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Randomized Clinical Trial of Continuous Femoral Nerve Block Combined with Sciatic Nerve Block Versus Epidural Analgesia for Unilateral Total Knee Arthroplasty

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ABSTRACT

Pain control following total knee arthroplasty (TKA) is crucial to hasten rehabilitation and decrease morbidity. We evaluated whether there is a difference between epidural infusion and continuous femoral nerve block with respect to postoperative pain control and rehabilitation course. Fifty patients completed the study. There was no statistically significant difference in the pain scores ($P = 0.33$), morphine consumption ($P = 0.09$) mean blood pressure or heart rate ($P = 0.957$, and $P = 0.716$) between groups. The postoperative daily mobilization ($P = 0.80$), knee joint range of motion ($P = 0.83$), and straight leg test ($P = 0.99$) were also similar between both groups. Patients were highly satisfied with their pain management in both groups without statistically significant difference ($P = 0.98$).

Pain remains one of the major challenges for anesthesiologists following total knee arthroplasty (TKA). Despite the tremendous work in this field almost half of the patients still have moderate to severe pain following TKA [1]. The impact of severe pain after TKA is not only unpleasant, but may be associated with severe systemic complications [1]. Multiple pain management modalities have been evaluated: patient controlled analgesia (PCA), continuous epidural infusion (CEI), "three-in-one" block [2], single shot femoral and sciatic nerve blocks [3], continuous femoral nerve block (CFNB), continuous posterior lumbar plexus block [4], and unilateral spinal anesthesia [5]. However, optimum analgesia after TKA is still an unresolved issue.

A systematic review of these studies has failed to prove superiority of any one approach over another and has failed to prove utility of adding sciatic nerve block to femoral nerve block in controlling postoperative TKA pain [6]. One of the major drawbacks of both FNB and CEI is prolonged motor blockade that prevents early mobilization thereby increasing the length of stay with persistent quadriceps weakness, and increased risk of falling [7].

It has been found that the use of ultrasound guidance helps to achieve more effective FNB with minimal local anesthetic volume [8,9]. However, there are few studies that compare the use of ultrasound guided CFNB with CEI, and their results were inconclusive and contradictory [10–12].

The aim of this randomized clinical trial was to compare ultrasound-guided CFNB in addition to single shot sciatic nerve block by the standard CEI in terms of postoperative pain control, hemodynamic changes, rehabilitation course and patients pain management satisfaction.

Methodology

Enrollment

Following institutional review board approval (King Saud University, Riyadh, Saudi Arabia, number E.12.589) patients' consent was obtained prior to enrollment. Fifty-six patients who were scheduled for unilateral knee total knee arthroplasty (TKA) were randomized (1:1) in a prospective, parallel, randomized control trial. The study conducted during the period between January 2012 and May 2013. Patients who planned for unilateral TKA and aged between 18 and 75 years regardless of their gender and BMI were considered eligible. Those with bilateral TKA or revision surgery, or has sickle cell disease, or allergy to local anesthetics were excluded. This study was designed and written according to the CONSORT 2010 statement [13].

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Randomization

Patients were randomized into two groups: continuous epidural infusion (CEI group), and continuous femoral nerve block with single shot sciatic nerve block (CFNB group). A computerized random number generator was used. Numbers were stored in opaque sealed envelopes. The patient was asked to select one envelope on the morning of surgery.

Perioperative Management and Procedures

Patients were premedicated with intravenous midazolam (1 to 2 mg) in the holding area. The regional analgesia was performed in the operating theater under standard monitoring (i.e. blood pressure, heart rate, pulse oxymeter and 3-leads EKG). After skin disinfection with iodine and covering the block site with a sterile drape, intradermal 2% lidocaine was used for local anesthesia. Procedures were performed as follow:

- CEI group: an epidural catheter (Portex®, Epidural Maxipack, Smiths Medical, UK) was place at the L3/4 or L4/5 level using a 17G Tuohy needle then inserted upward by 4 cm. Infused with 0.0625% bupivacaine + fentanyl (2 mcg/ml) with rate 5–10 ml/hour was started after initial bolus of 10 ml of 0.25% bupivacaine + 50 mcg fentanyl preoperatively. We selected to use 0.0625% bupivacaine concentration to fasten early mobilization as this concentration was previously used for walking epidural [14]. The catheter was covered with a sterile dressing to avoid dislodging and maintain sterility. The procedure performed in a sitting position.
- Ultrasound-guided CFNB: was performed according to the method described by Koscielniak-Nielsen et al [15]. While the patient was in supine position, a femoral nerve catheter (PAJUNK®, Geisingen, Germany) was place through a Touhy 18G × 100 mm cannula, and infused at a rate of 5 ml/hour 0.2% bupivacaine after initial bolus of 10 ml 0.25% bupivacaine under ultrasound guidance. In addition, all patients in this group had a single shot sciatic nerve block with 15 ml of 0.25% bupivacaine preoperatively under ultrasound guidance through anterior approach. The catheter was placed perpendicular to the femoral nerve, as a previously described by Wang et al [16]. The catheter was sutured to the skin to avoid dislodgment then covered with a sterile dressing. All blocks were done one by senior anesthesiologist (TZ). Blocks were performed under ultrasound guidance (M-Turbo, SonoSite Inc., Seattle, WA, USA) using a 15-MHz linear transducer.

The efficacy of the epidural and nerve blocks was assessed before the induction of anesthesia, by checking the motor and sensory blocks density and distribution.

General anesthesia was performed with 1 mcg/kg fentanyl and 2 mg/kg propofol, and a laryngeal airway mask (LMA) was inserted thereafter. The patients were mechanically ventilated, and Sevoflurane in air/oxygen without N_2O was used for maintenance. Intraoperative boluses of fentanyl (25–50 mcg), fluid, blood pressure and blood management were administered by the attending anesthesiologists based on clinical criteria. After anesthesia emergence, all patients were started on a patient-controlled analgesia (PCA) for rescue analgesia. The PCA was programmed to give 1 mg of morphine sulfate with a lockout of 8 minutes without background infusion.

Outcome Measurements (End Points)

Primary Outcomes

Postoperative pain scores [measuring the numerical rating score (NRS) in the scale of 0 to 10, where 0 = no pain and 10 = worst pain ever can tolerate], and postoperative morphine consumption. Each of these outcomes was recorded every 6 hours after the patient's discharge from post-anesthesia recovery unit (PACU) for up to 72 hours. All these measurements were collected by the acute pain service specialized nurses who were unaware of the study.

Secondary Outcomes

(1) Postoperative hemodynamic changes, reported as mean blood pressure (MAP) and heart rate variation in the first 72 hours after discharge from PACU. (2) Postoperative rehabilitation course, which was assessed by the physiotherapy team (who were unaware of the study) once daily as follows: maximum distance that the patient can walk (in meter) during the rehabilitation section, measuring the range of the knee joint motion using a goniometer, and the straight leg raising test (where the patient was asked to rise his leg from supine position as much as he/she can) to assess the ipsilateral motor block. (3) Patient

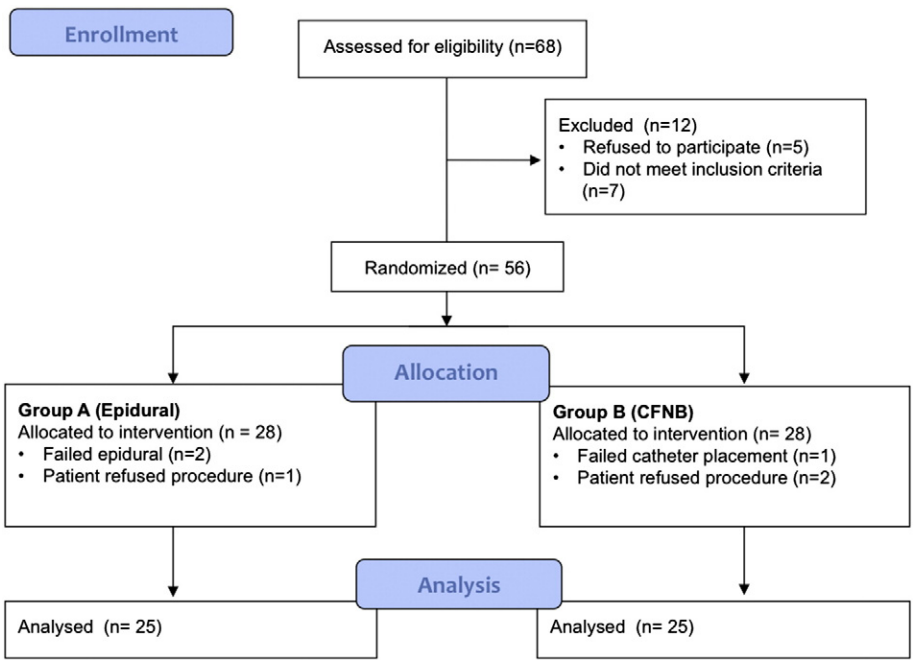

Fig. 1. CONSORT 2010 flow chart.