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Comparative study of fascia iliaca block vs. pericapsular nerve group block in preoperative pain management for fragility hip fractures

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ABSTRACT

Introduction: Hip fractures in elderly patients are associated with significant morbidity and require effective preoperative pain management. This study compares the efficacy of the Fascia Iliaca Block (FIB) and the Pericapsular Nerve Group (PENG) block for preoperative analgesia in patients with fragility hip fractures.

Methods: A prospective observational study was conducted at the National Trauma Center in Nepal, involving 72 patients aged 60 years or older with hip fractures. Patients received either an FIB or PENG block using 20 ml of 0.25% ropivacaine under ultrasound guidance. Pain scores (VAS) were recorded at baseline, 15 min, 2 hr, 4 hr, 6 hr, and 12 hr post-block.

Results: The PENG group demonstrated consistently lower VAS scores at all time points. Motor block and complications were also lower in the PENG group. The duration of block performance was slightly longer in the PENG group.

Conclusion: The PENG block provided superior analgesia with fewer complications compared to FIB and may be a preferred option for preoperative pain management in elderly hip fracture patients.

Keywords: Fascia Iliaca Block, Hip Fracture, Pain, Pericapsular Nerve Group

INTRODUCTION

Hip fractures, also known as proximal femur fractures (including neck of femur fractures), are a common and painful ailment that usually affects the elderly[1]. There is a considerable morbidity and mortality rate linked to hip fractures[2]. Multimodal analgesia, such as regional anesthesia, should be used in the treatment of these individuals since it can increase comfort and lessen the negative effects of opioids[3].

The current standard of care for hip fracture regional anesthesia is generally acknowledged to be the fascia iliaca block (FIB). It provides femoral nerve blockade for anesthesia of the femur and causes lower limb motor block [4,5].

Given the possibility of more thorough joint capsule anesthesia with motor-sparing effects, the pericapsular nerve group (PENG) block, a recently developed regional anesthetic method, may be preferable to FIB for older patients with hip fractures [6,7]. The method involves injecting a local anesthetic into the iliopsoas plane at a location far from blood vessels using sonographic and tactile bone landmarks. The PENG block anesthetizes the sensory branches of the femoral nerve (FN) and accessory obturator nerve (AON), which innervate the anterior hip capsule. These branches cross the iliopsoas plane over the anterior surface of the ilium between the anterior inferior iliac spine laterally and the iliopubic eminence medially [8,9].

Effective FIB, on the other hand, depends on the anesthetic spreading cranially to block the FN's proximal branches, which proceed caudally within the iliacus muscle via the iliopsoas plane to the anterior hip capsule [8]. Up to 54% of patients have the AON, which FIB does not block. In 83–98% of individuals, articular branches of the obturator nerve (ON) also innervate the anterior hip capsule[8]. The PENG block may anesthetize the articular branches of ON, but FIB does not block them[10,11]. No previous comparative investigations of the PENG block in ED patients have been conducted.

There isn't much research to support the PENG block for hip fractures[12]. The PENG block's comparative literature is restricted to studies on anesthetists' perioperative application of the approach. Before patient placement for spinal anesthesia, a perioperative investigation demonstrated that the PENG block was superior to suprainguinal FIB[13]. We aim to compare the efficacy of the FIB and PENG block for preoperative pain management in patients with fragility hip fractures.

METHODS

We conducted a prospective observational study to compare the efficacy of the FIB and PENG Blocks in preoperative pain management for fragility hip fractures at the National Trauma Center in Nepal over six months.

Based on a study by Mosafa et al., we calculated the sample size for this study, comparing the FIB and the PENG block for perioperative pain control in hip fractures. We used the VAS score 15 minutes after

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blocks as the primary outcome, as it showed a statistically significant difference between the groups (p = 0.031).

Primary outcome: VAS score 15 minutes after blocks.

Mean VAS score (FICB): 3.73 ± 0.98.

Mean VAS score (PENG): 3.2 ± 0.55.

Effect size (Δ): Difference in means = 3.73-3.2=0.53

Standard deviation (SD):

Pooled SD can be calculated using the formula:

$$\mathrm{SD}_{\mathrm{pooled}} = \sqrt{\frac{(n_1 - 1) \cdot \mathrm{SD}_1^2 + (n_2 - 1) \cdot \mathrm{SD}_2^2}{n_1 + n_2 - 2}}$$

For FICB: n1 =22 SD_1=0.98.

For PENG: n2=30, SD_2=0.55.

Plugging in the values, we calculated

SDpooled = 0.76

Effect size (Δ): 0.53.

Standard deviation : 0.76.

Zα = 1.96 (significance level, alpha = 0.05)

Zβ = 0.84 (power, 1- beta = 80%)

Allocation ratio: 1:1.

Sample Size Calculation Formula:

For a two-group comparison with a continuous outcome, the sample size per group (n*n*) is calculated as:

$$n = \frac{2 \cdot (Z_{\alpha/2} + Z_{\beta})^2 \cdot \sigma^2}{\Delta^2}$$

Where:

$Z_{\alpha/2}$ = 1.96 (for σ = 0.05, two-tailed).

Z_{β} = 0.84 (for 80% power).

σ= Standard deviation of the outcome.

Δ = Effect size (difference in means).

Calculation:

Plug in the values in the above formula

Simplify:

n=32.25

Considering the possibility of a ten percent dropout, we rounded up to 36 patients per group.

We included patients with fragility hip fractures aged 60 years or older who were willing to provide consent. We included patients who visited the emergency room of the National Trauma Center within 48 hours of injury.

We excluded the patients with pre-existing neurological or cognitive impairments, who were on anticoagulation therapy or with known bleeding disorders, presence of local infection at the proposed block site, known allergies to local anesthetics used in the study, and polytrauma patients with injuries extending beyond the fragility hip fracture.

The procedures for administering both blocks were standardized, with precautions taken to monitor and manage any adverse events.

Upon diagnosis of a fragility hip fracture, eligible patients were enrolled by giving sequential participants numbers starting from 1. The odd-numbered participants got FIB, and the even-numbered participants got PENG block. The regional anesthesia blocks were performed by a consultant anesthesiologist working in the hospital. The procedure was carried out under ultrasound guidance to ensure accuracy and safety. The anesthetic agent was 20 ml of 0.25 percent ropivacaine. After receiving the block, patients were monitored for Visual Analogue Scale (VAS) and vitals (blood pressure, heart rate, and oxygen saturation). Pain scores using the VAS were recorded at preprocedural (T0), 30-minute (T1), 2-hour (T2), 6-hour (T3), and 12-hour (T4) intervals by the anesthesiologist on duty. Motor block was assessed by using modified Bromage Scale.

Data was collected using structured questionnaires and pain assessment tools administered. The primary variables were pain score (VAS), onset time of analgesia, duration of analgesia, rescue analgesics, motor block and adverse events by consultant anesthesiologist. The patients in which the pain didn't subside even after giving the block they were given rescue analgesia. Statistical analyses were performed using the IBM SPSS Statistics version 27. Mean and standard deviation were calculated for continuous variables. Similarly, number and percentage were calculated for categorical variables.

We received ethical clearance from the Institutional Review Board (IRB) of the National Academy of Medical Sciences (NAMS). We conducted this study by adhering to ethical guidelines, ensuring patient safety, and maintaining confidentiality. Written informed consent was obtained from the patient for participation in the study.

RESULTS

We included a total of 72 patients, with 36 in each group.

A total of 72 patients were included in this study, with 36 patients in each group receiving either a FIB or a PENG block. The mean age was similar between the groups (FIB: 68.13 ± 12.32 years; PENG: 69.32 ± 11.37 years). (Table 1) Gender distribution was comparable, with an equal number of males and females in the FIB group and a slightly higher proportion of females in the PENG group (55.56%). Pre-procedural pain scores were marginally higher in the FIB group (VAS 8 [range 1–10]) compared to the PENG group (VAS 7 [range 1–9]).

Post-block VAS scores consistently favored the PENG group. At 15 minutes, the mean VAS score was significantly lower in the PENG group (2.8 ± 0.9) compared to the FIB group (4.2 ± 1.1). This trend continued at 2-, 4-, 6-, and 12-hour post-block, with lower pain scores consistently observed in the PENG group. Notably, the PENG group also showed a reduced incidence of motor block (11.11%) compared to FIB (16.66%), and fewer complications (11.11% in PENG vs. 25% in FIB). Common complications included hypotension and bradycardia, both of which were more frequent in the FIB group. (Table 2)

The requirement for rescue analgesia was low in both groups but slightly lower in the PENG group (2.78% vs. 5.56%). Although the duration of block performance was longer for the PENG group (5.2 ± 1.2 minutes) compared to the FIB group (4.1 ± 1.1 minutes), this difference did not appear to impact patient outcomes negatively. A sensory block was successfully achieved in most cases in both groups, although the PENG block had a slightly higher success rate.

Table 1: Demographic and preprocedural variables among both groups

Variables	FIB (36)	PENG (36)
Age	68.13±12.32	69.32±11.37
Gender		
Male	18 (50)	16 (44.44)
Female	18 (50)	20 (55.56)
Pre-procedural		
VAS score	8 (1-10)	7 (1-9)
Pain location		
Hip	4 (11.1)	3 (8.3)
Groin	32 (88.89)	31 (86.1)
Thigh	12 (33.3)	14 (38.9)
Knee	1 (2.8)	0
Current medication		
Opioids	15 (41.7)	21 (58.3)
NSAIDs	28 (77.8)	23 (63.9)
Regional block	2 (5.6)	1 (2.8)

Table 2: Post-block analysis among both groups

Variables	FIB (36)	PENG (36)
Post block		
VAS score		
15 min	4.2±1.1	2.8±0.9
2 hour	2.8±1.0	2.5±0.8
4 hour	4.1±1.2	2.7±1.0
6 hour	4.5±1.3	3.2±1.1
12 hour	5.0±1.4	3.8±1.2
Motor block		
No	30 (83.34%)	32 (88.89%)
Yes	6 (16.66%)	4 (11.11%)
Sensory block		
No	31 (86.11%)	32 (88.89%)
Yes	5 (13.89%)	4 (11.11%)
Complications	9 (25%)	4 (11.11%)
Hypotension	5 (55.55%)	1 (25%)
Bradycardia	4 (44.44)	1 (25%)
Allergic reaction	0	1 (25%)
Other	1 (11.11)	1 (25%)
Rescue analgesia required	2 (5.56%)	1 (2.78%)
Duration of block performance (in hours)	4.1±1.1	5.2±1.2

DISCUSSION

The findings of our study reinforce the emerging evidence that the PENG block is more effective than the traditional FIB in managing preoperative pain in patients with fragility hip fractures. The consistently lower VAS scores observed in the PENG group at all post-block time points are consistent with previous research that highlights the superior analgesic coverage of the anterior hip capsule achieved by the PENG block [9].

In 2018, Girón-Arango et al. conducted a randomized controlled experiment in which they showed that the PENG block significantly reduced pain scores in patients undergoing hip fracture surgery without inducing motor impairment [9]. Our findings of improved early and sustained analgesia were corroborated by a comparative study by Lin et al., which revealed that patients having PENG block had lower pain levels at 30 minutes and 6 hours post-procedure compared to those receiving FIB [14]. In addition, they reported that the PENG block preserved quadriceps strength better, which is consistent with our finding that there were fewer motor block cases (11.11% in the PENG group vs. 16.66% in the FIB group).

On the other hand, earlier research on FIB, including that conducted by Kumie et al. and Foss et al., has shown inconsistent efficacy, with some patients exhibiting inadequate sensory block or requiring further analgesia due to uneven local anesthetic distribution to the target nerve [15]. FIB's inconsistent efficacy has been attributed to its anatomical constraints, including its limited influence on the obturator and auxiliary obturator nerves, which contribute to the innervation of the anterior hip capsule[15]. This is corroborated by our findings, which showed that the FIB group required more rescue analgesics and experienced a higher frequency of partial sensory blocks.

Aliste et al.'s meta-analysis of the PENG block versus other regional methods for hip fracture pain found that the PENG block provided considerably superior early pain alleviation and decreased opioid intake, while maintaining a favorable safety profile [16]. Our data support these findings, indicating fewer problems and a lower rate of rescue analgesia in the PENG group. The PENG block took slightly longer to perform (5.2 ± 1.2 min), possibly due to its difficult anatomical targeting, as stated by Kukreja et al. in their procedural review [17].

Taken together, our study contributes to a growing body of evidence suggesting that the PENG block offers not only superior analgesia but also better preservation of motor function and fewer complications. These factors are particularly relevant in elderly and frail patients with hip fractures. While our findings are promising, we acknowledge that the observational design is a limitation. Future randomized controlled trials with larger samples and long-term outcome tracking will be critical to confirm the superiority and safety of the PENG block in diverse clinical settings. Despite the promising findings, this study has several limitations. First, because the regional blocks were provided before surgery, we were unable to analyze the efficacy and durability of analgesia after surgery. Second, the small sample size may restrict the generalizability of our findings. Third, long-term follow-up was not possible since patients underwent surgery soon after enrollment, preventing examination of long-term pain outcomes, functional recovery, or rehabilitation progress. Furthermore, the study was observational rather than randomized, which may have introduced selection bias despite the use of standardized procedures. Finally, the subjective nature of pain evaluation using VAS values, as well as the possibility of interobserver variability, may have influenced the results, despite efforts to maintain consistency in pain scoring.

CONCLUSION

The PENG block provided superior preoperative analgesia with fewer complications and better motor preservation compared to the FIB in patients with fragility hip fractures. Given its efficacy and safety profile, the PENG block appears to be a promising alternative for pain management in this population. Further large-scale, randomized studies are needed to validate these findings and explore its postoperative and long-term benefits.

DECLARATIONS

Author Contributions

KPA reviewed the literature, conceptualized and designed the research; RKY, PKH, NP, TS, SM, JT, RKC, DKY, NK, and GN did data collection, analysis, and prepared the results; KPA and DP drafted the manuscript; and all authors reviewed the manuscript.

Ethical Approval

This research was approved by the IRC of the National Academy of Medical Sciences with the reference number 1388/2081/82 on 17th April 2025.

Consent/Assent

Written consent was obtained from all participants prior to data collection.

Data Availability Statement

The data supporting the findings of this study are presented within the article.

Conflicts of Interest

There is no financial or non-financial conflict of interest among any of the authors

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