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Effect of Ultrasound Guided Sciatic Nerve Block on Post Operative Analgesia in Patients undergoing below Knee Orthopedic Surgeries under Spinal Anaesthesia – Prospective Randomized Study

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Abstract

Background and Aims: Ultrasound (US) guided sciatic nerve block has been found to provide adequate post operative analgesia for below knee procedures. The present study was designed to assess the effect of US guided sciatic nerve block on post operative analgesia in knee and below knee surgeries. **Methods**: This was prospective randomized double blind study involving 51 ASA physical status I and II patients undergoing knee and below knee orthopedic surgeries under subarachnoid block, randomly divided into 2 groups. Group A received Sciatic nerve block and group B received intravenous fentanyl 2 mcg/ kg in preoperative room. All patients received subarachnoid block 20 min after intervention. Pain during mobilization to operation theatre, positioning for SAB, and post operative pain and was noted using visual analogue scale First request for post operative analgesia and post operative 24 hour analgesic consumption was also noted. **Results**: The demographic parameters were comparable in both the groups. The duration of analgesia in Group A [mean ± SD - 285.80 ± 18.47 min(95% CI 279 to 293 min)] was prolonged compared to Group B [mean ± SD - 180.20 ± 10.94 min(95% CI 176 to 184 min)] (p<0.001). The 24 hour analgesic consumption of paracetamol and tramadol were lower in Group A [2,360.00 ± 489.90 (95% CI 2170 to 2550) gms] [106.00 ± 30 mg (95% CI 94.2 to 118 mg)] compared to Group B [3,160.00 ± 472.58 (95% CI 2980 to 3350)] gms, [160.00 ± 32.27 mg (95% CI 147 to 173 mg)] (p<0.001). The decrease in VAS scores [median(IQR)] was 5(4-5) and 2(2-3) at the time of positioning in group A and B respectively (p <0.001). None of the patients had any neurological deficits post operatively. **Conclusion**: Preoperative administration of US guided sciatic nerve block resulted in decreased pain scores while positioning for spinal anaesthesia, prolongation of analgesia and reduction in post operative analgesic requirements.

Keywords: Post Operative Analgesia, Ropivacaine, Sciatic Nerve Block

1. Introduction

Peripheral nerve blocks play an important part in reducing the post operative pain for longer durations. Effective and a good quality nerve block with reduced side effects are required for an improved patient care. Current methods of providing pre and post operative analgesia include Non-Steroidal Anti-Inflammatory Drugs (NSAIDS), oral or parenteral opioids, and regional anesthesia techniques. Sciatic nerve block can be a useful technique for post operative analgesia for below knee surgeries[1].

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There are various approaches described for sciatic nerve block. The anterior approach to sciatic block can be useful in patients who cannot be positioned in the lateral position due to pain, trauma, presence of external fixation devices interfering with positioning, and other issues.

Standard volume recommended for sciatic nerve block is 20-25ml of local anesthetic[1]. Studies involving sciatic nerve block under ultrasound guidance have used a volume of 20 ml for anesthesia and analgesia[2,3].

Studies showing effect of lower concentration and lower volume of local anesthetic for sciatic nerve block on post operative analgesia are sparse. Hence this study is designed to find the effect of a lower volume of ropivacaine for single shot Ultra-Sound (US) guided sciatic nerve block on post operative analgesia. Duration of analgesia was the primary outcome measure, reduction in preoperative Visual analogue score during positioning for spinal anaesthesia, 24 hour analgesic requirement, side effect profile were secondary outcome measures.

2. Methods

This was a prospective randomized double blind study conducted at hospitals attached to a tertiary medical college, after obtaining approval from hospital ethical committee. The study was conducted in accordance with Declaration of Helsinki.

Fifty one adult patients aged between 18-60 years of either sex, belonging to American society of Anaesthesiologist (ASA) grade I and II undergoing elective below knee orthopedic surgeries were included in the study. Patients with coagulopathies, neuropathies, uncompensated systemic disorders, history of epilepsy, presence of co existing nerve injuries, and allergy to study drug were excluded from the study.

Pre-anaesthetic evaluation was done and the use of Visual Analogue Scale (VAS) was explained to the patient during recruitment and informed written consent was obtained. Patients were premedicated with Tab Alprazolam 0.5mg and Tab Ranitidine 150mg on the night before surgery. After shifting the patient to operating room, standard monitors like pulse oximetry, non invasive blood pressure, electrocardiogram were applied. Patients were randomly divided into two groups based on random numbers generated by a computer program (www.randomizer.org). Group A – Received Sciatic nerve block with 10 ml of 0.5% Ropivacaine 20 min before shifting to the operation theatre. Group B-Received 1mcg/kg Fentanyl intravenous (IV) 20 min before shifting to the operation theatre. Both the interventions were done in the preoperative room with all precautions to handle inadvertent emergencies. The numbers generated through randomization sequence were placed in a sequentially numbered sealed opaque envelope, to be opened only just before the intervention to ensure allocation concealment. Baseline vital parameters and VAS score was recorded in both groups just before intervention.

In group A, the patients were kept in supine position with the operative limb kept slightly flexed and externally rotated at hip and knee. The sciatic nerve of the limb to be operated was blocked under ultrasound guidance under strict asepsis by an anesthesiologist not involved in further management of patient. An ultrasound machine with curvilinear array probe of low frequency 2-6 MHz (SonositeM-Turbo®, FUJIFILM SonoSite, Inc. Bothel, USA) was used. The anterior and medial aspect of the thigh was painted with antiseptic solution and draped the ultrasound probe was covered with a sterile plastic sheet after placing gel on the surface. The ultrasound probe was placed approximately 8cm from the inguinal crease and sciatic nerve was located on the image screen by sliding and tilting the probe medially and anteroposteriorly till the nerve appears as a hyper echoic shadow posterior and medial to the shaft or lesser trochanter of femur, in the fascial plane between adductor group and gluteus maximus muscle (Figure 1). The area of skin to be pricked was infiltrated with 2-3 ml of 2% lignocaine and then a 15cm 23G needle was inserted by in-plane approach from the medial side of the probe in posterolateral direction in the thigh, till the tip is visualised near the nerve and 1ml of drug solution was injected to confirm the location of the needle and patient was asked for paraesthesia if any. Then the total volume of the solution was injected and spread of the drug solution around the nerve was confirmed by ultrasound. For saphenous nerve block, the femoral artery was traced caudally from the inguinal crease. Once the femoral artery was identified, the probe was moved distally to trace the artery until it passes through the adductor hiatus to become the popliteal artery. The saphenous nerve block was performed at the mid thigh level in the adductor canal. The needle was inserted in plane in a lateral-to-medial orientation and advanced toward the femoral artery. Local anaesthetic solution was placed in the plane between the sartorius and vastusmedialis muscles, and the spread was confirmed. Patients in group B received intravenous fentanyl 1mcg/ kg intravenously 20 min before positioning of spinal anaesthesia. The anaesthesiologist involved in block/drug administration was not involved in further management of the patient.

Spinal anaesthesia was administered 20 min after intervention, in both groups, in sitting posture at L3-L4/ L2-L3 level using 2.5 ml of 0.5% bupivacaine heavy (12.5mg) by an anesthesiologist unaware of group allocation and intervention received. VAS score was recorded at the time of positioning of the patient for spinal anesthesia. If the reduction in pain was less than score of 2, from baseline, the intervention was considered as failure and additional dose of 1 mcg/ kg of fentanyl were administered as rescue analgesic. Highest level of sensory block on the side of fracture was noted 30 min after administration of spinal anaesthesia. Haemodynamic parameters (Heart rate, systolic blood pressure, diastolic blood pressure, mean blood pressure) and peripheral oxygen saturation were noted at baseline, 10^{th} and 20^{th} min after block and then every 5 min after spinal anaesthesia till end of surgery, at 30th min post op and every hour for first 6 hours, and at 9,12 and 24 hours post operatively. Visual analogue scores for pain recorded at baseline and at 20th min after block, at the time of positioning for spinal anaesthesia and at 30th min then hourly for first 6 hours, 9, 12 and 24 hours post operatively. Paracetamol 1 gm was administered intravenously when the VAS score was 3 and above in the post operative period. If pain did not subside within 30 min of administration of paracetamol, tramadol 50 mg was administered intravenously. Duration of post operative analgesia was defined as time from injection of local anaesthetic to demand for first rescue analgesia (VAS >3) post operatively. Paracetamol and tramadol requirement for first 24 hours was noted post operatively. All patients were monitored for perfusion of operated limb by periodic examination of pulse and pulse oximetry. Swelling at injection site, persistent paraesthesias, tingling and numbness if any were also recorded.

Based on pilot study, the mean duration of analgesia with spinal anaesthesia was 145 minutes we hypothesized that addition of sciatic nerve block to spinal anaesthesia would prolong the duration of analgesia. Assuming a standard deviation of 30 min, keeping power at 80% and alpha error at 5%, a minimum of 16 patients would be required in each group to detect a difference of 30 min in duration of analgesia between two groups. We included 25 patients in each group to compensate for dropouts and better validation of results.

Data was entered into Microsoft excel data sheet and tabulated. Categorical and quantitative discrete data is represented in the form of Frequencies and proportions. Continuous data was analyzed for normal distribution using Shapiro-Wilk test and parameters are represented

Figure 1. Consort diagram.

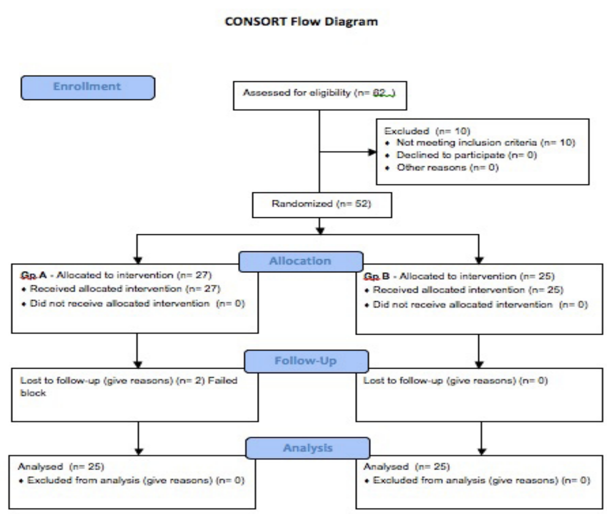

Figure 2. Ultrasound image of sciatic nerve, marked with circle.

as mean (SD) or median (IQR) for normal and skewed distribution respectively. Chi-square test is used as test of significance for qualitative data. Independent t test or Mann-Whitney test is used as test of significance to identify the mean difference between two quantitative variables. MS Excel is used to obtain various types of graphs such as bar diagram and Line 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.

3. Results

A total of 62 patients were screened and 52 included for study based on inclusion and exclusion criteria. Two patients in group A had failed block. (Figure 2) Fifty patients (tewnty five in each group) were included for final analysis. The demographic parameters were comparable in both the groups. The duration of surgery (0.152) and types of surgery were comparable between the two groups. The median (IQR) highest level of sensory block noted in group A was T10-and in group B was T8 (Table 1).

Table 1. Demographic parameters, type and duration of surgery in both groups

Parameter	Group A	Group B
Age in years [Mean(SD)]	39.84±11.98	38.24± 13.22
Gender (M:F)	25: 0	22: 3
Height in cms [Mean (SD)]	1.69± 0.06	1.68± 0.06
Weight in kilograms [Mean (SD)]	71.36± 9.23	69.60± 8.83
Body mass index (KG/ M^2) [Mean (SD)]	25.17± 3.86	24.71± 2.94
Duration of surgery (min) [Mean (SD)]	80.60 ± 17.58	92.60 ± 11.10
Type of surgery		
Interlocking nail for tibia fracture	16	15
Plating for tibial fracture	5	6
Foot and ankle surgery	4	4

Table 2. Preoperative visual analogue scores in both groups

Pre OP VAS	Group A (Mean ± SD)	Group B (Mean ± SD)	P value
Basal	8.00 ± 1.22	8.08 ± 1.15	0.813
20 min	4.32 ± 0.95	6.6 ± 0.95	< 0.001*
Positioning	3.60 ± 0.87	5.68 ± 0.98	< 0.001*

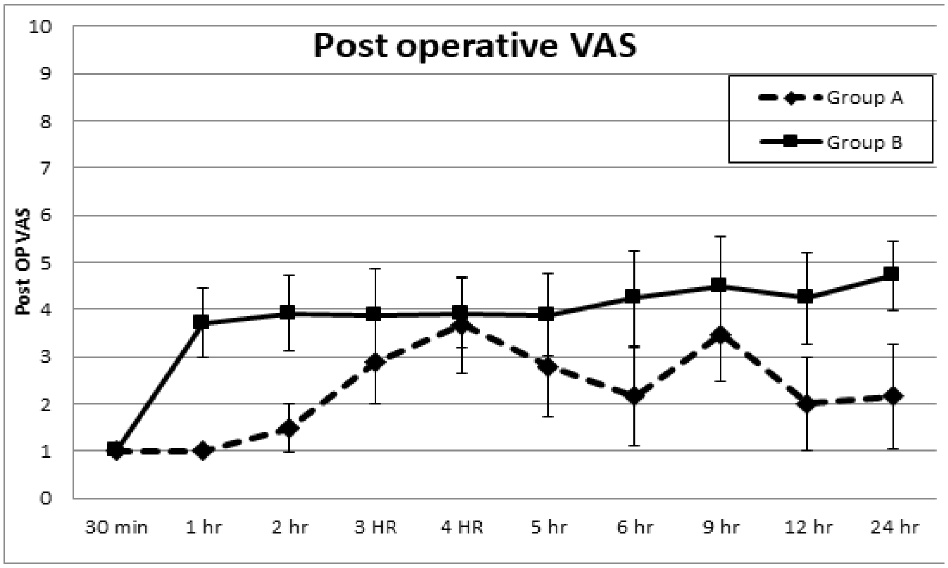

Figure 3. Comparison of postoperative visual analogue score between two groups.

The duration of analgesia in Group A [mean ± SD - 285.80 ± 18.47 min(95% CI 279 to 293 min)] was significantly prolonged compared to Group B [mean ± SD - 180.20 ± 10.94 min(95% CI 176 to 184 min)] (p<0.001).

The mean ± SD 24 hour analgesic consumption of paracetamol was lower in Group A [2,360.00 ± 489.90 (95% CI 2170 to 2550) gms] compared to Group B [3,160.00 ± 472.58 (95% CI 2980 to 3350)] gms (p<0.001). The (mean ± SD) 24 hour consumption of Tramadol was 106.00 ± 30 mg (95% CI 94.2 to 118 mg) in Group A and160.00 ± 32.27 mg (95% CI 147 to 173 mg) in Group B which was clinically and statistically significant.

Baseline VAS scores for pain was comparable between the two groups. The VAS scores were higher in Group B compared to Group A, at the end of 20 min and during positioning for sub arachnoid block, this was clinically and statistically significant. The magnitude of decrease in VAS scores [median(IQR)] was 4(7-9) in group A and 1(1-2) in group B at 20th min and, 5(4-5) and 2(2-3) at the time of positioning in group A and B respectively which was clinically and statistically significant (Table 2).

In the post operative period, the mean VAS scores were lower in Group A compared to group B during the entire 24 hours in the post operative period except at 4th hour. This was clinically and statistically significant (Figure 3).

The baseline heart rate and mean arterial pressure was comparable in both the groups. At the time of positioning there was a decrease in both heart rate and mean arterial pressure from baseline in Group A whereas both increased in group B. The magnitude of change in heart rate [median (IQR)] was -2(-6 to +2) beats per minute in Group A whereas it was 13(+10 to +16) beats per minute in Group B this was clinically and statistically significant (<0.001). The magnitude of change in MAP [median (IQR)] was -4(-11 to -3) mm Hg in Group A whereas it was 9(+6 to +17) mm Hg in Group B this was clinically and statistically significant (<0.001).

Five patients in Group A and 8 Patients in Group B had nausea and vomiting in the post operative period. No other side effects were noted in either group during the observation period.

4. Discussion

The present study demonstrated that pre operative administration of sciatic nerve block was associated with significant reduction in the VAS score during positioning for spinal anesthesia in those receiving sciatic nerve block compared to intravenous fentanyl. Pre operative administration of the block prolonged the time to request for first rescue analgesic, reduced requirement of paracetamol and tramadol during the first post operative day.

Sciatic nerve block is frequently used for anesthesia or analgesia during lower leg, ankle and foot surgery, and several different proximal approaches to the sciatic nerve have been described in the literature. Several approaches have been described that depend on the position of the patient. The sciatic nerve can be approached with the patient supine or in the Sims position.

The anterior approach to sciatic nerve block was first described by Beck (1963)[4] and Chelly (2003)[5] in 1963 who used the greater trochanter as an anatomic landmark. Since then various researchers have reported new techniques with different landmarks, but the success rate is influenced by the variations in the anatomical course of sciatic nerve[6]. However, the advent of ultrasound has renewed interest in sciatic nerve blockade. In contrast to the commonly used posterior approach for sciatic nerve block, the anterior approach has several advantages over the other approaches. The block is performed with patient in supine position which is advantageous in orthopedic trauma patients, patients with external fixators, and also in patients who cannot be positioned in lateral or other positions due to pain. Ultrasound guided approach will reduce the risk of femoral artery puncture compared with landmark approaches. Ultrasound guidance will also facilitate in deposition of the drug nearest to the nerve and the requirement of the drug is also reduced[7].

The volume and concentration of local anaesthetic solution used for block may influence the onset and success rate of anaesthesia, considering the thickness of sciatic nerve, being the thickest nerve of the body. It was observed that low volume, high concentration solution of local anaesthetic resulted in faster onset, higher success rate and greater incidence of complete motor block, compared to high volume and lower concentration of local anaesthetic[8]. It was demonstrated by another author that volume of 5 ml of 0.75% ropivacaine for sciatic nerve block resulted in satisfactory sensory and motor blockade, though the onset was prolonged when compared to 10 ml of same concentration of ropivacaine[9]. In a study assessing the Minimum Effective local anesthetic Volume (MEV) for surgical anesthesia by ultrasound guided sciatic nerve block. Thirty patients posted for elective below knee surgeries were included in the study, dividing them into two groups. They found that the MEV_{50} for 0.75% ropivacaine required for surgical anaesthesia in ultrasound guided sciatic block was found to be 6.14 ml and the ED_{50} was estimated to be 8.9ml[10]. A study conducted in 2009 revealed that there was no difference in anterior and posterior approach for the ease of block and the use of ultrasound guidance in these blocks. The authors found that both approaches were similar for execution time of sciatic nerve block and there were no differences in success rate, onset time or duration of blockade of the peroneal and tibial nerves between the two groups[11]. In the present study, we used 10 ml of 0.5% ropivacaine for sciatic nerve block by anterior approach, and block failure was not observed in any of the patient.

Sciatic nerve block has prolonged duration of analgesia, and was also associated with decrease in post operative analgesic requirement and this was similar to observations of earlier studies[12].

However, there is an argument stating that regional analgesic techniques may delay the recognition of post operative compartment syndrome, especially following closed surgeries like interlocking nailing of tibia. All the patients were periodically monitored for perfusion of operated limb in the post operative period using placement of pulseoximeter on the toes of operated limb and looking for pulsatile waveforms and saturation, also by examination of capillary refill. None of the patients in either group had compromise of perfusion due to compartment syndrome.

This study has few limitations, Firstly, it is a single blinded study where only the observer was blinded, but not the patient due to ethical issues and hence we could not avoid participant bias. We followed up the patient only for the first 24 hours after performing the block and hence the effect of block in long term and chronic pain could not be studied.

Future studies may be done to assess the effect of varying volume and concentration on the duration of post operative analgesia and opioid requirement in the post operative period. Also future studies on the effect this block on Post operative mobilization and hospital stay might add more knowledge to the existing scientific literature.

5. Conclusion

Pre operative administration of USG guided Sciatic nerve block with 10ml of 0.5% Ropivacaine in patients undergoing below knee orthopedic surgeries decreases pain during positioning of the patient for spinal anesthesia. It provides longer duration of post operative analgesia and reduces the Paracetamol and tramadol consumption during the first 24 hours of post operative period.

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