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Original Research Article

A Comparative Study of Pericapsular Nerve Group Block Vs. Fasica Iliaca Compartment Block in Patient Undergoing Femur Fracture Surgery

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Conflict of interest: Nil

Abstract:

Background: Effective analgesia during positioning and postoperative recovery is essential in femur fracture surgery. The Pericapsular Nerve Group (PENG) block has recently emerged as a targeted technique with potential advantages over the Fascia Iliaca Compartment Block (FICB).

Material and Methods: This prospective comparative study included 30 patients undergoing femur fracture surgery, who received either a PENG block or an FICB. Pain during positioning for spinal anaesthesia, postoperative analgesia duration, and hemodynamic parameters were recorded.

Results: The PENG block provided lower pain scores during positioning, prolonged postoperative analgesia, and greater hemodynamic stability compared with the FICB.

Conclusion: The PENG block may be considered a more effective regional anaesthesia technique for femur fracture surgery due to its superior analgesic and physiological profile.

Keywords: PENG Block; Fascia Iliaca Block; Femur Fracture; Regional Anaesthesia.

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Introduction

Fenur fractures represent one of the most painful orthopedic emergencies and are particularly common in elderly patients, where inadequate analgesia can worsen morbidity, delay surgery, and adversely affect rehabilitation outcomes [1]. Effective pre-operative analgesia is essential because positioning for spinal anaesthesia often provokes severe pain, increases sympathetic stimulation, and may lead to haemodynamic instability during block placement [2]. Therefore, peripheral nerve blocks have become a key component of multimodal analgesia for hip and femur fracture surgeries.

The Fascia Iliaca Compartment Block (FICB) is a well-established technique that provides analgesia by targeting the femoral, lateral femoral cutaneous, and obturator nerves. Studies have shown that FICB offers improved pain relief, decreased opioid consumption, and better patient comfort during positioning compared to systemic analgesia alone [3,4]. Pasquier et al. demonstrated that landmark-based FICB reduced peri-procedural discomfort and improved positioning for neuraxial anaesthesia in hip fracture patients [3], while Ma et al. reported fewer pre-operative complications and reduced pulmonary and cardiovascular stress responses in very elderly individuals receiving continuous FICB [4]. Other recent prospective trials reaffirm the role of ultrasound-guided FICB in minimizing pain scores and maintaining haemodynamic stability during hip and femur fracture management [5].

The Pericapsular Nerve Group (PENG) block, introduced more recently, has gained significant popularity because it specifically targets the sensory articular branches supplying the anterior hip capsule while sparing quadriceps strength. This selective action provides better analgesia for movement-related pain, particularly for patient positioning before spinal anaesthesia [6]. Alrefaey et al. showed that PENG block significantly reduced positioning pain for spinal anaesthesia in hip fracture surgery [6], while a randomized double-blind trial by Lin et al. demonstrated prolonged time to rescue analgesia and lower pain scores during mobilisation [7]. A 2024 retrospective study further reported that PENG block improved the success rate of spinal anaesthesia by facilitating better patient cooperation and reducing movement-evoked pain [8]. Recent

comparative studies between PENG and FICB indicate that both techniques are effective, but emerging evidence suggests differences in specific outcomes. Pavithra et al. found in 2024 that PENG block enabled quicker positioning and higher patient satisfaction, whereas FICB exhibited slightly longer postoperative analgesia duration [9]. A recent meta-analysis evaluating these blocks in hip and femur fracture surgeries reported that PENG provides superior short-term analgesia and better functional outcomes for positioning, whereas FICB may demonstrate more prolonged baseline analgesia depending on the anaesthetic volume used [10].

Considering the importance of achieving optimal analgesia before spinal anaesthesia, ensuring postoperative comfort, and maintaining haemodynamic stability, a direct comparison of PENG block versus FICB in femur fracture surgery is clinically relevant.

Therefore, this study aims to compare the effects of PENG block and FICB on: (i) analgesia during positioning for spinal anaesthesia, (ii) duration of postoperative analgesia, and (iii) peri-operative haemodynamic parameters in patients undergoing femur fracture surgery.

Material and Methods

This prospective, comparative, observational study was conducted over a period of three months, from January 2025 to March 2025, in patients undergoing femur fracture surgery. A total of 30 patients were included based on feasibility and anticipated case load, with 15 patients allocated to the Pericapsular Nerve Group (PENG) block group and 15 to the Fascia Iliaca Compartment Block (FICB) group. Patients were eligible for inclusion if they were undergoing femur fracture surgery, were aged 18 years or older, and belonged to ASA physical status I, II, or III. No exclusion criteria were applied.

All patients underwent a thorough pre-anaesthetic evaluation including medical history, physical examination, airway assessment, and relevant investigations according to institutional protocol. Written informed consent was obtained from every participant. Allocation into the two study groups was done using a simple alternating method for feasibility: every alternate patient was assigned to either Group P (PENG block) or Group F (FICB). Both nerve blocks were performed preoperatively under ultrasound guidance by experienced anaesthesiologists. For patients in Group P, the PENG block was performed under aseptic precautions using a high-frequency ultrasound probe. Local anaesthetic was injected between the psoas tendon and the superior pubic ramus to target the articular branches of the femoral, obturator, and accessory obturator nerves. In Group F, the FICB was performed by identifying the fascia iliaca plane under ultrasound guidance and administering local anaesthetic beneath the fascia to block the femoral and lateral femoral cutaneous nerves. Following administration of the block, patients were monitored for reduction in pain, and once adequate analgesia was achieved, they were positioned for spinal anaesthesia, which was carried out using standard technique and drug regimen.

The primary outcomes assessed were pain during positioning for spinal anaesthesia, measured using the Visual Analogue Scale (VAS), and the duration of postoperative analgesia, defined as the time from block administration to the first demand for rescue analgesia. Secondary outcomes included haemodynamic parameters such as heart rate and systolic, diastolic, and mean arterial blood pressure recorded at baseline, during positioning, immediately after spinal anaesthesia, and at 15, 30, 45, and 60 minutes postoperatively. The requirement for rescue analgesia and total consumption within the first 24 hours were also documented.

All data will be analyzed using suitable statistical software. Continuous variables such as VAS scores and haemodynamic parameters will be expressed as mean ± standard deviation and compared using either the unpaired t-test or Mann–Whitney U test, depending on normality of distribution. Categorical variables will be evaluated using the chi-square test or Fisher's exact test. A p-value of less than 0.05 will be considered statistically significant.

Results

Table 1 presents the demographic characteristics of the study population. The mean age of patients in the PENG group was 58.2 ± 12.4 years, while in the FICB group it was 56.8 ± 11.7 years, with no statistically significant difference ($p = 0.72$). The sex distribution was comparable between the groups, with a similar proportion of male and female patients ($p = 0.73$). This indicates that both groups were demographically comparable at baseline.

Table 2 shows the comparison of pain scores during positioning for spinal anaesthesia using the Visual Analogue Scale (VAS). The PENG block group demonstrated significantly lower VAS scores (2.4 ± 0.9) compared to the FICB group (4.8 ± 1.2), with a highly significant p-value (<0.001). This suggests that PENG block provided superior analgesia during positioning. Table 3 outlines the duration of postoperative analgesia measured as the time to first rescue analgesic requirement. Patients who received the PENG block had a longer analgesia duration (9.6 ± 2.1 hours) compared to those who received the FICB block (7.8 ± 1.9 hours), and this difference was statistically significant ($p = 0.01$). This indicates that PENG block offers prolonged postoperative pain relief. Table 4 compares the hemodynamic parameters between the two groups at different perioperative time points. Heart rate and mean

arterial pressure were similar at baseline in both groups. However, during positioning for spinal anaesthesia and at 30 minutes post-spinal anaesthesia, the FICB group showed significantly higher heart rate and mean arterial pressure values compared to the PENG group ($p < 0.05$ at all significant points). These findings indicate that the PENG block provided better hemodynamic stability during the perioperative period.

Table 5 provides a combined comparative summary of all primary and secondary outcomes. Across all parameters—pain during positioning, duration of postoperative analgesia, heart rate changes, and mean arterial pressure changes—the PENG group consistently demonstrated better analgesic efficacy and greater hemodynamic stability compared to the FICB group, with statistically significant differences.

Table 6 presents an overall direct comparison between Group P (PENG block) and Group F (FICB block). The PENG block provided superior analgesia during positioning, longer postoperative analgesia, and more stable hemodynamic responses. In contrast, the FICB block showed higher pain scores, shorter analgesia duration, and more pronounced increases in heart rate and blood pressure during positioning. Patient comfort and ease of positioning were notably better in the PENG group, indicating a clear functional advantage.

Table 1: Demographic Characteristics of Patients (n = 30)

Variable	PENG Block (n = 15)	FICB Block (n = 15)	p-value
Age (years), Mean ± SD	58.2 ± 12.4	56.8 ± 11.7	0.72
Sex (Male/Female)	9 / 6	8 / 7	0.73

Table 2: Comparison of Pain Score during Positioning for Spinal Anaesthesia (VAS Score)

Outcome	PENG Block (n = 15)	FICB Block (n = 15)	p-value
VAS Score During Positioning (0–10)	2.4 ± 0.9	4.8 ± 1.2	<0.001

Table 3: Duration of Postoperative Analgesia

Outcome	PENG Block (n = 15)	FICB Block (n = 15)	p-value
Time to First Rescue Analgesia (hours)	9.6 ± 2.1	7.8 ± 1.9	0.01

Table 4: Comparison of Hemodynamic Parameters (Intraoperative)

Parameter	Time Point	PENG Block (Mean ± SD)	FICB Block (Mean ± SD)	p-value
Heart Rate (bpm)	Baseline	84.2 ± 6.5	85.6 ± 7.1	0.62
	During Positioning	86.4 ± 7.8	94.2 ± 8.5	0.003
	30 min post-SA	82.1 ± 7.2	88.3 ± 6.8	0.01
Mean Arterial Pressure (mmHg)	Baseline	93.8 ± 6.1	94.4 ± 5.7	0.79
	During Positioning	95.1 ± 7.2	102.8 ± 8.4	0.002
	30 min post-SA	90.2 ± 6.5	96.7 ± 7.1	0.01

Table 5: Comparative Summary of Primary and Secondary Outcomes

Outcome	PENG Block	FICB Block	p-value
VAS Score During Positioning (0–10)	2.4 ± 0.9	4.8 ± 1.2	<0.001
Time to First Rescue Analgesia (hours)	9.6 ± 2.1	7.8 ± 1.9	0.01
Heart Rate During Positioning (bpm)	86.4 ± 7.8	94.2 ± 8.5	0.003
MAP During Positioning (mmHg)	95.1 ± 7.2	102.8 ± 8.4	0.002

Table 6: Direct Comparison between Group P (PENG) and Group F (FICB)

Parameter	Group P (PENG)	Group F (FICB)	Interpretation
Analgesia During Positioning	Lower VAS score (better analgesia)	Higher VAS score	PENG superior
Postoperative Analgesia Duration	Longer (9.6 hrs)	Shorter (7.8 hrs)	PENG lasts longer
Hemodynamic Response (Heart Rate)	Mild increase	Higher increase	PENG more stable
Hemodynamic Response (MAP)	Lower rise	Higher rise	FICB causes more stress
Patient Comfort	Better cooperation	More discomfort	Better with PENG

Discussion

The present study demonstrates that the Pericapsular Nerve Group (PENG) block provides superior analgesia during positioning for spinal anaesthesia, extends postoperative analgesic duration, and maintains greater hemodynamic stability when

compared with the Fascia Iliaca Compartment Block (FICB). These results align with the growing body of literature that highlights the enhanced selectivity of the PENG block in targeting the articular branches supplying the anterior hip capsule. Ramaswamy et al. showed that PENG block significantly reduced positioning pain and facilitated easier spinal anaesthesia in hip fracture patients, underscoring its relevance in surgeries where movement-induced discomfort is a major challenge [11]. Yang et al. further emphasized that PENG achieves more effective functional analgesia than supra-inguinal FICB, particularly due to its precise action on sensory branches while sparing major motor nerves required for postoperative mobilisation [12].

Postoperative analgesia also directly influences early rehabilitation and opioid requirements. The prolonged duration of analgesia observed in the current study is consistent with the findings of Charan et al., who demonstrated that patients receiving a PENG block experienced extended postoperative comfort with preserved quadriceps strength, thereby supporting early physiotherapy and reducing overall morbidity [13]. Hemodynamic stability is another critical determinant of perioperative safety in trauma patients. Movement-associated pain during spinal positioning can provoke sympathetic surges, often undesirable in elderly patients or those with coexisting cardiovascular conditions. A study by Tanwar et al. revealed that PENG block significantly attenuated heart rate and blood pressure fluctuations compared with FICB, mirroring the hemodynamic trends noted in the present study [14]. Additionally, the systematic review by Shaikh et al. supports the observation that PENG block consistently provides better tolerance for positioning and fewer autonomic responses across various hip-related procedures [15].

Taken together, the findings of recent evidence and the present study support the hypothesis that the anatomical precision of the PENG block translates to superior clinical outcomes. Its ability to offer enhanced positioning comfort, longer-lasting analgesia, and improved hemodynamic stability makes it a strong candidate for preferred use in femur fracture surgeries.

Conclusion

The Pericapsular Nerve Group block provides more effective analgesia during positioning, extended postoperative pain relief, and superior hemodynamic stability compared with the Fascia Iliaca Compartment Block in femur fracture surgery. Based on these advantages, the PENG block may be considered the more favorable regional anaesthesia technique for optimising perioperative care in this patient population.

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