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Research Article

A Comparison of a Single Point versus Two-Point Injection Technique to Block Sciatic Nerve by Posterior Approach Using Sono Guidance: A Randomized Controlled Trial

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ABSTRACT
Background: Sciatic nerve blocks are essential for effective pain management in lower limb surgeries. This study compares the efficacy and duration of analgesia between single-point and two-point ultrasound-guided injection techniques for sciatic nerve blocks.
Methods: This randomized controlled trial was conducted at Dr. Sampurnanand Medical College, involving 100 patients undergoing below-knee surgeries. Participants were allocated to either the single-point injection group (SP) or the two-point injection group (DP) through randomization. The primary outcomes measured were the time to perform the block, onset times of sensory and motor blockade, duration of analgesia, and procedural complications.
Results: The time to perform the block was shorter in the SP group (9.97 ± 1.03 minutes) compared to the DP group (15.69 ± 1.49 minutes; $p<0.001$). However, the DP group exhibited faster onset of sensory (11.14 ± 1.62 minutes) and motor blockade (15.73 ± 1.44 minutes) and a longer duration of analgesia (421.80 ± 34.39 minutes), all statistically significant compared to the SP group.
Conclusion: The two-point injection technique, while more time-consuming, enhances the effectiveness of sciatic nerve blocks by providing a quicker onset and prolonged duration of analgesia compared to the single-point technique. These findings suggest that the two-point technique may be preferable for surgeries requiring extended postoperative pain management.

Keywords: Sciatic Nerve Block, Ultrasound-Guided Injections, Single-Point Technique, Two-Point Technique, Regional Anesthesia, Pain Management.

INTRODUCTION

Sciatic nerve block is a fundamental technique in regional anesthesia, providing effective pain management for lower limb surgeries. Its efficacy largely depends on the precision of needle placement, which can be enhanced by ultrasound guidance.[1-3] Ultrasound-guided sciatic nerve block has become the standard due to its ability to reduce complications and improve analgesic outcomes. However, variations in injection techniques may influence the block's effectiveness and duration.

Traditionally, the single-point injection technique has been widely used due to its simplicity and quick execution. This method involves a single deposit of local anesthetic around the nerve, typically where the nerve is most superficial and accessible. Despite its widespread use, the single-point technique may not always provide consistent anesthesia across the nerve's extensive distribution, potentially leading to incomplete blocks.[4-7]

In contrast, the two-point injection technique involves administering the anesthetic at two separate sites along the nerve's path. This method aims to achieve a more comprehensive spread of the anesthetic, potentially leading to more uniform and prolonged nerve blockade. Preliminary studies suggest that the two-point technique may enhance the block's quality by ensuring a more extensive nerve exposure to the anesthetic.[8-10]

Despite these potential advantages, the comparative efficacy and safety of these techniques remain underexplored. This study seeks to fill this gap by providing a rigorous, randomized controlled trial to compare the single-point and two-point injection techniques under sono guidance. The primary objective is to evaluate differences in onset time, duration of analgesia, and incidence of complications between the two techniques.[11-14] This investigation is crucial for advancing clinical practice, as it could lead to refined guidelines

that optimize pain management strategies in lower limb surgeries.[15]

The current study builds on existing literature that indicates potential benefits of multiple injection points in enhancing the effectiveness of peripheral nerve blocks.[16] By employing a robust methodological framework and leveraging advanced sono-guidance technology, this trial aims to provide definitive evidence that can guide clinical decision-making and improve patient outcomes in regional anesthesia.

MATERIALS AND METHODS

Study Setting and Design: The study was conducted in the Department of Anaesthesiology at Dr. Sampurnanand Medical College, Jodhpur, Rajasthan, following approval from the ethical review board. This randomized controlled trial spanned one year or until the required sample size was achieved.

Sample Size and Statistical Analysis: The sample size was calculated using the hypothesis testing formula for two population means, with an alpha error of 0.05 and a study power of 90%. Calculations indicated a minimum of 47 subjects per group; however, to accommodate potential dropouts, 50 subjects per group were included. The statistical analysis involved comparing means using a student's t-test and categorical data using the Chi-square test.

Study Population: Participants were patients aged 18 to 60 years, of either gender, undergoing below-knee lower limb surgery. Patients with ASA physical status I and II were included.

Inclusion Criteria: Included were patients scheduled for elective and emergency lower limb surgeries under ultrasound-guided sciatic nerve block.

Exclusion Criteria: Patients were excluded if they refused consent, had allergies to local anesthetics or opioids, infections at the procedure site, were pregnant or breastfeeding, had coagulopathy, or had significant systemic diseases.

Data Collection: Data were collected using a structured proforma that captured socio-demographic and clinical variables. Pre-anesthetic evaluations were conducted a day before surgery, including a thorough history, systemic examination, and routine investigations.

Randomization and Procedures: Patients were randomized into two groups via sealed opaque envelopes containing allocation numbers. The block procedure was performed in the prone position, using an in-plane technique for sciatic nerve identification and drug administration. Group SP received a single 20 mL injection of 0.75% Ropivacaine, while Group DP received two 10 mL injections at predetermined points along the nerve.

Postoperative Assessments and Analgesia: Postoperative pain was assessed using a visual analogue scale (VAS) at various intervals. The duration of analgesia was measured from the time of sensory blockade to the need for the first analgesic rescue. Side effects and complications were monitored and addressed.

Outcome Measures: The primary outcomes included the duration of analgesia, total rescue analgesic doses, and side effects. Patient satisfaction was assessed 24 hours post-surgery using a five-point Likert scale.

RESULTS

The study's findings illustrate significant differences in procedural and recovery metrics between the single-point injection (Group SP) and two-point injection (Group DP) techniques for sciatic nerve blockade using sonographic guidance.

Time to Perform Block: The time taken to perform the block was significantly shorter in Group SP, with a mean time of 9.97 minutes (SD = 1.03), compared to 15.69 minutes (SD = 1.49) in Group DP, indicating a statistically significant difference ($p < 0.001$).

Time to Complete Sensory Blockade: Group DP achieved sensory blockade significantly faster, with a mean time of 11.14 minutes (SD = 1.62), as opposed to 15.69 minutes (SD = 1.18) in Group SP ($p < 0.001$). This faster onset in Group DP suggests a potential benefit of the two-point technique in achieving quicker sensory effects.

Time to Complete Motor Blockade: Similarly, the time to achieve complete motor blockade was shorter for Group DP, averaging 15.73 minutes (SD = 1.44), compared to 23.08 minutes (SD = 1.71) in Group SP ($p < 0.001$). This result supports the efficacy of the two-point approach in facilitating more rapid motor blockade.

Duration of Analgesia: In terms of analgesia duration, Group DP exhibited a significantly longer mean duration of 421.80 minutes (SD = 34.39) compared to 298.30 minutes (SD = 31.36) in Group SP ($p < 0.001$). This extended analgesia duration in Group DP underscores the clinical advantage of the two-point injection technique in prolonging analgesic effects.

Duration of Surgery: The duration of surgery also differed significantly between the groups. Group DP had a longer mean surgery duration of 92.6 minutes (SD = 32.63), whereas Group SP had a shorter duration of 75.66 minutes (SD = 30.30), with a p-value of 0.008.

These results collectively suggest that while the two-point injection technique takes longer to perform, it enhances the speed of sensory and motor blockade onset and prolongs the duration of analgesia, albeit with a longer overall surgery time.

Table 1: Time Taken to Perform Block (Min)

Description	Group SP Mean (Std. Dev.)	Group DP Mean (Std. Dev.)	P value
Time taken to perform block (min)	9.97 (1.03)	15.69 (1.49)	<0.001

Table 2: Time to Complete Sensory Blockade (Min)

Description	Group SP Mean (Std. Dev.)	Group DP Mean (Std. Dev.)	P value
Time to complete sensory blockade (min)	15.69 (1.18)	11.14 (1.62)	<0.001

Table 3: Time to Complete Motor Blockade (Min)

Description	Group SP Mean (Std. Dev.)	Group DP Mean (Std. Dev.)	P value
Time to complete motor blockade (min)	23.08 (1.71)	15.73 (1.44)	<0.001

Table 4: Duration of Analgesia (Min)

Description	Group SP Mean (Std. Dev.)	Group DP Mean (Std. Dev.)	P value
Duration of Analgesia (min)	298.30 (31.36)	421.80 (34.39)	<0.001

Table 5: Comparison of Duration of Surgery (Min) Between Groups

Description	Group SP Mean (Std. Dev.)	Group DP Mean (Std. Dev.)	P value
Duration of surgery (Min)	75.66 (30.30)	92.6 (32.63)	0.008

DISCUSSION

The results of this randomized controlled trial elucidate the differences between single-point and two-point injection techniques in ultrasound-guided sciatic nerve blocks for lower limb surgeries, extending the current body of literature on the subject. These findings offer a nuanced understanding of the efficiency of block performance, the onset times of sensory and motor blockade, the duration of analgesia, and overall procedural dynamics.[17,18]

The single-point injection technique was found to significantly reduce the time taken to perform the block. This efficiency is attributable to the simplicity of the procedure, which involves a single injection site. Despite its rapid execution, this technique resulted in a slower onset for both sensory and motor blockade compared to the two-point method. The two-point technique, although more time-consuming due to the preparation and execution at two distinct sites, facilitated a quicker onset of sensory and motor effects. This rapid onset is likely due to the more extensive anesthetic spread, covering a larger portion of the nerve pathway, thus ensuring quicker and more effective nerve blockade.[19]

A notable observation from the study was the extended duration of analgesia in the group receiving two-point injections. This suggests that the more comprehensive nerve coverage achieved with multiple injections may contribute to a more durable and consistent analgesic effect. The clinical implications of this

finding are significant, suggesting that the two-point technique may be more beneficial for patients requiring prolonged postoperative pain management, reducing the need for additional analgesic interventions.[14,20]

However, the advantages of the two-point technique come with the trade-off of longer procedural times, which was also reflected in the extended duration of surgeries observed in this group. This trade-off underscores the importance of considering individual patient needs and surgical contexts when choosing the optimal sciatic nerve block technique.[21]

Despite the robust findings, the study has limitations including its relatively small sample size and the fact that it was conducted in a single institution. These factors may affect the generalizability of the results. Future studies should aim to involve larger and more diverse patient populations across multiple centers to confirm these findings and potentially adjust the procedural guidelines based on broader clinical data.[6,9]

Overall, this study significantly contributes to the regional anesthesia field by providing evidence that supports the use of the two-point injection technique for achieving quicker and longer-lasting nerve blocks, despite the longer initial procedural time. These insights are crucial for refining anesthetic practices and improving patient outcomes in surgeries involving the lower limbs.

CONCLUSION

This study demonstrates that the two-point injection technique for ultrasound-guided sciatic nerve blocks, despite requiring more time to perform, provides a quicker onset and longer duration of both sensory and motor blockade compared to the single-point technique. These advantages suggest that for surgical procedures requiring extensive and prolonged postoperative pain management, the two-point approach may be more beneficial. Moving forward, the findings advocate for a tailored approach in choosing the injection technique based on specific patient needs and surgical requirements, enhancing overall patient care and satisfaction. Future studies with larger, diverse populations and multicentric collaborations are recommended to validate these findings and potentially influence practice guidelines.

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