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Local Infiltration Analgesia Versus Continuous Femoral Nerve Block in Pain Relief After Total Knee Arthroplasty: A Randomized Controlled Trial

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ABSTRACT

Background: Although both local infiltration analgesia (LIA) and continuous femoral nerve block (FNB) are common analgesic modalities for pain relief after total knee arthroplasty (TKA), we are aware of no parallel-group, randomized controlled trial that has solely compared the efficacy of LIA and continuous FNB.

Methods: We conducted a prospective, 2-arm, parallel-group, randomized controlled trial involving patients scheduled for TKA. A total of 45 patients were randomly assigned to either the LIA or the continuous FNB group. Except for the analgesic modality, perioperative managements were identical in both groups. The primary outcome was postoperative pain score at rest 1 day after surgery, measured using a 100-mm visual analog scale.

Results: Patients in the LIA group had a significantly lower visual analog scale score at rest 1 day after surgery than those in the continuous FNB group (34 ± 10 vs 42 ± 13 mm; $P = .028$). The opioid consumption during the initial 24 hours was significantly lower in the LIA group (12 ± 4 vs 16 ± 7 mg; $P = .031$). There were no differences in the rate of complications between the groups.

Conclusion: LIA was associated with better pain relief with a comparable complications rate for patients undergoing TKA than FNB. We recommend LIA for pain relief after TKA.

Total knee arthroplasty (TKA) may provoke intense early postoperative pain affecting the patients' satisfaction for surgery; however, the most effective analgesia remains controversial [1]. Although continuous femoral nerve block (FNB) has been used for pain control, its benefits should be weighed against the potential problems related to its use, which include nerve injury, local infection, and impaired muscle control [2,3]. Local infiltration analgesia (LIA) is becoming more commonly used owing to the excellent pain relief, the low frequency of complications, and the anti-inflammatory effect [4-8].

In previous literature, there has been only 1 randomized controlled trial to solely compare the efficacy of LIA with continuous FNB [9]. In that study, 16 patients scheduled for staged bilateral TKA received LIA or continuous FNB in 1 knee, whereas the different analgesic modality was alternatively applied to the contralateral knee after a minimum 3-month interval [9]. This crossover randomized controlled trial concluded that there were no significant differences in postoperative pain score and cumulative opioid consumption between the uses of LIA and continuous FNB [9]. In other previous randomized controlled trials comparing LIA and continuous FNB, intra-articular anesthetic injection was used as a supplemental pain control measure in 1 or both analgesic modality groups in the study [2,10-12].

The purpose of this study was to compare the efficacy of LIA and continuous FNB in patients undergoing TKA by a parallel-group, randomized controlled trial. Two hypotheses were tested: (1) LIA

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would achieve reduced pain with a lower visual analog scale (VAS) score and a smaller opioid consumption in the early postoperative period. (2) There would be no difference in the complication rate between LIA and continuous FNB.

Patients and Methods

Study Design

This prospective, 2-arm, parallel-group, randomized controlled trial was conducted at a single university hospital in Hyogo, Japan.

The study was approved by the institutional review board. All patients provided written informed consent. The study was registered as a randomized controlled trial titled "A randomized controlled trial comparing continuous femoral nerve block and local infiltration analgesia for total knee arthroplasty" with the University Hospital Medical Information Network registration number UMIN000018850. Postoperative pain 1 day after surgery was the focus in the study.

Participants

Participants were recruited from October 2010 to June 2011. Eligible patients were scheduled for unilateral TKA, 60-85 years of age, had an American Society of Anesthesiologists' physical status classification of I-III, and had the ability to cooperate with data acquisition. Exclusion criteria were history of allergy or intolerance to 1 of the study drugs, serious internal comorbidities, chronic inflammatory joint disease (ie, rheumatoid arthritis), or bleeding disorder.

Participants were informed that we were comparing the efficacy of LIA and continuous FNB for pain control after TKA and that they would be randomly assigned to either the LIA or the continuous FNB group.

Randomization and Blinding

We created the randomization sequence by permuted block randomization with a block size of 4 and a 1:1 allocation generated by computer software (SPSS for Windows version 17.0; SPSS Inc, Chicago, IL). The allocation sequence was prepared by an independent operator not otherwise involved in the trial. After the patients' eligibility had been confirmed and the consent procedures completed, we randomly allocated patients to the LIA group or the continuous FNB group using the randomization sequence. Both caregivers and patients were not blinded.

Interventions

The interventions of the study were LIA and continuous FNB.

Patients allocated to the LIA group received a periarticular injection with a solution containing 7.5 mg/mL of ropivacaine (Anapeine; Astrazeneca, Osaka, Japan; 40 mL), 20 mg/mL of ketoprofen (Capisten; Kissei, Matsumoto, Japan; 5 mL), 1 mg/mL of epinephrine (Bosmin; Daiichi-Sankyo, Tokyo, Japan; 0.5 mL), and 40 mL of normal saline. Half of the solution was injected into the posterior part of the capsule, the intercondylar area, and around the collateral ligaments just before cementing the implants. The remaining solution was injected into the anterior part of the capsule and the subcutaneous tissue after implantation. No subsequent bolus periarticular or intra-articular injection was performed beyond the operative day.

Patients allocated to the continuous FNB group had an FNB catheter inserted into them by an experienced anesthesiologist after induction of general anesthesia. During the insertion of the catheter for continuous FNB, a real-time monitor with ultrasound imaging was used to facilitate accurate needle placement and confirm the adequacy of local anesthetic deposition. A total of 20 mL of 2.0 mg/mL of ropivacaine was injected around the femoral nerve as an initial block. Postoperatively, 1.5 mg/mL of ropivacaine was continuously infused at the rate of 5 mL/h for 48 hours through the catheter.

Preoperative and Postoperative Medications

Immediately after the surgery, a patient-controlled analgesia (PCA) pump was applied to all patients with a program giving an intravenous bolus of morphine hydrochloride hydrate (Takeda, Osaka, Japan; 1 mg/dose) on demand with a lockout time of 5 minutes and no background infusion. The PCA was discontinued 24 hours after surgery, while the PCA pump device recorded the total volume of morphine consumed and the total number of doses. From the day after surgery, an oral nonsteroidal anti-inflammatory drug (60 mg of loxoprofen [Loxonin]; Daiichi-Sankyo) was administered 3 times a day.

Antibiotic prophylaxis with 1 g of cefamezin (Cefazolin; Astellas, Tokyo, Japan) was intravenously administered 30 minutes before surgery and every 8 hours after surgery until 2 days after surgery.

Thromboprophylaxis with fondaparinux (Arixtra; GlaxoSmithKline, Tokyo, Japan) or enoxaparin sodium (Clexane; Sanofi-Aventis, Tokyo, Japan) was started 1 day after surgery and continued for at least 5 days.

Surgery and Rehabilitation

All surgeries were performed under general anesthesia using a tourniquet with the medial parapatellar approach and patellar resurfacing.

The postoperative rehabilitation regimens were the same for both groups and started the day after surgery. Transfer to wheelchair and quadriceps setting exercise were started 1 or 2 days after surgery. Ambulatory training with weight bearing as tolerated and active-assisted range of motion exercise were started 3 days after surgery. Gait training using a walker was started at 7 days after surgery and using a cane at 10 days after surgery. Staircase climbing exercise and walking outside were started 14 days after surgery.

Outcome Measurements

Primary Outcome Measure

The primary outcome was pain at rest 1 day after surgery. Pain intensity was rated using a 100-mm horizontal VAS, for which 0 mm represented no pain and 100 mm represented extreme pain (Fig. 1). On the day of surgery, the VAS score at rest was measured at 4 hours after surgery. After the day of surgery, the VAS score was measured 3 times daily (at 8 AM, 2 PM, and 8 PM), and the mean value was adopted for comparison between groups.

Secondary Outcome Measures

The postoperative pain levels at rest other than 1 day after surgery were compared between groups.

Fig. 1. Pain intensity rating scale used in the study. In the horizontal scale, 0 mm represented no pain and 100 mm represented the most severe pain.