

Comparison of Ultrasound Guided Lateral and Posterior Approach of Popliteal Sciatic Nerve Block for below Knee Surgeries-A Randomized Comparative Study.

¹Dr. Pavithra S,²Dr. Sargunaraj A,³Dr. Udhaya Sankar S,⁴Dr. Ranjan R.V,⁵Dr. Suneeth P. Lazarus,

¹ 3rd Year Postgraduate, Department of Anaesthesiology, Sri Manakula Vinayagar Medical College Hospital and Research Centre, PUDUCHERRY, India

² Assistant Professor, Department of Anaesthesiology, Sri Manakula Vinayagar Medical College Hospital and Research Centre, PUDUCHERRY, India

³ Assistant Professor, Department of Anaesthesiology, Sri Manakula Vinayagar Medical College Hospital and Research Centre, PUDUCHERRY, India

⁴ Professor, Department of Anaesthesiology, Sri Manakula Vinayagar Medical College Hospital and Research Centre, PUDUCHERRY, India

⁵ Professor and Head, Department of Anaesthesiology, Sri Manakula Vinayagar Medical College Hospital and Research Centre, PUDUCHERRY, India

Abstract:

Background: The Popliteal Sciatic Nerve Block(PSNB) provides Excellent anaesthesia and analgesia and can be blocked through anterior,posterior,lateral approaches.We compared PSNB through Lateral and posterior approaches under ultrasound guidance (USG).We carried out this study since there are only few studies comparing sciatic nerve visibility(SNV)score and lateral and posterior approach under USG .The Assessment included SNV score,ease of performance, block success rate, Total duration of analgesia.

Method:70 patients received PSNB either through posterior approach(Group A(n=35))in prone position or lateral approach(group B(n=35))in supine position using USG and nerve stimulator.Both groups received 0.5% Bupivacaine(20ml).After USG scanning of the PSN,image was saved to evaluate SNV.Time taken,number of attempts required to perform the block, onset of sensory and motor block and hemodynamic parameters were assessed for 24 hrs.Postoperatively VAS score,total duration of analgesia and time for first rescue analgesic requirement were recorded for 24 hours.

Results: SNV score was better in posterior approach(4.49 ± 0.61) than lateral approach(4.11 ± 0.72).Less Block performance time required in posterior(10.26 ± 4.10 min) than lateral approach(12.37 ± 4.20 min).Less number of attempts were required in posterior approach(1.20 ± 0.41) than the lateral approach(1.43 ± 0.50).In Group A,80% of patients required single attempt and 20% required 2nd attempt to perform the block. In Group B, 57.1% of patients required single attempt and 42.9% required 2nd attempt which is statistically significant.

Conclusion: The sciatic nerve visibility,performer's ease score were better in posterior approach than lateral approach.Other parameters like block success rate,quality of blockade,total duration of analgesia,need for first rescue analgesia were similar in both the groups.

Keywords: PSNB, different approaches, SN visibility score.

INTRODUCTION:

Anaesthesiologist has the sole responsibility for providing adequate anaesthesia and post-operative analgesia without any complications which can be done with diligent efforts and adequate anatomical knowledge with good administrative technique.

PSNB is a well-established blockade among the regional blocks. It is easy to perform and shown to reduce postoperative pain, narcotic consumption, and decreasing the associated morbidity. So, they are considered as an ideal alternative for general anaesthesia and central neuraxial blockade.

PSN can be blocked at different stages, throughout its course and can be performed in the supine, prone, or lateral positions^{1,2}. It can be used either as sole block or in conjunction with a saphenous or femoral nerve block for below knee surgeries.

USG aids in direct visualization of nerve structures, real-time needle guidance to the target, and monitoring of local anaesthetic(LA) diffusion and shown to improve the block success rate and reduces the risk of complications³.

The classical posterior approach is reliable in terms of anatomy, yielding good results but has to be done in prone position which could be discomfort to the patient and difficult in morbidly obese, spinal deformity, hemodynamic instable, advanced stage of pregnancy.

Popliteal nerve can be easily blocked in supine position using lateral approach and it was found to be equivalent to the popliteal fossa –posterior approach⁴.

In one study, the modified lateral approach is simple and easy and results in longer duration of block and is more comfortable for the patients⁵. However in another study, the posterior approach was found to be better⁶.

The purpose of this study was to evaluate the clinical utility of the PSNB using lateral approach with that of the conventional posterior approach using combined USG and nerve stimulator and to compare their effectiveness, identification ease, SNV score and the ease of performance.

MATERIALS AND METHODS:

This randomized comparative study was conducted at Department of Anaesthesiology, Sri Manakula Vinayagar Medical College and Hospital (SMVMCH). The study was done on patients who are underwent below knee surgeries conducted as per good clinical practice (GCP) guidelines by World Health Organization for the duration of 18 months after obtaining Institutional Ethics Committee clearance and CTRI registration.

Ethics Committee approval number: SMVMCH-ECO/AL/218/2022 CTRI –Registration number: CTRI/2023/05/052239.

Study Sample:

All the patients satisfying the inclusion criteria in the period of this study was equally divided into 2

groups (group A, group B) and studied. An initial sample population of 35 in each group, making a total of 70 participants were included in the study.

Considering the higher mean Sciatic Nerve Visibility score found in the lateral approach sciatic nerve blockade of 3.25 (+/-0.60 s.d.) over the anterior approach (mean visibility score of 2.5 and S.D of 1.06) in a study by Zhu LJ et al⁷, the sample size for the present study was found to be 56 at 95% confidence interval and 90% power. Considering a 33 possible dropout rate of 15% the sample size was adjusted to 64 and rounded off to 70 the nearest whole number with 35 participants each in the two comparison groups

Randomization:

Block randomization with block size of 14 with the help of external person not involved in the study (epidemiology unit of the community medicine department). This was done using random allocation software.

Blinding:

The proposed study was a double blinded randomized study. The PSNB through lateral approach or posterior approach under USG was administered to the patient by a qualified anaesthesiologist who is not involved in the study. He/ She has administered the block according to the code received by the patient. The sciatic nerve visibility score, performer's ease score, onset time of block, success of block and other variable observations were made by an anaesthesiologist who is not involved in the study. The investigator who recorded the data was not aware of the participant's group. Sequence was handed over to the principal investigator in sealed envelope. Decoding done by the statistician.

Inclusion Criteria: Patients aged from 18 to 60 years of either sex belonging to ASA PS I&II, posted for below knee surgeries under popliteal block.

Exclusion Criteria:

Pregnant women, patients with Active infection at the site of block, Hypersensitivity to local anesthetics, Pre-existing neurological & neuromuscular diseases along the distribution of block, Fixed skeletal deformities at knee joint, Anticoagulants and anti-platelet therapy,

Coagulopathies, Below knee surgeries requiring tourniquet in thigh, Patients refusal for participating in study were excluded.

PLAN OF STUDY

The day before the procedure, a thorough history and pre-anesthetic assessment were carried out. Investigations like complete blood count blood grouping, blood urea, blood sugar and ECG was done. Written informed consent was obtained.

Patients were randomly divided into two groups of 35 each:

1. Group A-patients received ultrasound guided popliteal sciatic nerve block, by posterior approach.
2. Group B-patients received ultrasound guided popliteal sciatic nerve block by lateral approach

PATIENT PREPARATION

Nil per oral for 8 hours.

- Premedicated with Tablet alprazolam 0.5mg& tablet pantoprazole 40mg on the night before surgery. Patient data were documented in proforma. Enrolled patients were assigned to either group (A or B) based on the randomization sequence. Group A patients received USG guided posterior approach of PSNB , while group B patients recieved USG-guided lateral approach of PSNB.

Once patient shifted to OT, ASA standard monitors were attached and baseline vitals were noted. An appropriate IV cannula (18G) was secured.

Under sterile techniques using SonoSite ultrasound system (SonoSite Edge 1 Ultrasound System) with a high-frequency linear-array transducer (8-13MHz) with Stimuplex HNS 11, B. BRAUN AG a nerve stimulator, PSNB was performed using 100-mm 22-gauge needle (Stimuplex D; B. BRAUN AG). After obtaining best SN view, the ultrasound image of the SN was captured and saved.

The skin and subcutaneous tissue anaeshetized with 2 ml of 2% Lignocaine. Stimuplex needle connected to nerve stimulator was set up with an initial stimulating current and frequency of 1.0 mA and 2 Hz, respectively, and a pulse duration of 0.1 msec. Once the needle tip was in close proximity to the SN- plantar flexion or dorsiflexion of ankle was appreciated. The stimulation current was progressively reduced until twitches are observed at

0.5 mA. After confirming negative aspiration, 20 ml of 0.5% Bupivacaine was given around

the SN for both the groups. For group A through posterior approach and for group B- through lateral approach.

Senior anaesthesiologist expertise in regional anaesthesia performed all the blocks in-plane approach.The sensory and motor blockade was evaluated by an investigator who was blinded. For surgeries requiring anaesthesia of medial aspect of leg and foot were given additional saphenous nerve block at adductor canal under USG guidance as off record.

Table1: Showing procedures of posterior and lateral approach of PSNB

	POSTERIOR APPROACH	LATERAL APPROACH
PATIENT POSITION	Prone position with the foot placed perpendicular to the bed and the operating leg extended at the knee joint	Supine position with the foot placed perpendicular to the bed and the operating leg extended at the knee joint.
USG PROBE	High-frequency linear array transducer	High-frequency linear array transducer
NEEDLE	100-mm 22-gauge needle (Stimuplex D; B. BRAUN AG)	100-mm 22-gauge needle (Stimuplex D; B. BRAUN AG)
NERVE STIMULATOR (B. BRAUN stimuplex R Dig RC	RESPONSE- plantar flexion or dorsiflexion of ankle.	RESPONSE- plantar flexion or dorsiflexion of ankle.
USG PROBE PLACEMENT	7 cm from the popliteal crease, perpendicular to the skin.	10 cm proximal to the lateral femoral condyle.

SN VIEW	Between the biceps femoris and the semitendinosus and semimembranosus.	Between the biceps femoris and vastus lateralis
LOCAL ANAESTHETICS	20ml of 0.5% Bupivacaine	20ml of 0.5% Bupivacaine

If the sciatic nerve could not be stimulated, the ultrasound probe was adjusted and the needle was reinserted using the same technique in a fresh puncture site that was 5 mm lateral to the first one (second try). Until the intended response was achieved, this approach was repeated at fresh insertion sites (subsequent attempts) in 5-mm incremental lateral insertion.

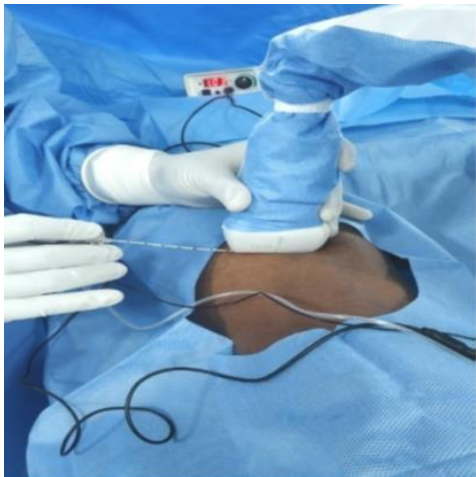


Image 1: depicting the patient and linear transducer

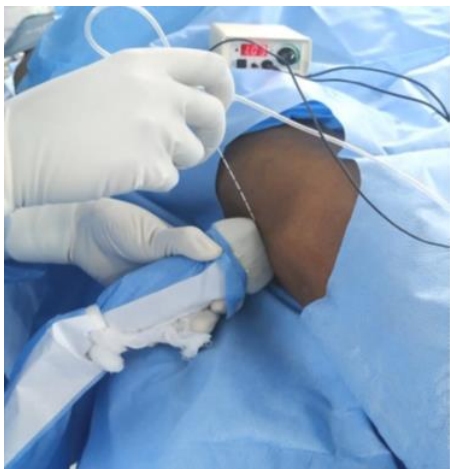


Image 2: depicting the patient and linear

position, in plane needle insertion technique transducer position, in plane needle in posterior approach of PSNB. insertion technique lateral approach of PSNB.

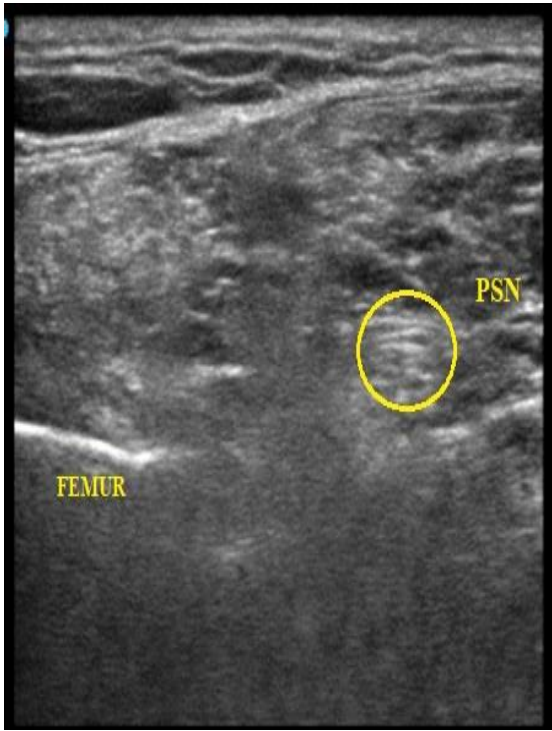


Image 3: depicts USG image of PSN Image 4: depicts USG image of PSN

in posterior approach lateral approach.

in

Data collection included the patient demographics, sciatic nerve(SN) visibility score, onset and duration of sensory and motor blockade, time taken to perform the block and the number of attempts, patients comfort during the procedure, need of first rescue analgesia.

To eliminate subjective and visual biases, assessors experienced in US-guided regional techniques has evaluated the SN visibility score. The assessors were also blinded.

A six-point visibility scale was used to calculate the SN visibility scores:

0- No nerve identified; 1- Nerve identified with high probability; 2- Nerve identified but most of it not visible; 3- Nerve identified and 50% of its borders precisely distinguished from surrounding structures; 4- Nerve completely visible but fascicles poorly defined; and

5- Nerve completely visible and multiple fascicles identifiable⁸.

Sensory blockade was evaluated by pinprick method, at dorsum /sole of the foot for common peroneal nerve and tibial nerve respectively using a blunted needle every 5 min after LA injection for upto 30 min. The scoring system adapted from Koscielniak-Nielsen et al⁹ was followed for checking sensory block. Grade 0- sharp pain ,Grade 1- touch sensation ,Grade 2- no sensation.

Motor blockade was assessed by asking the patients to plantar and dorsiflexion of the foot at every 5 minutes for upto 30 minutes following LA injection. Grade 0- no movement; Grade 1-light movement; ,Grade 2-normal movement¹⁰

The duration of motor blockade was considered from the onset of block to the return of normal movement. Quality of block assessed by complete block, partial block or no block.

Number of attempts, time taken to perform the block (from needle insertion to withdrawal) was noted by nurse. The surgery proceeded after successful block (complete sensory block affecting both division

within 30 min and absence of pain on surgical instrumentation).

If complete sensory blockade was not achieved within 30mins and the patient still perceiving pain, then it's considered as failed block. Spinal anaesthesia will be given. None of the patient in either of the groups had failed block.

The patient and the postoperative ward staff were instructed to note the time of return of pain postoperatively which was verified by the investigator. Hemodynamics of the patient were recorded every 10 minutes for 30 mins before the procedure and every 5 minutes after the block for first 30 mins and every 1 hour for next 6 hours or after the end of the surgery and every 4th hourly for 24 hours after the surgery.

The postoperative pain was assessed using Visual Analogue Score(VAS) at frequent intervals for 24hrs.Score >4 was considered significant and rescue analgesia Inj. Tramadol 50mg IM stat was given, the total duration of block was determined by time for first rescue analgesia requirement.

STATISTICAL ANALYSIS:

Categorical data was represented in the form of Frequencies and proportions. For qualitative data **Chi-square test** was used. Continuous data was represented as mean and standard deviation. **Normality of the continuous data**, was tested by **Kolmogorov–Smirnov test and the Shapiro–Wilk test**. **Independent t test** was used to identify the mean difference between two quantitative variables. **Mann Whitney U test** was used for Non parametric data between two groups.

Graphical representation of data: MS Excel and MS word was used to obtain various types of graphs such as Line diagram, bar diagram.

p value (Probability that the result is true) of <0.05 was considered as statistically significant after assuming all the rules of statistical tests.

Statistical software: MS Excel, SPSS version 22.0(IBM SPSS Statistics, Somers NY,USA) was used to analyze data.

CONSORT DIAGRAM:

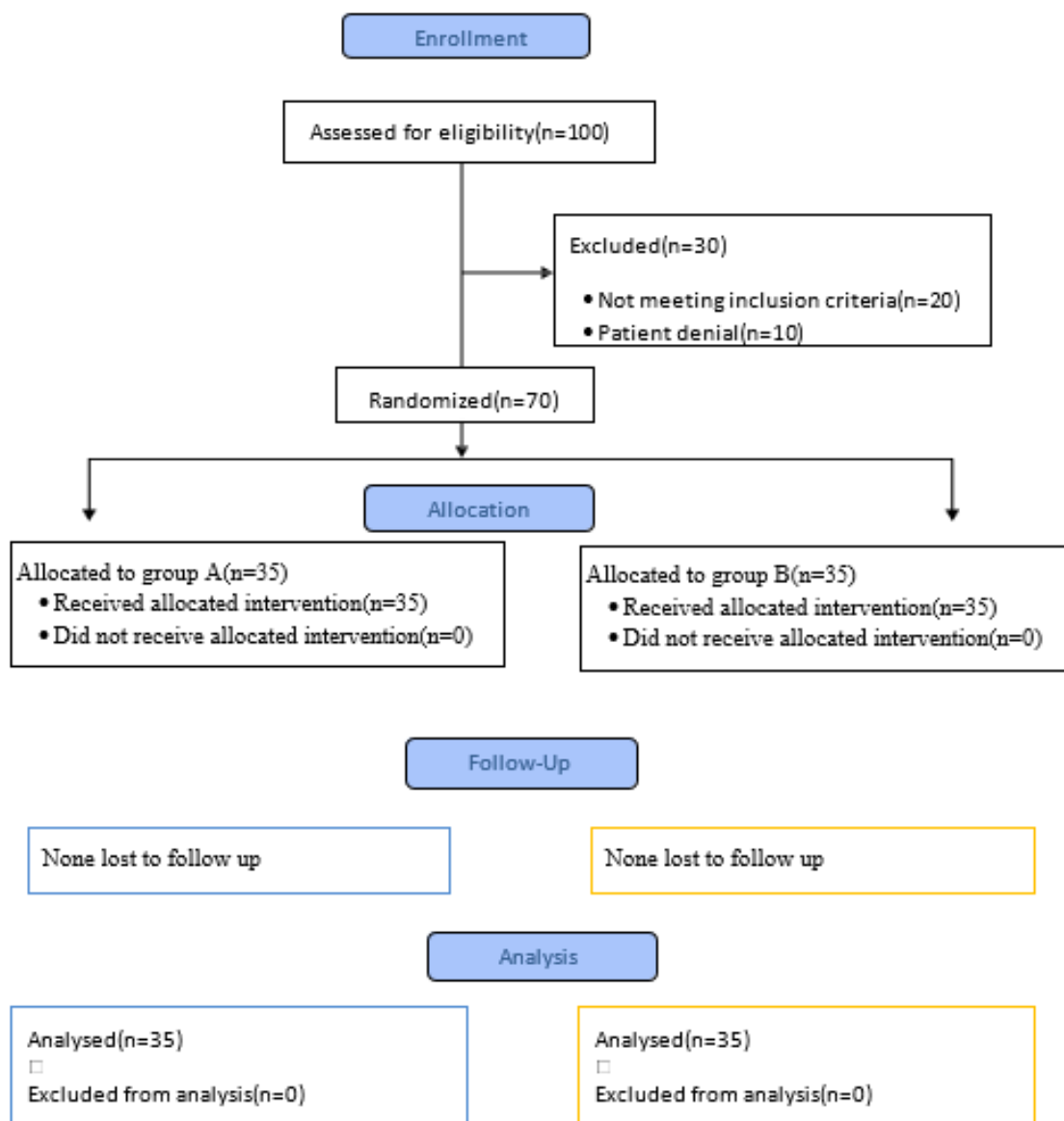


Table 2:Comparison of demographic variables among 2 groups

PARAMETER S	GROU P A	GROU P B	P VALU E
Age distribution	44.17 ±13.019	44.26 ±11.544	0.977
HEIGHT(cms)	160.77 ± 5.21	159.66 ± 5.52	0.388
WEIGHT(kgs)	66.20 ± 10.98	65.46 ± 5.52	0.758
BMI(kg/m2)	25.55 ± 4.00	25.63 ± 3.25	0.927

Sex distribution (M/F) –in group A is (25/10)& group B is (21/14)

ASA class (1/2)-in group A is (26/9)& group B is (22/13)

There is no statistical significant difference in age, sex, gender, anthropometry,ASA class among 2 groups

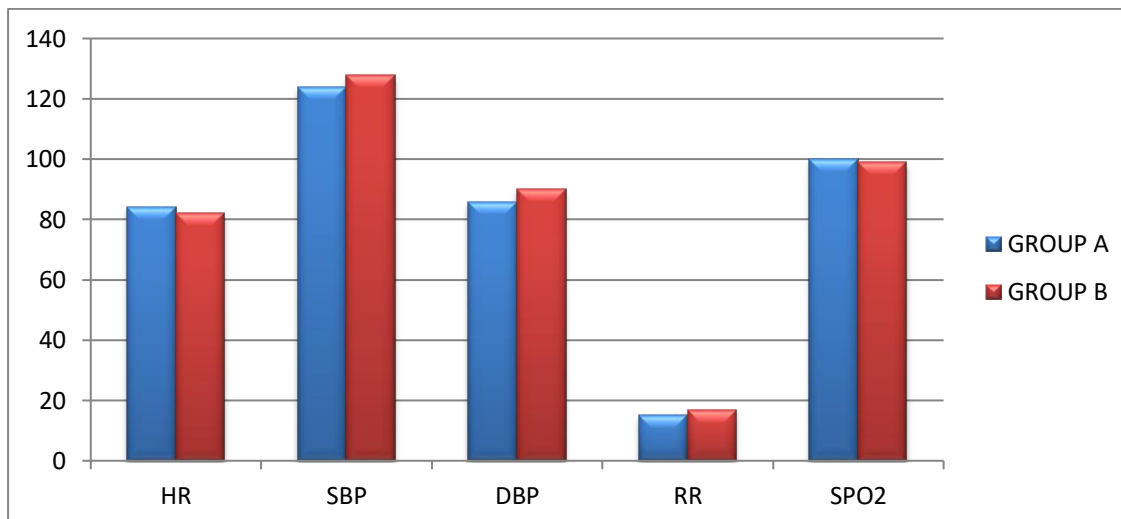
Table 3:Comparison of type of surgeries among 2 groups

		Group			
		Group 1		Group 2	
		Count	%	Count	%
Surgery	Foot Surgeries	16	45.7%	14	40.0%

Ankle Surgeries	15	42.9%	16	45.7%
Below Knee Surgeries	4	11.4%	5	14.3%
Total	35	100.0%	35	100.0%

There was no significant difference in surgery between two groups analysed

Image 5: Comparison of hemodynamic variables among 2 groups



No significance difference in measured at various time intervals throughout the study period.
HR,SBP,DBP,RR,SPO2 between 2 groups

Table 4: Comparison of various parameters among 2 groups

VARIABLES	GROUP A			GROUP B			P Value
	Mean	SD	Median	Mean	SD	Median	
SCIATIC NERVE VISIBILITY SCORE	4.5	0.61	5	4.11	0.7	4	0.023*
Block performance time(mins)	10	4.1	10	12.4	4.2	11	0.037*
Number of attempts to perform the block	1.2	0.41	1	1.43	0.5	1	0.04*
Onset time of the block(mins)	19	4.29	20	17.9	3.5	15	0.2
Total duration of blockade(Hrs)	9.6	1.13	10	9.59	1.6	9.5	0.9
Time of first rescue analgesia(Hrs)	11	3.08	12	10.8	2.5	11	0.9
Total dose of tramadol(mgs)	93	32.9	100	92.7	30	100	1
Quality of blockade	100%			100%			

*denotes statistically significant P value

Mean Sciatic nerve visibility score in Group A was 4.49 ± 0.61 and in Group B was 4.11 ± 0.72 with P value of 0.023 which was statistically significant. Mean Block performance time in Group A was 10.26 ± 4.10 mins and in Group B was 12.37 ± 4.20 mins with P value of 0.037 which was statistically

significant. Mean Number of attempts to perform the block in Group A was 1.20 ± 0.41 and in Group B was 1.43 ± 0.50 with P value of 0.04 which was statistically significant. In Group A, 80% of block was given in single attempt and in 20% block was given in second attempt. In Group B, 57.1% block was given in single attempt and in 42.9% block was given in second attempt.

There was no statistical difference in block onset time, total duration of blockade, quality of blockade, time for 1st rescue analgesia required, total dose of tramadol consumption, VAS score among 2 groups.

DISCUSSION:

PSNB is a well-known, quick, safe, and successful method for providing anaesthesia and analgesia for below knee surgeries. It can be used either as sole block or in conjunction with a saphenous or femoral nerve block for below knee surgeries. PSNB provides a good post-operative analgesia with very less hemodynamic and metabolic changes when compared with general anaesthesia. PSNB can be performed in the supine, prone, or lateral position. Patient should be positioned prone for posterior approach whereas lateral approach can be done in supine position. Both the approaches have merits and demerits which have to be compared for better understanding. Our study was conducted to compare the ultrasound guided lateral and posterior approach of popliteal sciatic nerve block for below knee surgeries. In our study the Mean Sciatic nerve visibility score in Group A was 4.49 ± 0.61 and in Group B was 4.11 ± 0.72 with p value of 0.023 which was statistically significant difference. Sciatic nerve visibility was better in posterior approach group than the lateral approach group. No other studies were found to compare the sciatic nerve visibility through posterior and lateral approach.

The study conducted by **Lin-Jia Zhu et al** [39] comparing the ease of identification, performance efficacy, and safety of sciatic nerve block using the anterior and above-knee lateral approaches among 53 patients scheduled for below-knee surgery. SNV score was [3.25 (3.17, 3.67)] among lateral group vs. 2.50 (1.86, 2.68) among anterior group with P value <0.001. Lateral approach showed a higher SNV visibility score than anterior approach.

In our study, performance score was assessed using time taken to complete the blockade and number of attempts required to perform the block. The Mean Block performance time in Group A was 10.26 ± 4.10 min and in Group B was 12.37 ± 4.20 min with P value of 0.037. The Mean Number of attempts to perform the block in Group A was 1.20 ± 0.41 and in Group B was 1.43 ± 0.50 with p value of 0.004.

In Group A, 80% of block was given in single attempt and 20% block was given in second attempt. In Group B, 57.1% block was given in single attempt and in 42.9% block was given in second attempt. So, the study results were Less time and a smaller number of attempts were required to perform the block through posterior approach than lateral approach.

The study conducted by **Lin-Jia Zhu et al** [39] comparing SNB using the anterior and above-knee lateral approaches among 53 patients scheduled for below-knee surgery. The time taken to perform the block was (49.70 ± 5.97 seconds) in lateral group, and in anterior group (71.50 ± 11.66 seconds) with P value of <0.001 which was statistically significant. So, less time was required to perform the block in lateral approach when compared to anterior approach.

A similar study by **Hadzic A et al** [36] to compare the lateral and posterior approaches of popliteal block among 50 patients. 52% and 32% the patients in posterior approach group required 1 or 2 attempts respectively whereas in lateral approach group 40% and 28% patient required 3 or 4 attempts respectively. Also, the time taken to complete the blockade was 6 min (1-16 min) in posterior group and 8 min (1-17 min) in lateral group with p value <0.005 which is statistically significant.

In our study, 80% of block was given in single attempt and 20% block was given in second attempt in group A. In Group B, 57.1% block was given in single attempt and in 42.9% block was given in second attempt. None of the patients in either of the group required more than 2 attempts. This difference in % of number of attempts required to perform the block in our study compared to **Hadzic A et al** [36] study is probably because of use of ultrasound combined with nerve stimulator in our study which aid in good visualization of the PSN and real time visualization of the needle in-plane technique. But still **Hadzic A et al** [36] study findings were similar to our study findings based on statistical significance where lateral approach required more number of attempts and more time taken to perform the block than posterior approach.

A study conducted by **Dr. Palaniappan T et al** [45] comparing lateral versus posterior approach of PSNB for diabetic foot surgeries using nerve stimulator among 58 patients. The posterior

approach was successful in 1 attempt in 51% of the patients, whereas in lateral approach group the success rate was only 21%. In 35% of the patients, both the posterior approach and lateral approach was successful in the second attempt. More number of attempts was required to perform the nerve blockade through the lateral approach than the posterior approach which was consistent with our study findings.

In our study, block success rate among lateral versus posterior approach was also assessed based on onset of sensory and motor blockade, quality of the blockade. In our study, Mean Onset time of the block in Group A was 19.14 ± 4.29 min and in Group B was 17.86 ± 3.49 min. In both the groups Quality of block was Grade 1 (i.e. complete block). There was no significant difference in Onset time of the block between two groups.

A study conducted by **Sinardi D et al**⁴³ comparing 0.5% Bupivacaine and 0.75% Ropivacaine in sciatic nerve block in lateral approach for hallux valgus repair among 60 patients. Patients in Bupivacaine group required 16.4 ± 3.3 min to achieve complete blockade which was similar to our study outcome.

It was found that Mean Total duration of analgesia in Group A was 9.63 ± 1.13 hrs and in Group B was 9.59 ± 1.56 hrs. There was no significant difference in total duration of analgesia between two groups. Mean Time of first rescue analgesia requirement in Group A was 11.21 ± 3.082 hrs and in Group B was 10.79 ± 2.532 hrs. There was no significant difference in Time of first rescue analgesia requirement between two groups.

A study conducted by **Sinardi D et al**⁴³ comparing 0.5% Bupivacaine (20ml) and 0.75% Ropivacaine (20ml) in sciatic nerve block in lateral approach for hallux valgus repair among 60 patients using nerve stimulator. The total time of analgesia in bupivacaine group was 13.26 ± 1.51 hrs which was consistent with our study findings.

In our study, Parameters like heart rate, blood pressure, respiratory rate, saturation were assessed for 24 hours at regular intervals which was statistically insignificant. the occurrence of postoperative pain was assessed by the VAS score at various intervals for 24 hrs. VAS score of >4 was considered significant and rescue analgesia Inj. Tramadol 50mg IM stat given, the duration of

blockade was determined by onset of blockade to first rescue analgesia.

There was no significant difference in VAS Score between two groups at all the intervals of follow-up. Mean Total dose of tramadol in Group A was 92.65 ± 32.873 mg and in Group B was 92.65 ± 30.482 mg. There was no significant difference in Total dose of tramadol consumption between two groups.

We conclude that sciatic nerve visibility, performers ease score was better in posterior group than in the lateral group. The other parameters like block success rate, quality of blockade, total duration of analgesia, need for rescue analgesia were similar in both the posterior and lateral groups.

There were no complications attributed to PSNB in either of the groups.

LIMITATIONS

1. Fixed dose of drug was used to all patients and not according to the weight of the patient.
2. Preoperative neurological examination of the patients were not done.
3. Late onset neuropathy couldn't be detected because of no long-term follow was done.

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