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Comparison of Ultrasound Guided Femoropopliteal Block versus Spinal Anaesthesia for Ankle Surgery

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ABSTRACT

Objective: To compare the sensory, motor, block duration and added analgesia requirements between ultrasound guided Femoropopliteal block and Spinal Anaesthesia in patients with malleolar fractures of the ankle.
Study Design: Randomized controlled trial (IRCT: 74290).
Place and Duration of Study: Department of Anaesthesiology, Combined Military Hospital, Rawalpindi Pakistan, from Aug 2023 to Feb 2024.
Methodology: One hundred ninety patients were analyzed randomized into the Spinal Anesthesia Group (Group S) (n=95) and the Femoropopliteal Block Group (Group F) (n=95). Primary variables measured were mean time to first rescue analgesia, patient satisfaction for pain relief 24 hours after surgery and 24- hour total dose of analgesia needed. Secondary variables observed were nausea/vomiting, hypotension, and headache 24-hours post-operatively.
Results: In the primary variables studied, mean time to require rescue analgesia as first dose was 3.780.54 hours in Group S versus 7.140.60 hours in Group F (*p*<0.001). Mean total dose of analgesia required in 24 hours post-operatively was 12.561.06 mg in Group S versus 6.290.63 mg in Group F (*p*<0.001).
Conclusion: Spinal Anesthesia provides early sensory and motor onset but Femoropopliteal block is superior when comparing block duration and total dose of analgesia needed in 24 hours post-operatively.

Keywords: Anaesthesia, Ankle, Block, Femoropopliteal, Spinal, Surgery.

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INTRODUCTION

Per-operative and post-operative surgical pain relief remains the prime responsibility of the anesthetist. Orthopedic surgeries are especially important in this regard since lower limb fractures are associated with considerable pain and if not treated effectively are associated with prolonged hospital stay, delayed mobilization and poor patient satisfaction.[1] Surgeries involving the ankle especially those involving the malleoli cause considerable pain.[2] The lateral malleolar fracture is the most common ankle fracture and requires surgical intervention in majority of the patients.[3]

The various anesthesia techniques used for surgical repair include spinal, epidural, and regional nerve block techniques. Spinal Anesthesia remains the modality of choice in majority of the setups especially in the developed countries where reginal block expertise or ultrasound machines are not readily available due to resource constraints or overburdened in the radiological departments.[4] With the advent of regional nerve techniques in our demographic setup and their increasing application in the operating room, majority surgeries involving the lower limbs can now be done under selective regional nerve blocks. Ultrasound guidance used for regional nerve blocks has resulted in excellent results with less chances of failure. The adoption of regional techniques has seen a considerable increase in our demographic area and medical setups but tangible literature comparing different regional techniques in our local setups remains scarce. Studies are needed to compare the efficacy of different regional blocks versus neuraxial anesthesia, and we aim to provide results and conclude whether both modalities offer any advantages or disadvantages over each other. We will compare the sensory, motor, block duration and added analgesia requirements between ultrasound guided Femoropopliteal block and Spinal Anesthesia in patients with malleolar fractures of the ankle.

METHODOLOGY

The randomized controlled trial was undertaken at the Anaesthesiology Department, Combined Military Hospital from August 2023 to February 2024 after approval from the ethical review board (letter no. 513) with trial ID 74290 registered at IRCT. A pilot

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study was carried out before the start of the trial with 15 participants in each Group, one to receive Spinal Anesthesia and the other to be administered Femoropopliteal block under USG guidance for malleolar fractures of the ankle. Mean duration of analgesia between both Groups was 4.121.02 hours for the spinal and 7.361.98 hours for the Femoropopliteal Block Group. Minimum sample size was then calculated using the mean values of both Groups, keeping the confidence interval at 95%, power of test at 80% with the population variance at 100. Sample size calculated for spinal and Femoropopliteal Group using WHO calculator was 93 and 29 respectively. We assessed 250 patients for eligibility and included 95 patients in each Group making the total trial size 190 patients. The method of randomization was non-probability consecutive sampling by lottery method.

Inclusion Criteria: All patients ASA-I and II male and female patients between ages 25-55 years presenting for surgical fixation of malleolar fracture of the ankle were inlcuded.

Exclusion Criteria: Patients with advanced cardiac compromise or repsiratory ailment, patients with failed spinal or Femoropopliteal block after three unsuccessful attempts, patients allergic to local anesthetics including bupivacaine, lignocaine and steroids including dexamethasone, patients with malignancy or metastatic disease, pregnant females were excluded.

The trial randomized all patients according to CONSORT guidelines and inclusion criteria established. The patients were divided into the spinal Group (Group S) (n=95) and the Femoropopliteal bock Group (Group F) (n=95). Once the patients were divided into the two Groups, consent was taken according to guidelines. Monitoring was attached and recorded during the procedure (Figure).

Spinal Anesthesia was administered in Group S using a standard 27 G Braun spinal needle in the L3-L4 spinal space under strict aseptic measures by a consultant anesthetist and 0.5% hyperbaric bupivacaine using a volume of 2.5ml was administered. Onset and quality of sensory and motor block was checked and re-assessed every 2 minutes using the modified Bromage scale for motor and cold spray method for check for sensory block integrity until an effective sensory level was achieved for spinal dermatomal level T12 and below and motor block effectiveness with a Bromage score of 1.[5,6]

Patients in the Femoropopliteal block Group were administered the block in prone position for the popliteal block blocking the tibial and common peroneal nerves in the popliteal space using 15ml of 0.5% bupivacaine with 2mg dexamethasone. Patients were then turned supine and 5ml of 0.5% bupivacaine with 0.5mg dexamethasone was administered in the femoral sheath for the femoral block. Both the blocks were performed under strict aseptic measures by a consultant pain specialist following standard guidelines furnished by NYSORA.[7] Onset of the block was checked and re-assessed every two minutes until sensory and motor blocks were achieved as in the spinal Group.

Adverse effect including hypotension (MAP <60 mmHg) and bradycardia (Heart Rate <60 bpm) were treated with IV Phenylephrine 100 mcg and IV Atropine 0.5 mg respectively during the procedure and per-operatively. Post-operatively, patients were kept in the HDU monitoring beds and observed for post-operative pain every hour for the next 24 hours. 0.5 mg/kg of Nalbuphine was once pain on the visual analog scale (VAS) reached 5 and total dose in 24 hours was calculated.[8] Patient satisfaction was evaluated and recorded at 24 hours after surgery on a 7-point Likert scale.[9]

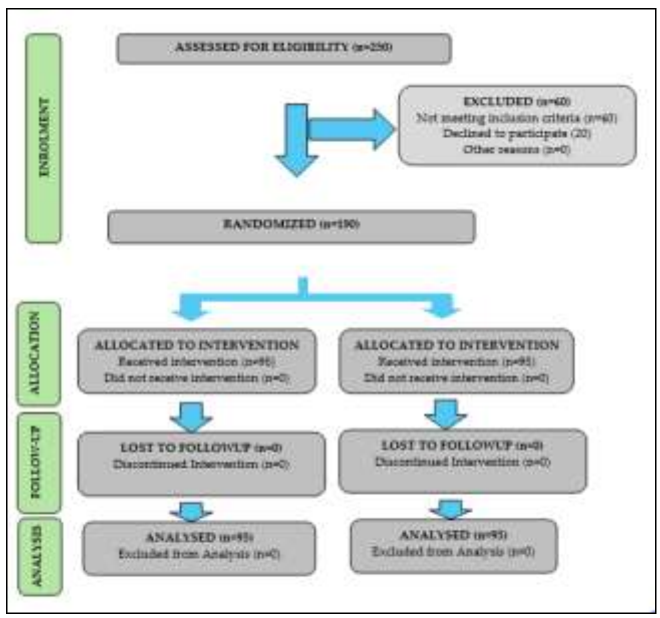

Figure: Phases of the Randomized Controlled Trial

All statistical calculations were performed using Statistical Package for Social Sciences 26.0. Primary variables measured were mean time to first rescue analgesia, patient satisfaction for pain relief 24 hours after surgery and 24- hour total dose of analgesia needed. Secondary variables observed were nausea/

vomiting, hypotension, and headache 24-hours post-operatively. Demographic data were statistically described in terms of mean and SD, frequencies, and percentages where appropriate. Independent t-test was used to compare statistically significant means between both Groups. Median satisfaction scores were compared using the Mann Whitney-U test. The *p*-value of ≤0.05 was considered statistically significant.

RESULTS

A total of 190 patients were included in the trial randomized into the Spinal Anesthesia Group (Group S) (n=95) and the Femoropopliteal block Group (Group F) (n=95). Mean age of patients in Group S was 35.048.16 years versus 35.078.27 years Group F (*p*=0.979). Mean weight of patients in Group S was 73.446.74 kg versus 74.326.40 kg in Group F (*p*=0.355). Gender distribution revealed 77(81.1%) males and 18(18.9%) females in Group S versus 74(77.9%) males and 21(22.1%) females in Group F (Table-I).

Table-I: Demographic Characteristics of Study Groups (n=190)

Variables	Spinal Anesthesia Group (Group S) (n=95)	Femoropopliteal Block Group (Group F) (n=95)	*p*-value
Mean age (years)	35.04±8.16	35.07±8.27	0.979
Mean weight (kg)	73.44±6.74	74.32±6.40	0.355
Gender			
Male	77(81.1%)	74(77.9%)	-
Female	18(18.9%)	21(22.1%)	-

Mean duration of surgery between both Groups was 50.89±4.29 minutes in Group S versus 51.14±4.27 minutes in Group F (*p*=0.685). In the primary variables studied, mean time to require first dose of rescue analgesia was 3.78±0.54 hours in Group S versus 7.14±0.60 hours in Group F (*p*<0.001). Mean total dose of analgesia required in 24 hours post-operatively was 12.56±1.06 mg in Group S versus 6.29±0.63 mg in Group F (*p*<0.001). Mean duration of HDU stay post-operatively was 5.83±0.67 hours in Group S versus 3.43±0.49 hours in Group F (*p*<0.001). When patient satisfaction was assessed subjectively on the Likert scale, median satisfaction score was 5.00 (IQR=1.00) in Group S versus 6.00 (IQR=0.00) in Group F (*p*<0.001) (Table-II).

When comparing the adverse effect profile between both Groups, nausea and/or vomiting was seen in 12(12.6%) patients in Group S versus 03(3.2%) patients in Group F. Hypotension was seen in 30(31.6%) patients in Group S versus 05(5.3%) patients in Group F. Headache was reported in 07(7.4%) patients in Group S and no headache was reported in Group F (Table-III).

Table-II: Comparison Per and Post-Operative Parameters (n=190)

Variables	Spinal Anesthesia Group (Group S) (n=95)	Femoropopliteal Block Group (Group F) (n=95)	*p*-value
Duration of surgery (minutes)	50.89±4.29	51.14±4.27	0.685
Mean time to sensory block onset (minutes)	3.30±0.46	13.46±3.50	<0.001
Mean time to onset of motor block (minutes)	4.69±0.46	14.86±0.79	<0.001
Mean time to first dose rescue analgesia (hours)	3.78±0.54	7.14±0.60	<0.001
Mean total dose of analgesia administered (mg/24 hr)	12.56±1.06	6.29±0.63	<0.001
Mean hdu stay (hours)	5.83±0.67	3.43±0.49	<0.001
Median 24 hr likert satisfaction score	5.00 (IQR=1.00)	6.00 (IQR=0.00)	<0.001

Table-III: Incidence of Side Effects between both Groups (n=190)

Variables	Spinal Anesthesia Group (Group S) (n=95)	Femoropopliteal Block Group (Group F) (n=95)
Nausea/Vomitting	12(12.6%)	03(3.2%)
Hypotension	30(31.6%)	05(5.3%)
Headache	07(7.4%)	00(0%)

DISCUSSION

We aimed to carry out our study to compare both modalities and assess whether the new regional techniques offered better advantages over neuraxial anesthesia for lower limb surgeries. Our study would be instrumental in proposing regional techniques in our institution at a broader level for better patient comfort and decreasing the burden of hospital resources by decreasing the duration of stay and early discharge after patient stability.

Since the nerve supply to the ankle involves multiple nerves namely the saphenous, tibial, sural, superficial, and deep peroneal nerves. All these nerves are derived from the sciatic nerve except for the sural nerve which is a branch of the femoral nerve.[10] For an effective sensory block of the ankle for malleolar surgery, the femoral nerve is blocked at the level of the femoral sheath and the sciatic nerve branches are blocked at the lower level of the popliteal fossa.[11] Although this block has been used for ankle surgeries with success rates of block varying between 89-95% when ultrasound guidance was used to do the block, satisfactory analgesia for malleolar surgeries of the ankle could not be achieved in some cases.[12] The high ankle joint block technique has been proposed to overcome failure rates but with varying results in various studies done.[13] The failed block rates are related to subjective errors than the block technique with difficult anatomical landmarks hindering local anesthesia spread in some cases.[12] However, literature by Khan *et al.*, and Anjum *et al.*, at our local demographic showed that when administered effectively, excellent sensory block below the level of knee was achieved using the Femoropopliteal block with success rates between 95-99%.[14,15]

Another added advantage of the Femoropopliteal block is that it can be safely used in critical trauma patients for lower limb surgeries as well. Studies done by Oguslo *et al.*, in critical limb ischemia patients showed good hemodynamic stability when neuraxial anesthesia was not possible or contraindicated.[16] Similar studies in critical and high risk patients done by Arjun *et al.*, also concluded that regional blocks of the lower limb offer attractive indications for use with minimal complications when compared with neuraxial techniques of spinal and epidural anesthesia.[17]

Our study concluded that Spinal Anesthesia was statistically superior when it came to onset of block time when compared with the Femoropopliteal block Group. A difference of approximately ten minutes was seen between the onset of sensory and motor block between both Groups which was of statistical significance but was of no clinical consequence. Since both blocks achieved complete sensory and motor blockade, the time of onset was minimal to be of concern to the surgeon or the anesthetist.

When it came to primary variables, requirement of first analgesia dose was significant with longevity of the block proffered by the Femoropopliteal block by almost three times when compared to the spinal block Group. This was of particular significance since it also reduced the total dose of analgesia requirement needed after surgery in the first 24 hours by almost half. Both these findings make the Femoropopliteal block an attractive alternative. Since the mobility of the leg was less compromised than the spinal Group in which bilateral block warranted late mobilization, mean HDU stay for patient observation was reduced resulting in early mobilization and availability of hospital resources to more patients. When comparing the adverse effect profile, both spinal headache and hypotension were concerns in the spinal block Group which less incidence seen in the block Group. These findings were consistent with favorable outcome of regional blocks when compared with spinal anesthesia.[18]

The study recommends Femoropopliteal block as an attractive and better alternative to Spinal Anesthesia with a more favorable adverse effects profile.

LIMITATIONS OF STUDY

The expertise required for successfully doing the block requires more patient prep-time and experience regional block consultants not readily available in our demographic area.

CONCLUSION

We conclude that Spinal Anesthesia provides early sensory and motor onset but Femoropopliteal block is superior when comparing block duration and total dose of analgesia needed in 24 hours post-operatively.

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Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

AS & KB: Data acquisition, data analysis, critical review, approval of the final version to be published.

JZ & MAH: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

NIZ & SAAS: Conception, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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