International Journal of Environmental Sciences
ISSN: 2229-7359
Vol. 11 No. 24s, 2025
https://www.theaspd.com/ijes.php

Efficacy Of Variable Concentrations Of Ropivacaine In Ultrasound-Guided Anterior Sciatic Nerve Block For Patients Undergoing Lower Limb Surgeries

Dr. Yannamaneni Himaja Rao[1]*, Dr. Prajwal Patel H S[2], Dr. Saikumar C Patil[3], Dr. Suraj M A[4], Dr. Prolin Eldo[5]

[1]Post Graduate, Department of Anaesthesiology, Adichunchanagiri Institute of Medical Sciences (A.I.M.S), Adichunchanagiri University, B.G. Nagara – 571448, Nagamangala Taluk, Mandya District, Karnataka, India.
[2]Professor, Department of Anaesthesiology, Adichunchanagiri Institute of Medical Sciences (A.I.M.S), Adichunchanagiri University, B.G. Nagara – 571448, Nagamangala Taluk, Mandya District, Karnataka, India.
[3]Assistant Professor, Department of Anaesthesiology, Adichunchanagiri Institute of Medical Sciences (A.I.M.S), Adichunchanagiri University, B.G. Nagara – 571448, Nagamangala Taluk, Mandya District, Karnataka, India.
[4]Senior Resident, Department of Anaesthesiology, Adichunchanagiri Institute of Medical Sciences (A.I.M.S), Adichunchanagiri University, B.G. Nagara – 571448, Nagamangala Taluk, Mandya District, Karnataka, India.
[5]Post Graduate, Department of Anaesthesiology, Adichunchanagiri Institute of Medical Sciences (A.I.M.S), Adichunchanagiri University, B.G. Nagara – 571448, Nagamangala Taluk, Mandya District, Karnataka, India.
*Corresponding author: yhimajarao@gmail.com

Abstract

Background and objectives: *Sciatic nerve block is a commonly used technique for providing anaesthesia and analgesia to the lower extremity. Neuraxial blockade as well as general anaesthesia are more frequently used alternative anaesthetic procedures. Traditionally, it is performed using posterior or lateral techniques. However, in some situations where patient positioning is difficult, an anterior approach may be more appropriate [3]. Nonetheless, an Anterior sciatic block is useful in controlling postoperative pain after lower-limb surgeries. Hence, with this study, we aim to assess the efficacy of variable concentrations of Ropivacaine in ultrasound-guided Anterior sciatic nerve block for patients undergoing lower limb surgeries.*

Methodology: *A prospective randomised study was conducted in sixty patients of ASA grade I and II, between the ages of 18 to 75 years, who underwent lower limb surgeries at Adichunchanagiri Institute of Medical Sciences and Research Centre, B. G. Nagara, Mandya, for a period of 18 months. Ultrasound-guided Anterior sciatic nerve block was performed using the anterior approach with the patient lying in the supine position. At the level of the lesser trochanter, the sciatic nerve is imaged approximately. The nerve is typically visualised at a depth of 5-8 cm. Ropivacaine 0.25% 15ml +4mg/ml dexamethasone or 0.5%Ropivacaine 15ml +4mg/ml dexamethasone is given according to randomised assignment. Onset of motor block, onset of sensory block, duration of analgesia, time for rescue analgesia, analgesia quality, and any adverse effects of the Anterior sciatic nerve block were evaluated. Statistical analysis of the data was done using Student-t-test for parametric data and Chi-square test for non-parametric data.*

Results: *The time of perception of pain was considered as the total duration of analgesia, and the mean duration of analgesia was 449.5 ± 17.36 minutes, with a range of 421 to 480 minutes in Group A and 905.43 ± 36.67 minutes, ranging from 840 to 960 minutes in Group B. All the study subjects received rescue analgesia when the VAS score was>4, and the time of receiving 1st rescue analgesia was 525.20 ± 16.65 minutes, ranging from 490 to 559 minutes in Group A and 985.06 ± 35.88 minutes, ranging from 905 to 1040 minutes in Group B.*

Conclusion: *In present, it can be concluded that 0.5% ropivacaine provides superior analgesic efficacy compared to 0.25% ropivacaine in ultrasound-guided anterior sciatic nerve blocks. Satisfactory sensory and motor blockade, with increased duration of analgesia without any adverse effects, with the added advantage of cost effectiveness.*

Keywords: *Ropivacaine, Dexamethasone, Ultrasound-guided Anterior sciatic nerve block*

INTRODUCTION:

Regional anaesthesia techniques like peripheral nerve blocks are effective and less invasive alternatives to general anaesthesia for limb surgeries, particularly for patients with comorbidities [1]. They use fewer resources and provide superior postoperative pain relief and patient satisfaction. The **anterior sciatic nerve block** is a key technique for lower limb surgeries, offering both anaesthesia and prolonged postoperative analgesia [2]. This approach is especially useful when patient positioning is challenging.

Long-acting local anaesthetics such as ropivacaine and bupivacaine are commonly used for these blocks, providing 12 to 18 hours of pain relief and reducing the need for opioids. While bupivacaine is potent, it carries

a risk of cardiotoxicity if injected into blood vessels. **Ropivacaine**, a newer amino amide anaesthetic, offers similar efficacy without this significant cardiotoxic risk [3]. To enhance the effectiveness and duration of nerve blocks, various additives are used, with **dexamethasone** being a notable adjunct due to its anti-inflammatory properties that significantly prolong pain relief [4].

Historically, landmark-guided blocks had lower success rates and posed risks like nerve injury and systemic toxicity [5]. Nerve stimulation improved success, but the most significant advancement has been **ultrasound guidance**. This technology allows for real-time visualisation of the needle, nerves, and the spread of the anaesthetic, greatly enhancing precision and safety while minimising the risk of nerve injury [6,7].

This study investigates the use of different concentrations of **ropivacaine** in **ultrasound-guided anterior sciatic nerve blocks** to evaluate their effects on the duration of postoperative analgesia and associated adverse outcomes.

MATERIALS AND METHODS

Study Design and Patient Selection

This experimental study was conducted at Adichunchanagiri Institute of Medical Sciences over 18 months to compare the efficacy of two different concentrations of ropivacaine in ultrasound-guided anterior sciatic nerve blocks for lower limb surgeries. The study included adult patients aged 18 to 75 years of both sexes who were classified as ASA physical status 1 or 2.

The sample size was calculated using the formula $n=(z\alpha + z\beta)^2 * \sigma^2 / d^2$ With a mean difference (d) of 1.4, a significance level (α) of 0.05, $Z_\alpha = 1.96$ and a standard deviation (σ) of 2.65(as per previous studies)[7], the minimum number of patients required was 26 per group. To account for potential dropouts, a total of 60 patients were enrolled and randomly assigned to one of two groups (30 patients each) using a computer-generated list in sealed, opaque envelopes.

Inclusion Criteria:

- Patients aged 18-75 years, of either sex.
- Undergoing lower limb surgery.
- ASA physical status I or II.
- Provided written informed consent for the procedure.

Exclusion Criteria:

- Local pathology at the injection site.
- History of peripheral neuropathy, common peroneal nerve, or tibial nerve injury.
- Known allergy to amide local anaesthetics.
- History of bleeding disorders.
- Systemic illnesses such as cardiac, respiratory, hepatic, or renal failure.

Methodology

The study received approval from the institutional ethics committee. All patients underwent a standard pre-anaesthetic evaluation. Before surgery, patients were instructed to take 0.5 mg of alprazolam and 150 mg of ranitidine orally the night before and to remain nil per oral (NPO) after 10 PM.

On the day of surgery, patients were moved to the operating room and placed in a supine position with the affected limb slightly abducted and externally rotated. Standard monitoring for heart rate, non-invasive blood pressure, ECG, and SpO2 was established, and an intravenous line was secured. Patients received 0.04 mg/kg of intravenous midazolam as premedication.

Anterior Sciatic Nerve Block Procedure

The anterior sciatic nerve block was performed under ultrasound guidance. With the patient supine, a curved transducer was placed on the anteromedial thigh to visualise the sciatic nerve as a hyperechoic oval structure located between the adductor magnus muscle and hamstring muscles, typically at a depth of 5-8 cm. The femoral artery and deep artery of the thigh were identified using colour Doppler for orientation.

The groups were defined as follows:

- **Group A:** Received 15 ml of Inj. Ropivacaine 0.25% with 4 mg/ml of Dexamethasone.
- **Group B:** Received 15 ml of Inj. Ropivacaine 0.5% with 4 mg/ml of Dexamethasone.

A peripheral nerve stimulator needle was inserted and advanced toward the nerve. If a motor response in the calf or foot was observed, the needle was considered to be in the correct position. The anaesthetic solution was then injected after careful aspiration.

Post-Procedure Assessment

After the block, the onset of sensory and motor blockades was assessed. Sensory blockade was evaluated using a pinprick test on a 3-point scale (normal, blunted, no sensation). Motor block was assessed on a 3-point scale (normal, reduced, no movement). The duration of analgesia was measured using a Visual Analogue Scale (VAS) (0 = no pain, 10 = worst pain) and was defined as the time until the patient requested rescue analgesia. All results and any adverse effects were recorded. Provisions for a subarachnoid block or general anaesthesia were available in case the peripheral block was inadequate or failed. Strict aseptic precautions were maintained throughout the procedure.

OBSERVATION AND RESULTS

The table summarises the age, sex, and ASA physical status distribution for both study groups.

The age distribution was statistically comparable between the two groups, with a p-value of 0.973. While there was an equal sex distribution in Group A, Group B had a slightly higher proportion of males. For ASA grading, Group A had more patients in Grade 1, whereas Group.

B had an equal number of patients in both Grade 1 and Grade 2.

TABLE 1:

Characteristic	Group A (N=30)	Group B (N=30)
Age (Years)		
Minimum	19	19
Maximum	60	60
Mean ± SD	39.40 ± 12.79	40.77 ± 12.56
Sex		
Female	15 (50.00%)	13 (43.33%)
Male	15 (50.00%)	17 (56.67%)
ASA Grade		
Grade 1	18 (60%)	15 (50%)
Grade 2	12 (40%)	15 (50%)

VAS SCORE, ONSET OF SENSORY AND MOTOR BLOCK:

- VAS Scores: Both groups experienced significant pain reduction, with scores approaching zero by 30 minutes. Group B showed a slightly faster pain relief at the 30-minute mark.
- Onset Times: Group B, receiving the higher concentration of ropivacaine, demonstrated a significantly faster onset for both sensory and motor blocks. The sensory block onset was approximately 6.2 minutes faster, and the motor block onset was about 7.5 minutes faster.
- Statistical Significance: The differences in VAS scores and onset of sensory block between the two groups were statistically significant ($p < 0.001$). The difference in the onset of motor block was also statistically significant. The t-test value of 10.03 corresponds to a p-value of <0.001.

TABLE 2 :

Outcome	Group A (0.25% Ropivacaine)	Group B (0.5% Ropivacaine)	pvalue	Mean Difference
Mean VAS Score (minutes)				

At 10 min	6.567 ± 0.7739	6.433 ± 0.5040	<0.001	0.134
At 30 min	0.000 ± 0.0000	0.033 ± 0.1826	<0.001	-0.33
At 60 min	0.000 ± 0.0000	0.000 ± 0.0000	N/A	N/A
At 120 min	0.000 ± 0.0000	0.000 ± 0.0000	N/A	N/A
Onset of Sensory Block (min)	24.17 ± 2.902	17.93 ± 2.18	<0.001	6.234
Onset of Motor Block (min)	35.93 ± 3.23	28.43 ± 2.459	0.21	7.5

TABLE 3 : **Analgesia and Rescue Analgesia Duration**

Characteristic	Group A (0.25% Ropivacaine)	Group B (0.5% Ropivacaine)	pvalue
Total Duration of Analgesia (min)			
Mean ± SD	449.50 ± 17.37	905.43 ± 36.68	0.000
Range	421 - 480	840 - 960	
Time to Rescue Analgesia (min)			
Mean ± SD	525.20 ± 16.66	985.07 ± 35.89	<0.001
Range	490 - 559	905 - 1040	

The data show that a higher concentration of ropivacaine significantly prolonged both the total duration of analgesia and the time until patients required rescue analgesia.

- **Total Duration of Analgesia:** The mean duration of analgesia in **Group B** (0.5% ropivacaine) was more than double that of **Group A** (0.25% ropivacaine), with a mean difference of approximately 455 minutes. This difference was statistically significant.
- **Time to Rescue Analgesia:** Similarly, the time to first request for pain medication was significantly longer in **Group B**, with a mean time of over 985 minutes compared to 525 minutes in **Group A**. This indicates that the higher concentration provided more sustained postoperative pain relief.

DISCUSSION

Hypothesis and Study Technique

The study's primary hypothesis was that varying the concentration of ropivacaine (0.25% vs. 0.5%) in an ultrasound-guided anterior sciatic nerve block would affect the onset, duration, and quality of anaesthesia and analgesia. The **anterior approach** was chosen over the more common posterior approach because it allows the procedure to be performed with the patient in a supine position, which is more comfortable and practical, especially for trauma patients. The block was performed under **ultrasound guidance** to ensure real-time visualisation of the needle and the nerve, enhancing the accuracy of anaesthetic deposition, improving success rates, and minimising the risk of systemic toxicity by reducing the required volume of the anaesthetic.

Drugs and Doses

Ropivacaine was the local anaesthetic of choice due to its lower cardiotoxicity and favourable sensory-motor differentiation compared to bupivacaine. A volume of 15 ml was used in both groups, where 15-30 ml was typically used in previous studies for landmark-based techniques. **Dexamethasone (4 mg/ml)** was added to both concentrations to act as an adjuvant, to extend the duration of analgesia.

Sensory and Motor Block Characteristics

The results confirmed a clear concentration-dependent effect on the onset of both sensory and motor blocks.

Onset of Sensory Block

- **Group A (0.25% Ropivacaine):** 24.17 ± 2.90 minutes
- **Group B (0.5% Ropivacaine):** 17.93 ± 2.18 minutes

The onset of sensory blockade was significantly faster in Group B, a finding consistent with the pharmacological principle that higher concentrations facilitate more rapid nerve penetration and diffusion.

Contrasting results were noted by Fredrickson and Price (2009)[8], who found no significant difference in onset times between 0.2% and 0.4% ropivacaine in continuous perineural catheter use for shoulder surgeries. This discrepancy highlights that the concentration-dependent onset effect may vary depending on anatomical site, type of block, and method of administration.

Onset of Motor Block

- **Group A (0.25% Ropivacaine):** 35.93 ± 3.23 minutes
- **Group B (0.5% Ropivacaine):** 28.43 ± 2.46 minutes

Similarly, motor block onset was significantly faster in the 0.5% ropivacaine group. These findings align with the expectation that increasing the local anaesthetic concentration reduces the latency period for both sensory and motor blockade. The discrepancy with some other studies, which found no significant difference in onset times with varying concentrations, may be due to differences in the anatomical site, block type, or administration method. **Duration of Analgesia**

- **Group A (0.25% Ropivacaine):** 449.50 ± 17.37 minutes (~7.5 hours)
- **Group B (0.5% Ropivacaine):** 905.43 ± 36.68 minutes (~15 hours)

The duration of analgesia was significantly longer in the 0.5% ropivacaine group. This result is consistent with previous research showing that higher concentrations of local anaesthetics provide extended postoperative pain relief, reducing the need for rescue analgesics. This finding, along with similar reports from other studies, reinforces the concentration-dependent relationship for the duration of pain relief. This is consistent with the findings of Dilish et al.

(2017) [8], who compared 0.5% bupivacaine and 0.5% ropivacaine in combined femoral and sciatic nerve blocks. They reported that the duration of motor block was significantly longer in the bupivacaine group compared to ropivacaine.

Although their study focused on bupivacaine vs. ropivacaine, the overall principle that higher concentrations of local anaesthetics lead to longer analgesia durations holds across both studies.[8]

Hemodynamic Parameters and Adverse Reactions

Hemodynamic parameters, including pulse rate and blood pressure, remained stable in both groups with no need for additional intervention. This confirms the favourable safety profile of ropivacaine, even at the higher concentration. No significant differences in cardiovascular stability were observed between the groups[8].

The study also reported minimal adverse reactions. There were no cases of intraoperative bradycardia, hypotension, or other systemic or neural complications. Two patients (one from each group) experienced mild pain at the injection site, but this was the only adverse event. These results are consistent with other studies that have highlighted the safety of ultrasound-guided nerve blocks[9].

Patient Satisfaction

Patient satisfaction was high in both groups, with 100% of patients reporting a satisfactory outcome. This suggests that both concentrations of ropivacaine, when used with ultrasound guidance, are effective and reliable for this procedure. While some literature suggests higher satisfaction with lower concentrations, this study found no significant difference, indicating that both concentrations provided adequate pain relief and a positive patient experience.

CONCLUSION

The findings of this study demonstrated that 0.5% ropivacaine provides superior analgesic efficacy compared to 0.25% ropivacaine in ultrasound-guided anterior sciatic nerve blocks. The higher concentration resulted in faster onset, prolonged duration of analgesia, and better overall patient satisfaction, without increasing the

incidence of adverse effects. Ultrasound guidance significantly improved the accuracy, safety, and effectiveness of the anterior sciatic nerve block, reinforcing its role in modern regional anaesthesia. The prolonged duration of analgesia with 0.5% ropivacaine reduced the need for postoperative rescue analgesia, contributing to better pain management and recovery outcomes.

REFERENCES

1. Casati A, Cappelleri G, Aldegheri G, Marchetti C, Messina M, De Ponti A. Total intravenous anaesthesia, spinal anaesthesia or combined sciatic-femoral nerve block for outpatient knee arthroscopy. *Minerva Anestesiol.* 2004 Jun 1;70(6):493-502.
2. Montes FR, Zarate E, Grueso R, Giraldo JC, Venegas MP, Gomez A, Rincón JD, Hernadez M, Cabrera M. Comparison of spinal anaesthesia with combined sciatic-femoral nerve block for outpatient knee arthroscopy. *J Clin Anesth.* 2008 Sep 1;20(6):415-20.
3. Richman JM, Liu SS, Courpas G, Wong R, Rowlingson AJ, McGready J, Cohen SR, Wu CL. Does continuous peripheral nerve block provide superior pain control to opioids? A meta-analysis. *Anesth Analg.* 2006 Jan 1;102(1):248-57.
4. Comparison of dexamethasone as an adjuvant to ropivacaine with ropivacaine alone in USG-guided popliteal sciatic block for post-operative analgesia in below-knee surgeries – a randomised controlled trial. *AJBR* [Internet]. 2024 Oct 7 [cited 2025 Mar 26];27(3S):1814-25.
5. Klein SM, Evans H, Nielsen KC, Tucker MS, Warner DS, Steele SM. Peripheral nerve block techniques for ambulatory surgery. *Anesth Analg.* 2005 Dec 1;101(6):1663-76.
6. Uz A, Apaydin N, Cinar SO, Apan A, Comert B, Tubbs RS, Loukas M. A novel approach for anterior sciatic nerve block: cadaveric feasibility study. *Surg Radiol Anat.* 2010 Nov;32:873-8.
7. Wang L, et al. Evaluation of a new method of sciatic nerve block: a prospective pilot study. *J Pain Res.* 2023 Jun 16;16:2091-9.
8. Dilish G, Kumar PA, Radhika J. Comparison of efficacy and safety of 0.5% bupivacaine and 0.5% ropivacaine for combined femoral nerve block and sciatic nerve block (anterior approach): a randomised controlled trial. *Indian J Clin Anaesth.* 2017;4(4):441-6.
9. Fredrickson MJ, Price DJ. Analgesic effectiveness of ropivacaine 0.2% vs 0.4% via an ultrasound-guided C5–6 root/superior trunk perineural ambulatory catheter. *Br J Anaesth.* 2009 Sep 1;103(3):434-9.