Section: Anaesthesiology

Original Research Article

PERICAPSULAR NERVE GROUP (PENG) BLOCK FOR FACILITATING POSITIONING DURING CENTRAL NEURAXIAL BLOCKADE IN HIP FRACTURE SURGERIES

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ABSTRACT

Background: Aims: Hip fractures in elderly patients are associated with severe pain, particularly during positioning for central neuraxial blockade (CNB). Inadequate analgesia at this stage may lead to patient discomfort, haemodynamic instability, technical difficulty, and multiple attempts at spinal anaesthesia. The Pericapsular Nerve Group (PENG) block is a motor-sparing regional technique that selectively targets the articular branches of the anterior hip capsule. This study aimed to evaluate the effectiveness of the PENG block in facilitating positioning for CNB in patients undergoing hip fracture fixation. **Materials and Methods:** This prospective observational study included 88 patients aged 55–75 years undergoing hip fracture surgery under CNB. Ultrasound-guided PENG block was administered using 20 ml of 1.5% lignocaine with adrenaline and 8 mg dexamethasone. Pain was assessed using the Numerical Rating Scale (NRS) during passive 15° limb elevation at baseline and at 5, 10, and 15 minutes after block administration. Time to positioning, ease of spinal positioning score (EOSP), ease of palpation of interspinous space, number of attempts for CNB, haemodynamic parameters, patient satisfaction, and adverse effects were recorded. **Results:** The mean NRS decreased significantly from 8.63 before block to 2.02 at 15 minutes. Seventy-five percent of patients were comfortably positioned within 15 minutes. CNB was achieved in a single attempt in 77% of cases. Haemodynamic parameters remained stable, and no block-related complications were observed. All patients reported good postoperative satisfaction. **Conclusion:** The PENG block is an effective and safe preoperative analgesic technique that significantly reduces pain and facilitates comfortable positioning for CNB in hip fracture patients. It offers a motor-sparing alternative to conventional regional techniques and may improve perioperative outcomes in elderly patients.

INTRODUCTION

Pain is defined by the International Association for the Study of Pain (IASP) as “an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage.”.[1] Acute pain, particularly in elderly patients with hip fractures, triggers significant physiological stress responses. Unrelieved pain increases sympathetic activity and catecholamine release, leading to vasoconstriction, impaired tissue perfusion, increased myocardial oxygen demand, hyperglycaemia, lipolysis, and muscle catabolism. Persistent severe pain may further contribute to chronic pain syndromes, psychological distress, and reduced quality of life. Therefore, effective perioperative pain management is essential, especially in geriatric patients with limited physiological reserve and multiple comorbidities.[2]

Pain perception begins with transduction at peripheral nociceptors, followed by transmission through primary afferent fibres to the dorsal horn of the spinal cord and ascent via the spinothalamic tract to the thalamus and cerebral cortex. Descending inhibitory pathways modulate nociceptive transmission at the spinal level.[3] Regional anaesthesia techniques interrupt this pathway by blocking voltage-gated sodium channels, thereby preventing action potential propagation and pain transmission.[4]

The hip joint has complex sensory innervation. The anterior capsule—rich in nociceptive fibres—is

primarily supplied by articular branches of the femoral nerve, obturator nerve, and accessory obturator nerve, while the posterior capsule receives contributions from the nerve to quadratus femoris, superior gluteal nerve, and sciatic nerve.[5] Given this intricate innervation, conventional regional techniques such as femoral nerve block and fascia iliaca block may provide incomplete analgesia, particularly due to inadequate obturator nerve blockade. Additionally, femoral nerve block may cause quadriceps weakness, potentially delaying mobilisation and increasing fall risk.

The Pericapsular Nerve Group (PENG) block is a newer ultrasound-guided regional anaesthesia technique designed to selectively target the articular branches supplying the anterior hip capsule. By depositing local anaesthetic between the psoas tendon and the superior pubic ramus at the level of the iliopubic eminence, the PENG block provides effective sensory analgesia while preserving motor function.[6] Lignocaine, an amide local anaesthetic, acts by reversible sodium channel blockade and has additional anti-inflammatory and antinociceptive effects.[7] The addition of dexamethasone as an adjuvant prolongs the duration of sensory blockade and enhances analgesic efficacy.[8]

Patients with hip fractures experience severe pain, particularly during movement and positioning for central neuraxial blockade. Inadequate analgesia at this stage can result in haemodynamic instability, patient discomfort, technical difficulty in spinal administration, multiple attempts, and potential block failure. Although perioperative pain management strategies have improved, preoperative pain—especially pain during positioning—remains relatively under-addressed. Conventional regional blocks may not consistently provide adequate analgesia for this purpose.

Pain assessment using the Numerical Rating Scale (NRS) offers a simple and validated method to quantify pain intensity and evaluate analgesic effectiveness, particularly in elderly patients.[9]

Given the anatomical basis of anterior hip capsule innervation and the limitations of traditional nerve blocks, the PENG block represents a promising motor-sparing technique for preoperative analgesia in hip fracture patients. However, literature specifically evaluating its role in facilitating positioning for central neuraxial blockade remains limited. Hence, this study was undertaken to assess the effectiveness of the PENG block in reducing pain, improving patient comfort, and facilitating spinal anaesthesia administration in patients undergoing hip fracture fixation.

MATERIALS AND METHODS

Study Design

This was a prospective observational study conducted to evaluate the effectiveness of the Pericapsular Nerve Group (PENG) block in facilitating positioning for central neuraxial blockade in patients undergoing hip fracture fixation.

Study Setting

The study was conducted in the Department of Anaesthesiology, Major orthopaedic operation theatre, Government Medical College, Kozhikode, a tertiary care teaching hospital.

Study Period

The study was carried out over a period of one year from May 2021 to April 2022.

Study Population: Patients admitted with fracture neck of femur, intertrochanteric fracture femur, or subtrochanteric fracture femur scheduled for surgical fixation under central neuraxial blockade were included in the study.

Sample Size: The sample size was calculated using the formula:

$$N = \frac{(Z_\alpha + Z_\beta)^2 \times SD^2}{d^2}$$

Where Zα = 1.96, Zβ = 0.84

As per Ashok et al[24], standard deviation (SD) = 0.34, and effect size (d) = 0.3. The minimum calculated sample size was 88 patients.

Inclusion Criteria

- Age between 55 and 75 years
- Either gender
- Patients undergoing elective or emergency hip fracture fixation
- Planned under central neuraxial blockade

Exclusion Criteria

- Patient refusal
- Coagulopathy
- Local or systemic infection at the block site
- Known allergy to local anaesthetic or study drugs
- Pre-existing neuropathy or nerve injury
- Cardiac conduction abnormalities

Preoperative Preparation and Monitoring

After obtaining Institutional Ethics Committee approval and written informed consent, eligible patients were enrolled. All patients were educated regarding the procedure and the Numerical Rating Scale (NRS) for pain assessment (0 = no pain, 10 = worst pain).

On arrival in the operating room, standard monitors including electrocardiography (ECG), pulse oximetry (SpO_2), respiratory rate, and non-invasive blood pressure (NIBP) were applied. An 18-gauge intravenous cannula was secured and Ringer lactate was administered at 15 ml/kg.

PENG Block Technique

With the patient in the supine position, the anterior superior iliac spine (ASIS) and pubic tubercle were identified and marked. Under strict aseptic precautions, a low-frequency curvilinear ultrasound probe (2–5 MHz) was placed over the line joining ASIS and pubic tubercle to obtain the sonoanatomical view of the iliopubic eminence.

After skin infiltration with 1 ml of 1% lignocaine, a 23-gauge spinal needle was advanced using an out-

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of-plane approach toward the iliopubic eminence. Correct needle placement was confirmed by hydrodissection under the iliopsoas muscle. Subsequently, 20 ml of 1.5% lignocaine with 8 mg dexamethasone was injected incrementally with repeated aspiration to prevent intravascular injection.

Pain Assessment and Positioning

Baseline pain scores were recorded using the Numerical Rating Scale. Pain reassessment was performed at regular intervals following the block. Once adequate analgesia was achieved, patients were positioned for central neuraxial blockade.

Comfort during positioning was assessed using the Ease of Spinal Position (EOSP) score (0 – unable to sit, 1 – severe pain requiring support, 2 – mild discomfort without support, 3 – comfortable without pain).

Central Neuraxial Blockade Assessment

Spinal anaesthesia or combined spinal epidural anaesthesia was administered as per surgical requirement. The anaesthesiologist graded the ease of palpation of interspinous space on a scale of 1 to 5 (1 – easily palpable to 5 – no space palpable). The number of attempts required and haemodynamic parameters during the procedure were documented.

Outcome Measures

Primary outcome:

- Reduction in NRS pain score during positioning.

Secondary outcomes:

- Time to positioning
- Ease of spinal positioning score
- Ease of palpation of interspinous space
- Number of attempts required
- Haemodynamic changes
- Patient satisfaction
- Block-related complications

Statistical Analysis

Data were entered into Microsoft Excel and analysed using appropriate statistical software. Qualitative variables were expressed as frequency and percentages, and quantitative variables as mean and standard deviation. A p-value<0.05 was considered statistically significant.

RESULTS

A total of 88 elderly patients with hip fractures were included in the study. The demographic characteristics, pain score trends, procedural outcomes, haemodynamic parameters, and safety profile of the PENG block are summarised below.

Table 1: Demographic Characteristics (n = 88)

Variable	Category	n (%) / Mean ± SD
Age (years)	Mean ± SD	65.48 ± 6.24
	Range	54 – 75
	50–60 years	23 (26.1%)
	60–70 years	43 (48.9%)
	70–80 years	22 (25.0%)
Sex	Male	42 (47.7%)
	Female	46 (52.3%)

The study population predominantly comprised elderly individuals, with the majority (48.9%) in the 60–70 years age group. A slight female predominance (52.3%) was observed.

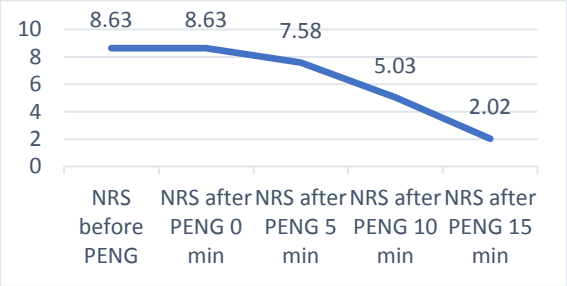

Figure 1: Pain Score (NRS) Changes Following PENG Block

Baseline pain severity was high, with a mean NRS score of 8.63 ± 0.78 (range: 7–10), indicating severe pain in most patients. No immediate change was observed at 0 minutes (8.63 ± 0.78), reflecting the expected onset time of the block. A gradual reduction in pain began at 5 minutes, with the mean NRS decreasing to 7.58 ± 0.83 (range: 6–9), followed by a clinically significant decline at 10 minutes to 5.03 ± 0.92 (range: 3–7), indicating transition to moderate pain. By 15 minutes, there was a marked reduction to 2.02 ± 0.86 (range: 0–4), corresponding to mild pain or near-complete analgesia. Overall, this represents an approximate 76% reduction in pain score from baseline, demonstrating a rapid, progressive, and clinically effective analgesic action of the PENG block within 10–15 minutes.(Fig 1)

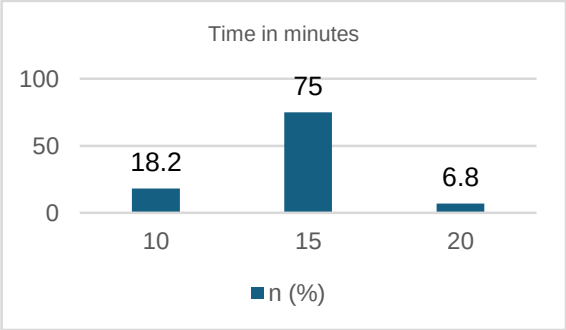

Figure 2. Procedural Outcomes and Statistical Association

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A. Time to Position

Most patients (75.0%) were positioned within 15 minutes, indicating rapid onset of effective analgesia following the PENG block.(Fig 2)

3B: Time to Position vs Ease of Spinal Positioning (Crosstab)

Time (min)	EOSP 1 n (%)	EOSP 2 n (%)	EOSP 3 n (%)	Total n (%)	χ^2 value	p-value
10	0 (0.0%)	0 (0.0%)	16 (100.0%)	16 (100.0%)	66.307	<0.001*
15	6 (9.1%)	55 (83.3%)	5 (7.6%)	66 (100.0%)		
20	2 (33.3%)	4 (66.7%)	0 (0.0%)	6 (100.0%)		
Total	8 (9.1%)	59 (67.0%)	21 (23.9%)	88 (100.0%)		

A statistically significant association was observed (χ^2 = 66.307, p<0.001), with earlier positioning associated with better comfort; all patients at 10 minutes had no pain, while most at 15 minutes were comfortable.

3C: Time to Position vs Ease of Palpation (Crosstab)

Time (min)	Score1 n (%)	Score 2 n (%)	Score 3 n (%)	Score 4 n (%)	Total n (%)	χ^2 value	p-value
10	11 (68.8%)	4 (25.0%)	1 (6.3%)	0 (0.0%)	16 (100.0%)	33.075	<0.001*
15	9 (13.6%)	43 (65.2%)	11 (16.7%)	3 (4.5%)	66 (100.0%)		
20	0 (0.0%)	2 (33.3%)	4 (66.7%)	0 (0.0%)	6 (100.0%)		
Total	20 (22.7%)	49 (55.7%)	16 (18.2%)	3 (3.4%)	88 (100.0%)		

There was a significant association (χ^2 = 33.075, p<0.001), showing improved palpation of interspinous space with increasing time, particularly at 15 minutes.

3D: Time to Position vs Number of Attempts (Crosstab)

Time (min)	Single n (%)	Two n (%)	Three n (%)	Total n (%)	χ^2 value	p-value
10	15 (93.8%)	1 (6.3%)	0 (0.0%)	16 (100.0%)	5.920	0.205
15	50 (75.8%)	13 (19.7%)	3 (4.5%)	66 (100.0%)		
20	3 (50.0%)	2 (33.3%)	1 (16.7%)	6 (100.0%)		
Total	68 (77.3%)	16 (18.2%)	4 (4.5%)	88 (100.0%)		

No statistically significant association was found (χ^2 = 5.920, p = 0.205), although most patients (77.3%) required only a single attempt.

3E: Time to Start of Surgery

Time (min)	n (%)
20	5 (5.7%)
25	12 (13.6%)
30	28 (31.8%)
35	30 (34.1%)
40	6 (6.8%)
45	5 (5.7%)
50	2 (2.3%)
Total	88 (100.0%)
Time (min)	**n (%)**

Surgery was initiated within 30–35 minutes in 65.9% of patients, indicating no delay in operative workflow.

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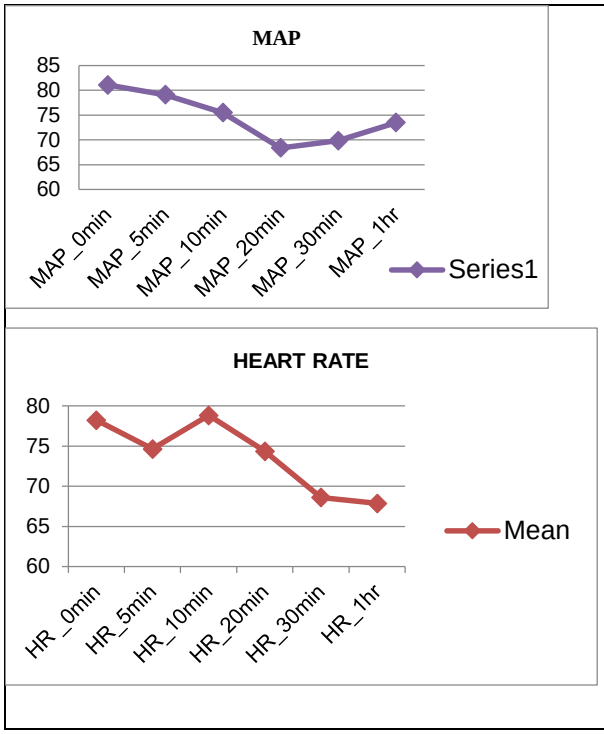

Figure 2 and 3: Change in HR (Mean ± SD) And MAP (Mean ± SD)

Haemodynamic parameters remained stable. All patients reported good satisfaction, and no adverse events were observed.(Fig 3 and 4)

DISCUSSION

Hip fracture is one of the most common orthopaedic emergencies in the elderly and is associated with significant morbidity and mortality.[10,11] The pain associated with hip fractures is often severe and contributes to adverse clinical outcomes. Approximately one-third of patients experience severe pain at rest, which increases to nearly three-quarters during movement.[14,11] Passive movement required for positioning during spinal anaesthesia can further exacerbate pain, resulting in difficulty in achieving optimal positioning and potentially delaying anaesthetic procedures.[18,2] Therefore, effective preoperative analgesia plays a crucial role in improving patient comfort and facilitating timely surgical intervention.

Various analgesic modalities have been employed to manage pain during positioning, including NSAIDs, paracetamol, systemic opioids, and regional nerve blocks.[13,11,20,19] However, pharmacological management in the elderly is often challenging due to associated comorbidities. Opioids are known to cause adverse effects such as respiratory depression, delirium, and confusion.[12] Similarly, NSAIDs may aggravate renal dysfunction and are associated with other systemic complications in this population.[15,16] In this context, regional analgesia techniques have gained preference due to their ability to provide effective pain relief while minimizing systemic side effects and reducing opioid requirements.[15,19]

Traditionally, femoral nerve block, fascia iliaca block, and 3-in-1 femoral nerve block have been widely used for hip fracture analgesia. However, anatomical studies have demonstrated that the anterior hip capsule receives articular innervation from branches of the femoral, obturator, and accessory obturator nerves, which course between the anterior inferior iliac spine (AIIS) and the iliopubic eminence (IPE).[26,5] Conventional regional techniques may not reliably block all these articular branches, potentially resulting in incomplete analgesia.

The Pericapsular Nerve Group (PENG) block, as described by Girón-Arango et al,[6] specifically targets these articular branches by depositing local anaesthetic in the plane between the AIIS and IPE. Additionally, spread of the anaesthetic into the subpectineal plane may facilitate blockade of obturator nerve branches, thereby providing more comprehensive analgesia of the anterior hip capsule.[5]

In the present study involving 88 elderly patients, the PENG block demonstrated rapid and effective analgesia, with mean NRS scores significantly decreasing from 8.63 at baseline to 2.02 at 15 minutes. This finding highlights the rapid onset and strong analgesic efficacy of the block. Similar reductions in pain scores have been reported in previous studies by Jadon et al,[24] Acharya et al,[21] and Lin et al,[23] supporting the consistency of our findings with existing literature.

Effective analgesia translated into improved procedural conditions. In our study, 75% of patients were comfortably positioned within 15 minutes, and 90.9% experienced minimal or no discomfort (EOSP score ≥2). Furthermore, there was a statistically significant association between time to positioning and ease of spinal positioning ($\chi^2 = 66.307$, $p<0.001$), as well as ease of palpation of the interspinous space ($\chi^2 = 33.075$, $p<0.001$). These findings indicate that adequate analgesia achieved through the PENG block facilitates optimal positioning and improves the technical ease of spinal anaesthesia. Similar observations were reported by Sahoo et al,[22] who demonstrated improved positioning conditions following PENG block administration.

Although a majority of patients (77.3%) required only a single attempt for successful central neuraxial blockade, no statistically significant association was found between time to positioning and number of attempts ($\chi^2 = 5.920$, $p = 0.205$). This suggests that while improved analgesia enhances patient comfort and positioning, the number of attempts may also depend on operator skill and anatomical variability.

Importantly, the PENG block did not delay surgical workflow, as surgery was initiated within 30–35 minutes in 65% of cases. This finding underscores the practical applicability of the technique in routine clinical settings.

Haemodynamic stability is a critical consideration in elderly patients. In the present study, heart rate and mean arterial pressure remained stable throughout the

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perioperative period, indicating that the PENG block does not adversely affect haemodynamic parameters. Additionally, all patients reported good satisfaction, and no procedure-related complications were observed. These findings are consistent with previous reports demonstrating the safety and tolerability of the PENG block.[22,25]

Overall, our study demonstrates that the PENG block provides effective and rapid analgesia, facilitates optimal positioning for spinal anaesthesia, improves procedural ease, and maintains haemodynamic stability, with an excellent safety profile. These advantages make it a valuable regional anaesthesia technique in the management of elderly patients with hip fractures.

CONCLUSION

The Pericapsular Nerve Group (PENG) block was found to be an effective and safe preoperative analgesic technique for patients undergoing hip fracture fixation. It significantly reduced pain scores within a short duration, thereby facilitating comfortable positioning for central neuraxial blockade and improving ease of spinal administration with fewer attempts. The block provided stable haemodynamics, excellent patient satisfaction, and no procedure-related complications. By selectively targeting the sensory innervation of the anterior hip capsule while preserving motor function, the PENG block offers a distinct advantage over conventional regional techniques, making it a valuable motor-sparing option for preoperative analgesia in elderly hip fracture patients.

Conflict of interest: Nil

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