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Research Article

COMPARISON BETWEEN THE POSTERIOR AND LATERAL APPROACHES OF THE POPLITEAL BLOCK FOR LOWER-LIMB EMERGENCY MINOR SURGICAL PROCEDURE: A PROSPECTIVE STUDY

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ABSTRACT

Objective: The objective of this study was to compare various factors such as technical difficulties, the onset of anesthesia, duration of anesthesia and analgesia, and the branches of the sciatic nerve stimulated for both the posterior and lateral approaches of the block.

Methods: A study was conducted in a tertiary care hospital from March 2021 to September 2022. With the patients' informed written consent, a total of 50 individuals undergoing lower-limb emergency minor surgical procedures were randomly assigned to two groups: Group L and Group P. Each group received a popliteal block (PB) using either a lateral or posterior approach. The patients were closely monitored to assess any technical difficulties associated with both approaches.

Results: According to the study findings, the participants in Group L had a median age of 46, while those in Group P had a median age of 37. Our investigation revealed that patients in Group L required a notably higher number of attempts and a greater depth for induction ($p=0.004$; $p<0.0001$ respectively). However, there were no notable distinctions observed between the two approaches in terms of the time it took for pain relief to begin, the length of the surgical procedure, and the overall duration of pain relief ($p=0.80$; $p=0.54$ and $p=0.36$, respectively).

Conclusion: The study found that patients who received lateral approaches for PB experienced more challenges during induction compared to those who received posterior approaches.

Keywords: Analgesia, Anesthesia, Lower-limb minor surgeries, Popliteal block.

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INTRODUCTION

Sciatic nerve block is a widely used method for administering anesthesia and pain relief after foot and ankle surgeries. In the past, sciatic nerve blocks have been less commonly performed by anesthesiologists. For foot surgeries, it is important to administer regional block, specifically the popliteal block (PB), to diabetic patients to prevent any systemic decompensation. Continuous sciatic blocks have been developed to address the growing interest in using continuous block techniques for acute post-operative pain management. Several factors can influence the onset time of a peripheral block, such as the concentration and volume of the injection, the use of additives, the application of double injection techniques, and the intensity of the current used in peripheral nerve stimulation [1,2].

The role of an anesthesiologist has expanded beyond the traditional provision of anesthesia care in the operating room. They now collaborate with other medical disciplines as part of perioperative medical-care teams. Various methods of anesthesia, including general anesthesia and regional techniques such as subarachnoid, epidural, and peripheral nerve blocks (PNBs), are employed to ensure effective anesthesia during lower-limb surgeries. PNBs are increasingly being used in surgical procedures due to their extended pain-relieving benefits and excellent safety record. Ensuring patients receive optimal post-operative analgesia and surgical anesthesia with minimal complications is the main focus of an anesthesiologist. A significant majority of patients who undergo surgical procedures encounter acute post-operative pain, with a considerable percentage reporting moderate to severe pain. Effective pain management is crucial for better clinical results [3].

PB is a commonly used technique in anesthesia for lower-limb surgeries below the knee. It involves blocking the sciatic nerve at the popliteal fossa to induce anesthesia. The sciatic nerve block in the popliteal fossa can be done using either a posterior or lateral approach [4-6].

The aim of this study was to compare various factors such as technical difficulties, duration of anesthesia and analgesia, onset of anesthesia, and the branches of the sciatic nerve stimulated for the posterior and lateral approaches to the PB.

METHODS

Patient selection

A total of 50 patients, ranging in age from 18 to 80 years old, and with ASA grades of I-IV, were included in the study. These patients had recently undergone minor surgical procedures on their lower limbs in emergency situations. Patients who were excluded from the study had various conditions that made them ineligible. These conditions included positioning issues, hypersensitivity to local anesthetic agents, infection at the site of block, coagulopathy, diabetes mellitus, pregnancy or lactation, peripheral vascular disease, and chronic analgesic therapy. Ethical approval was taken from the institutional ethical committee (ECR/635/INST/GJ 2014/RR-20) and written informed consent was taken from all the participants.

Sample size calculation

Group 1 had a sample size of 23, with a 95% confidence interval and a 25% precision. Similarly, Group 2 had a sample size of 20, with the same level of confidence interval and precision. After careful analysis, it was determined that the total sample size would be 50, with 25 participants

in each group. This calculation was made using the formula: Sample size (n) = Z^2S^2/d^2.

This study was conducted at a single hospital with the participation of patients who provided informed and written consent. It followed a prospective, randomized design and maintained patient blinding. Participants who met the criteria were assigned to either Group L or P through computer-generated block randomization.

- Group-L (n=25): PB with lateral approach
- Group-P (n=25): PB with posterior approach.

When patients arrived at pre-operative area, they were thoroughly evaluated by pre-anesthetic check-up with general, physical, and systemic examination on the day of surgery. General examination included measurement of pulse rate, blood pressure, airway assessment, cardiovascular system, spinal deformities, and location of any localized infections. Routine investigations were also completed. Patients from both groups were kept in NBM for 6 h before surgery. Standard monitors such as ECG, NIBP, and pulse oximeter were used to record the patient's baseline parameters such as pulse, blood pressure, respiratory rate, and SpO_2.

Intravenous line was secured and Patients were premedicated with:

- Injection glycopyrrolate (0.2 mg) IV
- Injection ranitidine (50 mg) IV
- Injection ondansetron (0.02 mg/kg) IV
- Injection midazolam 0.5 mg IV.

The popliteal nerve was blocked using a lateral or posterior approach with a local anesthetic drug mixture. 30 mL local anesthetic mixture was prepared by adding 20 mL of 0.5% bupivacaine, 10 mL of 1.5% lignocaine with adrenaline, with due consideration of patient's weight and maximum dose.

Techniques of block

Lateral approach

The patient was lying on their back with their leg straightened at the knee joint. The foot on the side to be blocked was positioned in a straight manner, allowing for easy detection of even the slightest movements of the foot or toes. Resting the foot on a footrest is the most effective way to achieve this. Using sterile techniques, a 100-mm 21-gauge insulated stimulation short bevel needle (Stimuplex B-Braun Medical) connected to a nerve stimulator was carefully inserted horizontally, 7 cm above the most prominent point of the lateral epicondyle. The insertion was made in the groove between the vastus lateralis and biceps femoris muscles, until intentionally reaching the shaft of the femur. Ensure that the fingers of palpating hands are firmly pressed and kept immobile in the groove. If the femur was not contacted within a 50 mm range, the needle was inserted 5–10 mm anterior to the initial insertion. Once the femur was reached, the needle was carefully pulled back to the skin and then repositioned at a 30° angle toward the back. If the initial attempt did not successfully locate the nerve, the procedure was repeated by making a new skin puncture 5 mm behind the original insertion point [7].

Posterior approach

The patient was lying face down, with their leg fully stretched out. The foot on the side to be blocked was carefully positioned, with the feet extending off the table to ensure that even the slightest movements of the foot or toes could be readily detected. Inserting the needle connected to a nerve stimulator perpendicularly at the midpoint between the tendons of the biceps femoris and semitendinosus muscles, 7 cm above the popliteal fossa crease, while following strict aseptic and antiseptic protocols. If the sciatic nerve was not stimulated, the needle was removed and the same maneuvers were performed through a new puncture site located 5 mm lateral to the original insertion site. The technique was repeated by gradually inserting in 5-mm increments laterally until the desired response was achieved [6].

The main objective of nerve stimulation in both methods is to generate noticeable or tangible twitches in the foot or toes by applying a current of 0.5 mA. There are two common twitches that can occur when the sciatic nerve is stimulated. The stimulation of the tibial nerve results in the foot being flexed downward and turned inward. The stimulation of the common peroneal nerve results in the movement of dorsiflexion and eversion of the foot. Once the initial twitches of the sciatic nerve are observed, the stimulating current is gradually decreased until the twitches are still detectable at 0.5 mA. At present, the needle is stabilized, and after ensuring there is no negative aspiration, a slow administration of a prepared mixture of 30 mL local anesthetic takes place.

The block performance time refers to the duration from when the needle is inserted to when the local anesthetic is fully administered near the nerve. The onset of sensory block was determined by the cessation of the local anesthetic injection until there was a complete absence of sensation to pinprick. The duration of the sensory block was measured as the time it took for the pinprick sensation to reappear in the distribution of the sciatic nerve. The duration of the motor block was determined by measuring the time it took for ankle and toe motion to return in the operating limb (MBS score 0).

Statistical analysis

The data were compiled and entered into a spreadsheet computer program (Microsoft Excel 2007) and then exported to the data editor page of SPSS version 15 (SPSS Inc., Chicago, Illinois, USA). Quantitative variables were reported using measures such as means and standard deviations or median and interquartile range, depending on their distribution. The presentation of qualitative variables was in the form of counts and percentages. Confidence level and level of significance were set at 95% and 5%, respectively, for all tests.

RESULTS

In the study group, half of the patients received the lateral approach while the other half received the posterior approach for induction. No statistically significant differences were found in age, weight, and height between the two groups, as indicated by the Mann–Whitney test (p=0.84; p=0.91; p=0.14, respectively) presented in Table 1. In addition, the Chi-square test found that there was no significant difference in gender and ASA category among the study patients (p=0.78 and p=0.56, respectively). This suggests that the technical challenges associated with the posterior and lateral approaches to PB were similar in both groups.

Table 2 shows that there were no significant differences between the two groups in terms of the onset of analgesia, the duration of surgery, and the total duration of analgesia. The p values for the three tests were 0.80, 0.54, and 0.36, respectively.

Based on our observations, it was found that the lateral approach required more attempts compared to the posterior approach (2 [2–3] and 1 [1–2], respectively). The Mann–Whitney test revealed a statistically significant difference in the number of attempts (p=0.004).

Table 1: Demographic distribution of study participants

Variables	Posterior approach, Median (IQR)	Lateral approach, Median (IQR)	p value
Age (years)	37 (30–45)	46 (40–52)	p=0.84
Weight (kg)	67 (63–69)	68 (62–70)	p=0.91
Height (cm)	163 (159–169)	160 (158–167)	p=0.14
Gender (%)	Male: 13 (52) Female: 12 (48)	Male: 13 (52) Female: 12 (48)	p=0.78
ASA Category (%)	Cat-1: 3 (12) Cat-2: 10 (40) Cat-3: 12 (48)	Cat-1: 5 (20) Cat-2: 9 (36) Cat-3: 11 (44)	p=0.56

Table 2: Comparison of approaches in relation to onset of analgesia, the duration of surgery, and the total duration of analgesia

Variables	Posterior approach, Numbers (Percentage)	Lateral approach, Numbers (Percentage)	p value
Attempt	1 (1–2)	2 (2–3)	p=0.0004
Depth (mm)	57 (55–60)	62 (59–66)	p=0.0001
Onset of analgesia (min)	15 (10–20)	15 (10–15)	p=0.80
Duration of surgery (min)	60 (57–70)	65 (60–70)	p=0.54
Total duration of analgesia (min)	210 (190–222)	200 (188–223)	p=0.36
Stimulation of the nerve	Tibial nerve: 17 (68) Peroneal nerve: 8 (32)	Tibial nerve: 9 (36) Peroneal nerve: 16 (64)	p=0.05

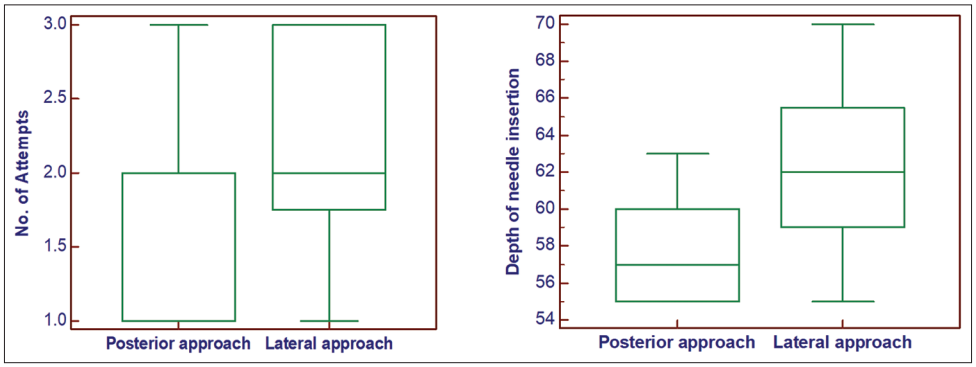

Fig. 1: Comparison of posterior and lateral approaches Regarding No of Attemps and Depth of needle insertion

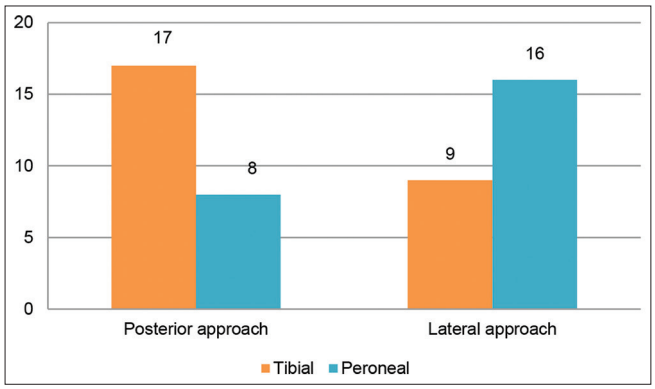

Fig. 2: Comparison of posterior and lateral approaches Regarding Tibial and Peroneal Nerve

During the procedure, it was found that the peroneal nerve was commonly encountered for the lateral approach, while the tibial nerve was commonly encountered for the posterior approach, as revealed by the Chi–square test. The p=−0.05 is displayed in Table 2.

During induction, we noticed that the lateral approach required a greater depth for needle insertion compared to the posterior approach. The difference was found to be statistically significant based on the Mann–Whitney test (p=0.0001), as indicated in Table 2.

DISCUSSION

Performing a PB involves administering a PNB to the sciatic nerve at the popliteal fossa. This technique is highly effective in providing anesthesia for foot and ankle surgeries. When utilized as the primary anesthetic, the PB offers exceptional anesthesia and extended post-operative pain relief. This method offers the option of using a calf tourniquet and avoids the potential complications associated with general, spinal, and epidural anesthesia. It helps prevent potential complications that can arise from general, spinal, and epidural anesthesia, both on a systemic and local level. These procedures are commonly performed to address foot issues, remove dead tissue, and repair the Achilles tendon. It extends down to about two-thirds of the leg. PB can be administered using either the posterior approach or the lateral approach. Our analysis includes a comparison of the posterior and lateral approaches, focusing on factors such as attempts, depth of needle insertion, onset of action, duration of analgesia, and the specific nerve encountered during each approach [8].

In this study, it was discovered that the lateral approach had a greater number of nerve blockade attempts at induction compared to the posterior approach. This difference was found to be statistically significant. Other studies conducted by Radhakrishnan [9] and Hadzić and Vloka [10] have also demonstrated that the posterior approach has a higher success rate for nerve location on the first attempt, with 66% and 80%, respectively, compared to only 20% for the lateral approach. In a study conducted by Palaniappan *et al.*, it was discovered that a significant 51% of patients achieved nerve blockade with just one attempt using the posterior approach [11]. One possible explanation for the higher number of attempts in the lateral approach is that the 100-mm needle tends to bend more upon insertion compared to the 50-mm needle used in the posterior approach. One possible reason for patient discomfort could be the insertion of the needle into the biceps and vastus lateralis muscles. Technical expertise and experience are crucial in achieving the desired results with the new lateral technique.

Our study found that patients who underwent the lateral approach required a stimulation depth of 62 MM, compared to 57 MM for those who underwent the posterior approach. This difference was statistically significant. According to a study conducted by Radhakrishan, it was found that there was a notable disparity in the depth of needle insertion between the two groups [9]. In the posterior approach, the measurement was 39.46 mm, while in the lateral approach, it was 54.83 mm. Another study conducted by Palaniappan *et al.* found that the average depth of the sciatic nerve was 3.20 cm in the group using the posterior approach, while it was 5.53 cm in the group using the lateral approach [11]. When it comes to estimating the necessary depth of needle insertion in the lateral approach, local contractions of the biceps femoris muscle can be quite helpful. After the local contraction of the biceps femoris, you can stimulate the peroneal nerve by advancing the needle 3–5 mm. To achieve the desired nerve response, a deeper understanding is needed when using a lateral approach.

Our study revealed that for both approaches, the average time to block onset was 15 min. According to a study by Hadzić and Vloka, it was found that it takes an average of 19 min to fully block a nerve in each case. Based on a study conducted by Sinardi *et al*., it was found that the lateral approach for full blocking with ropivacaine takes approximately 13 min, while bupivacaine requires around 16 min [12]. Our study found that the average time for onset is 15 min, which aligns with the results observed in the bupivacaine group. We utilized lignocaine in conjunction with bupivacaine. They observed that the block began at 11 min for the peroneal nerve and 15 min for the tibial nerve, which aligns with our findings.

In our study, we found that the average duration of pain relief was 200 min for the lateral approach and 210 min for the posterior approach. According to a study by Hadzić and Vloka, analgesia was given during surgery for an average of 630 min using a 40 mL injection of lignocaine and adrenaline. Just like a health journalist, Palaniappan *et al*. conducted a study using 30 mL of injectable lidocaine and 1:200,000 adrenaline (1.5%). Their findings showed that patients who received a PB using either approach did not require additional pain relief for the following 260 min.

According to our study, the tibial nerve was more frequently encountered in the posterior approach, while the peroneal nerve was more commonly encountered in the lateral approach. This aligns with the findings of Dr. Radhakrishan's study, which also observed a significant difference in stimulation of the tibial or peroneal nerve. The peroneal nerve was stimulated by 74% using a lateral approach. By contrast, the posterior approach yielded a stimulation rate of 44% with a p=0.0092. This finding aligns with the study conducted by Palaniappan *et al*., which reported a 72% success rate for tibial nerve stimulation on the first attempt and a 31% success rate for peroneal nerve stimulation using the posterior approach [11]. Research conducted by Davies and McGlade has revealed that sciatic nerve blocks often yield unsatisfactory results when a nerve stimulator is not used. According to a source cited in the article, most sciatic blocks are typically done using insulated needles and a nerve stimulator [13]. We utilized the B-Braun Stimuplex nerve stimulator, employing a low-voltage current for precise nerve stimulation. In a recent study, researchers compared the posterior and lateral approach to the sciatic nerve in the political fossa. The findings confirmed that both techniques are equally effective for patients undergoing lower extremity surgeries. Hadzić and Vloka's study [10] found that the posterior approach stimulated the tibial nerve (76%), whereas the lateral approach stimulated the peroneal nerve (72%). Reason for stimulating the peroneal nerve with the lateral approach is that it runs laterally. The common peroneal nerve is the lateral division of the sciatic nerve. It runs from the posterolateral side of the knee, around the biceps femoris tendon and fibular head, to the anterolateral side of the lower leg. Later, it leads to superficial and deep peroneal nerves.

CONCLUSION

When it comes to positioning, a lateral approach is often preferred and more convenient due to the patient being in a supine position, particularly for lower-limb orthopedic procedures. In the study, it was observed that patients who underwent lateral approaches had a higher number of induction attempts compared to those who had posterior approaches. Interestingly, the posterior approach more frequently involved the tibial nerve, while the lateral approach more commonly encountered the peroneal nerve. In our assessment, the posterior approach is considered to be relatively straightforward from a technical standpoint. In both approaches, the average time to onset of the block was 15 min. The total duration of analgesia did not show any significant difference between the lateral and posterior approaches. Whenever possible, it is recommended to use the prone position and opt for the posterior approach rather than the lateral approach. However, when faced with challenges in the prone position, the lateral approach can still provide similar anesthesia block effects in terms of the onset and duration of pain relief, despite its technical complexity.

AUTHOR'S CONTRIBUTION

Dr. Shahenaz N Master: Concept and design of the study, prepared the first draft of the manuscript. Dr. Deepa Gondaliya: Interpreted the results; reviewed the literature and manuscript preparation. Dr. Vandna S Parmar: Design of the study, literature search, data acquisition. Dr. Sanju Prajapati: Manuscript preparation, manuscript editing. Hitarthi Dineshbhai Vadsola: Editing of the manuscript. Mona Jitubhai Chavada: Data acquisition.

CONFLICTS OF INTEREST

The author confirms no conflicts of interest.

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REFERENCES

1. Saporito A, Petri GJ, Sturini E, Borgeat A, Aguirre JA. Safety and effectiveness of bilateral continuous sciatic nerve block for bilateral orthopaedic foot surgery: A cohort study. Eur J Anaesthesiol.2014;31(11):620-5.doi:10.1097/EJA.0000000000000027, PMID: 24296819
2. Hadzić A, Vloka JD, Kuroda MM, Koorn R, Birnbach DJ. The practice of peripheral nerve blocks in the United States: A national survey [p2e comments]. Reg Anesth Pain Med. 1998;23(3):241-6. PMID: 9613533
3. Popliteal Sciatic Nerve Block - Landmarks and Nerve Stimulator Technique - NYSORA (n.d.). Available from: https://www.nysora.com/topics/regional-anesthesia-for-specific-surgicalprocedures/lower-extremity-regional-anesthesia-for-specific-surgical procedures/foot and anckle/block-sciatic-nerve-popliteal-fossa [Last accessed on 2023 Jul 10].
4. Dagur G, Gandhi J, Smith N, Khan SA. Anatomical approach to clinical problems of popliteal fossa. Curr Rheumatol Rev. 2017;13(2):126-38. doi: 10.2174/1573397112666161128102959, PMID: 27894238
5. Malav K, Singariya G, Mohammed S, Kamal M, Sangwan P, Paliwal B. Comparison of 0.5% ropivacaine and 0.5% levobupivacaine for sciatic nerve block using labat approach in foot and ankle surgery. Turk J Anaesthesiol Reanim. 2018 Feb;46(1):15-20.
6. Cataldo R, Carassiti M, Costa F, Martuscelli M, Benedetto M, Cancilleri F, *et al*. Starting with ultrasonography decreases popliteal block performance time in inexperienced hands: A prospective randomized study. BMC Anesthesiol. 2012 Dec;12(1):33.
7. Sisk AL. Vasoconstrictors in local anesthesia for dentistry. Anesth Prog. 1992;39(6):187-93. PMID: 8250339, PMC2148619
8. Adibatti M, Sangeetha V. Study on variant anatomy of sciatic nerve. J Clin Diagn Res. 2014 Aug;8(8):AC07-9. doi: 10.7860/JCDR/2014/9116.4725, PMID: 25302181, PMC4190700
9. Radhakrishan A. Comparison between Posterior and Lateral Approaches of Popliteal Block for Llower Limb Emergency Minor Surgical Procedures [Masters]. Stanley Medical College, Chennai; 2009. Available from: https://repository-tnmgrmu.ac.in/7241 [Last accessed on 2023 Nov 03].
10. Hadzić A, Vloka JD. A comparison of the posterior versus lateral approaches to the block of the sciatic nerve in the popliteal fossa. Anesthesiology. 1998;88(6):1480-6. doi: 10.1097/00000542-199806000-00010, PMID: 9637640
11. Palaniappan T, Vani S, Ravikumar S, Mohan V. Comparison of lateral versus posterior approach of popliteal nerve block for diabetic foot surgeries. Indian Journal of Anaesthesia. 2006;50(4):262-5.
12. Sinardi D, Marino A, Chillemi S, Siliotti R, Mondello E. Sciatic nerve block with lateral popliteal approach for hallux vagus correction. Comparison between 0.5% bupivacaine and 0.75% ropivacaine. Minerva Anestesiol. 2004;70(9):625-9. PMID: 15467494
13. Davies MJ, McGlade DP. One hundred sciatic nerve blocks: A comparison of localization techniques. Anesth Intens Care 1993;21:76-8.