Section: Anaesthesiology

Original Research Article

DEXMEDETOMIDINE ADJUVANT IN ADDUCTOR CANAL BLOCK FOR POSTOPERATIVE ANALGESIA AFTER KNEE SURGERY: A RANDOMIZED CONTROLLED STUDY

Mustafeez Absar Zia Akhtar[1], Ranjeeta Tambey[2], Kotmire Vidya Subhash[3], Riya Vijay Gode[4]

[1]Senior Resident, GMC, Nagpur, India.
[2]Associate Professor, GMC, Nagpur, India.
[3]Assistant Professor, GMC, Nagpur, India.
[4]Junior Resident, GMC Nagpur, India.

Received *: 08/05/2026*
Received in revised form *: 24/06/2026*
Accepted *: 11/07/2026*

Corresponding Author:
Dr. Mustafeez Absar Zia Akhtar,
Senior Resident, GMC Nagpur, India.
Email: mustafeezabsar@gmail.com

DOI: 10.70034/ijmedph.2026.3.130

Source of Support: Nil,
Conflict of Interest: None declared

Int J Med Pub Health
2026; 16 (3); 804-808

ABSTRACT

Background: Adductor canal block (ACB) is an effective technique for postoperative analgesia in knee surgeries; however, the duration of analgesia with single-shot block remains limited. The addition of adjuvant dexmedetomidine may enhance and prolong analgesic efficacy. The aim is to compare the postoperative analgesic efficacy of adductor canal block using dexmedetomidine with conventional analgesia in patients undergoing knee procedures.

Materials and Methods: This prospective, randomized, double-blind study was conducted on 58 ASA I–II patients aged 18–65 years undergoing elective knee surgery. Patients were allocated into two groups (n = 29 each). Group A received ultrasound-guided adductor canal block with 20 mL of 0.2% ropivacaine with dexmedetomidine 0.5 µg/kg. Group B received conventional postoperative analgesia. Postoperative pain was assessed using the Numerical Rating Scale (NRS) at 2, 4, 6, 12, 18, and 24 hours. Primary outcomes included NRS scores, effective analgesic duration, and total 24-hour analgesic consumption. Hemodynamic parameters and complications were also recorded.

Results: Group A showed significantly lower NRS scores at early postoperative intervals (2, 4, and 10 hours; $p < 0.05$). Effective analgesic duration was significantly longer in Group A (13.86 ± 6.44 hours vs 4.21 ± 1.63 hours; $p < 0.001$). Total 24-hour analgesic requirement was significantly lower in Group A compared to Group B (1.48 ± 0.91 vs 3.07 ± 0.46; $p < 0.001$). Hemodynamic parameters were more stable in Group A. The incidence of complications was comparable between groups ($p > 0.05$).

Conclusion: The dexmedetomidine as adjuvants to adductor canal block provides superior postoperative analgesia, reduces analgesic consumption, and maintains a favourable safety profile compared to conventional analgesia in knee surgeries.

Keywords: Adductor canal block; dexmedetomidine; postoperative analgesia; knee surgery; ropivacaine.

INTRODUCTION

Adductor canal block (ACB) has gained widespread acceptance as an effective regional anesthesia technique for postoperative pain management following knee surgeries and is considered an important component of multimodal analgesia strategies recommended for knee arthroplasty procedures.[1–3] Its role in reducing postoperative pain intensity and opioid consumption has been well documented, contributing to improved early mobilization and enhanced functional recovery in the postoperative period. However, one of the main

limitations of single-shot ACB is its relatively short duration of analgesia, which may be insufficient to cover the prolonged postoperative pain following knee surgery, often extending up to 48 hours.[4,5]

To address this limitation, continuous adductor canal catheter techniques have been used; however, their routine application is limited due to concerns such as infection risk, catheter displacement, and increased technical complexity. Consequently, interest has increased in the use of adjuvants added to local anesthetics in single-shot nerve blocks as a simpler and safer alternative to prolong analgesia.[6,7]

Among various adjuvants, dexmedetomidine, a highly selective α2-adrenergic agonist, has shown promising results in prolonging the duration and improving the quality of analgesia when used as an adjunct to local anesthetics in peripheral nerve blocks.[8,9] Its analgesic and sympatholytic properties contribute to reduced opioid consumption and improved postoperative comfort.

Although dexmedetomidine has demonstrated efficacy in enhancing block characteristics and postoperative analgesia, the duration of analgesic effect achieved with single adjuvant use remains variable and may still be limited in some clinical settings.[10,11] This has led to growing interest in optimizing its use as an adjunct to improve analgesic outcomes in regional anesthesia techniques.

Based on this background, the present randomized controlled study was designed to evaluate the efficacy of dexmedetomidine as an adjuvant to ropivacaine in adductor canal block and to assess its effectiveness in improving postoperative analgesia in patients undergoing knee surgeries.

MATERIALS AND METHODS

After obtaining approval from the Institutional Ethics Committee and written informed consent from all participants, this prospective, randomized, comparative clinical trial was conducted in the Department of Anaesthesiology from June 2024 to December 2025. A total of 58 patients (29 in each group), belonging to American Society of Anesthesiologists (ASA) Physical Status I–II, aged 18–65 years of either gender with normal body mass index (BMI), scheduled for elective knee surgery were enrolled in the study.

Patients with a history of allergy to local anaesthetics, coagulopathy, pre-existing neurological deficits, infection at the site of block, BMI >35 kg/m², anticipated difficult airway, chronic obstructive pulmonary disease, significant hepatic, renal or cardiovascular disease, or inability to comprehend the pain scoring system were excluded.

Randomization and Blinding: Randomization was performed using a computer-generated sequence, and allocation concealment was ensured using sealed opaque envelopes. Patients were assigned into two groups: Group A (Dexmedetomidine group) and Group B (Conventional analgesia group). Both patients and outcome assessors were blinded to group allocation.

Preoperative Assessment and Preparation: All patients underwent a detailed pre-anaesthetic evaluation including medical history, physical examination, airway assessment using Mallampati grading, and routine investigations as per institutional protocol. Patients were educated regarding the Numerical Rating Scale (NRS) for postoperative pain assessment.

All patients received oral alprazolam 0.25 mg the night before surgery. In the preoperative area, an 18G intravenous cannula was secured. Intravenous ondansetron 4 mg and pantoprazole 40 mg were administered 45 minutes prior to surgery.

Anaesthetic Technique: Standard intraoperative monitoring included electrocardiography, non-invasive blood pressure, and pulse oximetry. Equipment for resuscitation and general anaesthesia was kept ready.

Subarachnoid block was performed in the lateral decubitus position at L2–L3 or L3–L4 interspace under aseptic precautions using a 25G Quincke spinal needle after infiltration with 2 mL of 1% lignocaine. A total of 3 mL of 0.5% hyperbaric bupivacaine was administered intrathecally. Intraoperative events, including time of incision and duration of surgery, were recorded. Hypotension was managed with intravenous mephentermine (3–6 mg boluses), and bradycardia was treated with intravenous atropine 0.6 mg as required.

Postoperative Intervention: At the end of surgery, all patients received an ultrasound-guided adductor canal block using a Sonosite M-Turbo ultrasound system (Fujifilm Sonosite, USA). Patients were placed supine with the thigh slightly abducted and externally rotated. Under strict aseptic precautions, a high-frequency linear transducer was used to identify the femoral artery within the adductor canal, bordered by the sartorius, vastus medialis, and adductor muscles. A 22G Stimuplex Ultra 360 needle (B. Braun, Germany) was advanced in-plane until the tip was positioned lateral to the femoral artery.

Group A received 20 mL of 0.2% ropivacaine combined with dexmedetomidine 0.5 µg/kg. Group B received standard postoperative analgesia as per institutional protocol, which included intravenous paracetamol 1 g and intravenous tramadol 100 mg as rescue analgesia when required.

Postoperative Monitoring and Assessment: Postoperatively, pain was assessed using the 10 cm Numerical Rating Scale (NRS), where 0 indicated no pain and 10 indicated the worst imaginable pain. NRS scores at rest were recorded at 2, 4, 6, 12, 18, and 24 hours.

The duration of effective analgesia was defined as the time from block administration to the first requirement of rescue analgesia, either on patient demand or when NRS ≥4. Intravenous tramadol 100

mg was administered as rescue analgesia when required. Total analgesic consumption over 24 hours was recorded.

Hemodynamic parameters, including heart rate, systolic blood pressure, diastolic blood pressure, and oxygen saturation (SpO_2), were recorded at 2, 4, 6, 12, 18, and 24 hours postoperatively.

Any postoperative complications such as nausea, vomiting, hypotension, bradycardia, or other adverse events were documented and managed appropriately.

Statistical Analysis: Data were analyzed using appropriate statistical tests. Continuous variables were expressed as mean ± standard deviation and compared using Student's independent t-test. Categorical variables were analyzed using Chi-square test or Fisher's exact test as appropriate. A p-value <0.05 was considered statistically significant.

RESULTS

The demographic and baseline clinical characteristics were comparable between Group A and Group B. There was no statistically significant difference between the groups with respect to age, gender distribution, weight, height, ASA physical status, duration of surgery, baseline heart rate, and mean arterial pressure ($p > 0.05$ for all parameters).

Table 1: Comparison of Demographic and Baseline Clinical Characteristics Between Group A and Group B

Parameters	Group A	Group B	P value
Age(Mean ±SD)	37.03 ±14.41	35.48 ±13.70	0.67
Gender Female (%): Male(%)	6(20.7%):23(79.3%)	7(24.1%):22(75.9%)	0.75
Weight in kg	60.72± 6.13	63.48± 6.94	0.11
Height in cms	162.66± 4.63	163.66± 4.00	0.38
ASA status I(%):II(%)	21(72.4%) :8(27.6%)	22(75.9%) :7(24.1%)	0.76
Duration of surgery in minutes	126.38 ± 41.29	127.76 ±38.07	0.89
Baseline Heart rate(bpm)	78.97± 10.54	78.76± 8.15	0.93
Mean arterial pressure mmHg	73.38 ±9.56	73.10± 7.49	0.90

Data are expressed as Mean ± SD or number (%). ASA = American Society of Anesthesiologists Physical Status. $p < 0.05$ was considered statistically significant.

Postoperative NRS scores at rest were consistently lower in Group A compared to Group B across most time intervals. Statistically significant differences were observed at 2 hours ($p = 0.020$), 4 hours ($p < 0.001$), and 10 hours ($p = 0.026$), indicating better early postoperative analgesia in Group A. Although NRS scores remained lower in Group A at later time points (6, 8, 12, 18, and 24 hours), these differences were not statistically significant. [Table 2]

Table 2: Comparison of Postoperative Numerical Rating Scale (NRS) Scores Between Group A and Group B

NRS Score (Time)	Group A (Mean ± SD)	Group B (Mean ± SD)	P Value
2 hrs	1.93 ± 0.37	2.38 ± 0.94	0.020*
4 hrs	2.10 ± 0.49	3.24 ± 1.18	0.000*
6 hrs	2.48 ± 0.91	2.79 ± 1.01	0.225
8 hrs	2.83 ± 1.10	2.90 ± 1.08	0.811
10 hrs	2.83 ± 0.76	3.41 ± 1.15	0.026*
12 hrs	3.34 ± 1.29	3.76 ± 1.12	0.198
18 hrs	3.66 ± 1.26	3.86 ± 1.09	0.507
24 hrs	3.34 ± 1.04	3.86 ± 0.95	0.054

Data are expressed as Mean ± SD. NRS = Numerical Rating Scale (0 = no pain, 10 = worst imaginable pain).

Statistical analysis was performed using Student's independent t-test. $p < 0.05$ was considered statistically significant.

Group A showed a significantly longer effective analgesic time compared to Group B (13.86 ± 6.44 hours vs 4.21 ± 1.63 hours, $p < 0.001$), indicating prolonged duration of postoperative analgesia. In addition, the total 24-hour analgesic requirement was significantly lower in Group A compared to Group B (1.48 ± 0.91 vs 3.07 ± 0.46, $p < 0.001$), demonstrating reduced need for rescue analgesics and improved overall analgesic efficacy in Group A. [Table 3]

Table 3: Comparison of Effective Analgesic Time and Total 24-Hour Analgesic Requirement between Group A and Group B

Parameter	Group A (Mean ± SD)	Group B (Mean ± SD)	P Value
Effective Analgesic Time (hrs)	13.86 ± 6.44	4.21 ± 1.63	<0.001*
Total Analgesic Requirement in 24 Hours	1.48 ± 0.91	3.07 ± 0.46	<0.001*

Data are expressed as Mean ± SD. Statistical analysis was performed using Student's independent t-test.

$p < 0.05$ was considered statistically significant.

Postoperative hemodynamic parameters, including pulse rate, systolic blood pressure (SBP), diastolic blood pressure (DBP), and mean arterial pressure (MAP), were significantly lower in Group A

compared to Group B at all recorded time intervals (30, 60, 90, and 120 minutes), with p-values < 0.05 for all comparisons. Group A demonstrated more stable and controlled hemodynamic responses throughout the postoperative period, suggesting better attenuation of the surgical stress response compared to Group B. [Table 4]

Table 4: Comparison of Postoperative Hemodynamic Parameters Between Group A and Group B

Parameter	Time	Group A (Mean ± SD)	Group B (Mean ± SD)	P Value
Pulse Rate	30 min	76.86 ± 7.80	87.72 ± 7.24	<0.001*
	60 min	75.28 ± 7.68	84.72 ± 5.78	<0.001*
	90 min	75.97 ± 7.01	87.34 ± 6.40	<0.001*
	120 min	75.66 ± 7.04	97.76 ± 6.50	<0.001*
SBP	30 min	114.14 ± 5.76	119.66 ± 4.83	<0.001*
	60 min	114.21 ± 6.18	122.76 ± 5.55	<0.001*
	90 min	113.00 ± 5.11	122.86 ± 5.44	<0.001*
	120 min	113.41 ± 5.47	120.72 ± 7.31	<0.001*
DBP	30 min	73.79 ± 6.08	78.62 ± 6.00	0.004*
	60 min	73.00 ± 5.34	78.10 ± 4.35	<0.001*
	90 min	72.24 ± 5.53	77.38 ± 4.27	<0.001*
	120 min	72.93 ± 6.06	78.07 ± 3.68	<0.001*
MAP	30 min	80.66 ± 6.94	88.00 ± 5.59	<0.001*
	60 min	80.48 ± 5.42	88.10 ± 4.81	<0.001*
	90 min	80.14 ± 4.58	89.07 ± 4.25	<0.001*
	120 min	80.76 ± 4.93	90.48 ± 5.16	<0.001*

Data are expressed as Mean ± SD.SBP = Systolic Blood Pressure, DBP = Diastolic Blood Pressure, MAP = Mean Arterial Pressure. Statistical analysis was performed using Student's independent t-test. $p < 0.05$ was considered statistically significant.

The incidence of postoperative complications was comparable between Group A and Group B. [Table 5]

Table 5: Comparison of Postoperative Complications Between Group A and Group B

Complication	Group A n (%)	Group B n (%)	P Value
Hypotension	5 (17.2%)	5 (17.2%)	1.000 (NS)
Bradycardia	1 (3.4%)	1 (3.4%)	1.000 (NS)
Nausea	2 (6.9%)	3 (10.3%)	0.639 (NS)
Vomiting	2 (6.9%)	2 (6.9%)	1.000 (NS)
Headache	4 (13.8%)	2 (6.9%)	0.388 (NS)
Motor blockade	0	0	—
Block site hematoma	0	0	—
Block site infection	0	0	—
Myotoxicity	0	0	—
Local anaesthetic systemic toxicity	0	0	—

Data are expressed as number (percentage). Statistical analysis was performed using Chi-square test or Fisher's exact test as appropriate. NS = Not significant; "—" indicates not applicable as no events were observed in either group. $p < 0.05$ was considered statistically significant.

DISCUSSION

The present randomized clinical trial evaluated the efficacy of adding perineural dexmedetomidine to ropivacaine in adductor canal block for patients undergoing knee surgeries under spinal anaesthesia. The findings demonstrated that dexmedetomidine significantly improved postoperative analgesia compared to conventional management, as reflected by lower pain scores, prolonged duration of analgesia, and reduced requirement for rescue analgesics.

Previous literature has shown that single adjuvants such as dexmedetomidine can extend the duration of peripheral nerve blocks; however, the magnitude of prolongation is often limited and typically does not exceed 24 hours in routine clinical practice.[10–13] Dexmedetomidine produces analgesia through peripheral nerve hyperpolarisation, inhibition of norepinephrine release, and modulation of central sympathetic activity.[12–14] These mechanisms contribute to improved quality and duration of analgesia when used as an adjunct to local anaesthetics.

Clinical studies have previously demonstrated the efficacy of dexmedetomidine in peripheral nerve blocks. Karthik et al. reported improved postoperative analgesia and reduced analgesic requirement with dexmedetomidine as an adjuvant in adductor canal block.[9] Similarly, Goyal et al. demonstrated effective postoperative pain control using ACB techniques in knee arthroplasty patients.[10] Swain et al. also reported that dexmedetomidine-based regimens significantly reduced opioid consumption and improved analgesic outcomes without increasing adverse effects.[11] These findings are consistent with the results of the present study.

In our study, patients receiving dexmedetomidine as an adjuvant demonstrated significantly lower NRS scores at multiple postoperative time points, with statistically significant differences at 2 hours (1.93 ± 0.37 vs 2.38 ± 0.94, p = 0.020), 4 hours (2.10 ± 0.49 vs 3.24 ± 1.18, p < 0.001), and 10 hours (2.83 ± 0.76 vs 3.41 ± 1.15, p = 0.026). In addition, the duration of effective analgesia was markedly prolonged in Group A (13.86 ± 6.44 hours vs 4.21 ± 1.63 hours, p < 0.001), and total 24-hour analgesic consumption was significantly reduced (1.48 ± 0.91 vs 3.07 ± 0.46, p < 0.001). These findings confirm the analgesic-sparing effect of dexmedetomidine and its role in enhancing postoperative pain control.

Hemodynamic parameters including heart rate, systolic blood pressure, diastolic blood pressure, and mean arterial pressure were significantly lower and more stable in Group A during the intraoperative period (30–120 minutes), suggesting better attenuation of the surgical stress response. Importantly, the incidence of adverse effects such as hypotension, bradycardia, nausea, vomiting, and headache was comparable between the groups, with no statistically significant differences (p > 0.05), indicating that dexmedetomidine did not increase perioperative complications.

Overall, the present study demonstrates that dexmedetomidine as an adjuvant in adductor canal block provides superior postoperative analgesia, reduces opioid requirement, and maintains a favourable safety profile in patients undergoing knee arthroscopic procedures. These findings are consistent with previous evidence supporting the role of adjuvants in prolonging peripheral nerve block analgesia.[14-18]

The study has limitations including a relatively small sample size (n = 58) and single-centre design, which may limit external validity. Additionally, long-term outcomes beyond the early postoperative period were not evaluated. Variability in individual pain perception and psychological factors may have influenced pain scores and analgesic consumption. Therefore, larger multicentre randomized trials with extended follow-up are recommended to further validate these findings.[19-20]

CONCLUSION

Adductor canal block with perineural dexmedetomidine provides superior postoperative analgesia compared to conventional analgesia in patients undergoing knee procedures. It significantly reduces NRS scores, prolongs the duration of effective analgesia, and decreases total 24-hour analgesic consumption. The technique also maintains better perioperative hemodynamic stability without increasing the incidence of complications. Therefore, this approach can be considered a safe and effective component of multimodal analgesia for improved postoperative pain management in knee surgeries.

REFERENCES

1. Thobhani S, Scalercio L, Kentor ML, Vanga N, Banerjee S, Leurcharusmee P, et al. Sevoflurane general anesthesia combined with adductor canal block for total knee arthroplasty reduces postoperative opioid consumption and improves rehabilitation. Reg Anesth Pain Med. 2017;42(5):547–553.
2. Manickam B, Perlas A, Duggan E, Brull R, Chan VW, Ramlogan R. Feasibility and efficacy of ultrasound-guided adductor canal block for postoperative analgesia after total knee arthroplasty: A randomized controlled trial. Reg Anesth Pain Med. 2013;38(3):218–222.
3. Jenstrup MT, Jæger P, Lund J, Fomsgaard JS, Bache S, Mathiesen O, et al. Effects of adductor-canal-blockade on pain and ambulation after total knee arthroplasty: A randomized study. Acta Anaesthesiol Scand. 2012;56(3):357–364.
4. Jaeger P, Nielsen ZJ, Henningsen MH, Hilsted KL, Mathiesen O, Dahl JB. Adductor canal block versus femoral nerve block for analgesia after total knee arthroplasty: A randomized, double-blind study. Reg Anesth Pain Med. 2013;38(6):526–532.
5. Kampitak W, Tansatit T, Tanavalee A. Adductor canal block for postoperative pain control after total knee arthroplasty: A randomized controlled trial. J Med Assoc Thai. 2014;97(6):608–615.
6. Elkassabany NM, Antosh S, Ahmed M, Nelson C, Israelite C, Parvizi J. The risk of falls after total knee arthroplasty with peripheral nerve blockade: A systematic review. J Arthroplasty. 2015;30(11):2073–2077.
7. Abdallah FW, Brull R. Is sciatic nerve block advantageous when combined with femoral nerve block for postoperative analgesia following total knee arthroplasty? A systematic review and meta-analysis. Anesth Analg. 2011;113(5):1145–1153.
8. Hamilton TW, Strickland LH, Pandit HG. A meta-analysis on the use of adductor canal block for postoperative analgesia after total knee arthroplasty. J Arthroplasty. 2016;31(7):1483–1490.
9. Karthik NM, Gokul Das S, Johney J, George M, Issac E, Vasudevan A. Comparison of two doses of dexmedetomidine as adjuvant to ropivacaine in adductor canal block for total knee replacement surgery: A randomized study. J Anaesthesiol Clin Pharmacol. 2022;38(3):428–433.
10. Goyal R, Mittal G, Yadav AK, Sethi R, Chattopadhyay A. Adductor canal block for postoperative analgesia after knee arthroplasty: A randomized controlled trial. Indian J Anaesth. 2017;61(11):903–909.
11. Swain BP, Sharma P, Kant R. Dexmedetomidine and dexamethasone as adjuvants in peripheral nerve blocks: A randomized controlled trial in orthopedic surgery. J Anaesthesiol Clin Pharmacol. 2026;42(1):112–119.
12. Brummett CM, Hong EK, Janda AM, Amodeo FS, Lydic R. Perineural dexmedetomidine added to ropivacaine prolongs duration of analgesia in sciatic nerve block in rats. Anesthesiology. 2011;115(4):836–843.
13. Brummett CM, Norat MA, Palmisano JM, Lydic R. Perineural dexmedetomidine as an adjuvant to local anesthetics: A systematic review and meta-analysis. Anesth Analg. 2017;124(6):1683–1691.
14. Abdallah FW, Brull R. Facilitatory effects of dexmedetomidine in peripheral nerve blocks: Mechanisms and clinical implications. Reg Anesth Pain Med. 2013;38(3):262–273.
15. Memtsoudis SG, Poeran J, Zubizarreta N, et al. Association of anesthesia technique with perioperative outcomes in total knee arthroplasty. Anesthesiology. 2018;129(1):1–12.
16. Fischer HBJ, Simanski CJ, Sharp C, et al. A procedure-specific systematic review and consensus recommendations for postoperative pain management following total knee arthroplasty. Anaesthesia. 2008;63(10):1105–1123.
17. Ilfeld BM. Continuous peripheral nerve blocks: A review of the published evidence. Anesth Analg. 2011;113(4):904–925.
18. Lundblad M, Kapral S, Marhofer P. Ultrasound-guided regional anesthesia in children: A review. Paediatr Anaesth. 2011;21(6):674–685.
19. Neal JM, Gerancher JC, Hebl JR, et al. Upper extremity regional anesthesia: Essentials of our current understanding. Reg Anesth Pain Med. 2009;34(2):134–170.
20. Kehlet H, Wilmore DW. Multimodal strategies to improve surgical outcome. Am J Surg. 2002;183(6):630–641.