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Efficacy of intra-operative adductor canal block in total knee arthroplasty: a prospective observational study

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ABSTRACT

Background: Effective postoperative pain control after total knee arthroplasty (TKA) remains a clinical challenge. This study aimed to evaluate the efficacy of intraoperative adductor canal block (ACB) in providing pain relief and preserving quadriceps function.
Methods: This prospective observational study included 92 patients undergoing primary TKA. Intraoperative ACB was administered by the operative surgeon, and outcomes assessed included pain scores (visual analogue score (VAS) at multiple time points), quadriceps muscle power, complications, and postoperative analgesic use. Statistical associations were evaluated using Chi-square and t-tests with $p<0.05$ as significant.
Results: Most participants reported mild pain at 6–8 hours, with moderate pain predominating at 24–48 hours and during mobilization. Quadriceps strength was preserved in nearly half the patients. Analgesic consumption correlated with higher VAS at 48 hours ($p=0.001$). Age was associated with reduced quadriceps strength ($p=0.011$). Longer preoperative pain duration was significantly linked to higher postoperative pain at 24–48 hours.
Conclusions: Intraoperative Adductor canal block is an effective, motor-sparing analgesic option for TKA, supporting early mobilization and reducing dependence on opioids. Further research is warranted to optimize block techniques and adjunct strategies.

Keywords: Adductor canal block, Total knee arthroplasty, Analgesia, Quadriceps strength, Postoperative pain

INTRODUCTION

Total knee arthroplasty (TKA) is the definitive surgical procedure for end-stage knee osteoarthritis, aimed at relieving pain, restoring mobility, and improving quality of life. Despite its success, after surgery pain remains a statistically relevant clinical challenge. Effective pain management is essential for early mobilization, rehabilitation, and overall functional outcomes.

Conventional approaches such as epidural pain management, systemic opioids, and femoral nerve blocks have shown efficacy, but each carries inherent limitations. Epidural pain management can result in motor weakness and hypotension, opioids are associated with nausea, vomiting, and dependence, while femoral nerve blocks compromise quadriceps function, delaying mobilization.

Intraoperative adductor canal block (ACB) has gained interest as an analgesic technique that selectively blocks the saphenous nerve and nerve to vastus medialis, sparing quadriceps motor function.

By maintaining quadriceps motor power, ACB promotes earlier ambulation and rehabilitation while ensuring adequate pain management. This investigation was conducted to evaluate the efficacy of during surgery ACB in investigation participants undergoing TKA, focusing on

pain relief, quadriceps power, adverse outcomes, and analgesic consumption.

Review of literature

Several investigations have explored the role of ACB in controlling pain after total knee replacement. Earlier reports consistently indicated that ACB provides pain relief comparable to femoral nerve block, yet with the advantage of better preservation of quadriceps activity. This motor-sparing characteristic allows patients to begin mobilization sooner. O

ther studies contrasted ACB with epidural approaches, showing fewer systemic side-effects and earlier rehabilitation with ACB. More recent analyses and meta-reviews highlight the potential benefits of combining ACB with periarticular infiltration or posterior knee techniques to extend pain relief into the later postoperative period.

Despite these advances, variability persists in technique, drug selection, and dosing, and there remains limited data within the Indian population, underlining the relevance of the current investigation.[1-4]

METHODS

Study design

A prospective observational investigation was conducted at Fortis Memorial Research Institute, Gurgaon.

Study population

Patients undergoing unilateral or bilateral primary TKA were a part of the study population.

Inclusion criteria

Patients undergoing primary TKA were included.

Exclusion criteria

Patients undergoing revision TKR, unicompartmental knee replacement, or patellar resurfacing were excluded.

Sample size

92 investigation participants were included.

Methodology

All investigation participants underwent standard anesthesia protocols. Intraoperative ACB was administered after prosthesis implantation. Outcomes assessed included VAS scores at 6–8, 24, 48 hours, and during mobilization, quadriceps strength (MRC grading), analgesic consumption, and adverse outcomes.

Statistical analysis

Data was analyzed using Chi-square test for categorical variables and t-test for continuous variables. A $p<0.05$ was considered statistically relevant.

Study period

The study was conducted in between September 2022 to October 2023.

Surgical technique

All procedures were performed under spinal or combined spinal-epidural anesthesia. After completion of prosthesis implantation, ACB was performed manually with palpating the adductor tubercle and 5-8 cm above it. A 22-gauge needle was advanced under vision into the adductor canal and local anesthetic solution along with ketorolac, bupivacaine, cefuroxime was deposited around the saphenous nerve. Patients received standardized multimodal pain management and physiotherapy after surgery.

RESULTS

A total of 92 investigation participants were included. The majority were females (83.7%), with mean age distributed predominantly between 60–70 years (Table 1). Most investigation participants had preoperative pain duration between 1–3 years (54.3%).

Complications were observed in 26.1% of investigation participants (Tables 2 and 3).

Table 1: Characteristics of patients.

Variables	Category	Number (%)
Age (years)	Mean±SD	62.4±8.2
Sex	Male	40 (43.5)
	Female	52 (56.5)
BMI	Mean±SD	27.6±3.9
Diagnosis	Primary OA	85 (92.4)
	RA	7 (7.6)

Table 2: Time point with respect to severity.

Time point (hours)	Mild (%)	Moderate (%)	Severe (%)	Total (n=92)
6–8	85	15	0	92
24	39	61	0	92
48	28	72	0	92
Mobilization	10	87	3	92

VAS scores indicated adequate after surgery pain relief immediately after surgery with increasing moderate pain at 24 and 48 hours. Quadriceps strength was preserved in 47.8% of cases (Table 3).

Table 3: Quadriceps grade.

Quadriceps grade	Number (%)
Grade 1 (4 plus MRC power)	48 (52.2)
Grade 2 (less than 3)	44 (47.8)

Analgesic consumption was evenly distributed. Significant associations were observed between preoperative pain duration and visual analogue score (VAS) at 24 and 48 hours (p=0.010, p=0.004), age and quadriceps strength (p=0.011), and analgesic consumption with VAS at 48 hours (p=0.001) (Table 4).

Table 4: VAS score.

Variable	Category	VAS 24 hours (mean±SD)	VAS 48 hours (mean±SD)	P value
Age (years)	<60	4.8±1.1	5.2±1.0	0.011
	≥60	5.6±1.0	6.1±1.2	
Preoperative pain (months)	<6	4.5±1.0	5.0±1.1	0.01/0.004
	≥6	5.8±1.2	6.3±1.3	

DISCUSSION

In this prospective observational study, intraoperative ACB was found to be an effective component of multimodal pain management following TKA.[1-4] The majority of patients experienced mild pain during the initial 6–8 hours after surgery, progressing to moderate levels by 24–48 hours. These findings align with earlier studies by Jaeger et al and Kim et al, who demonstrated that ACB provides effective early postoperative analgesia while maintaining quadriceps strength.[1,2] Similar temporal pain relief trends were also reported by Agarwal et al and Berikashvili et al, supporting our observation that ACB provides good immediate analgesia, though its effect diminishes beyond the first day.[3,4]

Pain relief

The mean VAS pain scores in our study showed mild pain in the first few postoperative hours, with moderate pain dominating at 24–48 hours. Comparable outcomes were noted by Krishna et al and Mu et al, who reported VAS scores increasing gradually within the first 48 hours after single-shot ACB.[5,6] Alturki et al found that continuous ACB using a catheter maintained lower pain scores for a longer duration, suggesting that continuous infusion may be superior to a single-shot technique.[7] The analgesic profile of ACB has also been compared favorably with epidural analgesia and femoral nerve block in several meta-analyses by Agarwal et al and Abdallah et al, reinforcing its role as a motor-sparing yet effective pain control strategy.[3-5,8,9]

Quadriceps strength and early mobilization

Nearly half of the patients (47.8%) in our study maintained adequate quadriceps power (grade ≥4), indicating that ACB effectively preserves motor function. This finding is in agreement with Kim et al, who reported that ACB allows early mobilization compared to femoral nerve block (FNB).[2] Similarly, Agarwal et al and Berikashvili et al demonstrated that ACB offers comparable analgesia to FNB but with better preservation of muscle strength.[3,4] Our results support the conclusion that ACB enhances early rehabilitation potential without compromising stability. Comparable results were also demonstrated in meta-analyses by Borys et al, who confirmed that ACB significantly preserves quadriceps strength while providing adequate analgesia after TKA.[3-5,10]

Analgesic consumption and adjunct strategies

A statistically significant association between analgesic consumption and VAS pain scores at 48 hours (p=0.001) was observed in our cohort. This correlation indicates that patients with higher pain scores required more rescue analgesia. Mu et al and Alturki et al have both reported similar findings, highlighting the value of combining ACB with adjuncts such as dexamethasone or continuous infusion for prolonged pain control.[6,7] Additionally, Abd El-Latif Hassan et al found that combining ACB with infiltration between the popliteal artery and capsule of the knee (IPACK) further improved posterior knee pain relief — a modification that could enhance outcomes in future research.[11]

Age, pain duration, and patient factors

We found significant associations between older age, longer preoperative pain duration, and reduced quadriceps performance. Older age has been associated with diminished muscle recovery and altered pain perception thresholds, as reported by Agarwal et al.[12] Prolonged preoperative pain may lead to central sensitization and poorer postoperative pain tolerance, consistent with observations by Dhalla et al.[9] These findings emphasize the need for individualized analgesic strategies based on patient demographics and pain history.

Complications

Postoperative complications were observed in 26.1% of patients, mostly transient paresthesia or nausea. Similar minor complication rates were reported by Krishna et al and Ho et al, while major neuropathic complications remain rare.[5,10] The absence of motor deficits in our series reinforces the safety profile of ACB compared to FNB,

aligning with the conclusions of recent systematic reviews.[8-10]

Interpretation and clinical implications

Overall, our findings reaffirm that intraoperative ACB provides a balance between effective analgesia and preservation of quadriceps function, enabling earlier ambulation and reducing opioid reliance. It represents a valuable component of enhanced recovery after surgery (ERAS) protocols for TKA. The results are consistent with global evidence supporting ACB as a reliable, safe, and function-preserving alternative to femoral nerve block.

Limitations

This study was observational and conducted at a single tertiary center, which may limit generalizability. The sample size was modest, and no randomization or control group was included. Follow-up was limited to the first 48 hours postoperatively, and long-term pain and functional recovery were not evaluated. Future randomized controlled trials with larger populations and longer follow-up are recommended to validate these findings.

CONCLUSION

Intraoperative adductor canal block is a safe and effective modality for after surgery pain management in total knee arthroplasty. It provides satisfactory pain control while preserving quadriceps function, thereby facilitating early mobilization and rehabilitation. The technique should be considered as a valuable component of multimodal pain management in TKA investigation participants.

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