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"A comparative study between Pericapsular nerve group block and Suprainguinal fascia iliaca compartment block for positioning patients with hip fractures before regional anesthesia"

Keywords
Analgesia; Hip Fractures; Local anesthetics; Nerve block; Pain management; Patient Positioning; Regional anesthesia; Ultrasonography.

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Abstract

Background and aims: Pain during positioning for neuraxial anesthesia in hip fracture patients remains a significant challenge. Ultrasound-guided regional nerve blocks are effective opioid-sparing techniques for improving positioning conditions. This study compared efficacy of ultrasound-guided Pericapsular Nerve Group (PENG) and Suprainguinal Fascia Iliaca Compartment (SIFI) blocks in hip surgical patients, using fast acting Lignocaine to facilitating positioning during regional anesthesia.

Methods: In this double-blinded study, 70 patients with hip fractures were randomized into two groups : Group P (PENG block) and Group S (SIFI block), with 35 patients each. Pain was assessed using the Numerical Rating Scale (NRS) at rest and during 15° passive limb elevation at baseline, 10, 20, and 30 minutes post-block. Ease of spinal positioning (EOSP) at 30 minutes was the primary outcome. Secondary outcomes were to compare time to achieve adequate analgesia (NRS < 3) and requirement of rescue analgesia.

Results: NRS scores significantly reduced post blockade in both groups. At 10 minutes, the SIFI group had statistically significant lower NRS during limb elevation than PENG group($p = 0.03$) but scores were comparable at 20 and 30 minutes. EOSP scores were similar, with all patients achieving optimal positioning. Time to achieve NRS < 3 did not differ significantly with none requiring rescue analgesia.

Conclusion: Both PENG and SIFI blocks provide effective analgesia at 30 minutes for positioning in hip fracture patients with SIFI block showing earlier dynamic pain relief. The use of Lignocaine adds practical advantage of faster block onset potentially improving turnover in busy settings.

1. INTRODUCTION

With increasing life expectancy, there has been a surge in the number of elderly patients presenting with hip fractures often resulting from trauma to osteoporotic bone and represent a major health and socioeconomic burden worldwide. Hip fractures are associated with significant morbidity, mortality and prolonged hospitalization, particularly among elderly individuals with multiple comorbidities [1]. Regional anesthesiais therefore commonly preferred in this population as it may reduce perioperative complications associated with general anesthesia [2,3].

Severe pain associated with proximal hip fractures presents a significant challenge during positioning for neuraxial anesthesia [4]. This dynamic pain frequently results in difficulty in achieving optimal positioning for regional anesthesia, leading to patient discomfort, prolonged procedural time and occasionally failed neuraxial attempts.

Several intravenous analgesics such as paracetamol, non-steroidal anti-inflammatory drugs and even opioids have been used to provide preoperative pain relief.While effective at rest, they often fall short in providing adequate dynamic analgesia for movement and positioning. Also, these medications are associated with potential adverse effects including respiratory depression, sedation, renal impairment and delirium, particularly in elderly individuals [5].

Several regional techniques have been utilized for hip fracture analgesia, evolving from landmark-based approaches to precise ultrasound-guided injections, from single nerve blocks to various nerve group and facial plane blocks. Consequently, ultrasound-guided regional nerve blocks have gained increasing popularity as an effective opioid-sparing strategy for perioperative analgesia.

Fascia iliaca compartment block and femoral nerve block have been widely employed to provide analgesia in these patients. The suprainguinal access to fascia iliaca block allows more proximal spread of local anesthetic within this compartment, resulting in more reliable blockade of the femoral nerve, lateral femoral cutaneous nerve and on few occassions even the obturator nerve [6].

More recently, the pericapsular nerve group block has been described as a novel regional anesthetic technique which acts upon the articular branches of the femoral, obturator and accessory obturator nerves supplying the anterior hip capsule providing effective analgesia to the hip joint without affecting the quadriceps contraction [7].

The PENG block and suprainguinal fascia iliaca block are useful ultrasound-guided techniques for hip fracture analgesia, but their comparative value for positioning remains uncertain , which is one of the most challenging steps in management of hip fracture patients in agonising pain.

The present study was therefore designed to directly compare the analgesic efficacy of ultrasound-guided Pericapsular nerve group (PENG) block and Suprainguinal fascia iliaca (SIFI) block using a fast acting local anesthetic Lignocaine for facilitating patient positioning, reducing procedural delays during regional anesthesia in patients with hip fractures.

By assessing parameters such as pain scores, ease of spinal positioning, time to achieve adequate analgesia and requirement of rescue analgesia, this study aims to provide clinically relevant evidence to guide anesthesiologists in selecting the most effective regional analgesic technique for improving patient comfort and procedural success during regional anesthesiain proximal hip fracture surgery. The result of the study could provide insights for options to customize according to the patient and case, utilising a faster and optimal drug choice, cutting short the wait time in high volume settings.

Methods:

This study was undertaken in a tertiary health care institute for a duration of over two years between 2024-2026, after obtaining the Institutional ethics committee approval (IEC number: ECR/1628/Inst/KA/2021) and registering in Clinical Trial Registry of India (Registration number: CTRI/2024/03/064946). The study followed the principles of Declaration of Helsinki. .

The study involved patients aged above 40 years with hip fractures of less than one week of trauma, belonging to the American Society of anesthesiologist (ASA) physical status class I-III of both genders posted for surgery under regional anesthesia. A total of 70 patients with proximal hip fractures either intertrochantric fracture or neck of femur fracture, who provided written informed consent were included to participate in our study. The sample size calculation was based on expected differences in EOSP observed in earlier study which was 0.5 [7]. At 95% confidence interval and a power of 80% , 56 participants were required at $P < 0.05$. Considering > 10% attrition in the study, 70 patients were enrolled with 35 in each group. The formula used was,

$k = n_2/n_1 = 1$,

$n_1 = (\sigma_1^2 + \sigma_2^2 / K)\,(z_{1-\alpha/2} + z_{1-\beta})^2 / \Delta^2$; $n_1 = (0.67^2 + 0.67^2 / 1)\,(1.96 + 0.84)^2 / 0.5^2$, $n_1 = 28$,

$n_1 = 28$, $n_2 = K \times n_1 = 28$ in each group.

$\Delta = [\mu_2 - \mu_1]$ = absolute difference between two means;

σ_1, σ_2 = variance of means;

n_1 = sample size of group 1; n_2 = sample size of group 2; α = probability of type-1 errors (0.05); β = probability of type-2 error (0.2);

z = critical Z value for a given α or β; k = ratio of sample for Group 2 to Group 1.

On the morning of surgery, the patients fulfilling the inclusion criteria of the study were shifted to the operation theatre, standard monitors were connected and an intravenous line was secured. The patients were then assigned to either of the two study groups based on a computer generated random number table.

1. Group P- received ultrasound guided PENG block
2. Group S- received ultrasound guided SIFI block

The first anesthesiologist was blinded to the patients group allotment and assessed the patients for baseline pain score using Numerical rating scale from 0 = No pain to 10 = worst pain experienced, both at rest and 15° passive limb elevation.

A second anesthesiologist who was conventionally trained in performing ultrasound guided PENG and SIFI

blocks and was blinded to pain assessment, performed the respective assigned blocks under strict asepsis. Sonosite M turbo ultrasound scanning machine was used for performing the blocks. Linear 3 to 11 MHz was used for the SIFI block and a curvilinear 5 to 8 MHz ultrasound probe was used for PENG block.

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Patients in Group P received 20 ml of 1% Inj.Lignocaine + Adrenaline in Pericapsular Nerve group block (Figure: 1). The drug was deposited between the psoas tendon and the ilio-pubic eminence (IPE) [8 ,9]

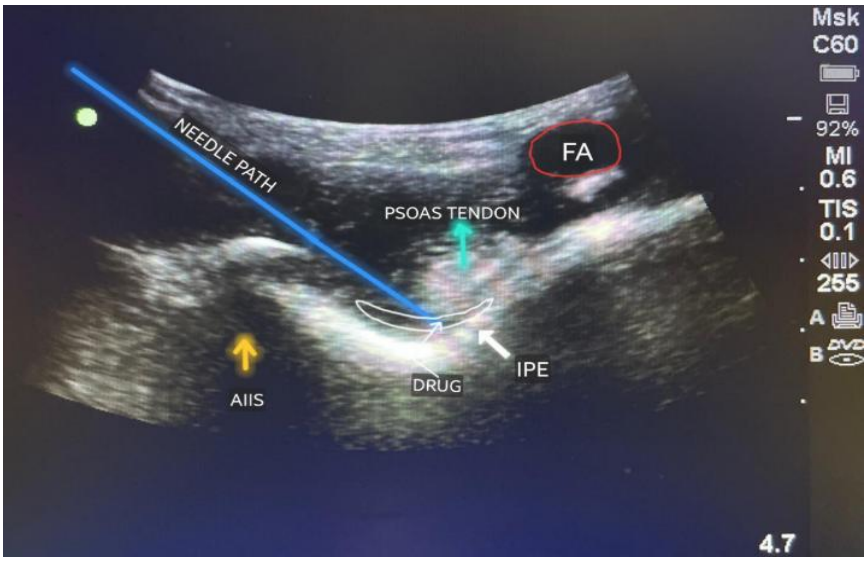

Figure 1: Sono anatomy showing PENG block landmarks. [AIIS-Anterior inferior iliac spine, IPE-Ilio pubic eminence].

Patients allotted to Group S received 30ml of 1% Inj.Lignocaine + Adrenaline in Suprainguinal fascia Iliaca block (Figure: 2). The point of injection was between fascia iliaca and iliacus muscle [10,11].

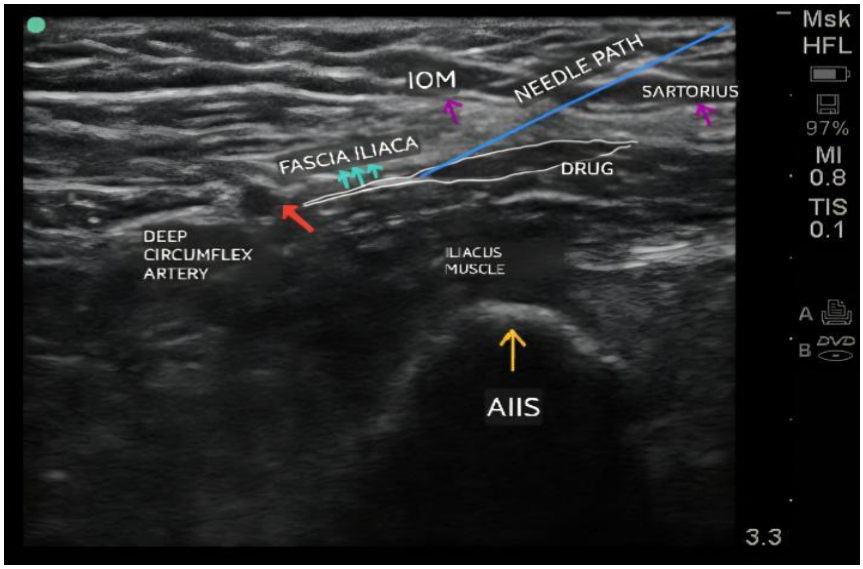

Figure 2: Figure 2: Sono anatomy showing SIFI block landmarks [AIIS- Anterior inferior iliac spine, IOM-Internal oblique muscle].

This second anesthesiologist was then relieved from the patient care after performing the block. The first anesthesiologist continued the patient care and assessed the analgesic efficacy using NRS at 10, 20, 30 minutes intervals both at rest and 15° passive limb elevation. Standard monitoring of the patients were continued which included heart rate, non-invasive blood pressure and oxygen saturation and for signs or symptoms of local anesthetic toxicity for the next 30 minutes.

At 30 minutes, after achieving Numerical rating scale (NRS) < 3, patients were positioned in sitting position for the planned central neuraxial technique. If NRS < 3 was not achieved, intravenous Inj. Fentanyl 0.5 µg/kg was planned to be given.

The patients were assessed for the Ease of spinal positioning (EOSP) on a scale of 0–3 (0 = unable to position, 1 = patient had abnormal posturing due to pain and required support for positioning, 2 = mild discomfort but does not require support to sit for positioning, 3 = able to sit comfortably without support).
The central neuraxial block (CNB) was performed. After the procedure the patient was made to lie down. The anesthesiologist performing CNB opined about the optimal/ suboptimal positioning for performing CNB. The patients underwent surgery and later shifted to the postoperative ward.
Data analysis was done using SPSS Version 16. Independent Student's t-test was used to compare continuous variables (age,height,weight) between groups which were expressed as mean ± standard deviation. Categorical variables (sex, rescue analgesia, anesthesiologist grading) were expressed as frequencies and percentages, and group differences were analyzed using the Chi-square test or Fisher's exact test. NRS scores and EOSP scores, being ordinal data, were expressed as medians (interquartile range) and compared using the Mann-Whitney U test. All statistical tests were two tailed and interpreted at a 95% confidence interval. For independent Student's T Test , the degree of freedom were 68. A $P < 0.05$ was considered statistically significant.

Results:
A total of 70 patients were included in this study, with 35 patients randomized into the PENG block group (Group P) and 35 patients randomized into the SIFI block group (Group S) (Figure 3)

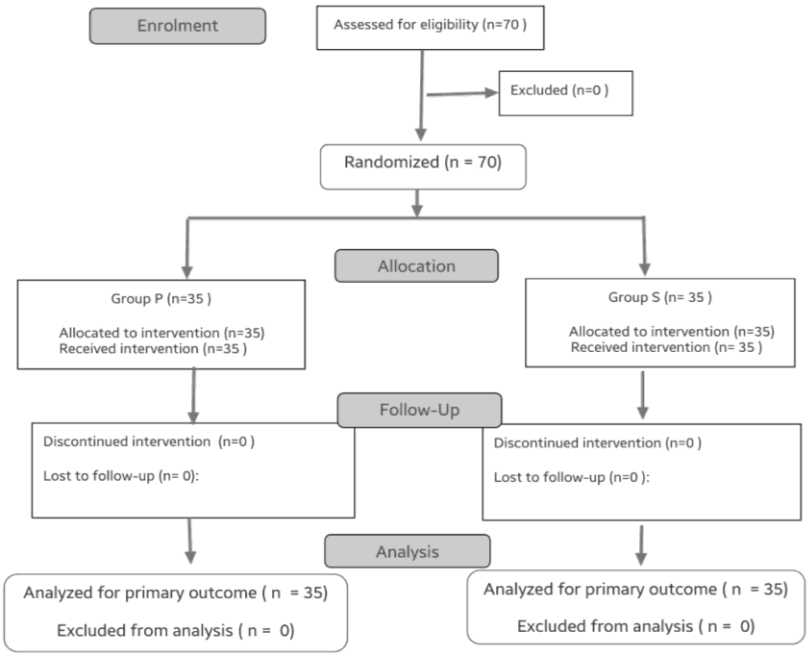

Figure 3: CONSORT flow diagram showing participant enrollment, allocation, follow-up, and analysis.

There were no significant differences in the demographic characteristics between the two groups. The mean age in the PENG group was comparable to the SIFI group (P = 0.103). Sex distribution (P = 0.811) and Body mass index (P = 0.371) were also statistically similar between the groups (Table 1).

Table 1: Demographic comparison table of Group P and Group S.

Parameter	Group P (mean± SD)	Group S (mean± SD)	P value
Age (years)	73.00± 7.84	69.37±10.35	0.103
Sex (Male/ Female)	17/18	19/16	0.811
Height (cm)	150.0 ± 8.0	153.0 ± 6.0	0.074
Weight(kg)	62.0 ± 8.0	63.0 ± 7.0	0.576
BMI (kg/m²)	27.6 ± 3.4	26.9 ± 3.1	0.371

Primary Outcome: Analgesic efficacy (NRS scores) - The NRS scores at rest and during 15° limb elevation were recorded at pre-block baseline, 10, 20, and 30 minutes post-block.
Baseline pain scores were similar in both groups. Upon assessment at 10 minutes post-block, both groups exhibited a marked reduction in pain scores, a statistically significant difference was observed during 15° limb elevation (P = 0.026), with the SIFI group showing lower NRS scores. Analgesic efficacy equalized between the two groups by the 20-minute mark. There were no statistically significant differences in NRS scores at rest or during movement at 20 or 30 minutes post-block (Table 2).

Table 2: Comparison of NRS scores over time between the groups.

Time point	Group P, median (IQR)	Group S median (IQR)	P value
Pre-block (Rest)	8.0(1.5)	8.0(1)	0.212
Pre-block (15° Elevation)	9.0(0.5)	9.0(2)	0.162
10 min (Rest)	4.0(2)	3.0(2)	0.093
10 min (15° Elevation)	5.0(1.5)	4.0(1.5)	0.026*
20 min (Rest)	1.0(1)	1.0(1)	0.876
20 min (15° Elevation)	2.0(1.5)	2.0(1)	0.323
30 min (Rest)	1.0(0)	1.0(0)	0.339
30 min (15° Elevation)	1.0(1)	1.0(1)	0.563

*IQR-interquartile range,*p < 0.05 compared between groups.*

Ease of Spinal Positioning (EOSP): There was no significant difference in the ease of spinal positioning between the two groups (Table 3).

Table 3: EOSP scores comparision between the groups.

Parameter	Group P Median (IQR)	Group S Median (IQR)	P value
EOSP score	3.0 (0.0)	3.0 (0.0)	0.697

IQR-interquartile range.

Rescue Analgesia: There was no requirement for rescue analgesia in both the groups and hence comparable between the groups (P = 1.0). anesthesiologist's Grading: Both groups reported 100% "Optimal" grading for spinal positioning, indicating no significant difference (P = 1.0) (Table 4).

Table 4: Requirement of rescue analgesia and anesthesiologist grading.

Parameter	Group P	Group S	P value
Rescue Analgesia Required	0 (0%)	0 (0%)	1
Anesthetist Grading (Optimal)	35 (100%)	35 (100%)	1

Optimal grading indicates satisfactory positioning for central neuraxial block without difficulty.
Time to achieve NRS <3: The comparison between Group P and Group S regarding the time required to achieve a target NRS score of < 3 showed no statistically significant difference in onset times between the two groups. At rest, both groups achieved this benchmark in approximately 16 minutes on average. During 15° limb elevation, the SIFI group achieved the target roughly 2.5 minutes faster than the PENG group (19.14 vs 21.71 minutes). While this represents a clinical trend toward faster movement-related relief, it did not reach statistical significance (Table 5).

Table 5: Mean time to achieve NRS <3 between the groups. Footnotes: Values are presented as mean ± standard deviation.

Condition	Group P (mean±SD)	Group S (mean±SD)	P-value
At rest	16.57 ± 5.39	15.71 ± 6.55	0.542
15°elevation	21.71 ± 5.68	19.14 ± 7.02	0.101

DISCUSSION:

The present study demonstrates that both PENG and SIFI blocks are effective in reducing pain and facilitating positioning for neuraxial anesthesia in patients with hip fractures. Although both techniques achieved comparable analgesia at 20 and 30 minutes, the SIFI group showed a trend towards better dynamic pain relief at 10 minutes, suggesting a relatively faster onset for movement-related analgesia.

This early advantage with SIFI may be explained by its mechanism of action. The suprainguinal approach enables extensive spread of local anesthetic within the fascia iliaca compartment, reliably blocking the femoral nerve, lateral femoral cutaneous nerve and occasionally the obturator nerve. This broader neural coverage likely contributes to improved dynamic analgesia during limb movement. In contrast, the PENG block is a more targeted technique that primarily blocks the articular branches supplying the anterior hip capsule. While this selective blockade is advantageous for preserving motor function, the onset of analgesia for dynamic pain may be slightly delayed.

A key strength of present study is use of 1% lignocaine for both blocks which provided rapid onset advantage compared to longer acting drugs used in earlier studies. This can be beneficial in reduced waiting time for block effect and gave more time for regional procedures, that could be conducted more efficiently in this high volume, resource limited rural center. Also, the volume used in PENG block is 20 ml [12], as compared to 30 ml in SIFI block[4], may have resulted in a slightly faster onset of analgesia due to wider nerve coverage as described in an earlier study demonstrating volume related spread difference [13, 14] and faster diffusion through fascial planes as indicated by a borderline significance at 10 min (P = 0.026). Despite the lower volume, PENG block being target specific, not volume driven, achieved similar pain scores by 20 minutes, indicating that the clinical relevance of this difference is limited. These findings are consistent with previous studies such as Kulkarni et al., [8] and Pativada et al.,[15] which reported comparable efficacy between PENG and fascia iliaca-based blocks for positioning during spinal anesthesia. However, some studies, including Jadon et al.,[4], have reported superior ease of positioning with PENG block and Bauiomy et al,.[16] and Koh et al.,[17] favored PENG for pain relief and positioning; in contrast, Huang KT et al,.[18] found both blocks equally effective at 30 minutes, highlighting variability that may be related to drug choice, volume, or technique.

Ease of spinal positioning was comparable in both groups, with a high proportion of patients achieving optimal positioning. This reinforces the role of both blocks in improving patient comfort and procedural conditions. The patients can be safely positioned by 20–30 minutes post block regardless of the block chosen. These findings are consistent with the study by Kulkarni et al., which emphasized that regional techniques significantly improved patient comfort and anesthesiologist's satisfaction compared to traditional systemic analgesics.

One of the documented advantages of PENG block is its motor-sparing nature, which may be preferable in certain post-operative recovery pathways to avoid quadriceps weakness. However, for the specific task of positioning for spinal anesthesia, the potential for quadriceps weakness with SIFI is less of a concern since the patient will immediately receive a neuraxial block.

Notably, none of the 70 patients in our study required rescue fentanyl. This is a critical outcome for the geriatric population. Avoiding systemic opioids reduces the incidence of common complications in this demographic, such as respiratory depression, nausea, and postoperative delirium.

From a practical standpoint, the choice between PENG and SIFI may depend on clinical priorities. SIFI may be preferred when rapid onset is desired, whereas PENG block may be advantageous in situations where preservation of motor function is important. However, for the purpose of positioning prior to neuraxial anesthesia, both techniques appear equally effective.

The study used a short-acting local anesthetic, limiting assessment of postoperative analgesia. Motor blockade and duration of analgesia were not evaluated. Larger multicentric studies are required to validate these findings.

CONCLUSION:

Both PENG block and SIFI are effective regional analgesic techniques for facilitating positioning in hip fracture patients undergoing neuraxial anesthesia. Although SIFI may provide early relief of dynamic pain, both techniques achieve comparable analgesia within 20–30 minutes.Either technique can be used safely as part of a multimodal, opioid-sparing analgesic strategy in this patient population.

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