Section: Anaesthesiology

Original Research Article

ROLE OF IPACK BLOCK IN MULTIMODAL ANALGESIA FOR TOTAL KNEE REPLACEMENT: A PROSPECTIVE OBSERVATIONAL STUDY

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ABSTRACT

Background: Total Knee Replacement (TKR) often causes significant postoperative pain, affecting early mobilization, rehabilitation, and patient satisfaction. Effective pain management is essential for enhanced recovery after knee arthroplasty. Multimodal analgesia, combining systemic medications with regional anaesthetic blocks, helps reduce opioid use and improve outcomes. The Interspace between the Popliteal Artery and Capsule of the Knee (IPACK) block is a newer ultrasound-guided technique that targets posterior knee pain while preserving motor function. The objective is to evaluate the role and effectiveness of IPACK block as part of multimodal analgesia in patients undergoing Total Knee Replacement surgery. **Materials and Methods:** This prospective observational study was conducted at Government Virudhunagar Medical College from May 2025 to March 2026. It included 150 patients aged 50–70 years undergoing elective unilateral total knee replacement surgery. All patients received spinal anaesthesia followed by an ultrasound-guided IPACK block with 0.25% bupivacaine as part of multimodal analgesia. Postoperative pain was assessed using the Visual Analogue Scale (VAS) for 48 hours after surgery. Time to first rescue analgesia, total opioid consumption, early ambulation, and complications were also recorded and statistically analyzed. **Result:** Patients who received IPACK block demonstrated satisfactory postoperative analgesia with significantly lower VAS scores during the initial postoperative period. The mean duration before first rescue analgesia was prolonged, and opioid requirement was reduced. Most patients achieved early ambulation within 24 hours due to preservation of motor function. No major complications such as nerve injury, vascular injury, or local anaesthetic toxicity were observed. **Conclusion:** IPACK block is an effective and safe adjunct in multimodal analgesia for Total Knee Replacement surgeries. It provides superior posterior knee pain relief, decreases opioid requirement, preserves quadriceps muscle strength, and facilitates early postoperative rehabilitation and recovery.

INTRODUCTION

One of the most popular orthopaedic treatments for patients with severe osteoarthritis and other degenerative knee joint conditions is total knee replacement (TKR).[1] The number of TKR procedures carried out globally has dramatically increased due to rising life expectancy and the incidence of osteoarthritis in the older population. Even though total knee replacement (TKR) significantly enhances joint function and quality of life, postoperative pain continues to be a significant obstacle to early rehabilitation and patient recovery.[2]

A complete functional recovery after total knee replacement depends on adequate postoperative analgesia. Inadequate pain management can cause chronic postoperative pain, increase patient discontent, delay mobilization, and lengthen hospital stays. Systemic opioids were once often used to treat postoperative pain, but their use has been restricted due to opioid-related side effects such nausea, vomiting, drowsiness, respiratory depression, and delayed ambulation. As a result, multimodal analgesia has become the method of choice for managing postoperative pain following orthopaedic procedures.[3]

To effectively manage pain while minimizing the use of opioids and their side effects, multimodal

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analgesia combines various pain-relieving methods and medications that work through different mechanisms. In total knee replacement surgeries, regional anaesthetic techniques such as the femoral nerve block and adductor canal block are commonly used. However, these approaches may not adequately address posterior knee pain, which can significantly increase patient discomfort after surgery.[4]

A more recent approach, known as the Interspace between the Popliteal Artery and Capsule of the Knee IPACK block, is an ultrasound-guided localized anaesthetic technique designed to relieve pain in the posterior knee capsule without greatly affecting muscle function. This block helps maintain quadriceps strength and supports early walking by specifically targeting the sensory nerves of the joint.[5]

Promising outcomes regarding increased postoperative analgesia and improved recovery using IPACK block have been shown in recent research. Nevertheless, there is a dearth of information from tertiary care facilities in India. In order to assess IPACK block's contribution to multimodal analgesia in patients undergoing total knee replacement surgery, the current study was conducted.[6]

MATERIALS AND METHODS

Study Design and Setting: This study, which is prospective observational research, was carried out in the Department of Anaesthesiology at Government Virudhunagar Medical College and Hospital located in Tamil Nadu, between May 2025 and March 2026. The study was conducted after receiving approval from the Institutional Ethics Committee. Before enrolling in the study, written informed consent was obtained from all participants.

Study Population: A total of 150 patients scheduled for elective unilateral Total Knee Replacement (TKR) surgery under spinal anaesthesia were included in the study.

Inclusion Criteria

- Patients aged between 50 and 70 years
- Both male and female patients
- American Society of Anaesthesiologists (ASA) physical status I and II
- Patients undergoing elective unilateral Total Knee Replacement surgery

Exclusion Criteria

- Patient refusal
- Known allergy to local anaesthetic agents
- Coagulopathy or patients on anticoagulant therapy
- Infection at the site of block administration
- Severe cardiac, hepatic, renal, or neurological disorders
- Revision knee arthroplasty
- Inability to understand the Visual Analogue Scale (VAS)

Preoperative Assessment: All patients underwent detailed pre-anaesthetic evaluation including medical history, physical examination, airway assessment, and routine laboratory investigations. Patients were educated regarding the Visual Analogue Scale (VAS) for postoperative pain assessment, where 0 indicated no pain and 10 indicated worst imaginable pain.

Anaesthetic Technique: On arrival to the operating room, standard monitoring including electrocardiography (ECG), pulse oximetry, and non-invasive blood pressure monitoring was instituted. Intravenous access was secured, and patients were preloaded with crystalloid solution.

Subarachnoid block was administered in the sitting position at the L3–L4 intervertebral space using 0.5% hyperbaric bupivacaine under strict aseptic precautions. Surgery was performed after achieving adequate sensory and motor blockade.

IPACK Block Technique: At the completion of surgery, ultrasound-guided IPACK block was administered with the patient in the supine position and knee slightly flexed. A high-frequency linear ultrasound probe was placed transversely over the popliteal fossa to identify the popliteal artery and posterior capsule of the knee joint.

Using an in-plane technique, a 22-gauge block needle was advanced into the interspace between the popliteal artery and posterior knee capsule. After negative aspiration, 20 mL of 0.25% bupivacaine was injected incrementally under ultrasound visualization to ensure proper spread of local anaesthetic.

Postoperative Analgesia Protocol: All patients received standard multimodal analgesia consisting of:

- Intravenous paracetamol 1 g every 8 hours
- Intravenous diclofenac 75 mg every 12 hours unless contraindicated

Rescue analgesia with intravenous tramadol 50 mg was administered when VAS score exceeded 4.

Outcome Measures

The primary outcome measured was postoperative pain intensity assessed using the Visual Analogue Scale (VAS) at:

- 2 hours
- 6 hours
- 12 hours
- 24 hours
- 48 hours postoperatively

Secondary outcome measures included:

- Time to first rescue analgesia
- Total opioid consumption within 48 hours
- Time to ambulation
- Incidence of complications such as nausea, vomiting, local anaesthetic toxicity, nerve injury, vascular injury, and motor weakness

Statistical Analysis: Data were entered in Microsoft Excel and analyzed using Statistical Package for Social Sciences (SPSS) software version 25. Quantitative variables were expressed as mean ± standard deviation, while qualitative variables were expressed as frequency and percentage. Continuous variables were analyzed using Student's t-test, and categorical variables were analyzed using Chi-square

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test. A p-value of <0.05 was considered statistically significant.

RESULTS

A total of 150 patients undergoing elective unilateral Total Knee Replacement surgery were included in the study. All patients successfully received ultrasound-guided IPACK block as part of multimodal analgesia without any technical difficulty.

Table 1: Demographic Characteristics of Study Participants

Variable	Value
Mean age (years)	62.4 ± 5.8
Male	54 (36%)
Female	96 (64%)
ASA I	58 (38.7%)
ASA II	92 (61.3%)

Table Note:
Values are expressed as mean ± standard deviation or number (%). ASA – American Society of Anaesthesiologists physical status classification.
Figure Note: Female patients constituted most of the study population undergoing Total Knee Replacement surgery.

Postoperative Pain Scores

Postoperative pain assessment using the Visual Analogue Scale (VAS) demonstrated effective analgesia following IPACK block administration. Lower pain scores were observed during the early postoperative period, indicating satisfactory pain control.

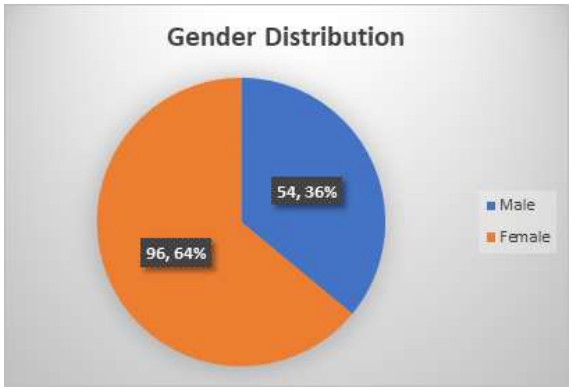

Figure 1: Gender Distribution of Study Participants

Table 2: Mean VAS Scores at Different Postoperative Time Intervals

Time Interval	Mean VAS Score
2 hours	1.8 ± 0.7
6 hours	2.3 ± 0.9
12 hours	3.1 ± 1.0
24 hours	3.8 ± 1.2
48 hours	2.6 ± 0.8

Table Note:
VAS – Visual Analogue Scale ranging from 0 (no pain) to 10 (worst imaginable pain). Values are expressed as mean ± standard deviation.

Figure Note:
VAS scores remained low during the early postoperative period, indicating effective postoperative analgesia with IPACK block.

Rescue Analgesia Requirement

The requirement for rescue analgesia was reduced in most patients. The mean duration before first rescue analgesia was prolonged, reflecting adequate postoperative pain relief.

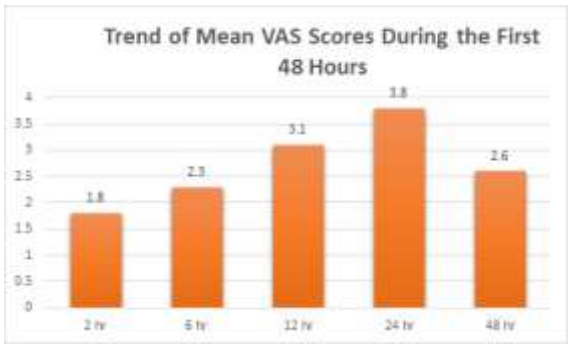

Figure 2: Trend of Mean VAS Scores During the First 48 Hours Postoperatively

Table 3: Analgesic Outcomes Among Study Participants

Parameter	Value
Time to first rescue analgesia	10.8 ± 2.6 hours
Mean tramadol consumption (48 hrs)	86 ± 24 mg
Patients requiring rescue analgesia	58 (38.7%)

Table Note: Values are expressed as mean ± standard deviation or number (%). Tramadol was used as rescue opioid analgesia when VAS score exceeded 4.

Early Ambulation: Preservation of quadriceps muscle strength facilitated early ambulation in the majority of patients.

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Table 4: Time to Ambulation Following Surgery

Ambulation Time	Number of Patients
Within 24 hours	128 (85.3%)
After 24 hours	22 (14.7%)

Table Note:
Early ambulation was defined as the ability to stand and walk with assistance within 24 hours after surgery.

Figure Note:
Most patients (85.3%) achieved ambulation within 24 hours postoperatively, indicating preserved motor function following IPACK block administration.

Postoperative Complications

No major complications related to the IPACK block were observed in the study population.

Figure 3: Distribution of Patients According to Time of Ambulation.

Table 5: Postoperative Complications Observed Among Patients

Complication	Number of Patients
Nausea/Vomiting	12 (8%)
Motor weakness	0
Nerve injury	0
Vascular injury	0
Local anaesthetic toxicity	0

Table Note: No serious complications such as nerve injury, vascular injury, or local anaesthetic systemic toxicity were observed during the study period.

Overall Interpretation of Findings

The findings of the present study demonstrate that ultrasound-guided IPACK block is an effective adjunct in multimodal analgesia for Total Knee Replacement surgery. Patients experienced lower postoperative pain scores, prolonged duration of analgesia, reduced opioid requirement, and early mobilization with minimal motor weakness.

Additionally, the procedure was found to be safe with very low incidence of complications. These findings support the routine incorporation of IPACK block into perioperative analgesic protocols to improve postoperative recovery and patient outcomes following Total Knee Replacement surgery.

DISCUSSION

The present prospective observational study evaluated the role of the Interspace between the Popliteal Artery and Capsule of the Knee (IPACK) block as a component of multimodal analgesia in patients undergoing Total Knee Replacement (TKR) surgery. The findings of the study demonstrated that IPACK block provided effective postoperative analgesia, reduced opioid requirement, preserved motor function, and facilitated early ambulation with minimal complications.[7]

Postoperative pain following Total Knee Replacement is often severe and may interfere with rehabilitation, patient satisfaction, and overall recovery. Effective pain management is therefore essential in achieving enhanced recovery after surgery. Traditional regional anaesthetic techniques such as femoral nerve block and sciatic nerve block provide satisfactory analgesia; however, they may result in motor weakness and delayed mobilization. The IPACK block has emerged as a motor-sparing regional anaesthetic technique specifically targeting the sensory innervation of the posterior knee capsule.[8]

In the present study, postoperative Visual Analogue Scale (VAS) scores remained low during the initial postoperative period, indicating satisfactory analgesic efficacy of the IPACK block. Similar findings have been reported in previous studies where IPACK block effectively reduced posterior knee pain after TKR surgery. Adequate pain control observed in this study contributed to improved patient comfort and facilitated rehabilitation.[9]

The mean duration before first rescue analgesia in the present study was prolonged, and postoperative opioid consumption was significantly reduced. Reduction in opioid requirement is clinically important because opioid-related adverse effects such as nausea, vomiting, sedation, constipation, and respiratory depression may negatively affect postoperative recovery. The opioid-sparing effect observed with IPACK block supports its usefulness as part of multimodal analgesia protocols.[10]

An important finding of the present study was preservation of motor function. Most patients achieved early ambulation within the first postoperative day with minimal quadriceps weakness. Unlike sciatic nerve block, which may impair lower limb motor function, the IPACK block selectively blocks sensory branches supplying the posterior capsule while sparing the major motor nerves. Early mobilization is a critical component of enhanced recovery protocols because it reduces the risk of thromboembolic complications, improves functional recovery, and shortens hospital stay.[11]

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The incidence of complications associated with IPACK block in the present study was minimal. No major complications such as vascular injury, local anaesthetic systemic toxicity, persistent neurological deficit, or infection were observed. These findings suggest that ultrasound-guided IPACK block is a safe and reliable technique when performed by trained anaesthesiologists.[5]

The findings of this study are consistent with previous literature supporting the use of IPACK block in Total Knee Replacement surgeries. However, the present study was observational in nature and lacked a comparison group, which may limit interpretation of outcomes. Further randomized controlled trials comparing IPACK block with other regional analgesic techniques are required to establish standardized protocols.[7]

Overall, the present study supports the incorporation of IPACK block into multimodal analgesia regimens for Total Knee Replacement surgery to improve postoperative analgesia, reduce opioid consumption, and enhance early functional recovery.

Limitations: This study has some limitations. First, it was carried out at a single tertiary care centre, which may affect how widely its findings can be applied. Second, the study used an observational design, so there is no comparison group for reference. Third, the study did not evaluate long-term functional results. Further research, including randomized controlled trials with larger groups of participants, is needed to provide clear evidence about the effectiveness of the IPACK block.

CONCLUSION

The present study demonstrates that IPACK block is an effective and safe component of multimodal analgesia for patients undergoing Total Knee Replacement surgery.

The technique provides satisfactory postoperative analgesia, reduces opioid consumption, preserves motor function, and promotes early mobilization. Incorporating IPACK block into perioperative pain management protocols may improve patient recovery and overall surgical outcomes.Future studies should focus on comparative analyses with other regional anaesthetic techniques and long-term rehabilitation outcomes.

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