Multimodal Periarticular Injection Vs Continuous Femoral Nerve Block After Total Knee Arthroplasty

A Prospective, Crossover, Randomized Clinical Trial

Fu-Yuen Ng, MBBS, FRCSE (Ortho), FHKAM (Ortho Surg),*
Jacobus Kwok-Fu Ng, MBChB, MD, FHKAM (Anaes),†‡
Kwong-Yuen Chiu, MBBS, FRCSE (Ortho), FHKAM (Ortho Surg),*
Chun-Hoi Yan, MBBS, FRCSE (Ortho), FHKAM (Ortho Surg),* and
Chi-Wing Chan, MBBS, FHKCA, FHKAM (Anaes)†

Abstract: This study compares the efficacy of pain control using continuous femoral nerve block (FNB) and multimodal periarticular soft tissue injection. This is a randomized, crossover, clinical trial. Sixteen patients having bilateral osteoarthritis of the knee scheduled for staged total knee arthroplasty were randomized to receive either FNB (0.2% ropivacaine), via indwelling catheter for 72 hours, or multimodal periarticular soft tissue injection in the first stage. In the second stage, they received the opposite treatment. The primary outcome measure was morphine consumption by patient-controlled analgesia in the first 72 hours postoperatively. Cumulative morphine consumption as well as rest pain and motion pain in the first 72 hours was comparable between the 2 groups. The functional outcomes did not differ significantly. We conclude that multimodal periarticular soft tissue injection provides comparable analgesia to continuous FNB after total knee arthroplasty. **Keywords:** multimodal periarticular injection, femoral nerve block, total knee arthroplasty.

Total knee arthroplasty (TKA) is one of the most successful surgical treatments for advanced osteoarthritis of the knee joint. Postoperative pain after TKA is a major concern of patients. Good postoperative analgesia facilitates rehabilitation, improves patient satisfaction, and may reduce length of hospital stay [1]. Conventional analgesia by parenteral opioid can control pain, but its use as the sole analgesic technique is frequently limited by dose-related side effects such as nausea, vomiting, drowsiness, constipation, urinary retention, and respiratory depression [2]. Femoral nerve block (FNB) with continuous infusion of local anesthetics via an indwelling femoral catheter has shown efficacious pain control and reduction of opioid consumption [3-5]. A new technique of pain control is multimodal periarticular injection (MPI). Results from recent studies show that using the method with a large volume of low-concentration local anesthetics, adrenaline, and anti-inflammatory agents such as nonsteroidal anti-inflammatory drugs or steroids have shown good pain control and improvement in range of motion after surgery [6,7]. However, there is no crossover comparison between MPI and FNB. Therefore, we have designed this study to compare the efficacy of pain control after TKA, using continuous FNB vs that of MPI.

Patients and Methods

This was a prospective, patient- and assessor-blinded, placebo-controlled, crossover randomized clinical trial. This study was approved by the institutional review board. Chinese patients scheduled for staged TKA for osteoarthritis were recruited. The staged operations were performed at a minimum interval of 3 months. Excluded from the study were patients with known

*From the *Department of Orthopaedics and Traumatology, The University of Hong Kong, Pokfulam, Hong Kong; †Department of Anaesthesiology, Queen Mary Hospital, The University of Hong Kong, Pokfulam, Hong Kong; and ‡Department of Pharmacology & Pharmacy, The University of Hong Kong, Pokfulam, Hong Kong.*
Submitted May 11, 2011; accepted December 16, 2011.
The Conflict of Interest statement associated with this article can be found at doi:10.1016/j.arth.2011.12.021.
Reprint requests: Fu-Yuen Ng, MBBS, FRCSE (Ortho), FHKAM (Ortho Surg), Division of Joint Replacement Surgery Department of Orthopaedics and Traumatology, The University of Hong Kong, 216 New Clinical Building, Queen Mary Hospital, Hong Kong.

0883-5403/2706-0067$36.00/0
doi:10.1016/j.arth.2011.12.021

allergies to any of the test drugs, those with major systemic illnesses (heart failure, renal impairment, and coagulopathy), chronic users of opioids, and patients who had failed femoral catheter insertions. Written informed consent was obtained from each patient. Femoral catheter insertion and periarticular injection were both performed in every operation. Patients who received active treatment via femoral catheter would receive periarticular injection of saline and vice versa. A unique design of our study is the crossover comparison, that is, treatment allocation during the first-stage operation, recorded and reversed in the second-stage operation for the contralateral knee. For example, if a patient received active treatment via FNB and saline MPI in the first stage, he/she would receive active treatment by MPI and saline FNB in the second stage. A randomization table was created to allow 50% of subjects treated to receive true FNB first and 50% of subjects to receive true MPI first, using SPSS software (version 14.0; SPSS Inc, Chicago, Ill). Patients and nurses responsible for recording pain scores were blinded to the treatment allocation. All operations were performed under general anesthesia using a standardized anesthetic technique. During anesthesia, only the ultra-short acting opioid, remifentanil was administered. Remifentanil infusion was stopped 10 minutes before the end of surgery, eliminating the risk of any residual opioid effect that might confound the assessment of pain in the immediate postoperative period. The catheter for continuous FNB (Contiplex D; B Braun, Melsungen, Germany) was inserted by the anesthesiologist authors (JKFN and CWC) before the induction of general anesthesia. The position of the femoral catheter was confirmed by using a peripheral nerve stimulator, with a positive contraction response at 0.5 mA or less (Stimuplex; B Braun). Depending on the randomization result, a single 20 mL bolus of either 0.2% ropivacaine or isotonic sodium chloride solution was administered at the same time as the periarticular injection, followed by continuous infusion at 10 mL/h, starting in the recovery room and continuing for 72 hours after the operation.

The operations were performed under a standard surgical protocol by the same team of surgeon authors (FYN, CHY, KYC), using a tourniquet over the thigh, which was inflated at 280 mm Hg during draping and was released after implantation of a prosthesis. A standard medial parapatellar arthrotomy approach was used. The same brand of TKA was implanted during both stages by the same surgeon. Depending on the randomization result, either MPI or isotonic sodium chloride solution was infiltrated. Contents of the MPI solution included ropivacaine (300 mg in 30 mL), adrenaline (1 mg in 0.5 mL), and isotonic sodium chloride solution (70 mL). Triamcinolone acetonide (40 mg in 1 mL) was added into half of the portion of the above contents. Two 50 mL syringes were then prepared with 1 syringe containing triamcinolone acetonide and 1 without. After lavage of the surgical site, 20 mL of the fluid containing triamcinolone acetonide was infiltrated into a posterior joint capsule before the implantation of the prosthesis. The remaining 30 mL of fluid was infiltrated into the periarticular soft tissue. A nonsuction drain was inserted before wound closure and was removed within 24 hours. The multimodal injection fluid without triamcinolone was infiltrated into the skin to avoid fat atrophy.

On top of the FNB or MPI according to the study protocol, patients also received patient-controlled intravenous morphine (1 mg patient-controlled analgesia [PCA] bolus, lockout 5 minutes, 1 hour maximum 6 mg) (Model 3300; Graseby, Watford, United Kingdom) postoperatively. Metoclopramide 10 mg every 4 hours pro re nata was routinely prescribed as the rescue antiemetic. All patients were educated in the use of the PCA pump and pain score before surgery. Ward nurses assessed the rest pain and motion pain and also recorded opioid consumption via the PCA. Physiotherapists documented the range of knee motion and quadriceps power daily. Both assessors were blinded to the treatment group. A questionnaire about overall satisfaction with the perioperative pain management method was also conducted after completion of the 72-hour study period in each stage, respectively.

The primary outcome measurement was total morphine consumption of the PCA. From previous experience at our center, postoperative consumption of morphine approximates 30 mg, and the standard deviation is 10 mg. This study has 80% power to detect a 7-mg difference in consumption at a significant level of 5% if 16 patients are included. Statistical analysis was performed using SPSS (version 14.0; SPSS Inc, Chicago, Ill). $P < .05$ is considered statistically significant.

Results

From December 2008 to March 2010, 18 patients (15 females and 3 males) were recruited. One patient, who was randomized to the MPI group in the first-stage operation, refused the second-stage operation because of a spinal problem. Another patient who was randomized to the FNB group in the first-stage operation had a patella fracture 3 months after the operation because of an accidental fall. The results of the remaining 16 patients (14 females and 2 males) were analyzed. Patient demographics and operative details were shown in Table 1. These data were similar in both groups. Preoperative Knee Society Knee Score and Knee Society Functional Score were also comparable in both groups.

Daily and cumulative morphine consumption was shown in Fig. 1. The difference between the 2 groups was not statistically significant ($P > .05$).