Efficacy of Periarticular Injection of Bupivacaine, Fentanyl, and Methylprednisolone in Total Knee Arthroplasty

A Prospective, Randomized Trial

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Abstract: We evaluated the efficacy of periarticular infiltration of corticosteroid, opioid, and a local anesthetic by comparing pain scores, knee flexion, and quadriceps function on the day of surgery, first postoperative day, day of discharge, and 2 and 4 weeks after surgery between the infiltrated and the noninfiltrated knee in 40 patients undergoing simultaneous bilateral computer-assisted total knee arthroplasty who were randomized to receive the injection in the right or left knee. In comparison to the noninfiltrated side, the infiltrated knee showed significantly lower pain scores, significantly greater active flexion up to 4 weeks, and superior quadriceps recovery up to 2 weeks after surgery. This simple and inexpensive technique can significantly reduce pain and hasten functional recovery in the first month after total knee arthroplasty. **Keywords:** total knee arthroplasty, periarticular injection, pain score, knee flexion, extensor lag.

Total knee arthroplasty (TKA) is a major operation associated with considerable pain [1,2]. Adequate pain relief is essential for early mobilization and physiotherapy [3,4] to obtain optimum range of motion and may therefore influence the overall outcome [3]. Many modes of preoperative, perioperative, and postoperative analgesia have been reported for patients undergoing TKA [3] including periarticular [5-10] or intraarticular [1,2,7,11] injections of local anesthetic before [3,5-10] or after [1,5] joint closure.

There are conflicting reports on the usefulness of intraarticular local anesthetic [1-3,5,10-13] and opioid [3,5,11,13-15] injections in reducing postoperative analgesic requirements after TKA. Furthermore, there are very few reports on use of local corticosteroid injections after TKA [7,8]. However, there have been several reports on the benefit of local anesthetic, methylprednisolone, and opioid injection after arthroscopic knee surgery [16-21]. Moreover, there are very few reports highlighting the effect of local analgesic injections on knee flexion after TKA; and these have demonstrated equivocal results [1,3-5,10].

In view of the reported advantages of local anesthetic, corticosteroid, and opioid injection, the analgesic cocktail used in this study included a long-acting local anesthetic that provides more sensory than motor blockade (bupivacaine) [22], an opioid that is 100 times more potent than morphine (fentanyl) [23], and an intermediate-acting corticosteroid (methylprednisolone) [24].

Previous studies have been performed in different patient cohorts for comparing the effect of local analgesic injection on postoperative pain control and knee flexion. Pain threshold may vary from patient to patient which may account for the confusing and conflicting conclusions from earlier studies. The aim of this study was, for the first time, to evaluate patients undergoing bilateral simultaneous TKA in which a periarticular injection of local analgesic cocktail was infiltrated in just one knee so that we could compare, in randomized and blinded fashion, the postoperative pain scores and functional knee recovery between the infiltrated and the noninfiltrated knee in the same patient.

Patients and Methods

A prospective study was conducted over a 6-month period from July 2006 to December 2006 during which

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102 simultaneous bilateral TKAs for tricompartmental osteoarthritis were performed in 51 consecutive patients. Patients were excluded from the study if they had (1) rheumatoid arthritis, (2) diabetes mellitus, (3) neuromuscular deficit, (4) a known allergy to one of the drugs being injected, (5) a history of cardiac disease or arrhythmia requiring special monitoring, or (5) been administered general anesthesia. Eleven patients were excluded for one or more of the above reasons. This left 40 patients (29 female and 11 male) in whom 80 TKAs were performed and who form the basis of this study. The mean age of the patients was 65.8 years (range, 50-80 years), and the mean BMI was 31.1 kg/m^2 (range, 18.7-43.8 kg/m^2). The study protocol was approved by the ethics committee. Patients signed informed consent before participation in the study.

All patients were given an oral COX-2 inhibitor (etoricoxib 60 mg) the night before surgery as a preemptive analgesic [25,26]. Combined spinal (3.5 mL of 0.5% bupivacaine heavy) and epidural (bolus 6-8 mL of 0.5% bupivacaine) anesthesia was given in all patients.

All TKAs were performed by the senior surgeon (AM), and these were approached through an anterior midline incision and standard medial parapatellar arthrotomy. All TKAs were navigated using Ci software (DePuy, Leeds, United Kingdom). Posterior stabilized components fixed with cement (Press Fit Condylar Sigma, DePuy) were used in all patients; the patella was resurfaced in all. The surgeries were performed sequentially. Infiltration was performed before the tourniquet was deflated while the cement was curing. All patients received periarticular infiltration of analgesic cocktail in one knee, whereas the other knee was not infiltrated. The tissues that were infiltrated were the edges of the arthrotomy, quadriceps tendon, medial collateral ligament, retropatellar fat pad, and posteromedial soft-tissue sleeve. The side to be infiltrated in each patient was randomized prospectively by using computer-generated numbers. Twenty patients had infiltration in the right knee; and the other 20, in the left knee. The order in which the knees were operated upon (ie, which side was done first or second) was such that we alternated the order in terms of the side that was to be infiltrated with that which was not. The ingredients of the analgesic cocktail and their dose are shown in Table 1, and the timeline of administration of various medications is depicted in Fig. 1.

Table 1. Ingredients of the Analgesic Cocktail and Their Dose

Drug	Dose
Bupivacaine	2 mg/kg body weight
Fentanyl	100 μg
Methylprednisolone acetate	40 mg
Cefuroxime	750 mg
Sodium chloride 0.9% wt/vol	25 mL

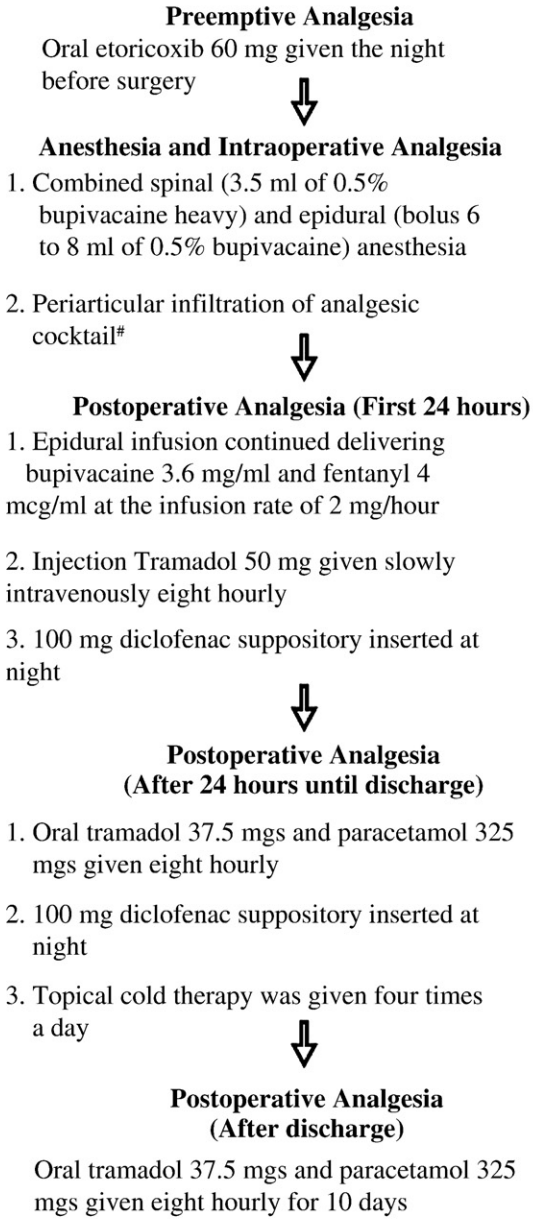

Fig. 1. Timeline of administration of various medications.

A negative suction drain was inserted into the joint before closure of the arthrotomy. Postoperatively, the drain was kept clamped and opened every 2 hours for 10 minutes because this method has been shown to significantly decrease the postoperative blood loss after TKA [27].

The epidural infusion was continued postoperatively, delivering bupivacaine 3.6 mg/mL and fentanyl 4 μg/mL at the infusion rate of 2 mL/h. Adjuvant analgesics included injection tramadol 50 mg given slowly intravenously every 8 hours for 24 hours and a 100-mg diclofenac suppository inserted at night. After 24 hours, the epidural catheter was removed; and the