

EFFICACY OF FEMORAL NERVE BLOCK AND INTRAVENOUS FENTANYL FOR EASE OF POSITIONING DURING SPINAL ANAESTHESIA FOR FRACTURE NECK FEMUR SURGERIES: A RANDOMIZED COMPARATIVE STUDY

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ABSTRACT

Background: Femur neck fractures are extremely painful injuries requiring surgical fixation, typically under spinal anaesthesia. However, optimal positioning for subarachnoid block is challenging due to severe pain during movement. This study compared the efficacy of femoral nerve block (FNB) versus intravenous fentanyl for facilitating positioning during spinal anaesthesia in patients undergoing fracture neck femur surgeries. **Materials and Methods:** This randomized prospective study included 60 patients (ASA I-III) aged 18-75 years scheduled for fracture neck femur surgery under spinal anaesthesia. Patients were randomly allocated to Group A (n=30) receiving FNB with 15ml of 1% lignocaine using landmark technique, or Group B (n=30) receiving intravenous fentanyl 1µg/kg. Visual Analogue Scale (VAS) scores were assessed at baseline, 10 minutes after intervention, and during positioning. Ease of positioning, pain grading, time to perform spinal anaesthesia, additional analgesic requirements, sedation scores, haemodynamic parameters, and complications were recorded. **Result:** Both groups demonstrated significant reduction in VAS scores from baseline ($p<0.0001$). However, Group FNB showed significantly greater reduction during positioning (2.7 ± 0.95 vs 4.36 ± 0.76 ; $p<0.0001$). Excellent positioning (angle $>90^\circ$) was achieved in 67% of FNB group versus 40% in fentanyl group ($p=0.04$). Pain grading was significantly better in FNB group (1.6 ± 0.72 vs 2.03 ± 0.89 ; $p=0.04$). Two patients in fentanyl group required additional analgesia; none in FNB group. Sedation was significantly higher in fentanyl group ($p<0.0001$). Haemodynamic parameters were stable in both groups with no serious complications. **Conclusion:** Femoral nerve block provides superior analgesia, better positioning quality, reduced sedation, and comparable safety profile compared to intravenous fentanyl for facilitating spinal anaesthesia positioning in fracture neck femur surgeries.

INTRODUCTION

Fracture of the femur is a common orthopedic injury following trauma across all age groups, ranging from simple nondisplaced to complex comminuted fractures. The femur, being a deeply innervated long bone, elicits severe pain upon fracture, primarily due to the involvement of the periosteum, which has one of the lowest pain thresholds among deep somatic structures.^[1]

The mainstay of management for femur fractures is surgical fixation. Spinal anaesthesia is preferred over general anaesthesia as it provides better surgical conditions, good postoperative analgesia, prevention of respiratory tract complications, reduced cardiopulmonary and thromboembolic events, and fewer postoperative complications like nausea and vomiting, resulting in reduced hospital stay and burden.^[2]

However, achieving optimal positioning for subarachnoid block is often challenging due to severe pain associated with femoral fractures. Stabilization of the fractured limb and severe discomfort during movement hinder patient placement into the ideal position, even in those with otherwise normal spinal anatomy.^[2-4]

Various analgesic modalities are employed to facilitate positioning, including NSAIDs, opioids, ketamine, and peripheral nerve blocks such as femoral nerve block, 3-in-1 block, and fascia iliaca block.^[3,4] Among opioids, fentanyl is widely used due to its potency, rapid onset, and shorter duration of action, with lower incidence of sedation, respiratory depression, nausea, and histamine-mediated side effects when used in titrated doses.^[3]

Femoral nerve block is an effective, safe, superficial technique with easily identifiable landmarks, making it simple to perform.^[5-7] It reduces opioid requirements and associated side effects while providing good postoperative analgesia.^[3,8,9]

This randomized prospective study evaluated the efficacy of femoral nerve block in facilitating positioning for subarachnoid block in patients undergoing fracture neck femur surgeries and compared it with intravenous fentanyl.^[1]

MATERIALS AND METHODS

Study Design and Setting: This randomized prospective study was conducted in the Orthopaedic Operation Theatre, Civil Hospital, Ahmedabad, from September 2024 to February 2025. The study was approved by the Institutional Ethics Committee (Ref No: PH-06/2024 Dated: 30/12/2024).

Sample Size Calculation: Sample size was calculated based on a previous study by Pakhare et al. (2016).^[5]

$$n = (\alpha + \beta)^2 \times (SD)^2 / d^2$$

Where $\alpha = 1.96$ (alpha error), $\beta = 0.84$ (beta error), $SD = 3.7$ (from reference), $d = \text{mean difference}$

This yielded 27 patients per group. Accounting for 10% dropout, the total sample size was 60 patients (30 per group).

Subject Selection

Inclusion Criteria

- Age 18-75 years
- Either gender
- ASA Grade I, II, III
- Unilateral fracture neck femur surgery under spinal anaesthesia
- Written informed consent
- Ability to understand VAS for pain assessment

Exclusion Criteria

- Patient refusal
- ASA Grade IV, V
- Local infection at lumbar puncture site
- Allergy to local anaesthetic or fentanyl
- Multiple fractures
- Neuromuscular or coagulation disorders
- History of drug or alcohol abuse

Randomization and Blinding: Patients were randomly allocated to two groups using a computer-generated randomization chart. The study was open-label due to the nature of interventions.

Study Protocol: All patients received Injection Ondansetron (0.15 mg/kg) and preloading with crystalloid (10-15 ml/kg) intravenously. VAS scoring was explained to all patients. Interventions were performed 10 minutes prior to positioning for subarachnoid block:

Group A (FNB): Received femoral nerve block using landmark technique with 15 ml of 1% lignocaine.

Group B (Fentanyl): Received intravenous fentanyl 1 µg/kg.

Femoral Nerve Block Technique: The inguinal ligament was identified between the anterior superior iliac spine and pubic tubercle. The femoral artery was palpated just below the inguinal crease. The needle was inserted approximately 1 cm lateral to the femoral artery pulse and 1.5 cm below the inguinal ligament in a cephalad direction. After negative aspiration for blood, 15 ml of 1% lignocaine was injected.

Outcome Measures

Primary Outcome:

- Visual Analogue Score (VAS) assessed at baseline, 10 minutes after intervention, and during positioning

Secondary Outcomes:

1. Pain Grading during Positioning:
 - Grade 1: Sitting without pain with minimal help
 - Grade 2: Mild pain (grimacing/verbal expression)
 - Grade 3: Severe pain but tolerates positioning with help
 - Grade 4: Cannot tolerate positioning, requires additional analgesia
2. Ease of Positioning (Angle Obtained):
 - A: Good flexion ($>90^\circ$)
 - B: Average flexion ($<90^\circ$) without twisting/hand support
 - C: Poor flexion with twisting/hand support
3. Time to Achieve SAB: From beginning of sitting positioning to completion of SAB
4. Additional Fentanyl Requirement: 0.5 µg/kg IV fentanyl repeated every 5 minutes until VAS ≤ 4 ; patients requiring >2 µg/kg excluded
5. Modified Ramsay Sedation Score [Table 1]
6. Haemodynamic Parameters: Heart rate, systolic BP, diastolic BP, MAP, respiratory rate, SpO₂
7. Complications: Hypotension, bradycardia, respiratory depression, nausea, vomiting, pruritus, muscle rigidity, hematoma, block failure

Statistical Analysis: Data were analyzed using R software. Continuous variables were expressed as mean $\pm$ standard deviation and analyzed using Student's t-test. Categorical variables were analyzed

using Chi-square test. P-value <0.05 was considered statistically significant.

RESULTS

Table 1: Age Distribution

Parameter	Group A (FNB) (n=30)	Group B (Fentanyl) (n=30)	P-value
Mean Age (years)	54.84 ± 14.82	61.97 ± 14.26	0.27

Table 2: Sex Distribution

Sex	Group A (FNB) n (%)	Group B (Fentanyl) n (%)
Male	19 (63.33%)	21 (70%)
Female	11 (36.67%)	9 (30%)

Table 3: ASA Physical Status Distribution

ASA Grade	Group A (FNB)	Group B (Fentanyl)
I	4	3
II	16	14
III	10	13

Table 4: Visual Analogue Score Comparison

Time Point	Group A (FNB) Mean ± SD	Group B (Fentanyl) Mean ± SD	P-value
Baseline	7.63 ± 0.81	7.4 ± 0.72	0.25
10 min after analgesia	4.3 ± 0.79	5.6 ± 0.93	<0.0001
During positioning	2.7 ± 0.95	4.36 ± 0.72	<0.0001
Intragroup p-value	<0.0001	<0.0001	-

Both groups showed significant reduction in VAS from baseline (p<0.0001). However, FNB demonstrated significantly greater reduction

compared to fentanyl at 10 minutes (p<0.0001) and during positioning (p<0.0001).

Table 5: Pain Grading

Grade	Group A (FNB) n (%)	Group B (Fentanyl) n (%)
Grade 1	16 (54%)	9 (30%)
Grade 2	10 (33%)	13 (43%)
Grade 3	4 (13%)	6 (20%)
Grade 4	0 (0%)	2 (7%)
Mean Grade ± SD	1.6 ± 0.72	2.03 ± 0.89

The mean pain grade was significantly lower in FNB group (p=0.04).

Table 6: Ease of Positioning (Angle Obtained)

Category	Group A (FNB) n (%)	Group B (Fentanyl) n (%)	P-value
A: Good (>90°)	20 (67%)	12 (40%)	0.04
B: Average (<90°)	9 (30%)	13 (43%)	0.28
C: Poor	1 (3%)	5 (17%)	0.08

Significantly more patients in FNB group achieved good flexion angle (p=0.04).

Table 7: Time to Achieve SAB

Parameter	Group A (FNB) Mean ± SD (min)	Group B (Fentanyl) Mean ± SD (min)	P-value
Time to achieve position	9.27 ± 1.91	9.32 ± 1.17	0.90

No significant difference was observed between groups (p=0.90).

Table 8: Additional Fentanyl Requirement

Additional Dose	Group A (FNB) n (%)	Group B (Fentanyl) n (%)
1 dose (0.5 µg/kg)	0 (0%)	2 (6.67%)
2 doses	0 (0%)	0 (0%)

Two patients in fentanyl group required additional analgesia; none in FNB group. Difference was statistically insignificant (p>0.05).

Table 9: Sedation Scores

Sedation Score	Group A (FNB) n (%)	Group B (Fentanyl) n (%)
Score 1	30 (100%)	16 (53.33%)
Score 2	0 (0%)	14 (46.67%)
Score ≥3	0 (0%)	0 (0%)

All patients in FNB group had sedation score 1, while 46.67% in fentanyl group had score 2. Difference was statistically significant ($p < 0.0001$).

Heart Rate:

Time Point	Group A (FNB) Mean $\pm$ SD	Group B (Fentanyl) Mean $\pm$ SD	P-value
Baseline	88.53 $\pm$ 2.67	89.73 $\pm$ 2.50	0.08
10 min after analgesia	86.07 $\pm$ 2.20	85.80 $\pm$ 2.31	0.64
During positioning	83.07 $\pm$ 2.08	83.80 $\pm$ 1.99	0.17
15 min after SAB	80.93 $\pm$ 1.36	81.67 $\pm$ 1.67	0.06
30 min after SAB	78.73 $\pm$ 1.34	79.00 $\pm$ 1.64	0.48
60 min after SAB	77.73 $\pm$ 2.01	78.6 $\pm$ 2.17	0.11
90 min after SAB	76.67 $\pm$ 2.48	77.86 $\pm$ 2.85	0.08

Table 10: Mean Arterial Pressure (MAP)

Time Point	Group A (FNB) Mean $\pm$ SD	Group B (Fentanyl) Mean $\pm$ SD	P-value
Baseline	95.89 $\pm$ 3.81	98.40 $\pm$ 4.35	0.02
10 min after analgesia	95.11 $\pm$ 5.89	95.53 $\pm$ 3.36	0.66
During positioning	94.18 $\pm$ 3.47	94.53 $\pm$ 3.10	0.68
15 min after SAB	87.64 $\pm$ 4.09	88.62 $\pm$ 3.40	0.31
30 min after SAB	85.87 $\pm$ 3.20	86.04 $\pm$ 3.08	0.83
60 min after SAB	84.98 $\pm$ 3.40	84.84 $\pm$ 2.34	0.85
90 min after SAB	85.38 $\pm$ 2.83	84.82 $\pm$ 1.98	0.37

Haemodynamic parameters were comparable between groups with no statistically significant differences except baseline MAP.

Respiratory Rate and SpO₂: No statistically significant differences were observed in respiratory rate or SpO₂ between groups at any time point ($p > 0.05$ for all comparisons).

Complications: No complications were observed in either group, including nausea, vomiting, pruritus, muscle rigidity, hematoma, block failure, or respiratory depression.

DISCUSSION

Fracture of the femur is a common orthopaedic injury associated with severe pain due to the rich innervation of the periosteum, which has one of the lowest pain thresholds among deep somatic structures.^[1] Spinal anaesthesia is the preferred anaesthetic technique for these surgeries as it provides better surgical conditions, good postoperative analgesia, and fewer complications compared to general anaesthesia.^[2] However, achieving optimal positioning for spinal anaesthesia is challenging due to severe pain during movement.^[2,4] This study compared the efficacy of femoral nerve block (FNB) with intravenous fentanyl in facilitating sitting position for spinal anaesthesia in patients undergoing fracture neck femur surgery. Both techniques significantly reduced pain from baseline; however, FNB demonstrated superior analgesic efficacy.

Analgesic Efficacy: Our study found that both FNB and intravenous fentanyl significantly reduced VAS scores from baseline ($p < 0.0001$ for both), indicating that both techniques are effective in providing analgesia for fracture femur pain. However, FNB demonstrated significantly greater reduction in pain compared to fentanyl at 10 minutes after intervention (4.30 ± 0.79 vs 5.60 ± 0.93 ; $p < 0.0001$) and during positioning (2.70 ± 0.95 vs 4.36 ± 0.76 ; $p < 0.0001$).

These findings are consistent with several previous studies. Jadon et al.,^[4] found that mean VAS score during positioning was significantly lower in the FNB group (0.57 ± 0.31) compared to the fentanyl group (2.53 ± 1.61 ; $p = 0.0020$). Similarly, Sia et al.,^[3] reported significantly lower VAS scores during positioning in the FNB group (0.5 vs 3; $p < 0.0001$). Bantie et al.,^[14] compared IV fentanyl, FNB, and fascia iliaca block and found that NRS pain scores during positioning were significantly lower in FNB and FICB groups than in the fentanyl group (median: 2, 2, and 3 respectively; $p < 0.001$).

The superior analgesic efficacy of FNB can be attributed to its mechanism of action. The femoral nerve (L2-L4) provides articular branches to the anterior capsule of the hip joint, which is the primary source of nociceptive input in hip pathology [19]. Femoral nerve block provides localised analgesia by directly blocking nociceptive signals from the fracture site, whereas intravenous fentanyl acts centrally on μ -opioid receptors, which may be less effective for severe somatic pain.^[30] Additionally, lignocaine 1% has a rapid onset (5-10 minutes) with moderate duration of action and minimal motor blockade, making it ideal for this indication.^[31]

In contrast, Iamaroon et al.,^[8] did not find significant differences between FNB and fentanyl, possibly because they used 0.3% bupivacaine for FNB, which has a longer and more variable onset of action (25-30 minutes for maximum effect).^[23,34] Our study used lignocaine 1%, which has a rapid onset of 5 minutes, explaining the superior results.^[3,4]

Ease of Positioning and Pain Grading: In our study, a significantly higher proportion of patients in the FNB group achieved good flexion angle ($>90^\circ$) during positioning (67% vs 40%; $p = 0.04$). Pain grading was also significantly better in the FNB group, with 54% of patients in Grade 1 (sitting without pain) compared to only 30% in the fentanyl group ($p = 0.04$).

These findings are consistent with Jadon et al.,^[4] who reported that the mean score for positioning quality was significantly higher in the FNB group (2.67 ± 0.606 vs 1.967 ± 0.85 ; $p=0.00027$). Bantie et al,^[14] and Durrani et al.,^[9] also found significantly better positioning quality and patient acceptance with FNB compared to intravenous analgesics.

The improved positioning quality with FNB can be explained by the effective pain relief it provides, allowing patients to flex their spine adequately without discomfort. Achieving optimal flexion ($>90^\circ$) enhances the likelihood of successful needle insertion and reduces the number of attempts, ultimately improving the success rate of spinal anaesthesia.^[25]

Time to Achieve Spinal Anaesthesia: The time taken to achieve SAB was comparable between both groups (9.27 ± 1.91 minutes in FNB vs 9.32 ± 1.17 minutes in fentanyl; $p=0.90$). This finding is consistent with Rajbala et al,^[18] who also found no significant difference in time to perform spinal anaesthesia between FNB and intravenous fentanyl groups.

However, some studies have reported shorter times with FNB. Sharma et al,^[17] found that time to perform SAB was significantly shorter in the FNB group (4.05 ± 0.82 min vs 8.02 ± 2.89 min; $p<0.0001$), possibly because they used ultrasound-guided FNB, which allows for more accurate needle placement, improved block success, and faster onset compared to the landmark technique used in our study. Other studie.^[12,13,33] also reported shorter times with FNB, possibly due to differences in the time interval between trauma and surgery, which may have an unpredictable effect on pain.

Additional Analgesic Requirements: In our study, 2 patients (6.67%) in the fentanyl group required an additional dose of rescue analgesia, while no patient in the FNB group required rescue analgesia. Although this difference was not statistically significant ($p>0.05$), it demonstrates the clinical advantage of FNB in providing more complete analgesia.

Pakhare et al,^[5] reported that no rescue analgesia was required in the FNB group, whereas 100% of patients in the fentanyl group required rescue analgesia. The difference in their results may be due to the use of a higher dose of fentanyl ($3 \mu\text{g/kg}$) in their study, which may have provided better initial analgesia but still required rescue due to the severity of pain during positioning.

Sedation Scores: Sedation scores were significantly lower in the FNB group (all patients had score 1) compared to the fentanyl group, in which 46.67% of patients had score 2 (cooperative, oriented, tranquil) ($p<0.0001$). This is expected as FNB provides localised analgesia without affecting central consciousness, whereas intravenous fentanyl, being a centrally acting opioid, can cause varying levels of sedation.^[4,17] The absence of sedation-related complications in both groups supports the safety of both techniques when appropriately dosed.^[17]

Haemodynamic Parameters and Complications:

Haemodynamic parameters (heart rate, SBP, DBP, MAP, respiratory rate, and SpO₂) were comparable between both groups at all time intervals, with no statistically significant differences ($p>0.05$). No complications such as nausea, vomiting, pruritus, muscle rigidity, haematoma, block failure, hypoventilation, or fall in oxygen saturation were observed in either group.

These findings are consistent with previous studies.^[5,8,12,14] that reported no significant incidence of complications with either technique. Sia et al.,^[3] however, noted a fall in oxygen saturation in the fentanyl group when using a higher dose ($3 \mu\text{g/kg}$), highlighting the importance of using appropriate doses of fentanyl. Our study used a lower dose ($1 \mu\text{g/kg}$), which may explain the absence of respiratory complications.

CONCLUSION

Femoral nerve block with 1% lignocaine (15 ml) provides superior analgesia, better positioning quality, lower sedation, and reduced rescue analgesic requirements compared to intravenous fentanyl ($1 \mu\text{g/kg}$) for facilitating sitting position during spinal anaesthesia in patients undergoing fracture neck femur surgery. Femoral nerve block is safe, effective, and easy to perform, making it a preferable technique over intravenous fentanyl for this indication.

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