Section: Anaesthesia

Original Research Article

COMPARATIVE STUDY OF PERICAPSULAR NERVE GROUP BLOCK VS FEMORAL NERVE BLOCK FOR POSITIONING UNDER SPINAL ANESTHESIA IN SURGERY OF FEMUR FRACTURE UNDER ULTRASOUND GUIDANCE

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Abstract

Background: Hip fractures are common in emergency departments, affecting older and younger age groups. Painful and difficult to position for anaesthesia, they are often treated with lower-extremity peripheral nerve blocks, which can provide moderate analgesia. This study aimed to compare the analgesic effect of the PENG block and femoral nerve block before positioning for spinal anaesthesia in patients undergoing surgery for femoral fractures. **Materials and Methods:** This prospective, randomised, double-blinded clinical trial study was conducted from February 2022 to July 2022, involving 44 patients at Govt. Kilpauk Medical College Hospital and Govt Royapetah Hospital, Chennai. Forty-four patients were divided into Group P: 22 patients received peri-capsular nerve group block (PENG) with 20 ml of 0.25% bupivacaine, and Group F: 22 patients received femoral nerve block (FN) with 20 ml of 0.25% bupivacaine. **Result:** There was no significant difference in heart rate, systolic blood pressure, and diastolic blood pressure between the groups before and after the block (30 min after injection). Before the block, the mean pain scores at rest and during leg elevation were similar between groups. However, pain scores decreased significantly after the block in both groups ($p<0.0001$), indicating a significant difference in pain relief. The PENG group experienced lower pain levels, better sitting position, and no adverse systemic toxicity of bupivacaine, vascular puncture, or complications within 24 hours postoperatively. **Conclusion:** A USG-guided PENG block is more effective than a USG-guided Femoral nerve block in reducing pain associated with positioning (sitting) for a subarachnoid block in patients with a fractured femur.

INTRODUCTION

Fractures in and around the hip are common in the emergency department. Femoral fractures are commonly seen in older people due to osteoporotic changes.[1] However, younger age groups are also affected, mostly as a result of high-velocity trauma. Irrespective of age, these fractures are extremely painful, and it is difficult to position patients for anaesthetic procedures.[2] Most of these are performed under spinal anaesthesia, which requires the patient to be in a sitting or lateral position. Adequate pain relief before administering spinal anaesthesia will increase the patient's cooperation.[3] Lower extremity peripheral nerve blocks like femoral nerve (FN) block, fascia iliaca block (FIB), and 3-in-1 FN block are popular analgesic techniques mainly due to their opioid-sparing effects and reduced opioid-related adverse effects.4 Analgesia from these blocks is only moderate, and literature suggests that the articular branches of these nerves are inconsistently blocked.[4-6]

The anterior hip capsule is innervated by the articular branches of the femoral nerve, obturator nerve, and accessory obturator nerve (AON), as reported in previous anatomical studies, suggesting that these nerves should be the main targets for hip analgesia, which can be blocked by the pericapsular nerve group (PENG) block.[7,8] This study aimed to compare the analgesic effect of the PENG and femoral nerve blocks before positioning for spinal anaesthesia in patients undergoing surgery for femoral fractures.

MATERIALS AND METHODS

This prospective, randomised, double-blinded clinical trial study was conducted from February 2022 to July 2022, involving 44 patients in an ortho theatre at Govt. Kilpauk Medical College Hospital and Govt Royapetah Hospital, Chennai. The study

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received approval from the institutional ethics committee before its initiation.

Inclusion Criteria

Patients aged 18-70 undergoing elective femur fracture surgeries under spinal anaesthesia, of both sexes, with ASA (American Society of Anesthesiologists) class I or II, and who have provided informed written consent were included.

Exclusion Criteria

Patients who declined participation had a history of allergy to local anaesthetics, fell under American Society of Anesthesiologists (ASA) class III and IV, exhibited an inability to comprehend and use the visual analogue score (VAS), possessed bleeding disorders, presented vertebral column deformities, or were suspected to have compartment syndrome in the lower limbs were excluded.

Forty-four patients were divided into Group P: 22 patients received peri-capsular nerve group block (PENG) with 20 ml of 0.25% bupivacaine, and Group F: 22 patients received femoral nerve block (FN) with 20 ml of 0.25% bupivacaine.

The equipment for the procedure included an intravenous set with intravenous fluid and an 18 G IV cannula, a laryngoscope, an airway, a bougie, and an appropriately sized endotracheal tube. Additionally, the required drugs consisted of 0.25% intravenous bupivacaine and emergency medications. Monitoring tools, such as NIBP, ECG, SPO2, EtCO2, and temperature devices, are essential. Boyle's apparatus/workstation and a 22 G, 100 mm insulated needle were used. Sterile gauze and an ultrasound machine equipped with linear and curvilinear probes were used to complete the necessary materials.

Data collection: Age, sex, weight, visual analogue scale pre-op-at rest and dynamic hip movements, and after block (30 min) at rest and dynamic hip movements, and HR, SBP, DBP, RR, and SPO2 pre and post-block were collected.

Visual analogue scores were recorded before and 30 min after the block (at rest and during dynamic hip movements). All outcome measures were collected by an anaesthesiologist who was not involved in the block performance.

RESULTS

The mean age in group P was 59.23 years (with a standard deviation of 12.67), whereas that in group F was 55.91 years (with a standard deviation of 16.61), and there was no significant age difference between the groups. In Group P, 54.5% were males; in Group F, 40.9% were males; females accounted for 45.5% in Group P and 59.1% in Group B. The gender distribution did not differ significantly between the study groups (p=0.365) [Table 1].

The mean heart rate before the block was 82.64 in group P and 79.36 in group F. The mean heart rate post-block (30 min after the block) was 83.95 in group P and 82.82 in group F. There was no significant difference in the heart rate between the groups before and after the block (30 min after injection). The mean systolic BP before the block was 138.50 in group P and 132.45 in group F, and post-block (30 min after the block) was 127.77 in group P and 126.32 in group F. The groups showed no significant differences in systolic blood pressure before and after the block (30 min after the block).

The mean diastolic BP before the block was 76.05 in group P and 76.00 in group F. Post-block (30 min after the block) was 76.59 in group P and 75.82 in group F. The groups showed no significant differences in diastolic blood pressure before and after the block (30 minutes after injection).

In group P, before the block, the mean pain score at rest was 5.18; at 30 °, leg elevation was 8.95; in group F, it was 5.41 and 8.73. In group F, post-block (30 min after the block) at rest was 2.23 and 3.50, and in group F was 2.36 and 5.36%, respectively. Before the block, the mean pain scores at rest and during leg elevation were similar between groups. However, after the block, the pain scores decreased significantly in both groups (p<0.0001), indicating a significant difference in pain relief [Table 2].

The PENG block was associated with better patient experience. Pain levels were lower in the PENG group than in FNB, resulting in a better sitting position for neuro axial procedure. No adverse systemic toxicity of bupivacaine, such as seizures, arrhythmia, or cardiovascular collapse, was noted in the FNB group. Vascular puncture and paraesthesia did not occur. No complications, such as haematoma, infection, or persistent paraesthesia, were observed within 24 hours after the operation. None of the patients in either group had hypoventilation (ventilatory rate 10/min) or an oxygen saturation of 95%.

Table 1: Demographic data of the study population

	Group P	Group F	P value
Age	59.23±12.67	55.91±16.61	0.481
Gender	10(45.5)	13(59.1)	0.365
	12(54.5)	9(40.9)	

Table 2: Mean pre- and post-haemodynamic parameters of the study population

	Pre			Post		
	Group P	Group F	P-value	Group P	Group F	P-value
HR	82.64±11.06	79.36±9.38	0.296	82.82±7.82	83.95±9.37	0.665
SBP	138.50±14.11	132.45±16.83	0.204	126.32±8.49	127.77±7.94	0.56
DBP	76.05±6.41	76±4.35	0.978	75.82±4.37	76.59±4.99	0.588
VAS	5.18±0.73	5.41±0.59	0.264	2.23±0.61	3.50±0.60	<0.0001
	8.95±0.65	8.73±0.70	0.273	2.36±0.49	5.36±0.58	

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DISCUSSION

A femoral fracture is a particularly painful bone injury because the periosteum has the lowest pain threshold for deep somatic structures. Surgical repair most commonly involves either internal fixation of the fracture or replacement of the femoral head with an arthroplasty. Any movement by the patient leads to severe pain. Providing adequate pain relief increases comfort in these patients and has also been shown to improve spinal block positioning. Different regional blocks were employed to facilitate patient positioning for spinal anaesthesia.[9-11]

The sensory innervation pattern of the hip capsule differs between the anterior and posterior areas. The anterior hip joint capsule contains the highest number of sensory fibres and mechanoreceptors. Branches from the femoral and obturator nerves innervate the anterior hip capsule. The articular branches of the femur provide most of the innervation to the lateral and superomedial hip capsule, while the branches innervate the inferomedial part of the capsule. The accessory nerve obturator also contributes to the medial capsule innervation. The proximal articular branches from the femoral nerve and AON are consistently found between the AIIS and IPE, whereas the obturator nerve is close to the inferomedial acetabulum. Branches from the sciatic nerve innervate the posterior surface of the hip joint capsule: the superior gluteal nerve and the nerve to the quadratus femoris.[8,12-14]

At our institution, spinal block is used more frequently than general anaesthesia (GA) for femoral fracture surgery. The peri-capsular nerve group (PENG) block is a recent regional technique that blocks the articular branches of the hip joint. This prospective study compared the analgesic effects of FNB with a PENG block before positioning for a spinal block in patients with fractured femurs. As per the study by Girón et al., the analgesic effect of the PENG block was superior, with a mean reduction of the VAS scale by 7 points on the decimal scale.[15]

Guay et al. study concluded that the analgesic effect of the blocks was moderate, with a mean decrease of 3.4 out of 10 on the VAS scale. The PENG block will not relieve pain related to the skin incision and subcutaneous dissection, which the lateral cutaneous nerve covers. Combining the LFCN and PENG blocks has been suggested to provide better analgesia than the PENG block alone. In addition, complete anaesthesia of the hip joint is assumed to require a sciatic nerve block. However, the anterior capsule receives most of the sensory innervation of the hip joint.[16]

Acharya and Lamsal reported five cases of fractured hip joints, and the PENG block succeeded in decreasing pain levels at rest and during positioning for spinal anaesthesia.[17] In the Jain et al. study Using 0.5% Ropivacaine, they compared the analgesic efficacy of USG FNB with USG FICB in patients with fractured femur in reducing pain associated with positioning (sitting) for subarachnoid block. They concluded that USG FNB is more efficacious than USG FICB in reducing pain associated with positioning (sitting) or subarachnoid block in patients with fractured femurs.[18] Alrefaey et al. concluded that preoperative PENG block is an effective option to control positioning-related pain during spinal anaesthesia, improving patient sitting angle, thus decreasing the time required for a spinal block and improving the anesthesiologist and patient experience.[19] Lin et al. reported that patients undergoing hip fracture surgery who received PENG block experienced less postoperative pain than those who received femoral nerve block.[20] Aydin et al. described a new indication for the PENG block beyond the hip pathology. The patients underwent vein ligation and stripping in the FN and ON dermatomes segment under an effective PENG block for surgical anaesthesia.[21] Not many studies compare PENG block and FNB for positioning during spinal anaesthesia.

Our study found that The PENG block was associated with better patient experience. Pain levels were lower in the PENG group than in FNB, resulting in a better sitting position for neuro axial procedure. No adverse systemic toxicity of bupivacaine, such as seizures, arrhythmia, or cardiovascular collapse, was noted in the FNB group. Vascular puncture and paraesthesia did not occur. No complications, such as haematoma, infection, or persistent paraesthesia, were observed within 24 hours after the operation. None of the patients in either group had hypoventilation (ventilatory rate 10/min) or an oxygen saturation of 95%.

CONCLUSION

In conclusion, a USG-guided PENG block is more effective than a USG-guided Femoral nerve block in reducing pain associated with positioning (sitting) of a subarachnoid block in patients with a fractured femur. It can be performed safely without complications, providing good patient comfort during positioning for spinal anaesthesia and providing postoperative analgesia in patients undergoing surgery for a fractured femur.

Limitations: The major limitations of our study include the assessment of the VAS score, which is subjective and varies with the level of understanding between the patient and anaesthesiologist, and the assessment of comfort level that may vary from person to person according to their experience. Thus, objective assessment of these parameters is difficult.

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