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Comparing the outcomes of adductor canal block versus femoral nerve block in total knee arthroplasty: A randomized controlled trial

R Nagadivya and Praveen Kumar Reddy

Abstract

Background and Objective: Effective postoperative pain control is critical for early mobilization and rehabilitation following total knee arthroplasty (TKA). The femoral nerve block (FNB) has been traditionally used for analgesia, but it may impair quadriceps strength, delaying recovery. The adductor canal block (ACB), a more distal block, offers a potentially motor-sparing alternative. This randomized controlled trial was conducted to compare the analgesic efficacy and functional outcomes of ACB versus FNB in patients undergoing unilateral TKA.

Materials and Methods: A total of 40 patients scheduled for primary unilateral TKA under spinal anesthesia were randomly assigned into two groups (n = 20 each): Group A received an ultrasound-guided adductor canal block, and Group F received a femoral nerve block, both using 20 mL of 0.5% ropivacaine postoperatively. This study was conducted at the Department of Orthopaedics, Surabhi Institute of Medical Sciences, Siddipet-Husnabad, Mundrai, Telangana, India from February 2018 to January 2019. Pain scores using the visual analogue scale (VAS), quadriceps muscle strength, time to ambulation, opioid consumption, and patient satisfaction were assessed at 6, 12, 24, and 48 hours postoperatively. Data were analyzed using appropriate statistical tests, with $p < 0.05$ considered significant.

Results: Both groups demonstrated effective analgesia with no significant difference in VAS scores at 6 and 12 hours postoperatively ($p > 0.05$). However, at 24 and 48 hours, Group A (ACB) showed comparable analgesia with significantly better preservation of quadriceps strength ($p = 0.01$), earlier ambulation ($p = 0.02$), and reduced risk of falls. Opioid consumption over 48 hours was lower in the ACB group, although not statistically significant. Patient satisfaction scores were higher in the ACB group.

Conclusion: Adductor canal block provides effective analgesia similar to femoral nerve block following total knee arthroplasty but offers the added advantage of better quadriceps muscle preservation and earlier mobilization. ACB may be preferred for enhanced functional recovery and fall prevention in the immediate postoperative period.

Keywords: Total knee arthroplasty, adductor canal block, femoral nerve block, postoperative analgesia, quadriceps strength, early ambulation, randomized controlled trial

Introduction

Total Knee Arthroplasty (TKA) is one of the most commonly performed and successful orthopedic procedures for managing advanced osteoarthritis of the knee. Despite its effectiveness in relieving pain and restoring function, TKA is associated with considerable postoperative pain, which can impair early mobilization, delay rehabilitation, and prolong hospital stay. Therefore, optimizing postoperative analgesia is a key element of enhanced recovery after surgery (ERAS) protocols for TKA [1-3].

Traditionally, femoral nerve block (FNB) has been widely used as a regional analgesic technique for TKA due to its reliable pain control. It provides effective blockade of the anterior knee by anesthetizing the femoral nerve and its branches. However, FNB also causes motor blockade of the quadriceps muscle, which can hinder early ambulation, increase the risk of falls, and delay functional recovery. These limitations have led clinicians to seek alternative regional techniques that can provide comparable analgesia while minimizing motor impairment [4-6].

In recent years, the adductor canal block (ACB) has emerged as a promising alternative to FNB. The adductor canal, located in the mid-thigh, contains the saphenous nerve—a sensory branch of the femoral nerve—along with the nerve to vastus medialis. ACB predominantly blocks sensory fibers while preserving motor function of the quadriceps muscle. This motor-sparing property makes ACB particularly attractive in TKA, where early mobilization is crucial for patient outcomes and prevention of complications such as deep vein thrombosis or joint stiffness [7, 8].

Several studies have compared the analgesic efficacy and functional outcomes of ACB and FNB, with emerging evidence suggesting that ACB provides comparable pain control with better preservation of motor function. However, findings remain inconsistent across patient populations, types of local anesthetic, and evaluation protocols. There is a need for continued evaluation through well-designed randomized controlled trials to further validate the comparative effectiveness of these blocks in different clinical settings [9-11].

The present study was undertaken to compare the postoperative outcomes of adductor canal block versus femoral nerve block in patients undergoing unilateral total knee arthroplasty. We aimed to evaluate their effects on postoperative pain, quadriceps muscle strength, time to ambulation, opioid consumption, and overall patient satisfaction.

Materials and Methods

This study was conducted as a prospective, randomized controlled trial in the Department of Anesthesiology and Orthopedic Surgery at a tertiary care teaching hospital over a period of 12 months. This study was conducted at the Department of Orthopaedics, Surabhi Institute of Medical Sciences, Siddipet-Husnabad, Mundrai, Telangana, India from February 2018 to January 2019. The study was approved by the Institutional Ethics Committee, and written informed consent was obtained from all participants. A total of 40 patients scheduled to undergo primary unilateral total knee arthroplasty (TKA) under spinal anesthesia were enrolled and randomized into two equal groups.

Inclusion Criteria

- Adults aged 50-80 years.
- American Society of Anesthesiologists (ASA) physical status I-III.
- Patients undergoing primary unilateral TKA under spinal anesthesia.
- Patients willing to provide written informed consent.

Exclusion Criteria

- History of allergy to local anesthetics.
- Preexisting neurological or neuromuscular disorders affecting the operative limb.
- Coagulopathy or use of anticoagulants contraindicating regional blocks.
- Infection at the intended site of block administration.
- Body mass index (BMI) > 40 kg/m².
- Patients with revision or bilateral TKA.
- Refusal to participate or inability to cooperate with assessments.

Randomization and Blinding

Patients were randomized using a computer-generated random number table into Group A or Group F. The anesthesiologist performing the block was not blinded, but the postoperative pain assessments and functional evaluations were performed by an investigator blinded to group allocation.

Block Technique

Both blocks were performed under ultrasound guidance using a high-frequency linear probe in a sterile setting after surgery. Ropivacaine 0.5% (20 mL) was administered in both groups at the appropriate anatomical locations for adductor canal or femoral nerve block.

Data Collection

Pain scores (Visual Analogue Scale - VAS) at rest and on movement were assessed at 6, 12, 24, and 48 hours postoperatively. Quadriceps strength was assessed using manual muscle testing (graded 0-5). Time to first ambulation, opioid consumption, and patient satisfaction (via a 5-point Likert scale) were recorded. Any adverse events (e.g., nausea, vomiting, falls, or local anesthetic toxicity) were monitored.

Statistical Analysis

Data were analyzed using SPSS software version XX. Continuous variables were expressed as mean ± standard deviation and compared using Student's t-test. Categorical data were analyzed using the Chi-square test or Fisher's exact test. A *p*-value < 0.05 was considered statistically significant.

Results

A total of 40 patients undergoing unilateral total knee arthroplasty were included and randomized equally into two groups: Group A (Adductor Canal Block, n = 20) and Group F (Femoral Nerve Block, n = 20). All patients completed the study without major protocol violations. The baseline demographic and surgical parameters were comparable between the groups.

Table 1: Baseline Demographic and Surgical Characteristics

Variable	Group A (ACB)	Group F (FNB)	*p*-value
Age (years), mean ± SD	65.2 ± 7.4	64.5 ± 6.9	0.73
Gender (M/F)	8 / 12	9 / 11	0.76
BMI (kg/m²), mean ± SD	27.1 ± 3.2	27.5 ± 3.5	0.64
ASA Grade I/II/III	4/11/5	3/13/4	0.81
Duration of Surgery (min)	92 ± 10.1	94 ± 11.5	0.58

The table 1 shows that both groups were demographically and clinically similar at baseline. There was no statistically significant difference in age, gender, BMI, ASA physical status, or surgical duration between the two groups.

Table 2: Visual Analogue Scale (VAS) Pain Scores at Rest

Time Post-op	Group A (mean ± SD)	Group F (mean ± SD)	*p*-value
6 hours	2.6 ± 0.9	2.4 ± 0.8	0.48
12 hours	3.1 ± 0.7	2.9 ± 0.9	0.37
24 hours	3.3 ± 1.0	3.2 ± 0.8	0.69
48 hours	2.8 ± 0.6	2.6 ± 0.7	0.41

Pain scores at rest were comparable between the two groups at all-time intervals postoperatively, with no statistically significant differences. Both blocks provided effective analgesia within the first 48 hours.

Table 3: Quadriceps Muscle Strength

Time Post-op	Group A (mean ± SD)	Group F (mean ± SD)	*p*-value
6 hours	4.2 ± 0.5	2.8 ± 0.7	<0.001*
12 hours	4.5 ± 0.4	3.1 ± 0.6	<0.001*
24 hours	4.8 ± 0.3	3.6 ± 0.5	<0.001*
48 hours	5.0 ± 0.0	4.2 ± 0.4	<0.001*

Patients in the ACB group demonstrated significantly higher quadriceps strength scores at all time points, indicating better motor preservation compared to the FNB group.

Table 4: Functional Outcomes and Opioid Consumption

Outcome	Group A (ACB)	Group F (FNB)	*p*-value
Time to First Ambulation (hrs)	18.6 ± 2.3	24.8 ± 3.1	<0.001*
Total Opioid Use (mg morphine)	18.2 ± 4.1	21.5 ± 4.8	0.06
Fall Incidents	0	2	—

Patients receiving ACB ambulated significantly earlier than those receiving FNB. Although opioid use was lower in the ACB group, the difference was not statistically significant. Two fall incidents occurred in the FNB group, highlighting potential motor block-related risks.

Table 5: Patient Satisfaction Scores

Satisfaction Level	Group A	Group F
Very Satisfied (5)	14	9
Satisfied (4)	5	7
Neutral (3)	1	4
Dissatisfied (1-2)	0	0

A higher proportion of patients in the ACB group reported being "very satisfied" with their postoperative experience compared to the FNB group. None of the patients in either group reported dissatisfaction.

Discussion

Postoperative pain management plays a vital role in enhancing recovery and improving functional outcomes after total knee arthroplasty (TKA). Femoral nerve block (FNB) has long been considered the gold standard for analgesia following TKA, providing effective pain control through blockade of the femoral nerve and its branches reported by Ganapathy *et al*., 1999. However, the major limitation of FNB lies in its associated quadriceps muscle weakness, which can delay mobilization and increase fall risk given by Ilfeld *et al*., 2008 [12-14].

In contrast, the adductor canal block (ACB) has gained increasing attention in recent years as a motor-sparing alternative that provides similar analgesic efficacy. The adductor canal primarily contains the saphenous nerve and nerve to vastus medialis, both predominantly sensory, allowing preservation of quadriceps strength while achieving analgesia given by Jenstrup *et al*., 2012; Lund *et al*., 2011 [15, 16].

Our study findings are consistent with these earlier reports. We observed no statistically significant difference in pain scores between the ACB and FNB groups during the first 48 hours postoperatively, confirming that ACB provides equivalent analgesia (Kim *et al*., 2014). However, patients in the ACB group demonstrated significantly greater quadriceps strength at all time intervals, facilitating earlier ambulation. These results support the motor-sparing advantage of ACB as reported by Grevstad *et al*., (2015) and Jaeger *et al*., (2013), who also found improved functional mobility with ACB over FNB [17-19].

While both groups had comparable opioid consumption, the ACB group had a lower mean dose, although not statistically significant. This is in line with findings from Jæger *et al*., (2013), who demonstrated similar opioid-sparing effects with ACB. Importantly, the absence of falls in the ACB group versus two falls in the FNB group further highlights the safety advantage of ACB in early postoperative mobilization reported by Memtsoudis *et al*., 2014) [20, 21].

Patient satisfaction was notably higher in the ACB group, which likely reflects a combination of adequate pain control, earlier ambulation, and fewer adverse motor effects. This aligns with current enhanced recovery protocols that emphasize early mobilization, minimal opioid use, and rapid functional return. Limitations of our study include the relatively small sample size and short follow-up duration. Additionally, we did not assess long-term functional outcomes or perform objective strength testing using dynamometry. Future studies with larger cohorts and extended follow-up periods are needed to validate these findings and explore long-term recovery trends [22, 23].

Conclusion

This randomized controlled trial demonstrated that the adductor canal block (ACB) provides postoperative analgesia comparable to the femoral nerve block (FNB) in patients undergoing total knee arthroplasty (TKA), with the added benefit of better preservation of quadriceps muscle strength and earlier ambulation. Although both techniques effectively managed postoperative pain, ACB was associated with improved functional outcomes and higher patient satisfaction, along with a reduced risk of falls. Given its motor-sparing advantage and enhanced recovery profile, ACB may be considered a superior regional anesthetic technique for routine use in TKA under enhanced recovery protocols.

Funding support

Nil.

Conflict of interest

None.

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