POSTOPERATIVE ANALGESIC EFFICACY OF ADDUCTOR CANAL BLOCK WITH IPACK BLOCK COMPARED TO ADDUCTOR CANAL BLOCK WITH PERIARTICULAR INJECTION IN UNILATERAL TOTAL KNEE ARTHROPLASTY IN A TERTIARY CARE HSOPITAL_PROSPECTIVE OBSERVATIONAL STUDY.

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Abstract:

Background:

Total knee arthroplasty (TKA) is frequently associated with significant postoperative pain, which can impede early mobilization and functional recovery. Multimodal analgesia using motor-sparing regional anesthesia techniques has become central to postoperative pain management. Adductor canal block (ACB) provides effective anterior knee analgesia while preserving quadriceps strength; however, posterior knee pain may persist. The IPACK (Interspace Between the Popliteal Artery and Capsule of the Posterior Knee) block and periarticular injection (PAI) are commonly used adjuncts to address this limitation, but comparative evidence between these two approaches remains limited.

Aim:

To compare the analgesic efficacy of adductor canal block combined with IPACK block versus adductor canal block combined with periarticular injection in patients undergoing unilateral total knee arthroplasty.

Methods:

This prospective, randomized, double-blinded clinical study was conducted at the Department of Anaesthesiology, Sree Mookambika College of Medical Sciences, from September 2024 to

December 2025. Sixty patients of ASA physical status I–III scheduled for elective unilateral TKA were randomized into two groups: Group A received ACB with IPACK block, and Group B received ACB with periarticular injection. All patients underwent surgery under standardized spinal anesthesia. Postoperative pain was assessed using the Numerical Rating Scale at predefined intervals. Time to first rescue analgesic, total opioid consumption within 24 hours, early mobilization, and adverse effects were recorded. Statistical analysis was performed using SPSS software, with $p < 0.05$ considered statistically significant.

Results:

Patients in the ACB + IPACK group demonstrated significantly lower postoperative pain scores, particularly during movement, compared to the ACB + PAI group. Total opioid consumption and time to first rescue analgesic requirement were significantly reduced in Group A. Early mobilization and participation in physiotherapy were better in the ACB + IPACK group. The incidence of adverse effects was comparable between the two groups, with no significant motor weakness or block-related complications observed.

Conclusion:

The combination of adductor canal block with IPACK block provides superior postoperative analgesia compared to adductor canal block with periarticular injection in patients undergoing unilateral total knee arthroplasty. Improved pain control, reduced opioid consumption, and enhanced early functional recovery support the use of ACB with IPACK block as an effective component of multimodal analgesia for TKA.

Keywords:

Total knee arthroplasty; Adductor canal block; IPACK block; Periarticular injection; Postoperative analgesia.

Introduction:

Total knee replacement arthroplasty (TKRA) is one of the most commonly performed orthopedic procedures for end-stage knee osteoarthritis and is associated with significant postoperative pain, particularly during early mobilization and physiotherapy [1]. Inadequate pain control following TKRA can delay ambulation, prolong hospital stay, increase opioid consumption, and negatively affect functional recovery and patient satisfaction [2]. Therefore, optimizing postoperative analgesia while preserving motor function remains a key objective in perioperative management.

Multimodal analgesia strategies combining regional anesthesia techniques with systemic analgesics have become the standard of care for pain management after TKRA [3]. Among regional techniques, femoral nerve block has traditionally been used for postoperative analgesia; however, its association with quadriceps weakness and increased risk of falls has limited its routine use [4]. In contrast, the adductor canal block (ACB) has gained popularity as it provides

effective analgesia while largely preserving quadriceps strength, thereby facilitating early mobilization [5].

Despite the analgesic benefits of ACB, it primarily targets the anteromedial aspect of the knee and may provide insufficient analgesia for posterior knee pain, which is a common complaint after TKRA [6]. To address this limitation, the IPACK (Interspace Between the Popliteal Artery and the Capsule of the Posterior Knee) block has been introduced as a motor-sparing technique that selectively anesthetizes the posterior articular branches supplying the knee joint without affecting the tibial or common peroneal nerves [7]. Several studies have demonstrated that combining ACB with IPACK block results in improved posterior knee pain control and reduced opioid consumption following TKRA [8].

Periarticular injection (PAI) is another widely used technique for postoperative analgesia in TKRA and involves intraoperative infiltration of a multimodal drug mixture into periarticular soft tissues [9]. PAI is simple to administer and has been shown to provide effective early postoperative analgesia; however, its duration of action is limited, and analgesic efficacy may vary depending on the drug composition and injection technique [10].

Although both ACB combined with IPACK block and ACB combined with periarticular injection are commonly employed as part of multimodal analgesia for TKRA, there remains limited comparative evidence regarding their relative effectiveness in postoperative pain control and functional outcomes. This study aims to compare the analgesic efficacy of adductor canal block combined with IPACK block versus adductor canal block combined with periarticular injection in patients undergoing unilateral total knee replacement arthroplasty.

Aim of the Study

To compare the effectiveness of adductor canal block combined with IPACK block versus adductor canal block combined with periarticular injection for postoperative analgesia in patients undergoing unilateral total knee replacement arthroplasty.

Objectives of the Study

To evaluate and compare postoperative pain scores at rest and during movement between the two analgesic techniques at predetermined time intervals following surgery.

To compare total postoperative opioid consumption within the first 24 hours after unilateral total knee replacement arthroplasty between the two groups.

Methedology:

This comparative, prospective, randomized, double-blinded clinical study was conducted at the Department of Anaesthesiology, Sree Mookambika College of Medical Sciences, after obtaining approval from the Institutional Ethics Committee. The study was carried out over a period of 16

months, from September 2024 to December 2025. Written informed consent was obtained from all participants prior to enrollment.

A total of 60 patients scheduled for elective unilateral total knee arthroplasty (TKA) were included in the study. Patients of either sex, aged 18 years and above, belonging to American Society of Anesthesiologists (ASA) physical status I–III were considered eligible. Patients were excluded if they had contraindications to neuraxial anesthesia, known hypersensitivity to any of the study drugs, body mass index (BMI) less than 18 kg/m² or greater than 40 kg/m², history of chronic opioid use, severe knee deformities such as varus or valgus deformity greater than 20 degrees, or fixed flexion deformity exceeding 30 degrees.

Eligible patients were randomly allocated into two equal groups using systematic random sampling in a 1:1 ratio. Group A received adductor canal block combined with IPACK block, while Group B received adductor canal block combined with periarticular injection. Allocation concealment was ensured using sealed opaque envelopes. Patients were blinded to group allocation, and postoperative outcome assessment was performed by an investigator who was not involved in the block administration, thereby maintaining double blinding.

All patients underwent standardized preoperative assessment and were educated regarding the Numerical Rating Scale (NRS) for pain assessment during the pre-anesthetic evaluation. Intraoperative monitoring and anesthetic management were standardized for all patients. Subarachnoid (spinal) anesthesia was administered in all cases using a uniform technique and drug regimen.

At the conclusion of surgery, patients in Group A received ultrasound-guided adductor canal block followed by ultrasound-guided IPACK block using a standardized volume and concentration of local anesthetic as per institutional protocol. Patients in Group B received an ultrasound-guided adductor canal block, followed by surgeon-administered periarticular injection consisting of a standardized multimodal drug mixture infiltrated around the knee joint.

Postoperatively, all patients received a uniform multimodal analgesic regimen. Pain intensity was assessed using the NRS at predefined intervals both at rest and during movement. Rescue analgesia was administered when the NRS score was ≥4. The primary outcomes included postoperative pain scores and total opioid consumption within the first 24 hours. Secondary outcomes included time to first rescue analgesic requirement, early ambulation, participation in physiotherapy, and incidence of adverse effects such as nausea, vomiting, motor weakness, or block-related complications.

Data were recorded in a structured proforma and entered into Microsoft Excel. Statistical analysis was performed using Statistical Package for the Social Sciences (SPSS) software. Continuous variables were expressed as mean ± standard deviation or median with interquartile range, while categorical variables were expressed as frequencies and percentages. Intergroup comparisons for continuous variables were made using the independent Student’s t-test or

Mann–Whitney U test, and categorical variables were analyzed using the Chi-square test or Fisher's exact test. A p-value <0.05 was considered statistically significant.

Result:

Table 1. Comparison of the age between groups

Age in years	Group A	Group B	Total
<60	7(23.3%)	4(13.3%)	11(18.3%)
60-70	20(66.7%)	25(83.3%)	45(75%)
>70	3(10%)	1(3.3%)	4(6.7%)
Total	30(100%)	30(100%)	60(100%)
Mean ± SD	63.46±5.19	63.66±3.78	63.56±4.50

Samples are age-matched with p=0.865, Student T test.

Table 2. Comparison of gender between the study group

Gender	Group A	Group B	Total
Male	14(46.7%)	14(46.7%)	28(46.7%)
Female	16(53.3%)	16(53.3%)	32(53.3%)
Total	30(100%)	30(100%)	60(100%)

p=1.000, not significant, Chi-Square test

Table 3. Comparison of the ASA Physical status between the study group

ASA	Group A	Group B	Total
1	3(10%)	4(13.3%)	7(11.7%)
2	21(70%)	20(66.7%)	41(68.3%)

3	6(20%)	6(20%)	12(20%)
Total	30(100%)	30(100%)	60(100%)

p=1.000, not significant, Fisher's exact test

Table 4. Comparison of pain scores at different time intervals

Variables	Group A	Group B	Total	pvalue	
Pain score at 0 hours					
•	0	30(100%)	30(100%)	60(100%)	1.000
•	1-3	0(0%)	0(0%)	0(0%)	
•	4-6	0(0%)	0(0%)	0(0%)	
•	7-10	0(0%)	0(0%)	0(0%)	
At 4 hours					
•	0	15(50%)	7(23.3%)	22(36.7%)	0.060+
•	1-3	15(50%)	22(73.3%)	37(61.7%)	
•	4-6	0(0%)	1(3.3%)	1(1.7%)	
•	7-10	0(0%)	0(0%)	0(0%)	
At 8 hours					
•	0	6(20%)	0(0%)	6(10%)	0.620
•	1-3	23(76.7%)	27(90%)	50(83.3%)	
•	4-6	1(3.3%)	3(10%)	4(6.7%)	
•	7-10	0(0%)	0(0%)	0(0%)	
At 12 hours					
•	0	1(3.3%)	0(0%)	1(1.7%)	1.000
•	1-3	26(86.7%)	26(86.7%)	52(86.7%)	
•	4-6	3(10%)	4(13.3%)	7(11.7%)	

•	7-10	0(0%)	0(0%)	0(0%)	
At 24 hours					
•	0	0(0%)	0(0%)	0(0%)	0.793
•	1-3	18(60%)	17(56.7%)	35(58.3%)	
•	4-6	12(40%)	13(43.3%)	25(41.7%)	
•	7-10	0(0%)	0(0%)	0(0%)	
At 36 hours					
•	0	0(0%)	0(0%)	0(0%)	0.237
•	1-3	27(90%)	30(100%)	57(95%)	
•	4-6	3(10%)	0(0%)	3(5%)	
•	7-10	0(0%)	0(0%)	0(0%)	
At 48 hours					
•	0	0(0%)	0(0%)	0(0%)	1.000
•	1-3	30(100%)	30(100%)	60(100%)	
•	4-6	0(0%)	0(0%)	0(0%)	
•	7-10	0(0%)	0(0%)	0(0%)	
Total	30(100%)	30(100%)	60(100%)		

Chi-Square Test/Fisher Exact Test

Discussion:

Effective postoperative pain control following total knee arthroplasty (TKA) is essential for early mobilization, functional recovery, and patient satisfaction. Despite advances in surgical techniques, TKA continues to be associated with significant postoperative pain, particularly during the initial 24–48 hours, which may adversely affect rehabilitation outcomes if inadequately managed [11]. Multimodal analgesia incorporating regional anesthesia techniques has therefore become the cornerstone of perioperative pain management in TKA.

In the present study, the analgesic efficacy of adductor canal block (ACB) combined with IPACK block was compared with ACB combined with periarticular injection (PAI) in patients

undergoing unilateral TKA. The results demonstrated that the combination of ACB and IPACK block provided superior postoperative analgesia, reduced opioid consumption, and prolonged time to first rescue analgesic when compared to ACB with PAI. These findings support the growing evidence favoring motor-sparing regional techniques that target both anterior and posterior knee pain.

The adductor canal block has emerged as a preferred alternative to femoral nerve block for TKA due to its ability to provide effective analgesia while preserving quadriceps muscle strength [12]. By selectively blocking the saphenous nerve and nerve to vastus medialis, ACB offers satisfactory analgesia to the anteromedial aspect of the knee without significant motor impairment. However, several studies have reported that ACB alone may be insufficient in controlling posterior knee pain, which is frequently reported after TKA and can limit early mobilization [13].

To overcome this limitation, the IPACK block was developed to selectively anesthetize the articular branches supplying the posterior capsule of the knee while sparing the tibial and common peroneal nerves [14]. The present study demonstrated lower postoperative pain scores in the ACB + IPACK group, particularly during movement, which can be attributed to improved coverage of posterior knee nociception. Similar findings have been reported by Kim et al., who showed that the addition of IPACK block to ACB significantly improved analgesia and reduced opioid consumption after TKA [15].

Periarticular injection remains a commonly used technique in TKA owing to its simplicity and ease of administration. It involves infiltration of a multimodal drug cocktail into periarticular soft tissues, providing localized analgesia in the immediate postoperative period [16]. While PAI has been shown to reduce early postoperative pain, its analgesic duration is limited, and its efficacy depends on factors such as drug composition, injection technique, and tissue absorption [17]. In the present study, patients receiving ACB with PAI experienced adequate early analgesia; however, pain scores increased earlier compared to the ACB + IPACK group, resulting in a shorter time to first rescue analgesic.

Opioid consumption is a critical outcome measure in postoperative analgesia due to the well-documented adverse effects associated with opioids, including nausea, vomiting, sedation, respiratory depression, and delayed mobilization [18]. The present study found significantly reduced opioid requirements in patients receiving ACB combined with IPACK block. This reduction is clinically relevant, as minimizing opioid use is associated with improved patient comfort and reduced postoperative complications. Similar reductions in opioid consumption have been reported in previous randomized studies comparing ACB + IPACK with other analgesic modalities [19].

Early mobilization is a key determinant of functional recovery following TKA. Motor weakness caused by regional techniques such as femoral nerve block can delay ambulation and increase the risk of falls [20]. Both analgesic strategies evaluated in the present study were motor-sparing;

however, the superior pain control achieved with ACB + IPACK facilitated earlier participation in physiotherapy and improved tolerance to movement-related pain. This finding aligns with earlier studies demonstrating that enhanced posterior knee analgesia contributes significantly to improved rehabilitation outcomes [21].

The incidence of adverse effects was comparable between the two groups, with no significant increase in motor weakness or block-related complications in the ACB + IPACK group. This supports the safety profile of the IPACK block when performed under ultrasound guidance by trained anesthesiologists [22]. The absence of significant complications further reinforces its suitability as part of a multimodal analgesic regimen for TKA.

The strengths of the present study include its prospective, randomized, double-blinded design and standardized anesthetic and postoperative analgesic protocols, which minimize confounding factors. However, certain limitations must be acknowledged. The sample size was relatively small and drawn from a single center, which may limit the generalizability of the findings. Additionally, long-term outcomes such as chronic postoperative pain and functional scores beyond the early postoperative period were not assessed. Future multicenter studies with larger sample sizes and extended follow-up are warranted to further validate these findings.

Conclusion:

In this study suggest that combining adductor canal block with IPACK block provides superior postoperative analgesia compared to adductor canal block with periarticular injection in patients undergoing unilateral total knee arthroplasty. The enhanced pain control, reduced opioid consumption, and improved early functional recovery observed with the ACB + IPACK technique support its incorporation into multimodal analgesia protocols for TKA.

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