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Evaluation Of Combined Ultrasound – Guided Popliteal Sciatic And Adductor CanalBlock For Below-Knee Surgeries

Dr. M. Bastina Jenoffia, Dr. R. Shankar Anand, Dr. Vinodh Mani, Dr. B. Chandravathi*,

1MD in Anaesthesiology, Assistant Professor, Department of Anaesthesia, Tagore Medical College and Hospital
2DNB in Anaesthesiology, Associate Professor, Department of Anaesthesia, Tagore Medical College and Hospital
3MD in anaesthesiology, Associate Professor, Department of Anaesthesia, Tagore Medical College and Hospital
4DNB in Anaesthesiology, Senior Resident, Department of Anaesthesia, Tagore Medical College and Hospital
Corresponding Author- Dr.B.Chandravathi,
No:6, Aadhi Parasakthi Street, Near Mayas hostel SRM Potheri, Kattankulathur post, Chengalpet district- 603203 Phone number-9790089809 Email ID: chandravathi92@gmail.com

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ABSTRACT:
For below-knee procedures, adductor canal block is a promising alternative to femoral nerve block because it allows for better conservation of the functioning of the muscle strength of the quadriceps, easy visualisation, high success rate and lesser incidence of adverse effects. Hence, we aimed to estimate the time required for onset of sensory and motor block,variations in the hemodynamic parameters, associated adverse events and duration of post-operative analgesia for below – knee surgery under ultrasound guided combined popliteal sciatic and adductor canal block

METHODS: This was a Descriptive study, data collection was done for the period of 18 months. Universe Sampling method done for the selection of study subjects with computerized randomisation for the allocation of interventions. Patient variables are recorded and the data were entered into Microsoft excel and analysed using SPSS 16.

RESULTS: The Haemodynamic parameters such as pulse rate, diastolic blood pressure, and mean arterial pressure were stable throughout,and there was a slight increase of systolic blood pressure at 30 and 40 minutes. The Post-Op Analgesia NRS Scale score from 30 min to 150 min among the subjects were 0, The mean scores increased to nearly 0.5 from 180 min to 240 min. The mean scores increased to nearly 1.5 from270 min to 300 min, to nearly 2 at 330 min and 4 at 4 hours.

CONCLUSION: Ultrasound – Guided Popliteal Sciatic and Adductor Canal Block can be safe andeffective with good success rate, onset of motor and sensory blockade, haemodynamic stability, Post-Operative Analgesia, and patient satisfaction, can be recommended widely for below knee surgeries.

KEY WORDS: Sciatic nerve block, prolonged analgesia, adductor block, recovery criteria.

INTRODUCTION:

Spinal anaesthesia is considered as an established technique for lower limb surgeries. The first surgery performed under spinal anaesthesia was in 1898 in Germany by August Bier. [(1)] The use of a central neuraxial block or general anaesthesia has its own set of complications in terms of hemodynamics and perioperative morbidity.

Peripheral nerve blocks are a type of regional anaesthesia, wherein the local anaesthetic is injected near a specific nerve or bundle. [2,3] Compared with local anaesthesia with infiltration, regional anaesthesia with the nerve block has fewer injections necessary to achieve adequate anaesthesia, longer duration, smaller volume of anaesthetic required, and less disturbance of the wound site. [4,5]

Nerve blocks can be given as single injection block or as a continuous infusion. Upper limb surgeries require one or more blocks, whereas lower limb surgeries mandate two or more blocks. [6]

With a thorough understanding of the lower limb's dermatomes, myotomes, and osteotomes, as well as the appropriate usage of ultrasonography for peri-neural deposition of local anaesthetics, we can establish a success rate with prolonged duration of analgesia, besides overcoming the adverse effects of spinal anaesthesia.

Also, among the high-risk patients, both general and spinal anaesthesia will be dangerous and difficult. The need for the anaesthesia with the nerve blocks arise for that point. Below knee surgeries comprise of a huge number in modern day surgical practice. Using the Ultrasound, the visualization of infiltration of the localanaesthetic is made easy. [7]

For below-knee procedures, adductor canal block is a promising alternative to femoral nerve block because it allows for better conservation of the functioning ofthe muscle strength of the quadriceps, easy visualisation, high success rate and lesser incidence of adverse effects, etc. [8]

On the contrary, While the nerve blocks are relatively safer and effective, it can produce serious side effects like nerve injury and multi-organ dysfunction (usually due to intraneural injection of local anaesthesia). [2,3]

Combined popliteal sciatic and adductor canal block can be effectively used without complications and with good patient satisfaction and less pain scores. [(9-11)]Therefore, this study aims to estimate the time required for onset of sensory and motor block, variations in the hemodynamic parameters, associated adverse events, and duration of post-operative analgesia for ultrasound guided combinedpopliteal sciatic and adductor canal block in the patients undergoing below – kneesurgeries.

To assess the efficacy of below – knee surgery under ultrasound guided combinedpopliteal sciatic and adductor canal block in terms of post-operative pain, time required for onset of sensory and motor block and duration of post-operative analgesia.

To assess the efficacy of below – knee surgery under ultrasound guided combinedpopliteal sciatic and adductor canal block in terms of hemodynamic parameters and adverse events.

MATERIALS AND METHODS:

One hundred and fifty patients undergoing elective upper limb surgeries under brachial plexus block under in a tertiary care hospital**.** This was a Descriptive study, data collection was done for the period of 18 months. Universe Sampling method done for the selection of study subjects with computerized randomisation for the allocation of interventions. Approval from the Ethics Committee: dated 4/10/2019. No-VMMC/ANESTH/2019/ was obtained. This study was registered in clinical trials registry India (CTRI/2019/11/0220311) in Nov 2019. Informed consent was obtained from the patients fulfilling the inclusion criteria. We included patients with age between 18-60 years of both the sexes and belonging to ASA physical status I and II posted for elective below knee surgeries of all the specialities done under regional anaesthesia. Exclusion criteria were the patient refusal for regional anaesthesia, pregnant and lactating mothers, emergency surgeries , head injuries and also the patients with known allergy to anaesthetic drugs. (Fig 1)

SAMPLE SIZE CALCULATION:

According to **B K Arjun et al** study, [12] considering the standard deviation ofDuration of postoperative analgesia in hours as 0.8 with a precision of 0.111 and 95% confidence interval, the sample size is calculated as,

$$N = Z^2_{1-\alpha/2} * \sigma^2 / d^2$$

Z1-α/2 - two tailed probability for 95% confidence interval = 1.46

σ - standard deviation of Duration of postoperative analgesia in hours = 0.8

d - precision or allowable error for Duration of postoperative analgesia in hours

= 0.111

N = 1.46^2 * 0.8^2 / 0.00111^2

N = 149.54

Thus, the total sample size required for the study is 150

METHODOLOGY:

In the operation theatre, standard monitors like electrocardiograph, non-invasive blood pressure and pulse oximeter were attached. All sterile aseptic precautions were taken, and the ultrasound machine was placed on the opposite side of the limb that had to be blocked. For adductor canal block, the patient will lie supine with leg in extended position and slightly rotated outwards.

A high-frequency linear ultrasound probe was rested on the patient's anterior aspect of the thigh at the mid-thigh level. The femur bone was identified, and probe was directed medially until the boat-shaped sartorius muscle and femoral vesselssituated underneath it was visualised. A 21-gauge insulated needle was inserted via in-plane technique, 10 ml of 0.25% Bupivacaine was injected on either side ofthe femoral artery after checked for negative aspiration. Then for popliteal sciatic nerve block, the patient was laid laterally on the opposite side of the limb which must be blocked.

The limb which is to be blocked was partially flexed at hip and knee joint. Using ahigh-frequency linear probe, the popliteal fossa was scanned to detect the tibial and common peroneal nerves separately which were lying superficially and posteriorly to popliteal artery. Movement of the probe proximally brings tibial and common peroneal nerves together to form the sciatic nerve at a variable point, above the popliteal crease.

At that level, using plane technique and 21 gauge insulated needle, 20 ml of 0.25% bupivacaine was emptied after negative aspiration and real-time spread of local anaesthetic was observed in sub-para neural space around the sciatic nerve. All the patients received 0.03 mg/kg of intra-venous midazolam and oxygen was supplied by face mask throughout the procedure.

Surgery was started after adequate sensory and motor blockade was achieved. Inpatients with failure to achieve adequate surgical anaesthesia after 20 minutes ofadministration of block, it was considered as a block failure and converted to general anaesthesia. Tourniquet was not used in any of the cases. Assessment of the parameters was done intra-operatively and post operatively. (Table 1 & 2).

The three-point Likert's scale was used to determine patient satisfaction. After transferring the patient to the post-anaesthesia care unit, pain was assessed every 30 minutes using the numeric rating scale (NRS, 0–10 scale, with 0 representing no pain and 10 representing the worst pain); if the NRS score was greater than 3, an intravenous injection of Tramadol 1 mg/kg was given as a rescue analgesic. (Table 3)

Numerical variables like Age, Duration of postoperative analgesia, onset timefor motor and sensory block, Haemodynamic Parameters such as Heart rate, Systolic, diastolic blood pressures etc., are represented in mean, median, mode and standard deviation.
Categorical variables like gender, adverse events, ASA status, etc., are represented in frequencies and percentages. Pie-charts and bar diagrams are used as appropriate. Data was entered in MS excel sheet and analysed using SPSS software version 16.

RESULTS:

The mean heart rate, systolic blood pressure, diastolic blood pressure, and mean arterial pressure were similar in the baseline between the groups.

The mean Age (years) among the subjects was 51.04 (± 12.12) years ranging from 21 to 70 years. Among the study population with Age group distribution, 41 (27.33%) were in

51 - 60 years Age group followed by 37 (24.67%)were in 41 - 50 years Age group and least 9 (6%) were in 21 - 30 years Age group. Among the subjects, 114 (76%) were Males and 36 (24%) were Females. (Fig 2)

The mean Onset of motor blockade (min) among the subjectswas 14.91 (± 1.95) min ranging from 12 to 18 min. The mean Onset of sensory blockade (min) among the subjects was 11.38 (± 1.76) min ranging from 9 to 14 min.

The Haemodynamic parameters such as pulse rate, diastolic blood pressure, and mean arterial pressure were stable throughout,and there was a slight increase of systolic blood pressure at 30 and 40 min.

The Post-Op Analgesia NRS Scale score from 30 min to 150 min among the subjects were 0, The mean scores increased to nearly 0.5 from 180 min to 240 min. The mean scores increased to nearly 1.5 from270 min to 300 min, to nearly 2 at 330 min and 4 at 4 hours.

The mean Time for postop analgesia after surgery (hrs) among the subjects was 5.85 (± 0.36) hours ranging from 4.5 to 6 hours. Among the subjects, 105 (70%) had 1 score and 40 (26.67%) had 2 score.

(Fig 4 and 5)

Among the subjects, 5 (3.33%) had Block Failure and 145 (96.6%)had a successful block.

Comparing the Age group with Block Failure distribution, 41 - 50 years had higher proportion of Block Failure with 8.1% followed by 61 - 70 years with 2.7% and least in 21 - 30 years with 0%. The difference in Block Failure between different Age group was not statistically significant ($p > 0.05$). The mean Weight(kg) among block failed was 65.2 (± 7.09) which is higher by 0.21 but not statistically significant compared to 64.99 (± 8.52) in block success.

DISCUSSION:

The main objective of the study is to know the effectiveness of intra operative pain and sedation scores, hemodynamic changes, respiratory effects surgeon satisfaction and postoperative analgesics need among the patients. This was a descriptive study, among 150 patients undergoing below knee surgery with Ultrasound – Guided Adductor Canal

Femoral nerve and Popliteal Sciatic Block was administered with 10 ml and 20 ml of 0.25% bupivacaine respectively after negative aspiration and real-time spread of local anaesthetic.

SR Sankineani et al (13), in their study, studying adductor canal block and IPACK block (interspace between the popliteal-artery and the capsule of the posterior- knee) observed a mean age of their population as 61 and 63. In this study, The mean Age (years) among the subjects was 51.04 (± 12.12) years ranging from 21 to 70 years. Among the study population with Age group distribution, 41 (27.33%) were in 51 - 60 years Age group followed by 37 (24.67%) were in 41 - 50 years Age group and least 9 (6%) were in 21 - 30 years Age group.

Rebound pain was observed in female gender higher in peripheral nerve block in GS Barry et al. (14) In this study, Among the study subjects, 114 (76%) were Males and 36 (24%) were Females. While studying the peripheral nerve blocks, many authors did control in their study results for gender. Also, we noted that they did not observe any significant difference in gender on the outcomes of the peripheral nerve blocks.

In this study, the mean Onset of motor blockade (min) among the subjects was 14.91 (± 1.95) min ranging from 12 to 18 min. The mean Onset of sensory blockade (min) among the subjects was 11.38 (± 1.76) min ranging from 9 to 14 min.

Sree Kolli et al, concluded that the adductor canal block a feasible replacement to femoral nerve block. Adductor canal saphenous nerve block has been proved effective in terms of lesser opioid consumption, efficient pain control, less side effects and earlier ambulation without the risk of quadriceps muscle weakness. (15)

In this study, The Haemodynamic parameters such as pulse rate, diastolic blood pressure, and mean arterial pressure were stable throughout, and there was a slight increase of systolic blood pressure at 30 and 40 min.

In this study, The Post-Op Analgesia NRS Scale score from 30 min to 150 min among the subjects were 0, The mean scores increased to nearly 0.5 from 180 min to 240 min. The mean scores increased to nearly 1.5 from 270 min to 300 min, to nearly 2 at 330 min and 4 at 4 hours.

B K Arjun et al, observed that Ultrasound-guided popliteal sciatic block and adductor canal block provided good haemodynamic stability, good overall patient satisfaction without any

additional analgesic requirement, with a mean & SD of duration for sensory and motor block onset time were 3.35 ± 0.49 and 4.65 ± 0.48 minutes respectively. The mean and standard deviation of duration of postoperative analgesia was 7.5 and 0.8 hours respectively. (12)

In this study, the mean Time for postop analgesia after surgery (hrs) among the subjects was 5.85 (± 0.36) hours ranging from 4.5 to 6 hours. **Jin-Hyeok Seo et al**, compared the adductor canal block (ACB) only and a blend of ACB and sciaticnerve block (SNB) in total knee arthroplasty. They observed that the ACB and SNB group had a significantly lesser NRS score, a smaller number of presses of patient-controlled analgesia button. 35% in ACB and SNB group had foot drop, that returned to normal on the post-operative day 1. [(16)]

Dalia Eissa et al [(17),] compared the total intraoperative and postoperative morphine consumptions between the patients undergone general anaesthesia without the Ultrasound-guided popliteal sciatic block and sub sartorial canal saphenous nerveblock and general anaesthesia with the block. The group received the general anaesthesia with the block had significantly reduced pain scores, Incidence of adverse effects, less morphine consumption, better postoperative analgesia during rest and movement, less opioid related side effects, higher Patient satisfaction, early recovery and early hospital discharge.

In this study, Among the subjects, 105 (70%) had 1 score and 40 (26.67%) had 2score. **Han Bum Joe et al**, compared the effectiveness of Adductor canal block versus femoral nerve block combined with sciatic nerve block and did not observe any difference in the time profiles, complications and patient satisfaction. The painscores were not inferior among the Adductor canal block group and they had significantly higher average dynamometer readings. [(1)]

Various studies have been done on the Success rate of the Ultrasound – GuidedAdductor Canal Femoral nerve and Popliteal Sciatic Block, with the infiltration of the local anaesthetic around the nerve effectively. Majority of the studies observeda success rate of around 85% to 95%. In this study, Among the subjects, 5 (3.33%) had Block Failure and 145 (96.6%) had a successful block.

In this study, the block failure rate was not significantly different with age, genderand weight of the individuals. In our study, we did not study the complication rates both short term and long-termcomplications.

Young U k Park et al, did a compared the Multiple-Site PeripheralNerve Blocks (sciatic nerve blocks, femoral nerve blocks, adductor canal blocks),and Popliteal Sciatic Nerve Block Alone Foot and Ankle Surgery. They concludedthat 92 (11.1%) of them developed neurologic symptoms after the surgery; 22 (2.7%) of them are likely to be resulted from the nerve blocks, and 7 (0.8%) of these were not resolved after follow-up visits. They did not observe any differencesin complication rates (both transient and long term) between combined blocks andsingle sciatic nerve blocks. [(18)]

Among the study population, 145 (96.6%) had a successful Ultrasound – Guided Popliteal Sciatic and Adductor Canal Block, which was not associated with the age, gender and weight of the individuals. Ultrasound – Guided Popliteal Sciatic and Adductor Canal Block provided a mean motor blockade at 14.91 min and sensory blockade at 11.38 min. Stability of haemodynamic parameters were betterthroughout. The Post-Op Analgesia NRS Scale score from 30 min to 150 min among the subjects was 0. The mean time for postop analgesia after surgery (hrs) among the subjects was 5.85 (± 0.36) hours. The majority of the subjects were satisfied.

FIGURES

Figure 1: Modified CONSORT flow diagram

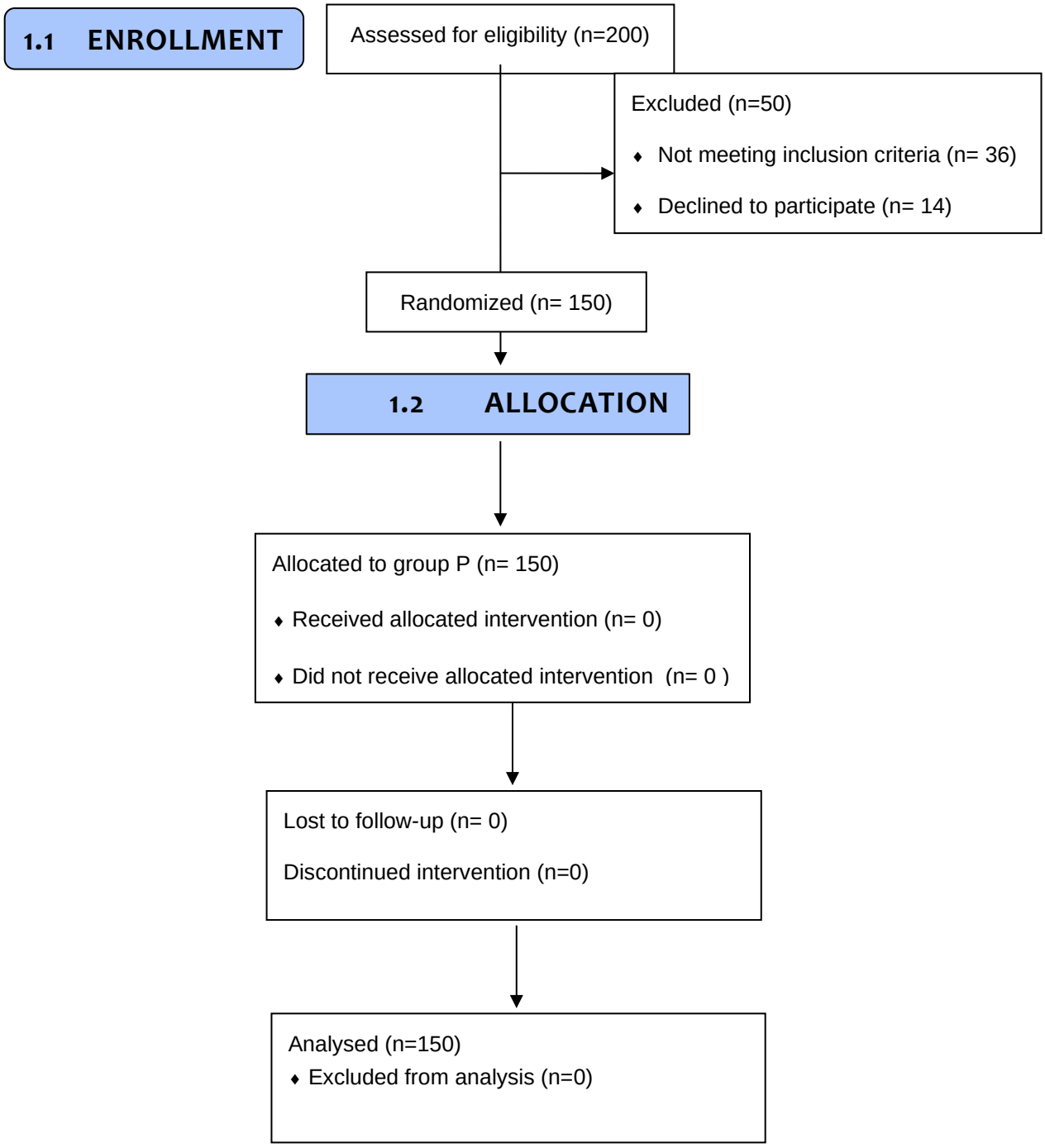


Table 1: Onset Of Motor Blockade (Minutes)

	N	**Mean**	**Std. Deviation**	**Minimum**	**Maximum**
Onset of motor blockade (minutes)	146	14.91	1.95	12.0	18.0

Table 2. Onset Of Sensory Blockade (Minutes)

	N	**Mean**	**Std. Deviation**	**Minimum**	**Maximum**
Onset of sensory blockade (minutes)	146	11.38	1.76	9.0	14.0

Figure 2- Age group distribution

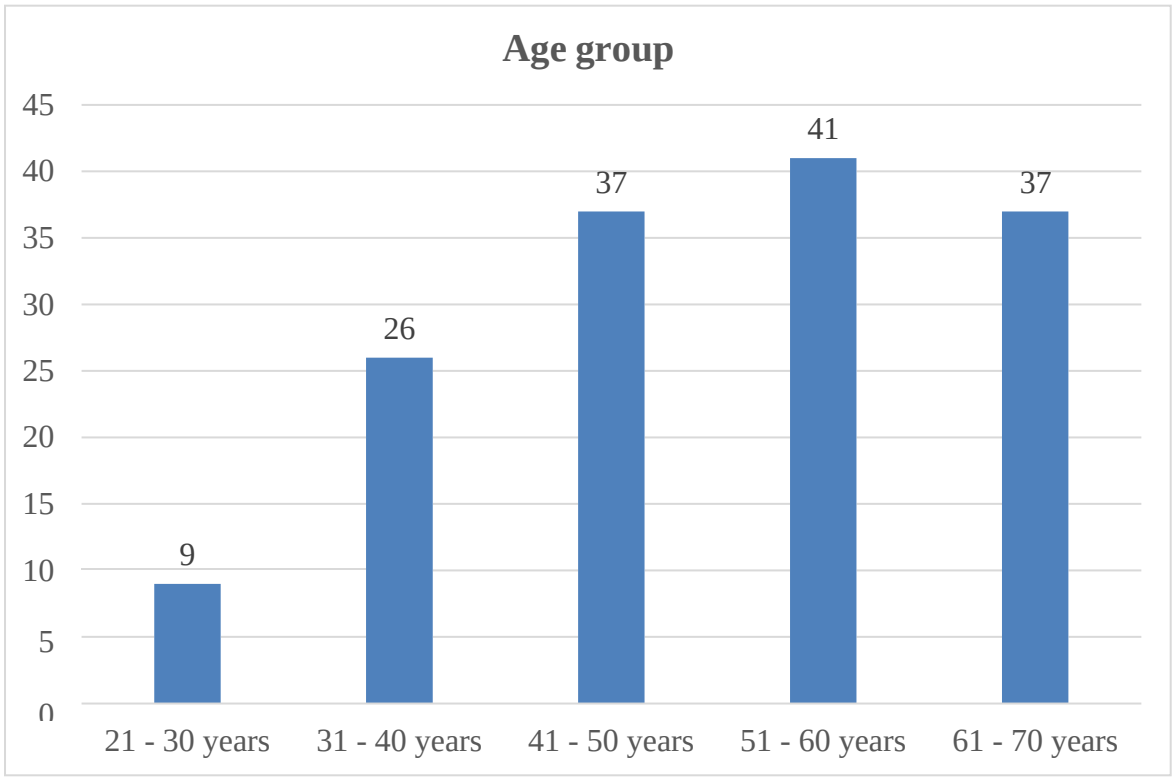


Table 3: Mean Arterial Blood Pressure

	N	**Mean**	**Std. Deviation**	**Minimum**	**Maximum**
MAP at Baseline	146	90.04	6.16	76.7	102.7
MAP at 5 min	146	90.26	6.23	78.7	103.3
MAP at 10 min	146	91.53	6.44	78.7	103.3
MAP at 20 min	146	91.06	6.32	77.3	103.3
MAP at 30 min	146	92.36	6.47	78.7	106.0
MAP at 40 min	117	92.95	6.76	78.7	106.0
MAP at 50 min	68	89.49	6.86	77.3	103.3
MAP at 60 min	64	92.38	5.94	80.0	103.3
MAP at 70 min	53	90.57	6.42	78.0	103.3
MAP at 80 min	45	89.91	5.87	79.3	104.7
MAP at 90 min	37	92.92	6.26	80.7	102.0
MAP at 100 min	7	85.71	4.35	80.0	90.7

Figure 3: Post-op analgesia Numeric Rating Scale (NRS)

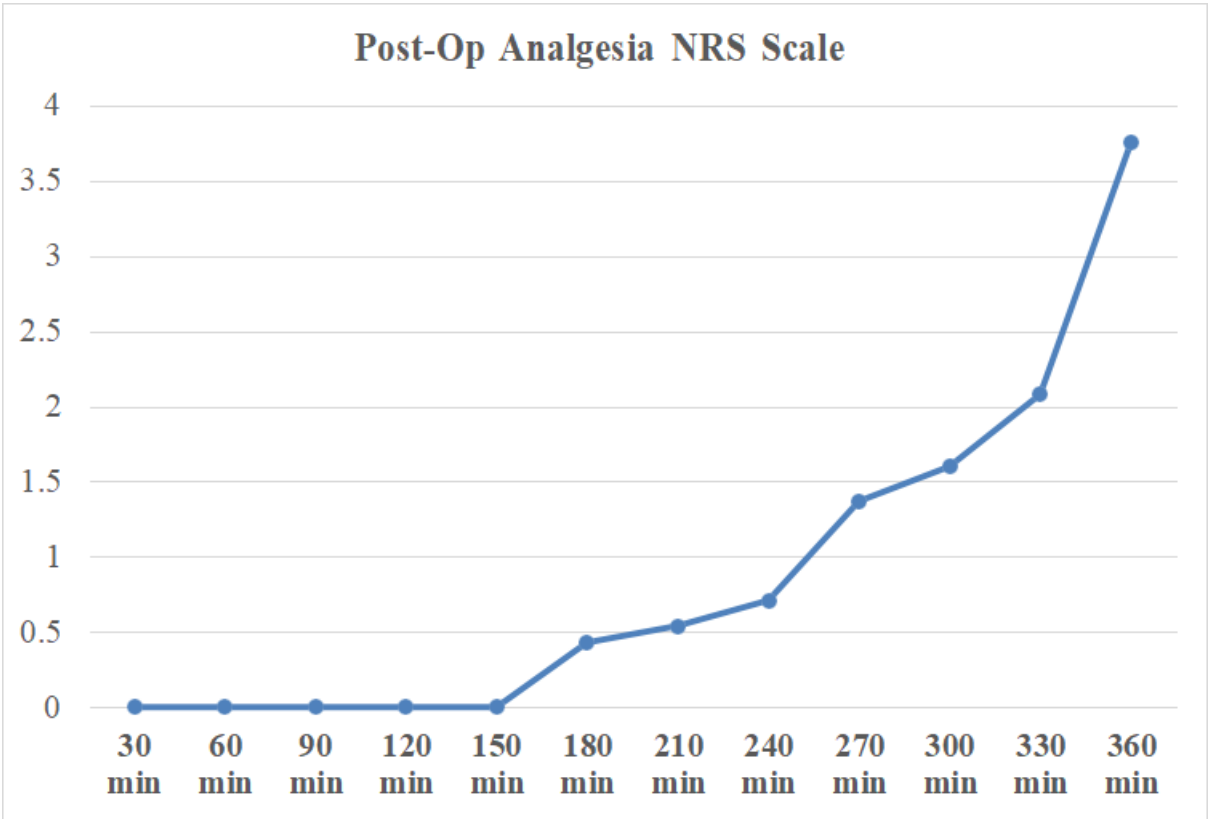


Figure 4: Satisfaction scale(12 hrs post-operatively)

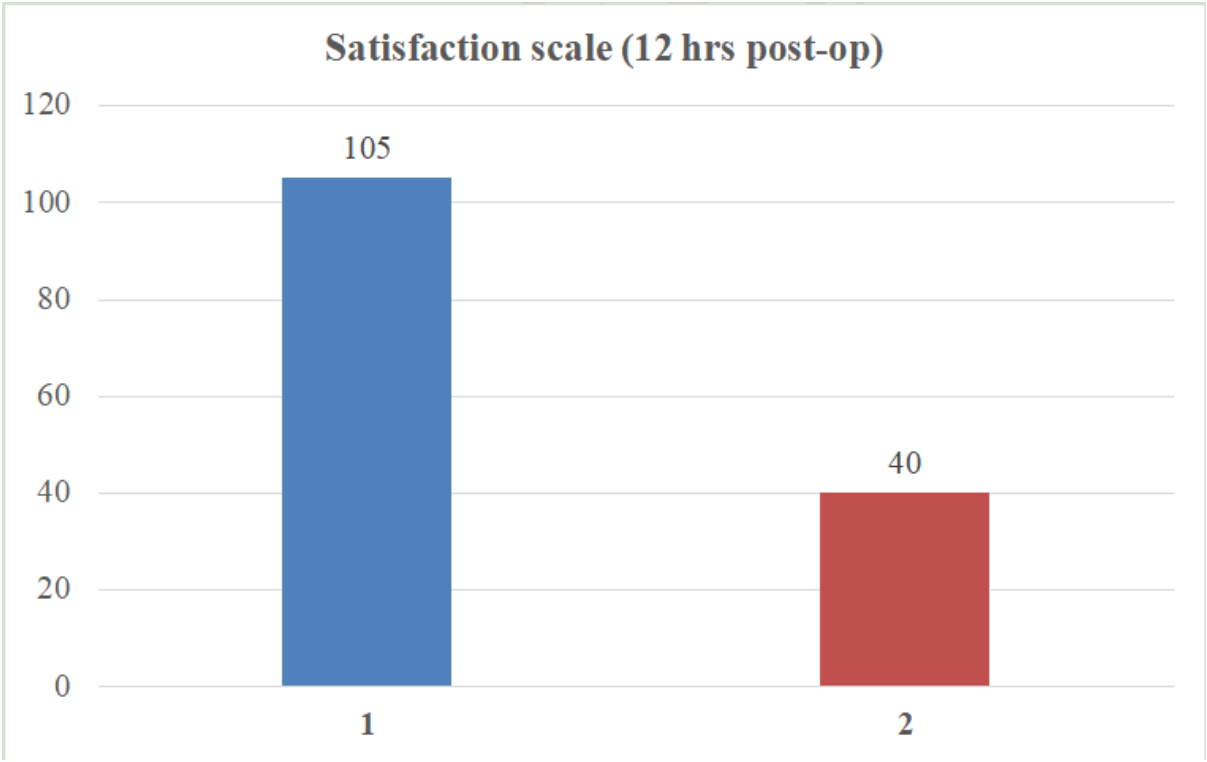
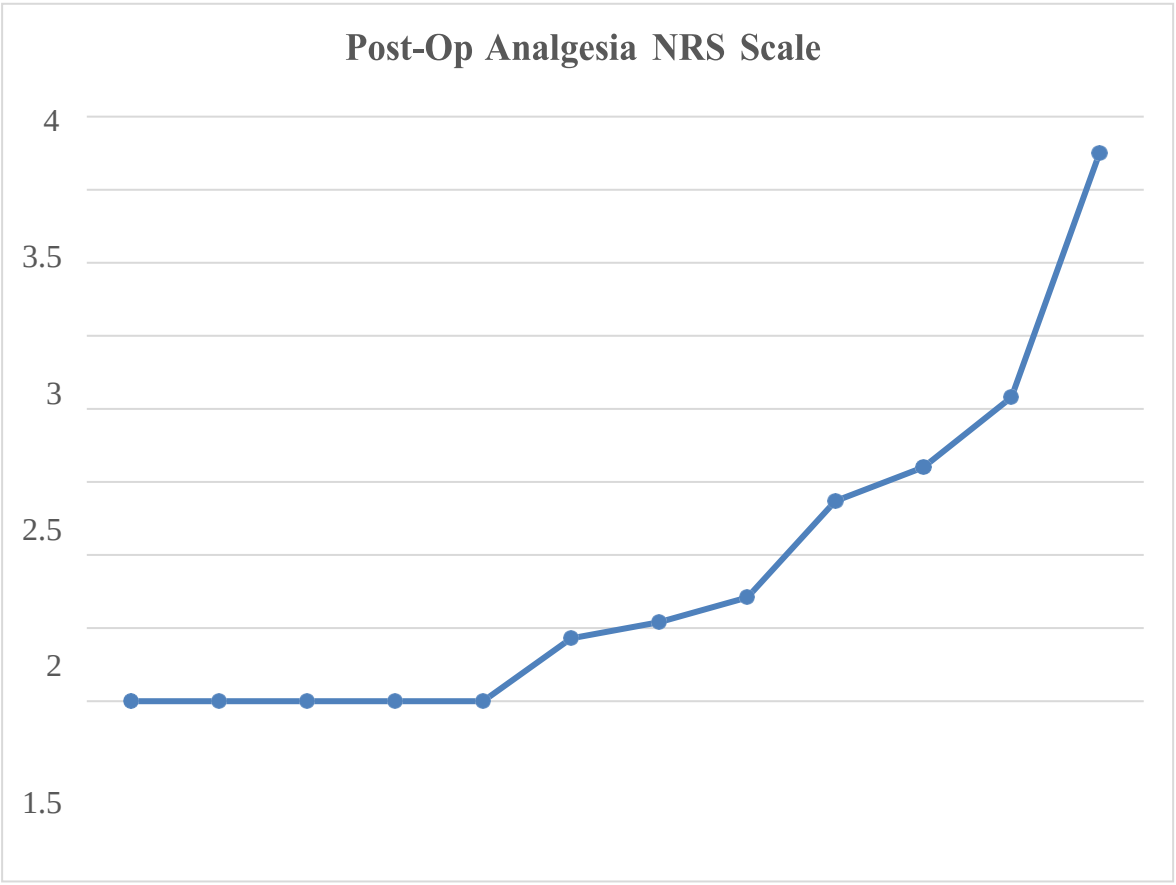


Figure 5: Time for postop analgesia after surgery



CONCLUSION:

Sole Ultrasound Popliteal Sciatic and Adductor Canal Block can be safe andeffective with a good success rate, the onset of motor and sensory blockade, haemodynamic stability, Post-Operative Analgesia, and patient satisfaction, and can be recommended widely for below-knee surgeries.

FUTURE SCOPE:

In this study, the block failure rate was not significantly different with age, gender and weight of the individuals. Further studies should focus on the factors associated, to increase the success rate.

Further studies with a comparison group (spinal) matched for confounding factors can give us information on the real effectiveness of the Ultrasound-Guided Popliteal Sciatic and Adductor Canal Block. The study was conducted with a comparatively better sample size, yieldinga good generalisability of the study outcomes.

CONFLICTS OF INTEREST

No potential conflict of interest relevant to this article was reported.

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