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Ultrasound-guided fascia iliaca compartment block for pain control in peritrochanteric fractures in the emergency department: A prospective observational study

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Abstract:

OBJECTIVE: Hip fractures are associated with moderate-to-severe pain, which is frequently managed inadequately in emergency departments (EDs). This study set out to evaluate the analgesic effectiveness of an ultrasound-guided fascia iliaca compartment block (FIB) administered by emergency physicians to patients with peritrochanteric hip fractures.

METHODS: A prospective observational study was conducted on 142 patients presenting to the ED with peritrochanteric hip fractures and a baseline Visual Analog Scale (VAS) score of 4 or higher. An ultrasound-guided FIB was performed, and pain scores were assessed at baseline, 1, 2, and 6 h. The primary outcome was ≥ 50% reduction in VAS. The secondary outcomes included need for rescue analgesia (intravenous fentanyl 1 μg/kg) and adverse events. Data were nonnormally distributed and analyzed using the Friedman test with Bonferroni-adjusted pairwise comparisons. Effect size and 95% confidence intervals (CIs) were calculated.

RESULTS: The median VAS decreased from 7 (interquartile range [IQR]: 6–8) at baseline to 3 (IQR: 2–3) at 1 h, 2 (IQR: 1–2) at 2 h, and 1 (IQR: 1–2) at 6 h ($P < 0.001$, Friedman test; effect size $r = 0.83$). A successful block (≥50% VAS reduction) was achieved in 97.2% of patients (95% CI: 92.9%–99.1%). Only 4 (2.8%) patients required rescue fentanyl. No complications, including local anesthetic systemic toxicity or delirium, were recorded.

CONCLUSION: Ultrasound-guided FIB administered by trained emergency physicians is associated with significant and sustained analgesia in patients with peritrochanteric hip fractures, with minimal need for rescue opioids and no observed adverse events.

Keywords:

Analgesia, emergency service, fascia iliaca compartment block, hip fractures, hospital, interventional, pain management, ultrasonography, Visual Analog Scale

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Box-ED Section

What is already known on the study topic?

- Pain from hip fractures is often suboptimally managed in emergency care
- Analgesia options for hip fractures include systemic medications (e.g. opioids) and regional anesthesia techniques such as the fascia iliaca compartment block.

How is this study structured?

- This was a single-center, prospective observational study that includes data from 142 patients.

What does this study tell us?

- There was significant pain relief following ultrasound-guided fascia iliaca compartment block in patients with peritrochanteric hip fracture
- The analgesic effect was sustained for several hours and was associated with minimal adverse events, likely due to the use of ultrasound guidance.

Introduction

Hip fractures among older adults represent a frequent presentation in emergency departments (EDs), accounting for up to 620.0 per 100,000 adults aged 65 years and above.[1] In India, the annual incidence of osteoporotic hip fractures was estimated at 600,000, a number expected to rise with the aging population.[2] Despite causing moderate-to-severe pain, hip fracture pain is frequently undertreated, especially in a crowded ED, a phenomenon known as oligoanalgesia.[3] This undertreatment stems from factors such as underestimation of pain intensity, fear of analgesic side effects (particularly with opioids), and underestimation of the dose required to treat moderate-to-severe pain.[4] Poorly controlled pain is not a benign issue; it significantly elevates the likelihood of delirium – by as much as ninefold in hip fracture cases.[5] Although opioids remain a cornerstone of treatment, they are associated with side effects such as respiratory depression, hypotension, delirium, prolonged ED stay, and increased need for monitoring – particularly in frail elderly patients.[6] These challenges have prompted research into alternative pain management strategies, such as regional anesthetic techniques.

The fascia iliaca compartment block (FIB) is a regional technique that targets the femoral nerve and the lateral femoral cutaneous nerve, which supply sensory innervation to the hip. First described by Dalens *et al*. in 1989, FIB has demonstrated effective pain relief in patients presenting with hip fracture.[7] Notably, this procedure is relatively straightforward and safe even when performed by clinicians without formal anesthesia training.[8] The use of sonographic guidance further increases the success rate, reduces the time to analgesia, and enhances safety by allowing for precise delivery of a smaller volume of local anesthetic. Despite these benefits, less than one-third of emergency physicians report performing this block, often citing a lack of supporting evidence.[9,10]

Most existing studies are either anesthesia-led, prehospital, or involve small sample sizes. There is a need for prospective ED-based data – particularly from resource-variable environments – to determine whether emergency physicians can deliver this block safely and effectively under ultrasound guidance. We hypothesized that ultrasound-guided FIB administered by emergency physicians would result in ≥50% reduction in pain within 6 h in patients with peritrochanteric hip fractures, without significant adverse events or high opioid requirement.

Methods

Study design and setting

This was a single-center, prospective observational study conducted in the Emergency Medicine Department of Government Medical College, Calicut, Kerala, India, a tertiary care hospital, with an annual ED census of approximately 120000 visits.

Selection of participants

A convenience sample of 142 patients was enrolled from March 2021 to January 2023. Inclusion criteria were age 18 years or older, presentation to the ED with a peritrochanteric femur fracture, and a pain score of 4 or more on an 11-point Visual Analog Scale (VAS). Exclusion criteria included patient refusal for this mode of treatment, coagulopathy, preexisting cognitive impairment or polyneuropathy, polytrauma, other injuries to the affected limb, presence of a prosthesis in the involved limb, use of anticoagulants, or external injury over the fracture site [Figure 1].

Sample size estimation

The sample size for the study was calculated using the statistical formula $4pq/d^2$, where $p = 65$ and $q = 35$, based on the study by Groot *et al*.[11] and $d = 8$. Applying this formula, we got a sample size of 142.

Methods and measurements

Patients presenting to the ED with peritrochanteric hip fracture fulfilling the inclusion criteria were enrolled into the study after taking written informed consent. All blocks were carried out by emergency physicians (1 faculty and 2 senior residents), each having completed >10 supervised ultrasound-guided FIB procedures prior to study initiation. Using a linear ultrasound transducer (6–14 MHz), the femoral artery and iliopsoas were identified. The transducer was moved laterally to identify the sartorius muscle. An 80–100 mm, 22-gauge needle was inserted in-plane (long axis), with its tip positioned in

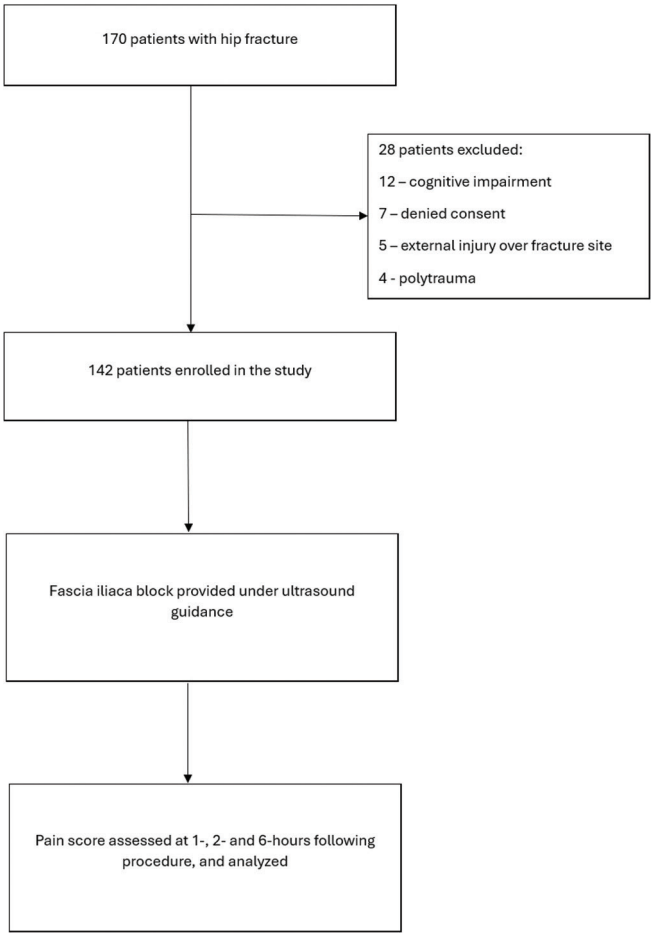

Figure 1: Recruitment of study participants

the potential space underneath the fascia iliaca, above the iliacus muscle. After negative aspiration, a bolus of 20–40 mL (based on patient habitus and spread visualization) of 0.25% bupivacaine was injected under direct visualization to ensure proper spread. No patient exceeded the recommended maximum safe dose. Once administered, the VAS pain score was assessed at 1, 2, and 6 h after the procedure by an emergency medicine resident doctor not involved in performing the block. In case of unrelieved pain (<50% decrease in VAS) or at the request of the patient, rescue intravenous (IV) analgesia was administered (IV fentanyl 1 µg/kg, slow IV push, repeatable once after 15 min if needed).

Outcomes

The primary outcome was to assess the change in pain intensity at 1, 2, and 6 h after the block, assessed using an 11-point VAS (0 = no pain and 10 = worst imaginable pain). A pain score reduction of more than 50% from the baseline VAS was defined as a successful block. Delirium scoring (using the Richmond Agitation Sedation Scale) in cases of unrelieved pain, and the need for an alternate mode of analgesia (rescue fentanyl), and any adverse events following the procedure were the secondary outcomes. Incomplete entries (<2%) were excluded from repeated-measures comparisons but retained in descriptive statistics. No imputation was performed.

Statistical analysis

Data preparation was done in Microsoft Excel (Microsoft corporation, United States of America) and quantitative data were analyzed using IBM SPSS Statistics, version 23.0 (IBM Corp. United Stated of America). Normality was assessed using the Shapiro–Wilk test. VAS scores were nonnormally distributed and expressed as median (interquartile range [IQR]). Repeated measures were analyzed using the Friedman test. Pairwise comparisons were performed with the Wilcoxon signed-rank test with Bonferroni correction (adjusted significance $P < 0.017$). Effect size (r) and 95% confidence intervals (CIs) for VAS reduction were calculated. $P < 0.05$ was considered statistically significant.

Ethical considerations

The study adhered to established ethical guidelines, securing ethical clearance from the Institute Ethics Committee for Human Studies on the date March 12, 2021, with approval number of GMCKKD/RP 201/IEC/58. Written informed consent was obtained from all the patients before inclusion in the study. Stringent measures were taken to maintain confidentiality and anonymity throughout the data collection process, with the data exclusively utilized for research purposes.

Compliance with manuscript writing guidelines

The manuscript is written in accordance with the guidelines for reporting prospective observational studies, modified from the Strengthening the Reporting of Observational Studies in Epidemiology statement.

Results

A total of 142 patients who presented to the ED with peritrochanteric fractures were included. Baseline demographic and clinical characteristics are shown in Table 1.

The median age was 72 years (IQR: 64–81), and 59.2% ($n = 84$) were female. Most injuries (97.2%) resulted from slip and fall. Intertrochanteric fractures were the most common type (62.7%).

Primary outcome

Pain score reduction

The median VAS score at arrival was 7 with an IQR of 6–8. At 1, 2, and 6 h following the procedure, the median pain scores were 3 (IQR: 2–3), 2 (IQR: 1–2), and 1 (IQR: 1–2), respectively [Figure 2]. The reduction was statistically significant across all time points (Friedman

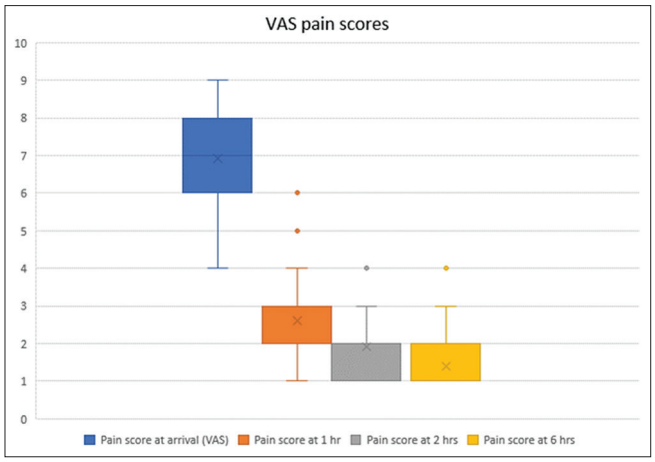

Figure 2: Median pain score over 1, 2, and 6 h following fascia iliaca compartment block. VAS: Visual Analog Scale

$\chi^2 = 378.65$, $P < 0.001$; effect size $r = 0.83$). The median percentage reduction in pain at 6 h was 78% (95% CI: 74–82) The number of patients achieving a successful block (>50% pain reduction) increased over time. At 1 h, 82.4% ($n = 117$) had a successful block, increasing to 92.3% ($n = 131$) at 2h and 97.2% ($n = 138$) at 6 h [Table 2].

The average values of VAS scores from baseline to 6 h of follow up were statistically significant according to the Friedman test [Table 3]. Comparison of VAS scores from baseline to 1, 2, and 6 h revealed a statistically significant outcome (pairwise Wilcoxon tests with Bonferroni correction: all $P < 0.001$) [Table 4].

Secondary outcomes

At the end of the 6-h observation period, only 4 (2.8%) patients required an alternate mode of analgesia, each receiving an appropriate dose of IV fentanyl (1 µg/kg IV). One patient had a persistent VAS of 6 and received fentanyl. Three patients showed partial response (40%–45% reduction in VAS) but declined further analgesia; all had body mass index >30 and deeper fascial depth on ultrasound. No adverse events, including signs of local anesthetic systemic toxicity or delirium (Richmond Agitation Sedation scores remained between −1 and 0), were reported in any of the subjects enrolled in this study.

Subgroup analysis

No statistically significant difference in analgesic response was noted between the subgroups based on gender, type of fracture, or age [Table 5].

Discussion

This study demonstrates that an ultrasound-guided FIB, when performed by trained emergency physicians, provides a profound and statistically significant reduction in pain for patients with peritrochanteric fractures. More than 82% of patients experienced a clinically meaningful decrease in pain within the 1st h, and over 97% continued

Table 1: Demographic variables and nature of fracture of study participants

Demographics	Total, *n* (%)
Age (years)	
18–25	1 (0.7)
26–35	3 (2.1)
36–45	1 (0.7)
46–55	11 (7.7)
56–65	27 (19.0)
66–75	46 (32.4)
76–85	37 (26.1)
86–95	16 (11.3)
Gender	
Male	58 (40.8)
Female	84 (59.2)
Mechanism of injury	
Fall	138 (97.2)
Road traffic incident	4 (2.8)
Fracture type	
Neck of the femur	44 (31.0)
Intertrochanteric fracture	89 (62.7)
Subtrochanteric fracture	9 (6.3)

Table 2: Visual Analog Scale score reduction after providing fascia iliaca block

Duration since FIB (h)	Number of patients with reduction in pain score (VAS)		Total number
	>50%	≤50%	
1	117	25	142
2	131	11	142
6	138	4	142

VAS: Visual Analog Scale, FIB: Fascia iliaca compartment block

Table 3: Comparison of VAS score from onset to 6 hours of follow up

Time point	Median pain score (Q1, Q3)	Test statistic	*P*-value
Baseline	7 (6,8)	Friedman χ^2=378.65	<0.001
1 hour	3 (2,3)		
2 hours	2 (1,2)		
6 hours	1 (1,2)		

VAS: Visual Analogue Scale, Q1: First quartile, Q3: Third quartile

Table 4: Bonferroni-adjusted pairwise comparison between Visual Analog Scale pain scores at various time points

Time points (h)	*P* (Wilcoxon, adjusted)
VAS at baseline and 1 h	<0.001
VAS at baseline and 2 h	<0.001
VAS at baseline and 6 h	<0.001
VAS at 1 h and 2 h	<0.001
VAS at 1 h and 6 h	<0.001
VAS at 2 h and 6 h	<0.001

VAS: Visual Analog Scale

Table 5: Comparison of Visual Analog Scale reduction at 6 h between subgroups

Subgroup comparison	Median % VAS reduction at 6 h	*P*
Male versus female	78 versus 77	0.62
Intertrochanteric versus neck of femur	79 versus 76	0.41
Age ≥75 versus <75 years	77 versus 78	0.74

VAS: Visual Analog Scale

to report relief at the 6-h mark. These findings are consistent with previous research conducted in the ED setting. For instance, Godoy Monzon *et al*. observed a fall in average VAS from 8.5 to 2.3 within 2 h,[12] while Haines *et al*. observed a drop in average numerical rating scale (NRS) scores from 5.5 to 1.9 within 60 min in a feasibility study involving ultrasound-guided FIB.[13] Similarly, a prospective study by Levente *et al*. involving 48 patients with confirmed upper femur fractures showed a 93.8% success rate with no reported complications.[14] Another noteworthy study by Ridderikhof *et al*. included 22 patients with hip fractures and demonstrated a decline in median NRS scores from 6.0 to 3.0 within 1 h postprocedure ($P < 0.001$).[15]

Randomized controlled trials have also echoed these findings. In a study comparing FIB with a 3-in-1 femoral nerve block in 162 hip fracture patients in the ED, Reavley *et al*. reported a reduction in 0–100 mm VAS scores from 65 to 38 mm within 60 min following a nonultrasound-guided FIB.[16] In another trial, Foss *et al*. administered either FIB or a placebo block with intramuscular morphine to 48 participants and observed a decline in resting pain scores from 5 to 2.5 at 1 h. Notably, 67% of the FIB group showed full or partial lumbar plexus blockade.[17]

Our study reinforces the value of ultrasound guidance for FIB. This technique allows for the direct visualization of anatomical structures and the spread of local anesthetic, which enhances the procedural safety and improves the success rate compared to conventional landmark-based techniques. The observed onset and duration of analgesia align with the known pharmacokinetics of bupivacaine, which typically produces an onset within 5–10 min and a duration of 8–10 h.

Subgroup analysis revealed no significant differences in pain response across fracture types, age, or sex. The few individuals with suboptimal response were obese, likely due to increased depth of fascia and reduced spread of local anesthetic – a finding that reinforces the procedural value of ultrasound over landmark-based approaches.

The ability to visualize the needle tip continuously helps to avoid critical vascular structures and prevents the inadvertent needle entry into unwanted areas, thereby minimizing complications such as neuropathy and pneumoretroperitoneum that have been reported with blind techniques.[18,19] None of the subjects in our study developed any complications related to the procedure, emphasizing the safety of this technique.

This study adds to existing literature by demonstrating high success and safety rates in a large ED cohort, in which all blocks were performed exclusively by emergency physicians using ultrasound guidance. The results are generalizable to similar resource-equipped settings but may not apply to facilities without ultrasound access or regional block training programs. Most prior studies involved anesthesiologists or prehospital providers and had smaller sample sizes. The clinical implications of these findings are substantial, especially for busy EDs. Hip fracture patients often face long waits for surgery, leading to prolonged periods of undertreated pain. A single, effective FIB can provide hours of profound analgesia, facilitating patient comfort, mobilization for imaging, and overall satisfaction without the risks associated with systemic opioids, such as delirium. The fact that nonanesthesiologists, including emergency physicians and even trained paramedics, can safely perform this block highlights its accessibility and utility.[20] As point-of-care ultrasound becomes increasingly integrated into emergency medicine practice, evidence supports that nerve blocks performed under sonographic guidance are not only more efficient but also require lower anesthetic volumes while improving block success rates.

Limitations

The authors acknowledge the following limitations in the study. First, the absence of a control group limits causal inference and precludes comparison with standard opioid-based analgesia or alternative blocks. Second, the use of a fixed local anesthetic volume rather than weight-based dosing introduces variability in drug exposure. Third, follow-up was limited to 6 h and did not include postoperative outcomes, mobilization, delirium incidence, or length of hospital stay. Fourth, convenience sampling may introduce selection bias. Despite these limitations, the study's prospective design, sonographic confirmation of needle placement, and low rate of missing data strengthen the internal validity of its findings.

Conclusion

Ultrasound-guided FIB performed by trained emergency physicians is associated with effective and sustained analgesia in patients with peritrochanteric hip fractures, with minimal need for opioid rescue and no observed complications. These findings support the incorporation of FIB into ED pain management pathways. Randomized

controlled trials are warranted to confirm comparative benefit and evaluate longer-term outcomes.

Author contribution statement

- VSR: Conceptualization (supportive), data curation (equal), formal analysis (lead), writing – original draft (lead), and writing – review and editing (supportive)
- SS: Methodology (lead), resources (lead), supervision (equal), and validation (supportive)
- KRS: Investigation (supportive), data curation (equal), and writing – review and editing (lead)
- ASL: Investigation (lead) and validation (supportive)
- AJM: Visualization (lead) and project administration (lead)
- MM: Conceptualization (lead) and visualization (supportive)
- CR: Supervision (equal) and validation (lead).

Conflicts of interest

None Declared.

Ethical approval

The study adhered to established ethical guidelines, securing ethical clearance from the Institute Ethics Committee, Government Medical College, Kozhikode, Kerala, India, on the date March 12, 2021, with approval number of GMCKKD/RP 201/IEC/58.

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