (TKA) is a common surgical procedure but is painful and requires careful management in order to balance patient comfort and early postoperative function. Traditional methods of pain management, such as the use of parenteral opioids provide inadequate pain relief and are limited by excessive adverse effects. Epidural analgesia (EA) is used in many institutions and can provide good pain control. However, the failure rate with EA approaches 20% and is commonly associated with adverse effects, such as excessive motor block.¹

The more recent use of peripheral nerve blocks, such as continuous femoral block, has been shown to provide pain control equivalent to epidural techniques, and with fewer adverse effects, especially when used as part of a multimodal analgesic regimen.² Consequently, the use of continuous femoral block in this context has come to be regarded by many to be the gold standard for pain relief after TKA.³ An initial bolus of ropivacaine 2 mg/mL and subsequent infusion^{4,5} of ropivacaine 1 to 2 mg/mL injected around the femoral nerve provides not only very good postoperative pain relief but also ready mobilization on the evening of and days after surgery.

Local infiltration analgesia (LIA) at the surgical site has become relatively common for a number of surgical procedures and can produce effective analgesia and has the advantage of relative simplicity compared with other regional anesthesia techniques.⁶ Subsequently, an effective protocol for LIA was developed and then shown to provide effective pain control and ability to ambulate in a series of 86 patients having TKA.⁷ Since then, there have been 20 further studies in which several studies demonstrated improved pain control and reduced adverse effects with the LIA technique compared with placebo. Currently, a few studies have been compared LIA with other regional anesthesia techniques; two studies with EA and two with continuous femoral nerve block (FNB).

A recent observational study⁸ quantified the incidence of persistent pain as 36% after primary knee arthroplasty, and showed that the most important independent predictor of persistent pain was the degree of pain relief in the first week after operation.

MATERIALS AND METHODS

A total of 60 patients were consecutively assigned alternately. All patients were operated with regional anesthesia: The local infiltration anesthesia group with spinal anesthesia and the epidural anesthesia group with spinal or epidural anesthesia. Thirty patients were assigned to the epidural anesthesia group with postoperative pain relief by infusion of local anesthetics (ropivacaine 2 mg/mL) through a lumbar epidural catheter introduced preoperatively. Another 30 patients were assigned to the local infiltration anesthesia group for postoperative

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pain relief with a mixture of ropivacaine 2 mg/mL, 150 mL; adrenaline 0.1 mg/mL, 5 mL; and ketorolac 30 mg/mL, 1 mL (a total of 156 mL) that was prepared under strict sterile conditions. The mixture was distributed into three 50 mL syringes. The patients were operated under spinal anesthesia (bupivacaine 5 mg/mL, 3–4 mL). Ropivacaine is new local anesthetic drug i.e., considered less toxic and has replaced bupivacaine as the local anesthetic of choice.⁸ We added adrenaline to ropivacaine for infiltration in the knee intraoperatively, as described by Kerr and Kohan.⁷ Ketorolac was added to supplement analgesia.

A visual analog scale (VAS) (Fig. 1) is a pain measurement instrument i.e., used to measure the intensity of pain. Using a ruler, the score is determined by measuring the distance (mm) on the 10-cm line between the “no pain” anchor and the patient’s mark, providing a range of scores from 0 to 10. A higher score indicates greater pain intensity. Based on the distribution of pain VAS scores in postsurgical patients who described their postoperative pain intensity as none, mild, moderate, or severe, the following cut points on the pain VAS have been recommended: No pain (0–4 mm), mild pain (5–44 mm), moderate pain (45–74 mm), and severe pain (75–100 mm).⁹

Surgical Technique

Surgery in both groups was performed using a tourniquet with pressure between 250 and 300 mm Hg. Average surgical time was 71 minutes. All patients had intravenous (IV) antibiotic prophylaxis given approximately 30 minutes preoperatively. A straight anterior skin incision and a medial parapatellar arthrotomy were used. The femoral bone cuts were made with the help of an intramedullary guide, and the tibial cuts with an extramedullary guide. Bone resections were cleaned with pulsative lavage. We used the PFC prosthesis (DePuy) with an all-poly tibial plateau, and all parts were fixed with cement with gentamicin (Palacos R+G; Heraeus Medical, Hanau, Germany).

Local infiltration anesthesia was performed in the following order:

- After preparation of the bone and before cementing the components, the posterior aspect of the capsule was infiltrated with 52 mL of the mixture.
- After cementing the components, the second syringe containing 52 mL was infiltrated in the structures medially and laterally and in the capsules.
- The capsule was closed and the last 52 mL was infiltrated in the front of the capsule, subcutaneously and in the skin after closure. Every patient had a drain. The same regime for postoperative oral analgesia was used in both groups. Low-molecular-weight heparin (0.6 mg) was given subcutaneously for 3 days, starting 1 day preoperatively.

Evaluation

Both groups were followed according to the same protocol. Pain was assessed using the VAS once an hour for 4 hours postoperatively, and then every fourth hour until 8 am on postoperative day 2. Intravenous analgesia, if used, was also registered with details of dosage and time given.

Patient Satisfaction

When pain registration was discontinued at 8 am on postoperative day 2, patients were asked to give their opinion regarding the postoperative pain control method. The options were “very satisfied,” “satisfied,” “acceptable,” and “not satisfied.”

Functional Recovery

Patient progress was documented daily by the patient’s physiotherapist regarding active range of motion, what postoperative day the patient independently moved in and out of bed, and what postoperative day the patient walked independently with crutches or walking frame. The number of patients with an extension defect of $>5^\circ$ on postoperative day 1 and at discharge was recorded. Range of motion was measured with a short-arm goniometer. Time spent in the recovery room (minutes) was recorded, as were number of days until discharge.

Acceptability

Visual analog scale for measuring pain was found to be quite acceptable to patients. Some older patients with cognitive impairment had difficulty in understanding and therefore completing the scale needed supervision to measure the score.

Reliability

Test–retest reliability has been shown to be good, but higher among literate ($r = 0.94$, $p = 0.001$) than illiterate patients ($r = 0.71$, $p = 0.001$) before and after attending a rheumatology outpatient clinic.

Ability to detect Change

In patients with chronic inflammatory or degenerative joint pain, the pain VAS has demonstrated sensitivity to changes in pain assessed hourly for a maximum of 4 hours and weekly for up to 4 weeks following analgesic therapy ($p = 0.001$).

RESULTS

There was no difference between groups in terms of pain. The mean pain score was 5.5 (local infiltration) and 4.2 (EA) (Table 1). Among 30 patients receiving local infiltration,

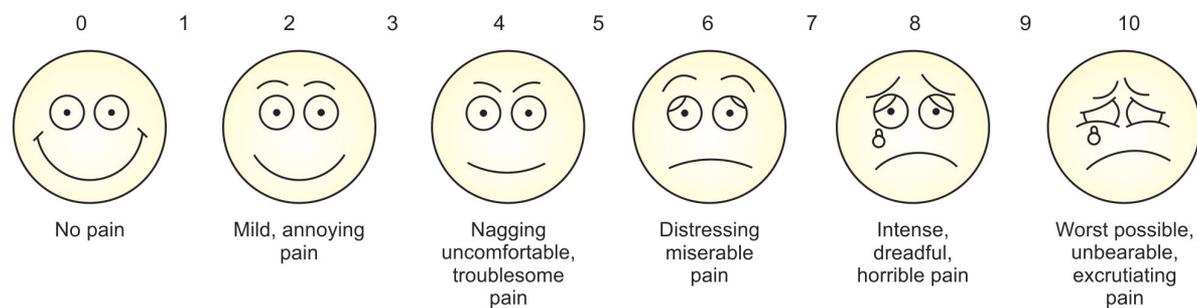


Fig. 1: Visual analog scale

3 also received IV analgesia and 1 received EA because of high pain scores. Among 30 EA patients, none received any extra analgesia for pain relief.

A difference in pain during walking between the groups was detected in the model. The β estimate for the treatment effect implies that the local infiltration group had a mean pain during walking of 0.81 points higher than did the EA group ($p = 0.0084$).

A borderline difference between the groups in pain during physiotherapy was detected. The β estimate for the treatment effect implies that the local infiltration group had a mean pain score during physiotherapy of 0.55 points higher than did the EA ($p = 0.0951$).

A difference in pain while using continuous passive movement (CPM) between the treatment groups was detected. The β estimate for the treatment effect showed that the local infiltration group had a mean pain score during CPM of 0.88 points higher than did the EA group ($p = 0.0132$) Table 1.

One adverse event was reported to our Institutional Review Board. This patient had received local infiltration and developed infection and had to be taken for wound wash. This was judged not to be related to participation in the study because it occurred on the 5th postoperative day.

Table 1: Pain score

Groups	Mean age	Mean pain score (VAS)	Pain score with physiotherapy	Pain score with CPM
EA	67	4.2	5.6	6.5
LIA	65	5.5	6.1	7.4

DISCUSSION

Although the primary outcome was similar in both groups, some secondary outcomes favored EA. Epidural analgesia patients had statistically significantly better pain control while walking and during CPM, although the difference was <1 on a scale of 0 to 10. A recent study reported similar pain scores with local infiltration compared with continuous FNB¹⁰ and recommended the former as a cheaper and easier alternative. Dalury et al¹¹ reported that local infiltration following total knee replacement (TKR) provided better analgesia than conventional pain management. Busch et al¹² found that local infiltration reduced

patient-controlled epidural anesthesia (PCEA) use and improved patient satisfaction. Kehlet and Andersen¹³ reviewed 14 studies and found support for local infiltration with a single injection, but not via a wound catheter. Limitations noted for many of the studies included the inadequate assessment of pain and unsatisfactory quality comparators, such as inadequate analgesic regimens for the controls or the use of nonsteroidal anti-inflammatory drugs (NSAIDs) in patients receiving local infiltration but not among controls. The effect of local infiltration on length of stay was unclear in these studies. McCartney and McLeod¹⁴ emphasized that only 4 of 21 studies of local infiltration after TKR compared it with other regional analgesic techniques, either PCEA or continuous FNB. Local infiltration provided better analgesia than either FNB or PCEA, but criticisms included the administration of NSAIDs to the local infiltration groups and complications associated with local infiltration. Raeder¹⁵ commented on a study that found that local infiltration provided better analgesia than intrathecal morphine along with IV PCEA,¹⁶ but this comparator was considered suboptimal. Local infiltration was deemed promising, but research was advocated both to identify the roles of each individual component of local infiltration and to compare it with the best potential alternatives. Our study addresses many of these criticisms by comparing local infiltration with an excellent alternative (PCEA) using NSAIDs in both groups, and using many detailed and validated outcome measures, analyzed at many time points.

Local infiltration might be better suited for patients for whom EA is contraindicated. Further research is also needed to determine whether the addition of a nerve block to local infiltration would improve postoperative analgesia. For institutions in which EA is not readily available, local infiltration provides similar length of stay and similar pain scores at rest following TKR.

CONCLUSION

Local infiltration analgesia is a simple technique and shows promise of early postoperative pain relief after TKA. However, in the present study, EA showed a significant edge in the intensity of pain relief after TKA.

REFERENCES

1. McLeod G, Davies H, Munnoch N, Bannister J, MacRae W. Postoperative pain relief using thoracic epidural analgesia: outstanding success and disappointing failures. *Anaesthesia* 2001 Jan;56(1):75-81.
2. Singelyn FJ, Deyaert M, Joris D, Penderville E, Gouverneur JM. Effects of intravenous patient-controlled analgesia with morphine, continuous epidural analgesia, and continuous three-in-one block on postoperative pain and knee rehabilitation after unilateral total knee arthroplasty. *Anesth Analg* 1998 Jul;87(1):88-92.
3. Hadzic A, Houle TT, Capdevila X, Ilfeld BM. Femoral nerve block for analgesia in patients having knee arthroplasty. *Anesthesiology* 2010 Nov;113(5):1014-1015.
4. Paauwe JJ, Thomassen BJ, Weterings J, van Rossum E, Ausems ME. Femoral nerve block using ropivacaine 0.025, 0.05 and 0.1%: effects on the rehabilitation programme following total knee arthroplasty: a pilot study. *Anaesthesia* 2008 Sep;63(9):948-953.
5. Brodner G, Buerkle H, Van Aken H, Lambert R, Schweppe-Hartenauer ML, Wempe C, Gogarten W. Postoperative analgesia after knee surgery: a comparison of three different concentrations of ropivacaine for continuous femoral nerve blockade. *Anesth Analg* 2007 Jul;105(1):256-262.
6. Bianconi M, Ferraro L, Traina GC, Zanolli G, Antonelli T, Guberti A, Ricci R, Massari L. Pharmacokinetics and efficacy of ropivacaine continuous wound instillation after joint replacement surgery. *Br J Anaesth* 2003 Dec;91(6):830-835.
7. Kerr DR, Kohan L. Local infiltration analgesia: a technique for the control of acute postoperative pain following knee and hip surgery: a case study of 325 patients. *Acta Orthop* 2008 Apr;79(2):174-183.
8. Puolakka PAE, Rorarius MGF, Roviola M, Puolakka TJS, Nordhausen K, Lindgren L. Persistent pain following knee arthroplasty. *Eur J Anaesthesiol* 2010 May;27(5):455-460.
9. Carli F, Clemente A, Asenjo JF, Kim DJ, Mistraletti G, Gomarasca M, Morabito A, Tanzer M. Analgesia and functional outcome after total knee arthroplasty: periarticular infiltration vs continuous femoral nerve block. *Br J Anaesth* 2010 Aug;105(2):185-195.
10. Affas F, Nygards EB, Stiller CO, Wretenberg P, Olofsson C. Pain control after total knee arthroplasty: a randomized trial comparing local infiltration anesthesia and continuous femoral block. *Acta Orthop* 2011 Aug;82(4):441-447.
11. Dalury DF, Lieberman JR, MacDonald SJ. Current and innovative pain management techniques in total knee arthroplasty. *J Bone Joint Surg Am* 2011 Oct;93(20):1938-1943.
12. Busch CA, Shore BJ, Bhandari R, Ganapathy S, MacDonald SJ, Bourne RB, Rorabeck CH, McCalden RW. Efficacy of periarticular multimodal drug injection in total knee arthroplasty: a randomized trial. *J Bone Joint Surg Am* 2006 May;88(5):959-963.
13. Kehlet H, Andersen LO. Local infiltration analgesia in joint replacement: the evidence and recommendations for clinical practice. *Acta Anaesthesiol Scand* 2011 Aug;55(7):778-784.
14. McCartney CJ, McLeod GA. Local infiltration analgesia for total knee arthroplasty. *Br J Anaesth* 2011 Oct;107(4):487-489.
15. Raeder JC. Local infiltration analgesia for pain after total knee replacement surgery: a winner or just a strong runner-up? *Anesth Analg* 2011 Oct;113(4):684-686.
16. Essving P, Axelsson K, Aberg E, Spännar H, Gupta A, Lundin A. Local infiltration analgesia versus intrathecal morphine for postoperative pain management after total knee arthroplasty: a randomized controlled trial. *Anesth Analg* 2011 Oct;113(4):926-933.