

Comparison of the Efficacy of Continuous Femoral Nerve Block with Epidural Analgesia for Postoperative Pain Relief after Unilateral Total Knee Replacement

Dr. Md Abdullah Hel Baki^{1*}, Dr. Kawser Ahmed², Dr. Monira Begum³, Dr. Nirmal Kumar Barman⁴, Dr. Md. Shafiqul Islam⁵, Dr. Milon Kumar Roy⁶, Dr. Shiladitya Shil⁷

¹Senior Consultant (Anaesthesiology), 250 Bedded General Hospital, Dinajpur, Bangladesh

²Assistant Professor (Anaesthesiology), Sheikh Hasina Medical College, Hobiganj, Bangladesh

³Junior Consultant (Anaesthesiology), M Abdur Rahim Medical College Hospital, Dinajpur, Bangladesh

⁴Assistant Professor (Anaesthesiology), Dept. of Anaesthesiology & CCM, M. Abdur Rahim Medical College, Dinajpur, Bangladesh

⁵Junior Consultant (Surgery), 250 Bedded General Hospital, Dinajpur, Bangladesh

⁶Senior Consultant (Orthopaedics), M Abdur Rahim Medical College Hospital, Dinajpur, Bangladesh

⁷Senior Consultant (Surgery), 250 Bedded General Hospital, Dinajpur, Bangladesh

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*Corresponding author: Dr. Md Abdullah Hel Baki

1Senior Consultant (Anaesthesiology), 250 Bedded General Hospital, Dinajpur, Bangladesh

Abstract

Original Research Article

Background: By identifying the most effective and safe approach to postoperative pain management, we can enhance patient recovery, improve their quality of life, and optimize healthcare resource utilization. **Objective:** Comparison of the Efficacy of Continuous Femoral Nerve Block with Epidural Analgesia for Postoperative Pain Relief after Unilateral Total Knee Rep. **Method:** The study was conducted as a randomized controlled trial at Tertiary Hospital in Dhaka. Sixty patients, consisting of 12 males and 48 females, between the ages of 40 and 90 years, were enrolled in the study. These patients were scheduled to undergo unilateral total knee replacement (TKR) for osteoarthritis and fell under American Society of Anesthesiologists (ASA) physical status classes I and II. The inclusion criteria required patients to weigh between 50 and 99 kg and have the ability to fully understand and respond to the numeric rating scale (NRS). Exclusion criteria comprised patients with ASA physical status class ≥ 3 , those on chronic opiate therapy, individuals with allergies to local anesthetics or equipment materials, or those with neuromuscular disease. Ethical approval was obtained, and the patients were divided into two groups: group A received epidural analgesia, while group B received a femoral nerve block for postoperative pain management. Pain assessments were conducted using the NRS at six, 12, and 24 hours postoperatively, and data were collected for analysis. **Results:** During the study, in group A (Epidural) and Group B (Femoral nerve block) mean age was 69.45 ± 7.34 and 65.45 ± 7.34 years. Mean Preoperative knee extension between two groups was Group A (Epidural): 9.05 ± 4.38 and Group B (Femoral nerve block): 7.76 ± 4.14 . The results showed a significant difference for NRS scoring at six hours and 12 hours. Patients who were in group A and were given Epidural postop for pain management showed better results and lower values for NRS and needed fewer extra boluses for their pain management while, on the other hand, group B patients who were given a femoral nerve block for pain management showed higher NRS scores and needed more extra boluses for relieving their pain. **Conclusion:** The femoral nerve block is inferior to epidural analgesia for pain management after unilateral TKR in the first 24 hours, with a greater need for extra boluses to relieve pain.

Keywords: Total Knee Replacement (Tkr), Pain Management, Numeric Pain Rating Scale, Femoral Nerve Block, Epidural Injections.

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INTRODUCTION

Postoperative pain management is a critical aspect of patient care after a unilateral total knee replacement (TKR) procedure. Effective pain control not only enhances patient comfort but also plays a vital role in facilitating early mobilization, reducing

complications, and improving overall patient satisfaction. Two commonly employed techniques for postoperative pain relief after TKR are continuous femoral nerve block (CFNB) and epidural analgesia (EA). Both techniques have their advantages and limitations, and a comprehensive comparison of their

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efficacy is crucial for optimizing pain management strategies.

Continuous femoral nerve block involves the placement of a catheter near the femoral nerve, allowing for the continuous delivery of local anesthetic agents to provide analgesia to the surgical site. It primarily targets the afferent pathways responsible for transmitting pain signals from the knee joint, resulting in effective pain relief. On the other hand, epidural analgesia involves the administration of local anesthetics or opioids into the epidural space, which blocks pain transmission from the surgical area through the spinal nerve roots. [1- 3].

The aim of this study is to compare the efficacy of continuous femoral nerve block with epidural analgesia for postoperative pain relief after unilateral total knee replacement. By examining various parameters such as pain scores, opioid consumption, patient satisfaction, adverse effects, and functional outcomes, we seek to determine which technique provides superior pain relief while considering factors like safety, ease of administration, and overall patient experience.

Previous studies have yielded conflicting results regarding the comparative efficacy of CFNB and EA in the context of postoperative pain management following TKR. Some studies have suggested that CFNB offers superior pain control and reduces opioid consumption compared to EA, while others have found no significant difference between the two techniques. Furthermore, there is limited research directly comparing these modalities, and additional evidence is necessary to guide clinical decision-making. [5- 7].

Understanding the relative merits and drawbacks of CFNB and EA is essential for orthopedic surgeons, anesthesiologists, and other healthcare providers involved in managing postoperative pain after TKR. By synthesizing existing literature and conducting a systematic review or a randomized controlled trial, we aim to contribute to the body of knowledge in this field and provide evidence-based recommendations for optimal pain management strategies in patients undergoing unilateral TKR. [8- 11].

Ultimately, the findings of this study will have significant implications for patient outcomes, healthcare costs, and the overall quality of care provided to individuals undergoing unilateral total knee replacement. By identifying the most effective and safe approach to postoperative pain management, we can enhance patient recovery, improve their quality of life, and optimize healthcare resource utilization.

OBJECTIVE

To assess the Efficacy of Continuous Femoral Nerve Block With Epidural Analgesia for Postoperative Pain Relief after Unilateral Total Knee Rep

METHOD

This study was a randomized controlled trial (RCT) that took place at a Tertiary Hospital following approval from the Ethical Board. The trial was conducted over a six-month period. The study included patients aged 40 to 90 years who were scheduled for unilateral total knee replacement (TKR) due to osteoarthritis and belonged to American Society of Anesthesiologists (ASA) physical status classes I and II. Patients were required to weigh between 50 and 99 kg and have the ability to fully understand and respond to the Numerical Rating Scale (NRS) [9]. Exclusion criteria consisted of patients with an ASA physical status class ≥ 3 , those using chronic opioid medications, individuals with allergies to local anesthetics or equipment materials, and patients with neuromuscular disease. Eligible patients were initially assessed in the pre-anesthesia clinic, where they received counseling from a consultant anesthetist regarding the procedures associated with both techniques and were educated on how to utilize the NRS to rate their pain on a scale from 0 to 10, with 0 indicating no pain and 10 representing the worst possible pain.

Consecutive random sampling was used to divide the patients into two groups. Group A, the epidural group, underwent combined spinal-epidural anesthesia at the L3-L4 interspace in the lateral decubitus position, with the operative site positioned on the dependent side. Spinal anesthesia with 2 ml of 0.75% bupivacaine and 20 ug of fentanyl was administered for the surgery. Group B, the femoral nerve block group, received intrathecal anesthesia using the same drugs in the lateral decubitus position, with the operative site on the dependent side. Following the change to a supine position, an ultrasound-guided femoral nerve block catheter was aseptically placed on the operative side. The surgery was performed under intrathecal anesthesia. In the post-anesthesia care unit (PACU), bupivacaine 0.187% infusion was initiated in both groups at a rate of 8-10 ml/hour through the epidural and femoral catheters. During the postoperative period, patients received intravenous paracetamol 1000 mg every six hours, intravenous ketorolac 30 mg every eight hours, and oral pregabalin 25 mg every 12 hours regularly. Injection tramadol 50 mg was administered as rescue medication if the pain score exceeded 4 on the NRS every six hours, accompanied by 25 mg of injection Gravinate. Pain assessments were conducted at six, 12, and 24 hours by a pain fellow, using the NRS, and the results were

documented on the proforma along with the total number of rescue tramadol administrations.

Continuous data were analyzed by calculating the mean ± standard deviation, as indicated in the results section. The Mann-Whitney U-test was employed to determine significant differences between the two independent groups. In all statistical tests, a p-value < 0.05 was considered statistically significant. Data analysis was conducted using Statistical Product

and Service Solutions (SPSS version 26; IBM Corp. Armonk, NY).

RESULTS

In table-1 shows demographic status of the patients where in group A (Epidural) and Group B (Femoral nerve block) mean age was 69.45 ± 7.34 and 65.45 ± 7.34 years. Mean Preoperative knee extension between two groups was Group A (Epidural): 9.05 ± 4.38 and Group B (Femoral nerve block): 7.76 ± 4.14.

Table-1: Demographic status of the patients.

	Group A (Epidural)	Group B (Femoral nerve block)
Mean Age	69.45 ± 7.34	65.45 ± 7.34
Gender:		
Male	60%	54%
Female	40%	46%
Body mass index	27.48 ± 3.09	26.48 ± 3.09
Duration of surgery	105.92 ± 21.68	107.30 ± 24.40
Preoperative knee flexion (degree)	113.16 ± 19.19	106.89 ± 13.09
Preoperative knee extension (degree)	9.05 ± 4.38	7.76 ± 4.14

Table-2 shows Mann-Whitney U-test scoring for NRS six, 12, and 24 hours postop. Intergroup analysis was carried out using the Mann-Whitney U-test

(non-parametric). The results showed a significant difference for NRS scoring at six hours and 12 hours.

Table-2: Mann-Whitney U-test scoring for NRS six, 12, and 24 hours postop.

	Group A (Epidural)	Group B (Femoral nerve block)	P value
NRS 6 hours postop	18.18	42.82	.000
NRS 12 hours postop	16.70	44.30	.000
NRS 24 hours postop	28.63	32.37	.354

Table-3 shows Number of boluses needed postop by patients to manage pain. Patients who were in group A and were given Epidural postop for pain management showed better results and lower values for NRS and needed fewer extra boluses for their pain

management while, on the other hand, group B patients who were given a femoral nerve block for pain management showed higher NRS scores and needed more extra boluses for relieving their pain

Table-3: Number of boluses needed postop by patients to manage pain

Variables	Bolus				
	.00	1.00	2.00	3.00	4.00
Group A (Epidural)	2	15	5	6	2
Group B (Femoral nerve block)	5	0	0	8	17

DISCUSSION

This study demonstrates that continuous femoral nerve block is less effective than epidural analgesia for providing analgesia at six and 12 hours after unilateral total knee replacement (TKR). The literature extensively documents the benefits of epidural analgesia and its impact on surgical outcomes. Modern approaches to care, such as enhanced recovery after surgery (ERAS) pathways, have been introduced, leading to reduced hospital stays for TKR patients [10]. Multimodal analgesia, including peripheral nerve blocks like femoral and sciatic nerve blocks, has been an integral part of these pathways for postoperative pain management after TKR [7-8]. Peripheral nerve blocks

are believed to offer targeted, intense analgesia with a lower incidence of side effects compared to other analgesic modalities [11]. Continuous catheter techniques prolong analgesia and enhance functional recovery, ultimately resulting in shorter hospital stays [12]. Considering TKR as a unilateral procedure, we conducted a comparative analysis of epidural analgesia and femoral nerve block while maintaining other elements of multimodal analgesia.

However, this study did not provide evidence supporting the equivalent analgesic efficacy of femoral nerve block compared to epidural analgesia (p-value<0.05 at 6 and 12 hours). This finding is understandable when considering the complex

innervation of the knee joint. The knee joint receives nerve supply from both the lumbar and sacral plexuses, following Hilton's law, which states that the nerves supplying the surrounding muscles also supply the joint [13]. Targeting only the femoral nerve, while ignoring contributions from other nerves, cannot be expected to achieve optimal analgesia, especially during the early postoperative period when pain is most intense. Previous studies also demonstrated higher pain scores within the first 24 hours in femoral nerve block groups [7- 9]. However, as time progressed, pain scores became comparable between the two groups. Similarly, in our study, significantly higher pain scores were observed at six and 12 hours postoperatively in the femoral nerve block group, but analgesic efficacy became comparable after 24 hours. Additionally, the femoral nerve block group required more opioid rescue analgesia, resulting in increased episodes of nausea and vomiting requiring additional antiemetics. According to Table 2, 17 patients in the femoral nerve block group received four boluses of tramadol in the first 24 hours, while only two patients in the epidural group received the same. Furthermore, five patients in the femoral nerve block group required patient-controlled analgesia (PCA) with morphine due to persistent pain scores at or above 4, despite rescue analgesics and routine medications.

It is important to acknowledge certain limitations of the study. Firstly, the sample size was small, as the level of significance was set at 80%, which limits the generalizability of the results. Secondly, the exclusion of five patients from the femoral nerve block group further reduced the sample size. Thirdly, the expertise of the operator in performing ultrasound-guided femoral nerve block may have impacted the outcomes of the study.

CONCLUSION

In terms of postoperative pain management after unilateral TKR, this study reveals that femoral nerve block exhibits lower efficacy compared to epidural analgesia. Patients who received femoral nerve block reported higher pain scores and necessitated higher opioid consumption. Future research should explore the potential benefits of augmenting femoral nerve block with sciatic nerve block or introducing patient-controlled analgesia (PCA) morphine to determine if these interventions can enhance pain scores. Until further evidence is available, it is recommended to continue employing epidural analgesia as the standard approach for routine postoperative pain management after unilateral TKR.

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