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Original Research Article

A new two in one approach to ultrasound guided anterior sciatic and adductor canal block for below knee surgeries

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Abstract

Background and Aims: Sciatic and saphenous nerve blocks are commonly performed at the midthigh level under ultrasound guidance, typically requiring two separate skin entry points. This traditional approach may increase procedural complexity and patient discomfort. This study evaluated a two-in-one technique to perform anterior sciatic and saphenous nerve blocks through a single skin puncture at the midthigh level, aiming to simplify the procedure. The primary objective was to assess the feasibility, clinical utility, and safety of this technique, while secondary objectives included evaluating procedural time, sensory and motor block onset, and the duration of postoperative analgesia.

Materials and Methods: The study included 60 patients aged 18 to 80 years, of either sex, with ASA status I-III, undergoing elective or emergency below-knee surgeries. The blocks were performed under ultrasound guidance, and procedural time, sensory and motor block onset, and duration of postoperative analgesia were recorded.

Results: The two-in-one technique was successfully performed in all patients with a single skin puncture. The mean procedural time was 11.4 ± 0.632 minutes. The average onset times for sensory and motor blocks were 6.8 ± 0.748 minutes and 11.6 ± 0.894 minutes, respectively. The mean duration of postoperative analgesia was 13 ± 0.748 hours.

Conclusion: This novel ultrasound-guided approach to anterior sciatic and adductor canal block at the midthigh level using a single skin puncture is a safe, reproducible, and clinically effective technique for achieving complete anesthesia for below-knee surgeries.

Keywords: Anterior sciatic block, Adductor canal block, Below-knee surgeries, Ultrasound-guided blocks.

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1. Introduction

Ultrasound guided peripheral nerve blocks for anaesthesia of lower limbs are becoming increasingly popular as sole anaesthetic technique for surgeries. Anaesthesia of lower limbs below knee require both sciatic and saphenous or femoral nerve blocks. There are several approaches to ultrasound guided sciatic nerve and saphenous nerve block techniques. Anterior sciatic nerve block under ultrasound guidance is very commonly performed at anterior mid-thigh level with patient in supine position. The anterior approach to sciatic nerve was originally described by Dr. George P Beck in 1963 later modifications and ultrasound guidance were added by different academicians and clinicians.[1] Saphenous nerve is a terminal, purely sensory branch of femoral nerve can be blocked at adductor canal in anterior thigh or by blocking femoral nerve in the inguinal region. The adductor canal approach for saphenous nerve block was described by Mansour and colleagues.[2] Later Gray et al in 2003 described the ultrasound guided approach to adductor canal block.[3] These two nerves are blocked in anterior thigh region but at different levels with two different entry points on the skin even with ultrasound guidance with patients in supine position. The major drawback encountered with these approaches is multiple skin punctures hence hampering patient satisfaction.

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A recently described two-in-one technique by Kumar and colleagues, utilizes an ultrasound-guided anterior approach to block the sciatic nerve and saphenous nerve in the adductor canal at the anterior mid-thigh region through a single skin entry.[4] This approach offers significant advantages over traditional methods, as it is performed in the supine position with a single puncture, eliminating the need for multiple skin entries and avoiding position changes. This is particularly beneficial for patients unable to assume lateral or prone positions due to pain, fractures, surgical requirements, or other constraints. Slight modifications to this technique were applied to assess its feasibility and clinical utility. The primary focus was to evaluate the effectiveness of this single-entry approach for anterior sciatic and saphenous nerve blocks. Procedural time, sensory and motor blockade onset, total duration of postoperative analgesia, and patient satisfaction (assessed verbally) were recorded in patients undergoing below-knee surgeries. Any drug- or procedure-related adverse effects or complications were also documented.

2. Materials and Methods

The Study was conducted on 60 patients of either sex, aged 18 to 80 years, with ASA I, II, or III status, who were admitted to the institute between January 2024 and June 2024 for elective or emergency below-knee surgeries. Institutional ethics committee approval (Approval No. AIMS/IEC/099/2024) and informed written consent were obtained from all participants. The study included a single interventional group, with the primary outcome variable being the feasibility and clinical applicability of the new two-in-one approach to ultrasound-guided anterior sciatic and saphenous nerve blocks. Additional variables studied included the time taken to perform the block with a single entry, patient satisfaction, onset time of sensory and motor blocks, total duration of postoperative analgesia, and any procedure- or drug-related adverse effects or complications observed during the procedure or postoperative period.

The study was designed with a single interventional non-randomized group. Since the outcomes ranged from simple to continuous variables, the sample size was estimation was primarily based on the single group mean of one of the key outcomes, the Visual Analogue Scale (VAS) scores. VAS is a continuous variable for which the mean and standard deviation are expression of results or estimates of population, so the sample size was estimated using the following formula, sample size n = $ƙ^2 \times 4\frac{SD^2}{d^2}$.

Where:

'ƙ' is normal deviate for two- tailed alternative hypothesis at a level of significance, 'SD' is the standard deviation obtained from previous or the pilot study, and 'd' is the accuracy of estimate or how close to the true mean.[5]

By substituting the values from our pilot study at 95% significance and 5% error, d = 2, ƙ = 1.96, SD = 3.5, sample size n = 1.96^2 x 4 $(3.5^2)/2^2$ = 47. Based on this, minimum number of participants required in this study group was atleast 47. To account for potential confounding factors in a non-randomized study, as well as an additional allowance of 10% for missing data, losses to follow-up, and withdrawals, a corrected sample size of 60 subjects was determined to ensure the study's robustness.

All the participants were thoroughly evaluated and pre-existing comorbid conditions were optimised as time permitted before taking up for surgical procedure. All patients posted for elective surgeries were given Tab.Ranitidine 150mg, Tab.Alprozolam 0.5mg orally the previous day at bed time. On the day of surgery, all the arrangements for administering sciatic and adductor canal block using ultrasound (LOGIQ E, GE health care system) were made. Alternatively, arrangements for subarachnoid block or general anaesthesia were also made in case of inadequacy or failure of block. Availability of emergency drugs and resuscitation equipment were ensured. Ensuring nil per oral status (NPO) in the morning, patients were shifted to OT. An intravenous line with 18G cannula secured, monitors connected for recording heart rate, non-invasive blood pressure, electrocardiogram, pulse oximetry and base line values were recorded. Injection midazolam 0.04mg/Kg intravenously was administered as a premedication routinely.

With the patients lying in supine position with a pillow under the knee joint, the hip and knee on the operative side flexed to 15^0 and the thigh externally rotated at approximately 45°. After skin sterilization with an iodine-containing solution, a curvilinear array low frequency ultrasound transducer probe was first positioned perpendicular to the skin at the anterior mid-thigh level (midway between inguinal ligament and the upper border of patella). The location was then scanned by sliding and tilting the transducer until a clear transverse image of the hyperechoic sciatic nerve located posterior and medial to the femur was obtained. After local infiltration at the skin entry, a 21-gauge insulated nerve block needle (Stimuplex A, B. Braun Melsungen AG, Germany) 100mm in length, connected to a nerve stimulator (B. Braun Melsungen AG, Germany) with a preset pulse duration of 0.1 ms and stimulating frequency of 2 Hz was inserted in-plane to the curvilinear transducer in a medial to lateral direction targeting the sciatic nerve till a motor response was elicited. Once dorsiflexion or plantarflexion was elicited at 0.5 mA, local anesthetic 20 cc of the mixture containing Inj.Ropivacaine 0.5% and Inj.Dexamethasone 4mg was injected incrementally after confirming negative aspiration for blood. After performing sciatic nerve block, needle was then redirected from the same puncture site in the same plane to the ultrasound probe through adductor longus muscle into adductor canal immediately next to femoral artery. A volume of 10 cc of the above said mixture was used to block greater saphenous nerve after negative aspiration. If a motor response involving vastus medialis was observed during needle advancement into adductor canal, the tip of the needle was considered beyond target area and was slightly withdrawn to inject the local anaesthetic solution into adductor canal (**Figure 1**, **Figure 2**).

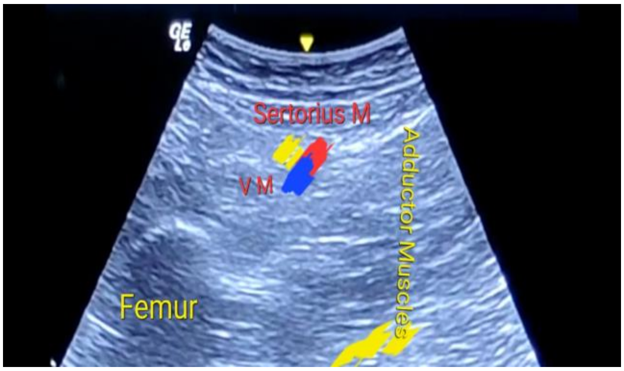

Figure 1: Ultrasonographic image showing the neurovascular bundle, bony and muscular anatomical landmarks for performing the anterior sciatic and adductor canal blocks

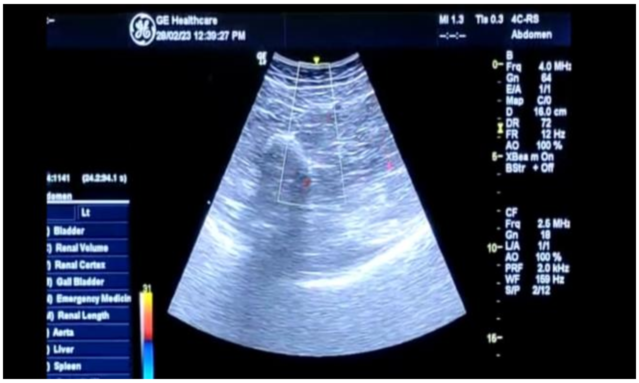

Figure 2: Ultrasonographic image of the anatomical landmarks with colour doppler

After performing the block procedure, testing for the onset of sensory blockade was done with pin prick method with 25gauge needle with a score of 0 to 2, where 0 meant sharp pain, 1- touch sensation only (hypoesthesia) and 2-not even touch sensation (anaesthesia). The assessment was made every minute till the patient feels no pain to pin prick. Similarly, the onset of motor block was assessed with movements at the ankle, where in 0-Normal movement, 1-Partial paresis of ankle and toe movement, and 2-Absent movement of ankle and toe. A grade 1 motor blockade was considered as time of onset of motor blockade and the grade 2 motor blockade as the time of peak motor block.

After adequate surgical anaesthesia was obtained surgical procedure was allowed to be performed. In case of partial or complete failure of block, surgical anaesthesia was obtained with single shot subarachanoid block or general anaesthesia based on clinical situation. After completing surgical procedure patients were assessed for the duration of sensory and motor blockade. The total duration of postoperative analgesia was assessed with Visual analogue scale. A score of 3 or more on VAS scale, or the time at request of rescue analgesia was considered cessation of analgesia. The time duration after completion of the surgical procedure till the cessation of analgesia was considered the total duration of postoperative analgesia. Rescue analgesia was given with Inj.Paracetamol 1 gram IV infusion. Results were recorded using preset proforma and any drug or procedure related adverse effects, complications were also noted down and treated accordingly.

Data was analysed using statistical software IBM SPSS version 26, and statistical analysis of all the recorded data was done using appropriate statistical tests and methods. The nominal and the ordinal data were analysed by calculating the percentage, continuous data was analysed by calculating mean and standard deviation using One-mean Z-test. The One-mean Z-test was chosen to analyse the continuous data for the reason that the sample size of study group was more than 30, the study population was a single group.

3. Results

The research examined a novel block procedure involving 60 participants with zero dropouts, providing a comprehensive assessment of a combined anterior sciatic and adductor canal block technique. The demographic data, including age distribution, is shown in **Table 1**, with a mean age of 45.68 years and a standard deviation (SD) of ±10.65 years. The gender and ASA physical status distribution of the study population, expressed as percentages, are provided in **Table 1**.

Table 1: Demographic and ASA physical status distribution

Characteristic	**Value**
Mean Age (years)	45.68 ± 10.65
Gender Distribution	
- Males	46%
- Females	54%
ASA Physical Status	
- ASA I	24%
- ASA II	36%
- ASA III	40%

The procedural time for performing the block, along with the sensory and motor block onset times, is summarized in **Table 2**. The mean time required to perform the block, combining the anterior sciatic and adductor canal, was 11.4 ± 0.632 minutes. The mean onset time for the sensory block, resulting in complete anaesthesia below the knee, was 6.8 ± 0.748 minutes, while the mean onset time for the motor block, observed at the ankle, was 11.6 ± 0.894 minutes. The mean duration of postoperative analgesia was 13.8 hours ± 0.748 hours, as shown in **Table 2**.

Participant acceptance of this novel approach, evaluated through verbal feedback, indicated that 95 percent of participants expressed satisfaction with the new technique, while only 5 percent preferred alternative approaches, as outlined in Figure 5 and **Table 3**.

Table 2: Block procedure and postoperative analgesia characteristics

Parameter	Mean time	Standard deviation
Time taken to perform the block	11.4 minutes	± 0.632 minutes
Time of onset of sensory block	6.8 minutes	± 0.748 minutes
Time of onset of motor block	11.6 minutes	± 0.894 minutes
Duration of post-operative analgesia	13.8 hours	± 0.748 hours

Table 3: Acceptance rate of the participants

Approaches	Two in one approach	May be other approaches
Acceptance rate	95%	5%

In all the participants the USG guided anaesthetic procedure was performed in a single attempt without any procedural failures, most of the participants (95%) had acceptance to this two in one single skin entry technique. There were no drug or procedure related adverse effects or complications in any of the participants.

4. Discussion

This study aimed to evaluate the clinical applications and importance of new two in one approach to anterior sciatic nerve block and greater saphenous nerve block with a single skin entry point under real-time USG guidance. The medial to lateral needle trajectory avoids the femoral vessels and the profunda femoral vessels running between the femur and the lateral aspect of the sciatic nerve.[6]

A study by Dolan J et al. clearly concluded the lack of reliable surface anatomical landmarks making anterior approach to the sciatic nerve block technically very challenging.[7] Hence, Ultrasound guidance is very useful, reliable for this approach. Previously, Ultrasound-guided anterior approach to sciatic nerve block has been described at the lesser trochanteric level.[8,9] But the nerve is located deep in intermuscular plane at this level, the visualization, identification of the nerve may not be easy and as good as in the posterior approaches. However, this new approach is appearing to be very useful in patients who cannot lie lateral/prone due to any reason. Furthermore, ergonomically it is an easier technique as concluded by Ota J and colleagues.[9]

Anterior sciatic block at the mid-thigh level with a curvilinear probe over antero-medial aspect of the thigh as described by the authors appears technically easier to perform due to better visualization and identification of the sciatic nerve contrasting against hamstrings and the muscles of adductor compartment even in the obese individuals.[10,11] Studies done by Peer S, Graif M and others showed that the sciatic nerve lies deep to the adductor muscles sandwiched between the adductor magnus and biceps femoris, semitendinosus and semimembranosus and can be identified typically as a circular or oval hyperechoic structure in the intermuscular plane deep to adductor magnus.[12,13] The greater saphenous nerve can be blocked in the adductor canal at the mid-thigh level with the same skin puncture by changing the trajectory of the block needle. The descending branch of the femoral artery along with saphenous nerve (SN) lie in close proximity in the adductor canal, they can be easy to identify by their "beads on a string" appearance in the fascial plane adjacent to vastus medialis under the sartorius muscle.[14,15] Marian AA et al. demonstrated that adductor canal approach (ACB) is superior to block at the distal trans-sartorial level in terms of success rate, with additional advantages of faster block onset time and better nerve visibility under ultrasound.[16] Gautier PE et al. confirmed that the local anaesthetic injected in adductor canal at mid-thigh level can also spread into popliteal fossa blocking the peroneal and tibial nerves.[17]

The spread appears to be volume dependant occurring through the adductor hiatus, the accessory hiatus, and/or in the intermuscular plane of the adductor magnus, resulting in some sensory block of the sciatic nerve and/or its branches, may further augment the anterior sciatic nerve block.[18] Meanwhile, Nair A identified, adductor canal block (ACB) placed too proximally in the thigh at the level of femoral triangle anesthetises the nerve to the vastus medialis muscle (NVM), and this explains the weakness of quadriceps femoris muscle hindering early mobilisation.[19] The NVM is a branch of the posterior femoral nerve which occurs more proximally in the thigh, lies within a distinct fascial plane lateral to femoral vessels separated from saphenous nerve by a thick fascia in the adductor canal, and has two different motor branches.[20] The thin slender lateral branch supplying the upper part of vastus medialis, a larger medial branch which supplies the remaining major middle and lower part of vastus medialis muscle. Watanabe and colleagues identified the medial branch of NVM which lies in close proximity with and indistinguishable from SN in adductor canal under USG guidance.[21] Multiple studies have shown a lateral to medial needle direction to block both anterior sciatic and saphenous nerve at midthigh level may injure the thin slender lateral motor branch which is lies in the lateral aspect of neurovascular bundles of adductor canal supplying the upper part of vastus medialis leading to muscle wasting involving the supplied part.[20-22] The authors chose to use a medial to lateral direction of needle insertion to avoid possible NVM and femoral vessels injury by the block needle. Kolli S in their study concluded that the midportion of the adductor canal at mid-thigh level could be an optimal site for local anesthetic administration, proximal enough to consistently block the SN and NVM while minimizing spread to the popliteal fossa, and distal enough to avoid significant spread to the femoral triangle.[23]

Adductor canal block (ACB) specifically has emerged as a novel technique consistently demonstrating comparable analgesic efficacy to femoral nerve block.[24] The NVM and SN innervate knee joint and antero-medial capsule of knee joint which results in profound analgesic and anaesthetic effect of ACB in knee and below surgeries.[23,24] Jaeger P et al demonstrated that the ACB significantly reduced quadriceps strength, but the reduction was only 8% from the baseline and such reduction is not considered functionally important.[25] In comparison, the FNB reduced quadriceps strength by 49% from the baseline, while ACB preserved quadriceps strength and ability to ambulate better than FNB did.[25] Another study by Kwofie at al concluded that the ACB has significant motor sparing effect compared to femoral nerve block.[26] In the present study, the authors also observed a slight reduction in quadriceps strength, restricting the extension at knee but a greater reduction was significantly avoided.

The authors could easily perform and reproduce this two in one approach achieving adequate surgical anaesthesia with no procedural failures in all the participants. This technique has an added advantages of performing SN and ACB in supine position with a single skin entry. We also noted a better acceptance of this approach by the participants due to its single skin puncture as indicated by the verbal conversation with the participants. No neurological, drug or procedure related complications were observed in the peri-operative period. We have explained the dos and don’ts and other factors which may influence the clinical outcomes, the success rate, applications of the above-described technique for optimising the results.

This study had a few limitations. The sample size was relatively small, and larger clinical trials are required to confirm and validate the findings. While the technique itself is not novel, its clinical applications and advantages are superior to the conventional two-entry technique, making it a valuable approach for achieving effective anaesthesia.

5. Conclusion

The two-in-one ultrasound-guided approach to combined anterior sciatic and adductor canal block offers a safe technique with a medial-to-lateral needle trajectory. It eliminates the risk of injury to the nerve to vastus medialis and vascular puncture of the femoral vessels. This approach is suitable for routine clinical practice, offering benefits like a single skin entry, high success rate, shorter procedure and block onset time, and use for both postoperative pain relief and surgical anesthesia in below-knee surgeries.

6. Source of Funding

None.

7. Conflict of Interest

None.

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