Ultrasound Guided Supra-Inguinal Fascia Iliaca Compartment Block Vs Femoral Nerve Block for Analgesia Management of Hip Fracture Patients in Emergency Department

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Abstract

Aim: Hip fractures cause severe pain, especially in elderly patients, making effective pain management crucial in the emergency setting. Regional anesthesia techniques are increasingly used to reduce opioid requirements and improve analgesia. However, the comparative efficacy of supra-inguinal fascia iliaca compartment block (SFIB) versus femoral nerve block (FB) remains unclear.

Methods: This prospective, randomized study included patients aged 18 years or older with radiologically confirmed proximal hip fractures. Patients were randomized to receive either ultrasound-guided SFIB or FB. Pain intensity was measured using the Numeric Rating Scale (NRS) at baseline and at 20 minutes, 2, 4, 6, and 8 hours after the block. Opioid consumption, additional analgesic use, and adverse events were recorded.

Results: A total of 48 patients were included (SFIB: 27, FB: 21). Baseline NRS scores were similar between the groups. The onset time of the block was shorter in the SFIB group ($p<0.001$). FB resulted in significantly lower NRS scores at all post-block time points ($p<0.05$). Time to first additional analgesic requirement was longer in the FB group ($p<0.001$). No significant differences were found in opioid consumption or adverse events.

Conclusions: Both SFIB and FB provided effective analgesia in patients with hip fractures. FB was superior for long-term pain control, while SFIB had a faster onset. These results may guide the choice of regional anesthesia techniques in the emergency department.

Keywords: *Hip fracture; nerve block; regional anesthesia; pain management; emergency service; hospital.*

1. Introduction

Hip fractures are often painful, and their management is challenging because patients are usually elderly and have multiple comorbidities. These patients frequently experience severe pain, making analgesic treatment a vital part of Emergency Department (ED) care. However, traditional pain management in older adults is complicated due to age-related physiological changes and comorbidities. Effective pain control has been associated with improved functional outcomes.[1] Regional anesthesia has become an increasingly preferred option in the ED, as it not only reduces pain but may also limit the adverse effects of systemic analgesics.[2-4] Several techniques have proven both effective and safe for providing pain relief in patients with hip fractures.[5] The fascia iliaca compartment block (FIB) involves the injection of a local anesthetic beneath the iliac fascia, targeting the femoral and lateral femoral cutaneous nerves that contribute to hip innervation.[6,7] Supra-inguinal fascia iliaca block (SFIB) is a modified technique described by Hebbard et al., which allows more proximal and dorsal spread of anesthetic in the iliac fossa, potentially increasing its success rate.[8] A recent randomized trial by Liang Chen et al. demonstrated the analgesic benefit of SFIB in older adults presenting to the ED with hip fractures. Their findings showed opioid-sparing effects and favorable pain scores, suggesting its value as part of early pain management protocols.[9] In a perioperative clinical study involving patients who underwent hip arthroplasty, Stevens et al. concluded

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that the supra-inguinal approach provided a significant reduction in opioid requirements when compared to a sham block.[10] However, it remains unclear whether SFIB offers advantages over the more commonly used femoral nerve block (FB), especially in terms of onset, duration, and opioid reduction.

The aim of this study was to compare the analgesic efficacy of ultrasound-guided SFIB and FB in patients with proximal hip fractures (fractures involving the femoral neck and intertrochanteric region) in the ED. We hypothesized that SFIB would provide satisfactory pain relief while minimizing the risk of complications. To our knowledge, very few studies have directly compared these techniques in the ED setting.

2. Materials and Methods

2.1. Study Design, Setting and Population

This prospective, randomized controlled trial was conducted at the Emergency Department (ED) of Kahramanmaraş Sütçü İmam University Faculty of Medicine between January and October 2019. The study was approved by the university's Clinical Research Ethics Committee (Decision No: 2017/03, dated 31.05.2017). The trial adhered to STROBE reporting guidelines.

We enrolled adult patients (≥18 years old) who presented to the ED with radiologically confirmed proximal hip fractures, defined as femoral neck or intertrochanteric fractures. Patients were excluded if they had: (1) femoral shaft fractures, (2) pathological fractures, (3) fracture occurring more than 24 hours before presentation, (4) known allergy to local anesthetics, (5) hemodynamic instability, (6) polytrauma, (7) known pregnancy, or (8) hematological disorders.

All eligible patients were randomized in a 1:1 ratio using sealed opaque envelopes into two groups: (1) the SFIB group, who received ultrasound-guided supra-inguinal fascia iliaca block, and (2) the FB group, who received femoral nerve block.

2.2. Blinding and Pain Assessment

The primary aim of this study was to evaluate the reduction in pain intensity, as assessed by the Numeric Rating Scale (NRS), 20 minutes after the administration of the supra-inguinal fascia iliaca compartment block (SFIB), compared with the baseline value recorded at the patient's initial presentation to the emergency department. The NRS, an 11-point scale where 0 represents no pain and 10 indicates the most severe pain imaginable, was used for this purpose. Secondary endpoints included pain scores measured at 2, 4, 6, and 8 hours following the block, as well as the need for additional opioid analgesia. The overall opioid consumption during the emergency department stay was calculated as morphine equivalent doses.

Data were also collected on the proportion of patients who required additional analgesics (such as acetaminophen or opioids), the timing and administration of these medications, and any adverse events that occurred. Patients were systematically asked about headache, nausea, vomiting, and dizziness, and were specifically monitored for arrhythmias and hypotension. Information regarding age, sex, type of fracture, and any analgesics administered prior to arrival at the hospital was also recorded. Pain assessments were performed by emergency physicians who were unaware of the type of block administered. To prevent any potential bias related to the volume of anesthetic solution, the syringes were masked with opaque tape so that the amount of solution could not be seen.

2.3. Block Procedures and Operator Experience

All blocks were performed by a single anesthesiologist (B.B.) with over 50 prior femoral nerve blocks and 20 supra-inguinal FIB procedures prior to the study, ensuring familiarity with both techniques. Standard monitoring included ECG, non-invasive blood pressure, and continuous pulse oximetry. All patients received 30 mL of 0.25% bupivacaine. No analgesics were given prior to block administration in the ED.

2.3.1. Supra-inguinal Fascia Iliaca Block

Patients were placed in the supine position. After identifying the anterior superior iliac spine (ASIS), a high-frequency linear ultrasound probe (LOGIQ 7; GE Healthcare, Milwaukee, USA) was positioned medial to the ASIS in a cranio-caudal orientation, with a slight lateral tilt. The 21 G/10 cm needle (Braun Stimuplex® Ultra 360, Germany) was inserted in-plane and advanced in a cephalad direction through the iliac fascia. After negative aspiration, the local anesthetic was slowly injected under direct visualization. Adequate spread beneath the fascia was confirmed by the presence of an anechoic fluid collection (Figure 1).

Figure 1

Sonographic visualization of SFIB. The spread is local anesthetic is seen in the fascia iliaca. IOM; internal oblique muscle, DCA; deep circumflex artery, LA; local anesthetic, AIIS; anterior inferior iliac spine.

2.3.2. Femoral Nerve Block

With patients supine, the femoral artery was identified below the inguinal ligament. The probe was oriented perpendicularly to visualize the femoral nerve lateral to the artery. A short-beveled needle was inserted in-plane. A test hydrodissection with 0.25 mL saline was performed to confirm needle position, followed by administration of the anesthetic solution (Figure 2). The blinding of anesthetic volume was ensured for both the physician and patient.

2.4. Outcome Measures

The primary outcome was the reduction in NRS pain score at 20 minutes after block compared to baseline. Secondary outcomes included NRS scores at 2, 4, 6, and 8 hours, total opioid consumption in morphine equivalents, time to first rescue analgesic use, need for additional analgesics, and any adverse events (e.g., nausea, vomiting, hypotension, dizziness, arrhythmias).

2.5. Statistical Analysis

Sample size was calculated using G*Power 3.1 (Heinrich-Heine University, Düsseldorf, Germany), based on an estimated large effect size (Cohen's d = 0.8), alpha = 0.05, and power = 80%, resulting in a required minimum of 21 patients per group. To account for dropouts, 48 patients were enrolled. Statistical analysis was performed using SPSS v25.0 (IBM Corp., Armonk, NY). Data normality was tested with Shapiro-Wilk and Kolmogorov-Smirnov

tests. Comparisons between groups used the t-test or Mann-Whitney U test as appropriate. Categorical variables were compared with chi-square or Fisher's exact test. Repeated measures were analyzed with the Friedman test, and within-group comparisons used the Wilcoxon signed-rank test. A p-value <0.05 was considered statistically significant.

Figure 2

Sonographic visualization of FB. The spread is local anesthetic is seen around the femoral nerve. FA; femoral artery, FN; femoral nerve, LA; local anesthetic.

3. Results

A total of 48 patients were enrolled in the study, with 27 randomized to the SFIB group and 21 to the FB group. Although patients were assigned using a 1:1 randomization method with sealed envelopes, the slight imbalance between groups occurred due to a small number of envelopes being inadvertently misallocated during peak admission times. The CONSORT flow diagram (Figure 3) outlines patient enrollment, allocation, and follow-up.

There were no significant differences in baseline demographics between the groups. However, the prevalence of diabetes mellitus was significantly higher in the FB group (76.2% vs. 29.6%, p = 0.001), while osteoporosis was significantly more common in the SFIB group (51.9% vs. 4.8%, p <0.001) (Table 1).

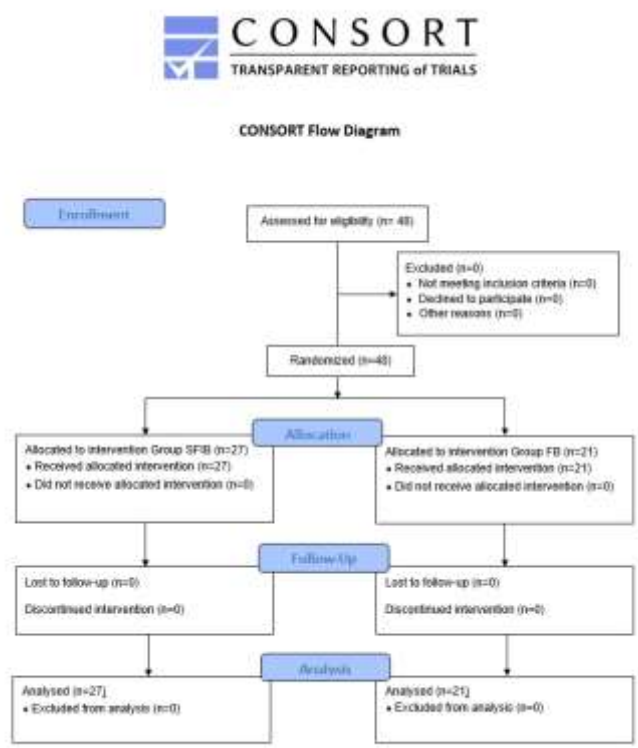
The time of block administration was measured by a trained emergency nurse who started the timer when the skin was cleaned and stopped when the injection was completed. The median application time was similar between groups (SFIB: 3.0 minutes; FB: 3.0 minutes, p = 0.078). However, the onset of analgesia was significantly faster in the SFIB group (median: 2.0 minutes) compared to the FB group (median: 5.0 minutes, p < 0.001) (Table 2).

The median baseline NRS score before the block was 10 in both groups. At 20 minutes post-block, both groups had a significant reduction in pain, but the FB group showed lower NRS scores at all time points: 20 minutes (p = 0.002), 2 hours (p = 0.001), 4 hours (p < 0.001), 6 hours (p <0.001), and 8 hours (p = 0.043).

No patients in either group required analgesics during their ED stay. "Analgesic use in the service" refers to analgesics administered after admission to the inpatient ward. The frequency of post-ED analgesic use was similar in both groups (p = 1.00). The time to first analgesic requirement was significantly longer in the FB group (median: 10 hours) compared to the SFIB group (median: 7 hours) (p < 0.001).

Pain was evaluated using a standardized protocol by trained ED staff, who routinely assessed pain at predefined intervals and administered additional analgesics if the NRS score exceeded 3. This ensured consistency in pain evaluation and management across both groups.

Figure 3



4. Discussion

Ultrasound-guided SFIB has been shown to produce a marked and clinically meaningful reduction in NRS pain scores for most patients with hip fractures treated in the emergency department.

Hip fractures and proximal femoral fractures rank among the most frequent types of fractures seen in the elderly population. The pain resulting from such fractures limits patients' ability to move and makes precise clinical evaluation challenging at the time of hospital admission. While surgical intervention is typically required for these individuals, the intense pain experienced can contribute to perioperative delirium and slow down postoperative recovery. As a result, achieving effective pain relief before surgery is vital for better outcomes in this patient group. Standard pain management in routine practice generally involves the use of systemic opioids and/or non-steroidal anti-inflammatory drugs (NSAIDs). However, both drug classes are associated with a range of potential side effects. Opioids may cause adverse effects including nausea, vomiting, delirium, and respiratory depression, whereas NSAIDs carry risks such as gastrointestinal bleeding and negative impacts on kidney function.

Table 1

Demographic and clinical data in hip fracture patients

		Group		p
		SFIB	FB	
Age[c]	Mean±SD	78.56±9.05	76.29±6.57	0.339
Gender[a]	Female, n(%)	15(55.6)	14(66.7)	0.435
	Male, n(%)	12(44.4)	7(33.3)	
Hypertension[a]	No, n(%)	11(40.7)	6(28.6)	0.382
	Yes, n(%)	16(59.3)	15(71.4)	
Diabetes Mellitus[a]	No, n(%)	19(70.4)	5(23.8)	0.001*
	Yes, n(%)	8(29.6)	16(76.2)	
Coronary Artery Disease[a]	No, n(%)	22(81.5)	16(76.2)	0.729
	Yes, n(%)	5(18.5)	5(23.8)	
Asthma[b]	No, n(%)	22(81.5)	21(100.0)	0.059
	Yes, n(%)	5(18.5)	0(0.0)	
COPD[b]	No, n(%)	26(96.3)	21(100.0)	1.00
	Yes, n(%)	1(3.7)	0(0.0)	
Atrial Fibrillation[b]	No, n(%)	25(92.6)	20(95.2)	1.00
	Yes, n(%)	2(7.4)	1(4.8)	
Demantia[b]	No, n(%)	25(92.6)	20(95.2)	1.00
	Yes, n(%)	2(7.4)	1(4.8)	
Malignancy[b]	No, n(%)	25(92.6)	21(100.0)	0.497
	Yes, n(%)	2(7.4)	0(0.0)	
Osteoporosis[a]	No, n(%)	13(48.1)	20(95.2)	p<0.001*
	Yes, n(%)	14(51.9)	1(4.8)	
Height (cm)[c]	Mean±SD	166.56±8.95	164.76±8.54	0.486
Weight (kg)[c]	Mean±SD	77.74±9.67	79.57±8.74	0.501

[a]Chi-Sqaure test; [b]Exact test; [c] Independent samples t test;a:0.05; Statistical significance. COPD, Chronic obstructive pulmonary disease.*

These complications tend to occur more frequently in elderly patients due to their existing comorbid conditions and reduced tolerance to pharmacologic treatments.[11]

Several studies have highlighted the effectiveness of SFIB in managing hip fracture pain within the emergency department. In one such study, Kassam et al. evaluated oral morphine consumption among patients with proximal femur fractures who underwent SFIB, comparing them to patients treated solely with oral morphine. Their findings indicated that the group receiving SFIB experienced notably lower pain scores and, on average, required 50 mg less oral morphine for adequate pain control.[12]

Chesters and Atkinson reviewed two randomized controlled trials that examined the use of SFIB for pain relief in patients with proximal femur fractures. The findings of these studies demonstrated, with statistical significance, that SFIB offered analgesia that was either superior to or comparable with other acute pain management approaches. Additionally, the authors reported that neither intervention group required supplemental opioid analgesia.[13] In our study there was no need for opioid analgesia in both groups.

As hip fractures are associated with nerve supply originating from the lumbar plexus, clinicians can utilize targeted regional anesthesia techniques to manage pain effectively. SFIB represents a peripheral nerve block that is frequently applied by anesthesia specialists as a component of multimodal pain control strategies for postoperative care following hip surgery. With adequate training, this advanced technique can also be safely performed by emergency physicians, physician assistants, and nurse practitioners. The supra-inguinal SFIB technique, which is easy to apply, can be considered as the anterior lumbar plexus approach since it targets the femoral nerve, lateral cutaneous part of the femoral nerve and obturator nerve.[14] Additionally, supra-inguinal approach is safer than the infra-inguinal approach due to its distance from the femoral nerve.[15] We think that the shorter onset time of block in group SFIB in our study is also related to lumbar plexus spread. The fascia iliaca compartment is a very large potential space. Volumes of more than 30 ml may be required to fill this potential space.[16] In our study, we used a volume of 30 ml.

Table 2

Pain scores and other features of block procedure.

		Group		p
		SFIB	FB	
Procedure app time (minute) [a]	Median(Q1-Q3)	3.00(3.00-5.00)	3.00(2.00-3.00)	0.078
Block onset time (minute) [a]	Median(Q1-Q3)	2.00(2.00-3.00)	5.00(5.00-5.00)	P<0.001*
Pre-procedural NRS [a]	Median(Q1-Q3)	10.00(10.00-10.00)	10.00(10.00-10.00)	0.336
Post-procedural 20. min. NRS [a]	Median(Q1-Q3)	0.00(0.00-2.00)	0.00(0.00-0.00)	0.002*
Post-procedural 2. h NRS [a]	Median(Q1-Q3)	0.00(0.00-2.00)	0.00(0.00-0.00)	0.001*
Post-procedural 4. h NRS [a]	Median(Q1-Q3)	1.00(0.00-3.00)	0.00(0.00-0.00)	p<0.001*
Post-procedural 6. h NRS [a]	Median(Q1-Q3)	3.00(1.00-4.00)	0.00(0.00-0.00)	p<0.001*
Post-procedural 8. h NRS [a]	Median(Q1-Q3)	2.00(1.00-3.00)	0.00(0.00-2.00)	0.043*
Analgesic use at emergency service [a]	No, n(%)	27.00(100.00)	21.00(100.00)	-
	Yes, n(%)	0.00(0.00)	0.00(0.00)	
Analgesic use at the service [b]	No, n(%)	1.00(3.70)	0.00(0.00)	
	Yes, n(%)	26.00(96.30)	21.00(100.00)	1.00
First analgesic use time (hour) [a]	Median(Q1-Q3)	7.00(6.00-8.00)	10.00(9.00-12.00)	p<0.001*

[a]Mann Whitney u test; [b]Exact test; a:0.05; Statistical significance. App: application, NRS: Numeric Rating Scale.*

Therefore, SFIB and FB efficacies may have been almost similar. If we had used more than 30 ml volumes, SFIB might have been more effective than FB.

Both ultrasound-guided techniques require experience with POCUS. In our study, the blocks were performed by an anesthetist experienced in ultrasound and regional anesthesia. It also has technical limitations for specialists in emergency departments who are not trained in this field.

Our study has some limitations. We used a fixed volume of 30 mL for both blocks; different results may be obtained with different volumes. Catheter can be inserted for continuous analgesia, we performed single-shot block. We did not perform dermatome analysis. Lastly, the relatively small sample size limits the statistical power of subgroup comparisons.

5. Conclusion

Both ultrasound-guided SFIB and FB provided effective analgesia in patients presenting to the ED with proximal hip fractures. While SFIB enabled faster onset of analgesia, FB offered longer-lasting pain control and delayed the need for rescue analgesics. These findings support the use of FB as a preferred option for extended analgesia in this patient population, particularly in settings where prolonged pain relief is prioritized.

Statement of ethics

The study was approved by the Kahramanmaraş Sütçü İmam University Faculty of Medicine Clinical Research Ethics Committee (Decision No: 2017/03, dated 31.05.2017).

genAI

No artificial intelligence-based tools or generative AI technologies were used in this study. The entire content of the manuscript was originally prepared, reviewed, and approved by both authors.

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Conflict of interest statement

The authors declare that they have no conflict of interest.

Availability of data and materials

This Data and materials are available to the researchers.

Author contributions

Both authors contributed equally to the article. Both authors read and approved the final manuscript.

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