E-ISSN 2250-0944
ISSN 2250-1150
doi: 10.31838/ijprt/16.01.579

Original Research Article

Ultrasound-Guided Fascia Iliaca Compartment Block is Superior to Intravenous Fentanyl for Facilitating Subarachnoid Block Positioning in Hip Fracture Patients: A Prospective Randomized Controlled Trial

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Received: 14.04.2026 Revised: 27.04.2026 Accepted: 10.06.2026 Published: 15.06.2026

ABSTRACT

Background: Positioning patients with hip fractures for SAB (Subarachnoid Block) is often associated with severe pain, leading to patient discomfort, hemodynamic instability, and technical difficulty during spinal anesthesia. Intravenous fentanyl is commonly used for analgesia but may be associated with inadequate movement-related pain relief and opioid-related adverse effects. Ultrasound-guided FICB (Fascia Iliaca Compartment Block) provides targeted regional analgesia and may offer superior conditions for positioning. This study compared the efficacy of FICB and intravenous fentanyl for facilitating SAB in patients with hip fractures.

Methods: A prospective, randomized, double-blind controlled trial was conducted on 60 patients (ASA I–II, 18–55 years) undergoing surgery for hip fractures. Patients were divided into two groups at random: the FENT group (n = 30) received titrated intravenous fentanyl, and the FICB group (n = 30) received ultrasound-guided fascia iliaca compartment block with 30 mL of 0.25% bupivacaine. The NRS (Numeric Rating Scale) was used to measure pain during placement. Haemodynamic variables, oxygen saturation, patient satisfaction, performance time and number of attempts for SAB and quality of positioning were all assessed.

Results: The FICB group demonstrated significantly lower pain scores during positioning compared with the fentanyl group (mean NRS 2.1 ± 0.9 vs. 4.8 ± 1.2; $p<0.001$). Optimal positioning was achieved in 50% of FICB patients compared with 16.7% in the fentanyl group ($p=0.004$). First-attempt spinal success was higher in the FICB group (76.7% vs. 46.7%; $p=0.027$), and patient satisfaction was significantly greater (90% vs. 63.3%; $p=0.012$). Hemodynamic parameters and oxygen saturation remained more stable in the FICB group throughout the study period ($p<0.05$).

Conclusion: Ultrasound-guided FICB provides superior analgesia, better positioning conditions, higher first-attempt spinal success, improved patient satisfaction, and greater hemodynamic stability compared with intravenous fentanyl. FICB should be considered a preferred pre-procedural analgesic technique for patients with hip fractures undergoing subarachnoid blocking.

Keywords: Fascia Iliaca Compartment Block, Intravenous Fentanyl, Hip Fracture, Subarachnoid Block, Spinal Anesthesia, Positioning Analgesia, Regional Anesthesia, Randomized Controlled Trial.

INTRODUCTION

A significant global health issue, hip fractures are linked to high rates of morbidity, mortality, and medical costs. The incidence of hip fractures continues to rise due to increasing life expectancy and aging populations, with more than 1.6 million cases occurring annually worldwide and projections indicating a significant increase in the coming decades.[1] Although younger patients may experience hip fractures after high-energy accidents, these injuries primarily affect the elderly after low-energy trauma. Hip fractures often result in prolonged immobilization, functional impairment, and increased postoperative complications, significantly affecting quality of life.[2]

In order to lower the risk of complications such as deep vein thrombosis, pulmonary embolism, pneumonia, and pressure ulcers, early surgical fixation within 24 to 48 hours is regarded as the standard of care.[3] Spinal anaesthesia is widely preferred for hip fracture surgeries because it is associated with reduced blood loss, lower thromboembolic risk, decreased postoperative cognitive dysfunction, and improved perioperative outcomes compared with general anaesthesia.[4] However, positioning patients with hip fractures for subarachnoid block remains a considerable challenge.

Positioning for spinal anaesthesia requires movement of the fractured limb and flexion of the hip and spine, which can cause severe pain and anxiety in patients with femoral neck, intertrochanteric, or subtrochanteric fractures. Inadequate analgesia during positioning may lead to poor patient cooperation, multiple spinal attempts, prolonged procedural time, and hemodynamic instability.[5] Intravenous fentanyl is commonly used to provide analgesia because of its rapid onset and short duration of action.[6] However, side effects include respiratory depression, nausea, vomiting, drowsiness, and urine retention are linked to systemic opioids, especially in old and weak individuals.[7] Furthermore, opioids may provide insufficient relief of movement-related pain during positioning.

The FICB (Fascia Iliaca Compartment Block) has emerged as an effective regional anaesthesia technique for hip fracture analgesia. By targeting the femoral, lateral femoral cutaneous, and occasionally obturator nerves, FICB provides superior pain relief during movement and positioning.[8] The use of ultrasound guidance has further enhanced block accuracy, success rates, and safety by enabling precise deposition of local anaesthetic while minimizing neurovascular complications.[9] Therefore, ultrasound-guided FICB may represent a superior alternative to intravenous fentanyl for facilitating comfortable positioning during subarachnoid block in patients with hip fractures.

AIMS AND OBJECTIVES

This prospective randomised controlled trial's objective was to assess the effectiveness of intravenous fentanyl versus ultrasound-guided FICB in helping patients with hip fractures undergoing subarachnoid block. The primary objective was to compare the analgesic efficacy of the two techniques using the NRS during positioning. Secondary goals included evaluating haemodynamic parameters like heart rate, systolic and diastolic blood pressure, and respiratory rate after intravenous fentanyl or FICB administration, as well as comparing the quality of positioning, performance time, and number of attempts needed for a successful subarachnoid block.

MATERIALS AND METHODS

Study Design

This prospective, randomized controlled clinical trial was conducted in the Department of Anaesthesiology of a tertiary health care centre over a period of 24 months (2024–2026) after obtaining approval from the Institutional Ethics Committee. After giving written informed consent, 60 patients of either sex, ages 18 to 55, who were scheduled for elective surgery for femur fractures under spinal anaesthesia and belonged to the ASA (American Society of Anaesthesiologists') physical status I and II, were enrolled. One of two ultrasound-guided FICB was given to each participant at random. FICB or intravenous fentanyl prior to positioning for subarachnoid block, and outcomes related to analgesia, positioning quality, procedural performance, and hemodynamic parameters were assessed.

Inclusion and Exclusion Criteria

After giving written informed consent, patients between the ages of 18 and 55 who were diagnosed with femur fractures, had ASA physical status I or II, and were scheduled for elective surgery under spinal anaesthesia were included in the study. Patients with hemorrhagic diathesis, neurological or psychiatric conditions, prior femoral bypass surgery, known allergies to opioids or local anaesthetics, polytrauma, injection site infections, long-term opioid use, or spinal deformities that might make it difficult to administer subarachnoid block or study interventions were excluded.

Sample Size Calculation

The sample size was calculated based on the difference in mean pre-test and post-test change in Visual Rating Scale (VRS) scores between two groups, derived from a similar study. With an assumed mean difference of 2.0, a pooled standard deviation calculated from group standard deviations (1.86 and 2.70), an alpha error of 5% (two-sided), and a power of 90%, the required sample size was 29 patients per group.After rounding off, 30 patients were included in each group, making a total sample size of 60.

The formula used was:

$n=2S^2(Z_{1}-\alpha+ Z_{1}-\beta)^2/ \delta^2$

Where $S^2=(S_1^2+S_2^2)/ 2$and δ= difference between means.

Patients were divided into two groups:

Group FICB (n=30): Patients received ultrasound-guided FICB.

Group FENT (n=30): Patients received intravenous fentanyl in titrated doses.

Data Collection Procedure

All patients were kept nil per oral for at least 6 hours before surgery and received standard perioperative monitoring, including ECG, non-invasive blood pressure, pulse oximetry, and respiratory rate monitoring. Baseline hemodynamic parameters were recorded, and an 18G intravenous cannula was secured for fluid administration. All patients received intravenous ondansetron (0.1 mg/kg) as premedication. Patients allocated to the FICB group underwent ultrasound-guided fascia iliaca compartment block using 30 mL of 0.25% bupivacaine administered 15 minutes before positioning for spinal anaesthesia under aseptic precautions. Patients in the fentanyl group received intravenous fentanyl in titrated doses of 0.5 µg/kg followed by two additional doses of 0.25 µg/kg at 5-minute intervals. Pain scores, positioning quality, spinal anaesthesia performance parameters, and hemodynamic variables were recorded after intervention. Postoperative analgesia was standardized in both groups with intravenous tramadol 50 mg administered at 8-hour intervals, with the first dose given upon the patient's complaint of pain.

Statistical Analysis

STATA version 10.1 was used to code and analyse the data. Qualitative data were reported as frequencies and percentages, whereas quantitative variables were summarised as mean ± standard deviation. The Shapiro-Wilk test was used to determine whether the data distribution was normal. The independent samples t-test was used to compare continuous variables between groups, whereas Pearson's Chi-square test was used to analyse categorical variables. One-way ANOVA and Bonferroni post-hoc testing were used to examine changes within groups across various time periods. Appropriate non-parametric tests, such as the Mann–Whitney U test and Wilcoxon signed-rank test, were used for non-normally distributed data. Statistical significance was defined as a p-value of less than 0.05.

RESULTS

Variable	FICB (n=30)	FENT (n=30)	p value
Age (in years)	41.8 ± 8.7	42.6 ± 9.1	0.726
Weight (kg)	66.4 ± 7.9	67.1 ± 8.3	0.742
Height (cm)	165.2 ± 6.5	164.8 ± 7.1	0.818
BMI (kg/m²)	24.3 ± 2.8	24.7 ± 3.0	0.598
Male Gender	18 (60%)	17 (56.7%)	0.790
ASA I	17 (56.7%)	16 (53.3%)	0.795
ASA II	13 (43.3%)	14 (46.7%)	0.795

Table 1. Baseline Demographic and Clinical Characteristics

The baseline characteristics of study participants are shown in Table 1. Age, anthropometric characteristics, gender distribution, and ASA status did not differ statistically significantly between the FICB and FENT groups (p > 0.05), indicating group comparability.

Parameter	FICB	FENT	p value
Baseline NRS Score	7.2 ± 1.1	7.1 ± 1.2	0.736
NRS During Positioning	2.1 ± 0.9	4.8 ± 1.2	<0.001
Pain Reduction (ΔNRS)	5.1 ± 1.2	2.3 ± 1.0	<0.001

Table 2. Primary Analgesic Outcomes

Table 2 demonstrates the superior analgesic efficacy of FICB. Although baseline pain scores were similar, patients receiving FICB experienced significantly lower pain during positioning and greater reduction in pain scores compared to intravenous fentanyl ($p < 0.001$).

Parameter	FICB	FENT	p value
Optimal Positioning	15 (50%)	5 (16.7%)	0.004
Good Positioning	12 (40%)	10 (33.3%)	
Satisfactory Positioning	3 (10%)	11 (36.7%)	
Unsatisfactory Positioning	0	4 (13.3%)	
Time to Achieve Positioning (sec)	36.5 ± 8.4	59.8 ± 11.3	<0.001
SAB Performance Time (sec)	58.4 ± 11.6	81.2 ± 16.4	<0.001
First Attempt Success	23 (76.7%)	14 (46.7%)	0.027
Successful Positioning Without Severe Pain	27 (90%)	18 (60%)	0.007

Table 3. Quality of Positioning and Procedural Outcomes

Table 3 shows that FICB significantly improved positioning quality and procedural ease. Patients in the FICB group achieved better positioning, required less time for spinal anesthesia, and had a higher first-attempt success rate than those receiving fentanyl.

Parameter	FICB	FENT	p value
Heart Rate (bpm)	79.6 ± 7.5	88.4 ± 9.3	0.001
Systolic BP (mmHg)	122.8 ± 9.4	137.2 ± 12.7	<0.001
Diastolic BP (mmHg)	74.6 ± 6.8	84.1 ± 8.4	<0.001
Respiratory Rate (/min)	17.1 ± 1.8	15.5 ± 2.3	0.009
SpO_2 (%)	98.7 ± 0.6	97.7 ± 1.5	0.004

Table 4. Hemodynamic Parameters at 15 Minutes

Table 4 highlights the hemodynamic and respiratory profile of both groups. FICB maintained significantly lower heart rate and blood pressure values, while preserving respiratory rate and oxygen saturation better than fentanyl, indicating improved physiological stability.

Parameter	FICB	FENT	p-value
Patient Satisfaction	27 (90%)	19 (63.3%)	0.012
Anaesthesiologist Excellent Rating	16 (53.3%)	6 (20%)	0.007
Good Rating	11 (36.7%)	12 (40%)	
Poor Rating	3 (10%)	12 (40%)	

Table 5. Patient and Anaesthesiologist Satisfaction

Table 5 reveals significantly higher satisfaction among both patients and anaesthesiologists in the FICB group. Better analgesia and positioning translated into improved procedural experience and operator satisfaction.

Adverse Event	FICB (n=30)	FENT (n=30)	p-value
Nausea/Vomiting	1 (3.3%)	5 (16.7%)	
Respiratory Depression	0	2 (6.7%)	
Hypotension	2 (6.7%)	7 (23.3%)	
Bradycardia	1 (3.3%)	4 (13.3%)	0.161
No Complications	27 (90%)	16 (53.3%)	0.048

Table 6. Adverse Events and Safety Profile

Table 6 demonstrates a superior safety profile of FICB. Adverse events were less frequent in the FICB group, whereas fentanyl was associated with a higher incidence of nausea, respiratory depression, hypotension, and bradycardia.

Outcome Measure	FICB	FENT	p-value
Mean NRS Score	2.1 ± 0.9	4.8 ± 1.2	<0.001
First Attempt SAB Success	76.7%	46.7%	0.027
Optimal Positioning	50%	16.7%	0.004
Patient Satisfaction	90%	63.3%	0.012
Successful Positioning Without Severe Pain	90%	60%	0.007

Table 7. Clinical Outcome Comparison

Table 7 summarizes the major study outcomes and clearly indicates that FICB outperformed intravenous fentanyl across all clinically relevant endpoints including pain control, positioning quality, procedural success, and patient satisfaction.

Variable	Odds Ratio	95% CI	p-value
Fascia Iliaca Block	4.82	1.67 – 13.90	0.004
Age	0.97	0.92 – 1.03	0.312
Male Gender	1.14	0.42 – 3.11	0.798
Baseline NRS Score	0.74	0.55 – 0.99	0.043

Table 8. Predictors of Optimal Positioning (Logistic Regression)

Table 8 identifies factors associated with optimal positioning. FICB emerged as an independent and significant predictor of successful positioning, increasing the odds of optimal positioning by nearly five times compared with intravenous fentanyl.

DISCUSSION

The current study showed that when it comes to helping patients with hip fractures position themselves for subarachnoid block; FICB is more effective than intravenous fentanyl. The FICB group's mean age was 41.8 ± 8.7 years, while the fentanyl group's was 42.6 ± 9.1 years ($p = 0.726$), indicating similar baseline demographic characteristics. Similar age distributions were reported by Korra and Rao (46 ± 11 vs 46 ± 9 years),[10] Agarwal et al., (46.2 ± 10.7 vs 41.6 ± 10.6 years; $p = 0.103$),[11] and Srinivas et al., (45± 17 vs 42 ± 15 years),[12] confirming comparability of study populations.

Pain during positioning was significantly lower in the FICB group, with a mean NRS score of 2.1 ± 0.9 compared with 4.8 ± 1.2 in the fentanyl group ($p < 0.001$). This finding is consistent with Korra and Rao, who reported pain scores of 1.1 ± 1.3 versus 2.3 ± 1.6 ($p = 0.0029$),[10] and Agarwal et al., who observed scores of 2.7 versus 5.3 ($p < 0.001$).[11] Srinivas et al. also demonstrated significantly greater pain reduction with FICB than fentanyl ($p = 0.0001$).[12] Furthermore, the meta-analysis by Hsu et al. reported a pooled standardized mean difference of −2.02 favouring FICB, confirming its superior analgesic efficacy [13].

Better analgesia translated into improved positioning quality. In the present study, optimal positioning was achieved in 50% of patients receiving FICB compared with only 16.7% in the fentanyl group ($p = 0.004$). Similar findings were reported by Korra and Rao, who observed optimal positioning in 50% versus 16.7% of patients.[10] Agarwal et al. reported excellent positioning in 67% of FICB patients compared with 13% of fentanyl patients,[11] while Srinivas et al. observed rates of 53% and 13%, respectively.[12] These findings demonstrate that superior pain control with FICB facilitates easier positioning for spinal anaesthesia.

The procedural benefits of FICB were also evident from the higher first-attempt success rate of spinal anaesthesia. In the present study, successful spinal anaesthesia on the first attempt was achieved in 76.7% of patients in the FICB group compared with 46.7% in the fentanyl group ($p = 0.027$). Additionally, the mean time required to achieve sitting position was significantly shorter in the FICB group (36.5 seconds) than in the fentanyl group (59.8 seconds; $p < 0.001$). Korra and Rao similarly reported significantly shorter time to perform subarachnoid block in patients receiving FICB

($p < 0.0001$),[10] indicating improved procedural efficiency.

Hemodynamic stability was significantly better with FICB. Heart rate during positioning was lower in the FICB group (79.6 beats/min) than in the fentanyl group (88.4 beats/min; $p = 0.001$). Similar findings were reported by Korra and Rao, who observed lower heart rates in the FICB group (86 vs. 80 beats/min; $p = 0.0022$).[10] Repeated-measures ANOVA in the present study further demonstrated significant differences in heart rate, systolic blood pressure, and diastolic blood pressure trends between groups ($p < 0.05$), suggesting better attenuation of the pain-induced sympathetic response with FICB.

Respiratory parameters also favoured FICB. The mean respiratory rate was 17.1 breaths/min in the FICB group compared with 15.5 breaths/min in the fentanyl group ($p = 0.009$), indicating mild respiratory depression in patients receiving fentanyl. Similar observations were reported by Korra and Rao (17 vs 15 breaths/min; $p < 0.0001$). Oxygen saturation remained significantly higher in the FICB group (98.7%) than in the fentanyl group (97.7%; $p = 0.004$). Although Korra and Rao found no significant difference in oxygen saturation,[10] Hsu et al., reported hypoventilation in approximately 20% of patients receiving intravenous opioid analgesia.[13]

Patient satisfaction was significantly higher among patients receiving FICB. In the present study, 90% of patients in the FICB group reported satisfaction compared with 63.3% in the fentanyl group ($p = 0.012$). Comparable findings were reported by Korra and Rao, who observed satisfaction rates of 96.7% and 76.7%, respectively ($p = 0.028$).[10] The superior analgesia, improved positioning, and lower incidence of adverse effects likely contributed to these higher satisfaction rates.

Adverse events were significantly less frequent in the FICB group. Only 10% of patients experienced complications compared with 47% in the fentanyl group ($p = 0.048$). Similarly, Agarwal et al. reported no adverse effects in the FICB group, whereas 13% of fentanyl-treated patients experienced nausea and drowsiness ($p = 0.038$).[11] The lower incidence of opioid-related side effects further supports the safety advantage of FICB.

An important finding of the present study was that FICB emerged as an independent predictor of optimal positioning. Logistic regression analysis demonstrated that patients receiving FICB were approximately five times more likely to achieve optimal positioning (OR 4.82; 95% CI 1.67–13.90; $p = 0.004$). This finding emphasizes the substantial contribution of effective regional analgesia to successful spinal anaesthesia in patients with hip fractures.

The present study demonstrates that FICB provides superior analgesia, better positioning quality, higher first-attempt spinal anaesthesia success, improved hemodynamic and respiratory stability, greater patient satisfaction, and fewer adverse events compared with intravenous fentanyl. These findings are in close agreement with those of Hsu et al.,[13] Korra and Rao,[10] Agarwal et al.,[11] and Srinivas et al.,[12] supporting the routine use of FICB as the preferred analgesic technique for facilitating subarachnoid block in patients with hip fractures.

Limitations

There are various limitations to the current investigation. The single-center approach and rather small sample size (n=60) may restrict how broadly the results can be applied. Performance bias might have been introduced if there had been no blinding. The study did not assess long-term outcomes such as postoperative pain management, functional recovery, or hospital stay; instead, it concentrated solely on acute perioperative results. Variations in pain perception and the use of subjective pain assessment scales may have influenced the results. Additionally, the impact of different block techniques and the cost-effectiveness of FICB were not assessed.

CONCLUSION

The current study shows that FICB is a better analgesic method for helping patients with hip fractures position themselves during subarachnoid block than intravenous fentanyl. FICB provided better pain relief, improved positioning quality, higher first-attempt spinal anesthesia success rates, and greater hemodynamic stability while preserving respiratory function. It was also associated with fewer adverse effects and higher patient and anesthesiologist satisfaction. Despite requiring a short additional time for administration, the overall benefits of FICB in terms of analgesic efficacy, safety, and procedural ease support its use as a preferred preoperative analgesic modality for hip fracture patients undergoing spinal anesthesia.

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