e-ISSN: 0976-822X, p-ISSN:2961-6042

Available online on http://www.ijcpr.com/

International Journal of Current Pharmaceutical Review and Research 2026; 18(7); 1663-1668

Original Research Article

Comparison of Two Different Volumes of Fixed-Dose 2% Lidocaine for Ultrasound-Guided Popliteal Sciatic Nerve Block in Below-Knee Surgeries: A Double-Blinded Randomized Controlled Study

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Received: 01-05-2026 / Revised: 25-06-2026 / Accepted: 12-07-2026
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Conflict of interest: Nil

Abstract

Background: Ultrasound-guided popliteal sciatic nerve block (PSNB) is an effective regional anesthetic technique for below-knee surgeries. Optimization of local anesthetic volume while maintaining a fixed dose is essential to enhance block efficacy and minimize complications.

Aim: To compare the efficacy and analgesic outcomes of two different volumes of a fixed dose of 2% lidocaine for ultrasound-guided popliteal sciatic nerve block in below-knee surgeries.

Methods: This double-blinded randomized controlled study included 68 patients undergoing elective below-knee surgery. Patients were allocated into two groups: Group A received 15 mL of 2% lidocaine with buprenorphine (0.5 mL), while Group B received the same dose diluted with 5 mL normal saline plus buprenorphine (0.5 mL). Primary outcomes included block onset and duration; secondary outcomes included rescue analgesic requirement and hemodynamic stability over 24 hours.

Results: Demographic characteristics, ASA grading, and baseline hemodynamic parameters were comparable between groups. Block duration was slightly longer in Group B (5.78 ± 1.84 h) compared with Group A (4.98 ± 1.49 h). Requirement of rescue analgesia was significantly higher in Group A (38.2%) than Group B (5.9%). Pain scores at rest and movement decreased rapidly in both groups after the first postoperative hour. Hemodynamic parameters and oxygen saturation remained stable with no adverse events.

Conclusion: Increasing the volume of fixed-dose 2% lidocaine using saline dilution improves analgesic efficacy and reduces rescue analgesic requirement without compromising safety in ultrasound-guided popliteal sciatic nerve blocks.

Keywords: Popliteal Sciatic Nerve Block; Ultrasound Guidance; Lidocaine Volume; Below-Knee Surgery; Regional Anesthesia.

DOI: 10.25258/ijcpr.18.7.248

Introduction

Peripheral nerve blocks play a pivotal role in modern regional anesthesia by providing effective intraoperative anesthesia and prolonged postoperative analgesia while minimizing systemic opioid requirements. Among lower-limb techniques, ultrasound-guided popliteal sciatic nerve block has gained prominence for surgeries involving the leg, ankle, and foot due to its precision, reliability, and favorable safety profile. Lidocaine remains widely used owing to its rapid onset and intermediate duration of action. However, the optimal volume of lidocaine for ultrasound-guided PSNB remains debated. While higher volumes may enhance spread and block reliability, they may also increase the risk of local anesthetic systemic toxicity. Ultrasound guidance permits volume optimization by enabling accurate perineural deposition.

This study was undertaken to evaluate whether altering the volume—while maintaining a fixed dose—of 2% lidocaine improves block characteristics and postoperative analgesia in patients undergoing below-knee surgery.

Aim and Objectives

Aim: To compare the efficacy of two different volumes of a fixed dose of 2% lidocaine in ultrasound-guided popliteal sciatic nerve block for patients undergoing below-knee surgeries.

Objectives

1. To evaluate and compare the onset and duration of sensory block achieved with two different volumes of fixed-dose 2% lidocaine in ultrasound-guided popliteal sciatic nerve block.
2. To compare postoperative pain intensity at rest and during movement using the Visual Analog Scale (VAS) over a 24-hour period.
3. To determine the requirement of rescue analgesia (tramadol) within the first 24 postoperative hours.

Materials and Methods

Study Design and Setting: A prospective, double-blinded, randomized controlled study was conducted at a tertiary care teaching hospital.

Sample Size: A total of 68 patients were enrolled and randomized equally into two groups (34 per group).

Inclusion Criteria

- Age >18 years
- ASA physical status I–III
- Elective below-knee surgery
- Consent for regional anesthesia

Exclusion Criteria

- Patient refusal
- Infection at block site
- Coagulopathy
- Known allergy to study drugs
- Pre-existing neuropathy

Intervention

- **Group A:** 15 mL of 2% lidocaine + buprenorphine 0.5 mL
- **Group B:** 15 mL of 2% lidocaine + 5 mL normal saline + buprenorphine 0.5 mL

Blocks were performed under ultrasound guidance proximal to the sciatic nerve bifurcation.

Outcome Measures

- Block duration
- Postoperative pain scores (VAS at rest and movement)
- Rescue analgesic (tramadol) requirement
- Hemodynamic parameters and oxygen saturation

Statistical Analysis: Data were analyzed using descriptive statistics and appropriate inferential tests. A p-value <0.05 was considered statistically significant.

Results

A total of 68 patients undergoing elective below-knee surgeries under ultrasound-guided popliteal sciatic nerve block were included. Patients were randomized into two equal groups (Group A and Group B). Results are presented below with corresponding interpretations.

Table 1: Baseline Demographic and Clinical Characteristics

Variable	Group A (n=34)	Group B (n=34)	p-value
Age <40 years	3 (8.8%)	3 (8.8%)	0.070
Age 41–60 years	21 (61.8%)	24 (70.6%)	
Age >60 years	10 (29.4%)	7 (20.6%)	
Male	13 (38.2%)	14 (41.2%)	0.486
Female	21 (61.8%)	20 (58.8%)	
ASA I	3 (8.8%)	4 (11.8%)	0.374
ASA II	29 (85.3%)	29 (85.3%)	
ASA III	2 (5.9%)	1 (2.9%)	

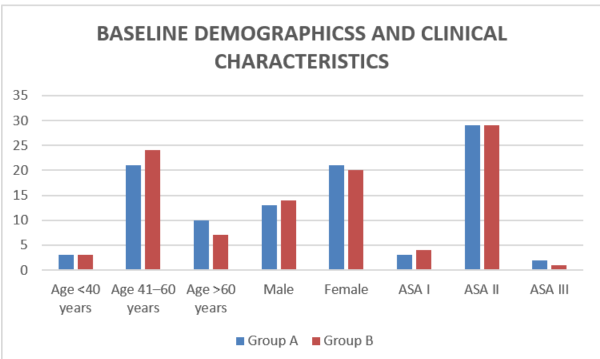

Figure 1: Baseline Demographic and Clinical Characteristics

Interpretation: Both groups were comparable with respect to age distribution, sex, and ASA physical status. The majority of patients belonged to the 41–60 year age group and ASA II category, ensuring homogeneity between study groups.

Table 2: Duration of Sensory Block

Parameter	Group A	Group B
Block duration (hours, mean ± SD)	4.98 ± 1.49	5.78 ± 1.84

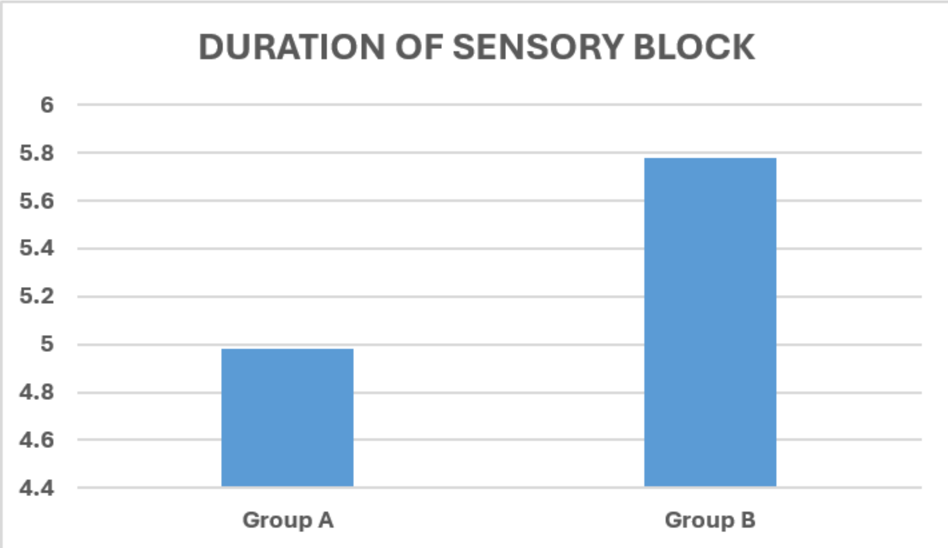

Figure 2: Duration of Sensory Block

Interpretation: Group B demonstrated a slightly longer duration of sensory block compared with Group A, suggesting improved anesthetic spread with increased volume, although the difference was not statistically significant.

Table 3: Requirement of Rescue Analgesia (Inj. Tramadol)

Requirement	Group A	Group B
Required	13 (38.2%)	2 (5.9%)
Not required	21 (61.8%)	32 (94.1%)

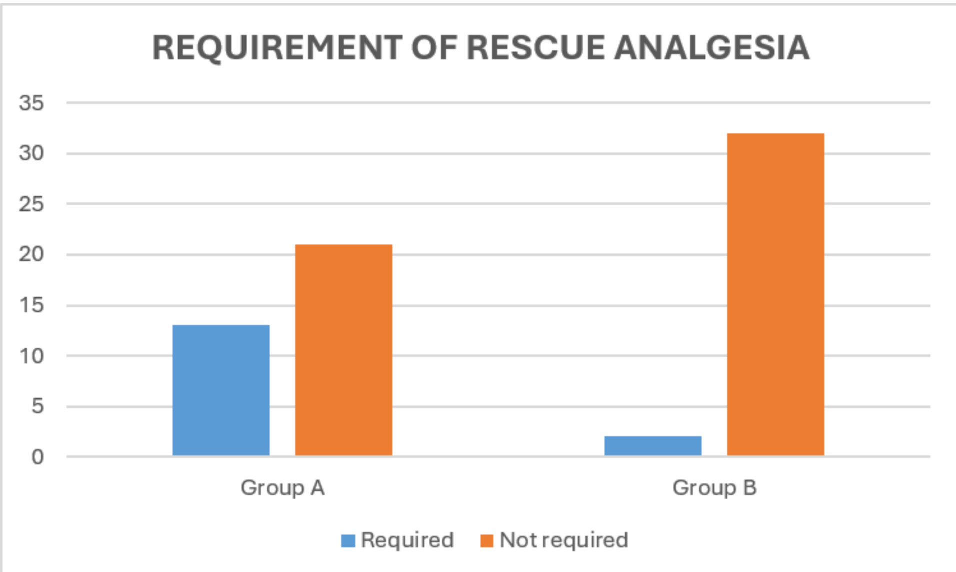

Figure 3: Requirement of Rescue Analgesia (Inj. Tramadol)

Interpretation: A significantly higher proportion of patients in Group A required rescue analgesia compared with Group B, indicating superior postoperative analgesia in the diluted-volume group.

Table 4: Postoperative Pain Scores (VAS)

Time	Group A (Mean ± SD)	Group B (Mean ± SD)
VAS at rest – 0 h	3.09 ± 0.83	2.88 ± 1.22
VAS at rest – 12 h	0.68 ± 0.47	0.32 ± 0.47
VAS at rest – 24 h	0.71 ± 0.46	0.82 ± 0.46
VAS on movement – 0 h	4.00 ± 0.78	3.56 ± 1.21
VAS on movement – 24 h	0.88 ± 0.59	1.35 ± 0.49

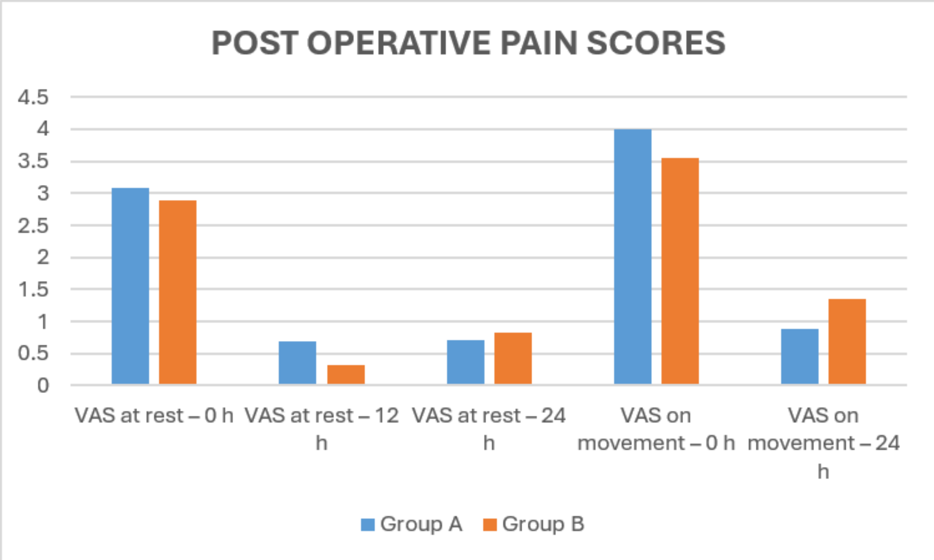

Figure 4: Postoperative Pain Scores (VAS)

Interpretation: Pain scores at rest and during movement were higher immediately postoperatively but declined markedly after the first hour in both groups. Pain control was satisfactory in both groups, with no clinically relevant differences during later postoperative periods.

Discussion

Ultrasound-guided popliteal sciatic nerve block (PSNB) has emerged as a reliable regional anesthesia technique for below-knee surgeries, offering effective anesthesia and prolonged postoperative analgesia with minimal systemic opioid requirements. The present double-blinded randomized controlled study compared two different volumes of a fixed dose of 2% lidocaine for ultrasound-guided PSNB and demonstrated that increasing the volume of local anesthetic, without increasing the dose, improves postoperative analgesic efficacy and reduces rescue analgesic requirements while maintaining hemodynamic stability and safety.

The baseline demographic characteristics and ASA physical status were comparable between the two groups, eliminating major confounding variables. Similar demographic homogeneity has been emphasized in earlier studies evaluating regional anesthesia techniques, including the work of Nag et al., who compared ultrasound-guided single- and double-point injection techniques for PSNB and highlighted the importance of standardized patient characteristics when assessing block efficacy. The comparable baseline profiles in the present study strengthen the validity of the observed differences in analgesic outcomes.

The duration of sensory block was marginally longer in the higher-volume group, although the difference did not reach statistical significance. This observation aligns with the findings of Perlas et al., who demonstrated that improved circumferential spread of local anesthetic within the common paraneural sheath resulted in faster onset and more consistent block characteristics. Their study reported approximately a 30% reduction in onset time and improved proximal and distal anesthetic spread, supporting the concept that volume and distribution, rather than concentration alone, are critical determinants of block success. Similarly, Techasuk et al. reported that a defined minimal effective volume could achieve successful PSNB in 90% of patients, reinforcing the relevance of volume optimization in ultrasound-guided nerve blocks. Postoperative pain scores at rest and during movement decreased rapidly in both groups after the first postoperative hour, indicating effective analgesia with both techniques. These findings are consistent with those of Echevarría et al., who demonstrated satisfactory postoperative analgesia using continuous sciatic nerve blocks with lidocaine and bupivacaine after foot and ankle surgery, with comparable pain scores and preserved motor function. Although the present study employed a single-injection technique, the overall pattern of effective early analgesia is comparable, underscoring the efficacy of lidocaine-based PSNB when appropriately administered.

A clinically significant finding of the present study was the markedly lower requirement for rescue analgesia in the higher-volume group. This outcome suggests superior block consistency and postoperative pain control when the local anesthetic volume is increased. Similar reductions in rescue analgesic consumption have been reported in studies evaluating adjuvants in peripheral nerve blocks. Choudary et al. demonstrated that the addition of dexmedetomidine or clonidine to levobupivacaine in femoro-sciatic nerve blocks significantly prolonged analgesia and reduced opioid requirements, with dexmedetomidine providing the greatest benefit. Although adjuvants were not the primary variable in the present study, the reduced tramadol requirement parallels these findings and highlights that strategies enhancing block quality—whether through volume optimization or adjuvant use—can meaningfully reduce postoperative opioid consumption.

Hemodynamic parameters and oxygen saturation remained stable and comparable between the two groups throughout the 24-hour observation period. These findings are consistent with those reported by Alfred et al., who showed that ultrasound-guided peripheral nerve blocks are associated with improved safety profiles and fewer hemodynamic disturbances compared with nerve stimulator–guided or landmark-based techniques. The absence of local anesthetic systemic toxicity or neurological complications in the present study further supports the safety of volume expansion when ultrasound guidance is employed.

The present results also align with studies evaluating minimal effective anesthetic concentrations and volumes. Investigations into lidocaine concentration optimization have demonstrated that effective nerve blockade can be achieved with lower concentrations and carefully titrated volumes, thereby minimizing toxicity risk while preserving efficacy. The current study extends this concept by demonstrating that increasing volume using saline dilution—without increasing the total drug dose—can enhance analgesic outcomes, a strategy that may be particularly valuable in elderly or high-risk patients. The findings of the present study are consistent with earlier literature emphasizing the importance of ultrasound guidance, optimal anesthetic spread, and tailored dosing strategies in regional anesthesia. This study contributes meaningful evidence toward refining ultrasound-guided PSNB techniques for below-knee surgeries by demonstrating improved postoperative analgesia and reduced rescue analgesic requirements with higher anesthetic volume

Conclusion

This double-blinded randomized controlled study demonstrates that increasing the volume of a fixed dose of 2% lidocaine for ultrasound-guided popliteal sciatic nerve block enhances postoperative analgesic efficacy in patients undergoing below-knee surgeries. Although the duration of sensory block was only marginally prolonged, the higher-volume technique resulted in a significantly reduced requirement for rescue analgesia, indicating more consistent and effective pain control.

Both study groups exhibited comparable baseline characteristics, stable hemodynamic parameters, and maintained optimal oxygen saturation throughout the perioperative period. Importantly, no adverse events or features of local anesthetic systemic toxicity were observed, underscoring the safety of volume expansion when performed under ultrasound guidance.

These findings support the concept that optimization of local anesthetic volume—without increasing the total drug dose—can improve the quality of regional anesthesia by facilitating better perineural spread and nerve coverage. Ultrasound-guided volume modulation represents a simple, safe, and clinically effective strategy to enhance analgesic outcomes while minimizing opioid consumption.

Further multicentric studies with larger sample sizes and extended follow-up are warranted to validate these findings, explore long-term outcomes, and assess the applicability of this approach with other local anesthetics and adjuvants.

References

1. Nag S, Ranjan R, Jaiswal S, Kumar S, Sinha R. Comparison of double-point and single-point techniques for ultrasonography-guided popliteal sciatic nerve block in below-knee surgeries. J Clin Anesth. 2020;65:109905.
2. Perlas A, Brull R, Chan VW, McCartney CJ, Nuica A, Abbas S. Ultrasound-guided popliteal sciatic nerve block: an analysis of block dynamics and the influence of paraneural spread. Anesthesiology. 2008;109(3):502–508.
3. Techasuk W, González AP, Bernucci F, Cupido T, Finlayson RJ, Tran DQ. Minimum effective volume of local anesthetic for ultrasound-guided popliteal sciatic nerve block. Reg Anesth Pain Med. 2014;39(6):473–478.
4. Echevarría S, Martínez C, López J, Rivas E, Gómez M. Continuous sciatic peripheral nerve block with lidocaine and bupivacaine for postoperative analgesia after foot and ankle surgery. Pain Med. 2019;20(9):1804–1811.
5. Alfred VM, Srinivasan G, Zachariah M. Comparison of ultrasound-guided versus

peripheral nerve stimulator-guided supraclavicular brachial plexus block. Indian J Anaesth. 2017;61(7):552–557.

6. Choudary S, Dogra N, Dogra J, Jain A. Comparison of clonidine and dexmedetomidine as adjuvants to levobupivacaine in femoro-sciatic nerve blocks. J Anaesthesiol Clin Pharmacol. 2016;32(4):473–478.
7. Maura P, Fabbro M, Pavan M, et al. Minimum effective analgesic concentration of bupivacaine for ultrasound-guided femoral nerve block. Br J Anaesth. 2016;116(1):88–95.
8. Byun SH, Lee JH, Kim MH, et al. Ultrasound-guided combined femoral and sciatic nerve blocks for bilateral below-knee amputation in a high-risk patient. Korean J Anesthesiol. 2016;69(6):604–608.
9. Tran DQ, Dugani S, Pham K, et al. Minimum effective volume of lidocaine for ultrasound-guided supraclavicular block. Reg Anesth Pain Med. 2011;36(5):466–469.
10. González AP, Bernucci F, Finlayson RJ, Tran DQ. Minimum effective volume of lidocaine for ultrasound-guided axillary brachial plexus block. Anesth Analg. 2013;116(1):196–201.
11. Taha AM. Minimum effective volume of lidocaine for ultrasound-guided femoral nerve block. Anesthesiology. 2012;117(5):1002–1008.
12. Kotekar N, Nagaraj R, Shenkar A. Postoperative pain management with peripheral nerve blocks: role of ultrasound guidance. Indian J Anaesth. 2015;59(9):554–560.
13. Neal JM, Barrington MJ, Fettiplace MR, et al. The third American Society of Regional Anesthesia and Pain Medicine practice advisory on local anesthetic systemic toxicity. Reg Anesth Pain Med. 2018;43(2):113–123.
14. Hadzic A. Textbook of Regional Anesthesia and Acute Pain Management. 2nd ed. New York: McGraw-Hill; 2017.
15. NYSORA. Ultrasound-guided popliteal sciatic nerve block. Available from: https://www.nysora.com.