Section: Emergency Medicine

Original Research Article

COMPARISON OF ULTRASOUND-GUIDED VERSUS ANATOMICAL FEMORAL NERVE BLOCK FOR PAIN MANAGEMENT IN FEMUR FRACTURES IN THE EMERGENCY DEPARTMENT

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Received : 26/03/2026
Received in revised form : 12/05/2026
Accepted : 28/05/2026

Keywords:
Femoral nerve block, ultrasound-guided, anatomical technique, femur fracture, emergency department, pain management.

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DOI: 10.47009/jamp.2026.8.4.183

Source of Support: Nil,
Conflict of Interest: None declared

Int J Acad Med Pharm
2026; 8 (4); 1088-1093

ABSTRACT

Background: Femur fractures are commonly encountered in the emergency department (ED) and are associated with severe pain requiring prompt and effective management. Conventional systemic analgesics such as opioids and non-steroidal anti-inflammatory drugs (NSAIDs) may lead to adverse effects including delirium, respiratory depression, and drug interactions. Regional anaesthesia techniques, particularly femoral nerve block (FNB), offer an effective alternative for pain control. With advancements in technology, ultrasound-guided (USG) techniques have been increasingly utilized to improve the accuracy and safety of nerve blocks. **Materials and Methods:** This prospective comparative study was conducted on patients presenting with femur fractures in the emergency department. A total of 60 patients were divided into two groups: Group A received ultrasound-guided femoral nerve block, while Group B received anatomically guided femoral nerve block. Pain was assessed using the Visual Analogue Scale (VAS) at rest and during movement at various time intervals. Additional parameters including time to onset of analgesia, need for rescue analgesia, and complications were also evaluated. **Result:** Both groups demonstrated a significant reduction in pain scores following administration of femoral nerve block. At rest, pain reduction was comparable between the groups with no statistically significant difference ($p > 0.05$). During movement, Group A consistently showed lower VAS scores compared to Group B, with a statistically significant difference observed at 4 hours ($p = 0.028$). The requirement for rescue analgesia was minimal in both groups, and no major complications or hemodynamic instability were observed. **Conclusion:** Both ultrasound-guided and anatomically guided femoral nerve blocks are effective and safe techniques for pain management in femur fractures. Ultrasound-guided technique provides slightly better and more sustained analgesia, particularly during movement, and may offer an advantage in clinical practice. However, anatomical technique remains a reliable option in resource-limited settings.

INTRODUCTION

Femur fractures are among the most common traumatic presentations encountered in the emergency department and are frequently associated with severe pain that requires immediate and effective management. Pain control in such patients is particularly challenging due to factors such as advanced age, associated comorbidities, and increased sensitivity to systemic analgesics. Inadequate pain management may lead to complications such as delirium, prolonged immobilisation, and increased morbidity, whereas excessive use of opioids may also contribute to adverse outcomes including respiratory depression and altered mental status.[1]

Traditional methods of pain control, including opioids and non-steroidal anti-inflammatory drugs (NSAIDs), are widely used but are associated with significant side effects such as gastrointestinal complications, renal impairment, and drug interactions. These limitations highlight the need for safer and more effective alternatives in acute pain management. Regional anaesthesia techniques,

particularly peripheral nerve blocks, have emerged as an important modality in this context, as they provide targeted analgesia while reducing the need for systemic medications.[1,2]

Femoral nerve block (FNB) is a widely used regional anaesthesia technique that provides effective analgesia for patients with femur fractures. It offers several advantages, including rapid onset of pain relief, improved patient comfort, and facilitation of procedures such as immobilisation, radiological imaging, and fracture reduction.[2] The femoral nerve is anatomically superficial and easily accessible, making the procedure relatively simple and easy to learn.[3] As a result, FNB has gained widespread acceptance in emergency medicine practice.

Historically, regional anaesthesia techniques have evolved significantly, from early methods of nerve compression to modern techniques involving advanced equipment and imaging modalities. The introduction of ultrasound guidance has revolutionized the practice of peripheral nerve blocks by allowing direct visualization of nerves, surrounding structures, and needle placement.[4] This advancement has improved the accuracy, efficacy, and safety of nerve block procedures, particularly in patients with difficult anatomy or obesity.

Femoral shaft fractures exhibit a bimodal age distribution, commonly affecting young males due to high-energy trauma such as road traffic accidents, and elderly females due to low-energy mechanisms such as falls associated with osteoporosis.[5,6] The incidence of femoral fractures ranges from 10 to 21 per 100,000 population per year, with a significant proportion resulting in complications such as blood loss, pulmonary embolism, and long-term disability.[5,7] Effective pain management is therefore crucial not only for patient comfort but also for improving clinical outcomes and reducing complications.

Ultrasound-guided femoral nerve block offers several advantages over the traditional anatomical (landmark-based) technique. These include real-time visualization of anatomical structures, accurate needle placement, reduced risk of vascular injury, and improved spread of local anaesthetic around the nerve.[8] Additionally, ultrasound guidance allows for identification of anatomical variations, thereby increasing the success rate of the procedure and reducing complications.[4] Studies have shown that ultrasound-guided techniques are associated with faster onset of action, improved analgesic efficacy, and reduced requirement of local anaesthetic agents compared to conventional techniques.[9]

Despite these advantages, the use of ultrasound-guided techniques in emergency settings remains limited due to factors such as lack of training, operator dependency, and time constraints.[8] As a result, anatomically guided femoral nerve block continues to be widely practiced in many settings. While effective, this technique relies on surface landmarks and tactile feedback, which may result in variable success rates and increased risk of complications.

Pain assessment in emergency settings is commonly performed using tools such as the Visual Analogue Scale (VAS), which provides a reliable measure of pain intensity and allows for objective comparison of analgesic interventions.[10] Effective pain management strategies should aim not only to reduce pain scores but also to improve patient satisfaction, facilitate early mobilisation, and minimise complications.

Several studies have compared femoral nerve block with systemic analgesics and other regional techniques, demonstrating its superiority in terms of pain relief and reduced opioid requirement.[11] Furthermore, recent studies suggest that ultrasound-guided femoral nerve block may offer additional benefits over anatomical techniques in terms of efficacy and safety.[12,13] However, there remains a need for further comparative studies to establish clear evidence regarding the superiority of one technique over the other, particularly in emergency department settings.

In this context, the present study aims to compare the efficacy and safety of ultrasound-guided femoral nerve block with anatomically guided femoral nerve block in patients presenting with femur fractures in the emergency department. By evaluating parameters such as pain relief, onset of analgesia, and complications, this study seeks to provide evidence that can guide clinical practice and improve patient outcomes.

Aim: To compare the efficacy and safety of ultrasound-guided femoral nerve block with anatomically guided femoral nerve block for pain management in patients with femur fractures in the emergency department.

Objectives

1. To compare and evaluate pain relief in both groups after administration of femoral nerve block.
2. To compare the time taken by both techniques to achieve maximum analgesic efficacy.
3. To compare the incidence of complications between ultrasound-guided and anatomically guided femoral nerve block.

MATERIALS AND METHODS

Study Design: This study was designed as a prospective analytical comparative study conducted to evaluate the efficacy and safety of ultrasound-guided versus anatomically guided femoral nerve block in patients presenting with femur fractures in the emergency department.

Study Setting: The study was conducted in the Emergency Medicine Department (EMD) of Bharati Hospital, after obtaining approval from the Institutional Ethical Committee.

ISSN (O): 2687-5365; ISSN (P): 2753-6556

Study Duration: The study was carried out over a period of 2 years 1 month, from 1st September 2020 to 1st October 2022.

Study Population: Patients presenting to the emergency department with fracture femur were screened for eligibility and included in the study based on predefined inclusion and exclusion criteria.

Sample Size: A total of 60 patients were included in the study and were equally divided into two groups:

- Group A (n = 30): Ultrasound-guided femoral nerve block
- Group B (n = 30): Anatomically guided femoral nerve block

Sampling Technique: Patients were allocated into the two groups using stratified random sampling to ensure uniform distribution.

Inclusion Criteria

- Patients diagnosed with fracture femur
- Age >18 years
- Patients belonging to ASA Grade I, II, and III

Exclusion Criteria

- Polytrauma patients
- Local infection at the site of block
- History of femoral vascular graft or kidney transplantation
- Hemodynamically unstable patients

Methodology: All patients presenting to the emergency department underwent an initial clinical assessment, including evaluation of presenting complaints and relevant history. Demographic details such as age and gender were recorded, along with a detailed history of comorbidities. Baseline vital parameters including pulse rate, respiratory rate, blood pressure, and oxygen saturation were noted. Pain assessment was performed using the Visual Analogue Scale (VAS) ranging from 0 to 10.

Following baseline assessment, femoral nerve block was administered according to the assigned group. Pain scores were recorded at predefined time intervals both at rest and during movement. Hemodynamic parameters were monitored throughout the study period. Patients were also assessed for the requirement of rescue analgesia and any complications associated with the procedure.

Procedure

Ultrasound-Guided Femoral Nerve Block (Group A)

Patients were positioned supine, and a high-frequency linear ultrasound probe was used to identify the femoral artery and nerve at the level of the femoral crease. The femoral nerve was visualized lateral to the femoral artery beneath the fascia iliaca. Using an in-plane approach under real-time ultrasound guidance, a needle was advanced towards the femoral nerve. After confirming appropriate needle placement, 15 mL of 2% lignocaine with adrenaline was injected, ensuring adequate spread of the local anaesthetic around the nerve.

Anatomically Guided Femoral Nerve Block (Group B)

Patients were placed in a supine position with slight abduction of the limb. The femoral artery was palpated below the inguinal ligament, and the injection site was identified approximately 1 cm lateral to the artery. A needle was inserted perpendicular to the skin, and the characteristic "double pop" sensation corresponding to penetration of fascia lata and fascia iliaca was noted. After confirming negative aspiration, 15 mL of local anaesthetic was injected.

Outcome Measures: The primary outcome of the study was pain relief as assessed by the Visual Analogue Scale at baseline and at multiple time intervals following the procedure, both at rest and during movement. Secondary outcomes included time taken to achieve effective analgesia, requirement of rescue analgesia, changes in hemodynamic parameters, and incidence of complications.

Rescue Analgesia and Monitoring: Rescue analgesia in the form of intramuscular tramadol 30 mg was administered if the VAS score exceeded 4 out of 10. Patients were continuously monitored for pain relief, vital parameters, and any adverse events such as local anaesthetic toxicity, allergic reactions, or vascular injury.

Statistical Analysis: All collected data were entered and analyzed using appropriate statistical software. Continuous variables were expressed as mean ± standard deviation, while categorical variables were expressed as frequencies and percentages. Comparison between the two groups was performed using the independent sample t-test for continuous variables and the chi-square test for categorical variables. A p-value of less than 0.05 was considered statistically significant.

RESULTS

A total of 60 patients with femur fractures were included and divided equally into two groups: ultrasound-guided femoral nerve block (Group A) and anatomically guided femoral nerve block (Group B).

Table 1: Distribution of Study Groups

Group	Description	Number of Cases (n)	Percentage (%)
Group A	Ultrasound-guided femoral nerve block	30	50.0
Group B	Anatomical (landmark-based) femoral nerve block	30	50.0
Total		60	100.0

[Table 1] shows the distribution of study participants between the two groups. Each group consisted of 30 patients, accounting for 50% of the total study population. This equal distribution indicates appropriate group allocation and comparability between the two intervention arms.

ISSN (O): 2687-5365; ISSN (P): 2753-6556

Table 2: Comparison of Mean Age between Groups

Parameter	Group A (n=30)	Group B (n=30)	p-value
Mean Age (years)	53 ± 22	58 ± 21	0.382

The mean age of patients in Group A was 53 ± 22 years, while in Group B it was 58 ± 21 years. The difference in mean age between the two groups was not statistically significant (p = 0.382). This suggests that both groups were comparable in terms of age distribution, minimizing age-related bias in outcome assessment.

Table 3: Gender Distribution between Groups

Gender	Group A (n=30)	Group B (n=30)	p-value
Male	22 (73.3%)	20 (66.7%)	
Female	8 (26.7%)	10 (33.3%)	0.573

[Table 3] illustrates the gender distribution among the study participants. In Group A, 22 patients (73.3%) were males and 8 patients (26.7%) were females. In Group B, 20 patients (66.7%) were males and 10 patients (33.3%) were females. The difference in gender distribution between the two groups was not statistically significant (p = 0.573). This indicates that both groups were comparable with respect to gender, thereby reducing potential gender-related bias in the study outcomes.

Table 4: Intergroup Comparison of Mean VAS Score during Rest

Time Interval	Group A (Mean ± SD)	Group B (Mean ± SD)	p-value
Baseline	5.2 ± 0.55	5.37 ± 0.56	0.248
10 minutes	0.83 ± 0.83	1.03 ± 1.03	0.413
20 minutes	0.83 ± 0.83	1.03 ± 1.03	0.413
30 minutes	0.83 ± 0.83	1.03 ± 1.03	0.413
1 hour	0.83 ± 0.83	1.03 ± 1.03	0.413
2 hours	0.83 ± 0.83	1.03 ± 1.03	0.413
3 hours	2.63 ± 0.56	2.73 ± 0.58	0.499
4 hours	3.87 ± 0.43	4.07 ± 0.36	0.058

[Table 4] presents the comparison of mean pain scores at rest between the two groups at different time intervals. At baseline, the mean VAS score was similar in Group A (5.2 ± 0.55) and Group B (5.37 ± 0.56), with no statistically significant difference (p = 0.248). Following administration of femoral nerve block, both groups demonstrated a significant reduction in pain scores from 10 minutes up to 2 hours, with mean VAS scores remaining consistently low (approximately 0.83 in Group A and 1.03 in Group B). At 3 hours, there was a gradual increase in pain scores in both groups, with Group A recording 2.63 ± 0.56 and Group B 2.73 ± 0.58 (p = 0.499). By 4 hours, pain scores further increased to 3.87 ± 0.43 in Group A and 4.07 ± 0.36 in Group B; however, the difference remained statistically non-significant (p = 0.058). Overall, although Group A consistently showed slightly lower mean pain scores compared to Group B at all time intervals, the differences were not statistically significant, indicating comparable analgesic efficacy of both techniques at rest.

Table 5: Intergroup Comparison of Mean VAS Scores during Movement

Time Interval	Group A (Mean ± SD)	Group B (Mean ± SD)	p-value
Baseline	8.10 ± 0.71	8.20 ± 0.61	0.561
10 minutes	1.97 ± 1.03	2.43 ± 1.41	0.148
20 minutes	2.03 ± 1.03	2.43 ± 1.41	0.214
30 minutes	2.03 ± 1.03	2.43 ± 1.41	0.214
1 hour	2.03 ± 1.03	2.43 ± 1.41	0.214
2 hours	2.03 ± 1.03	2.43 ± 1.41	0.309
3 hours	3.73 ± 0.69	3.97 ± 1.03	0.308
4 hours	5.17 ± 0.65	5.57 ± 0.73	0.028*

There was a significant reduction in pain scores during movement in both groups following femoral nerve block. Although Group A (ultrasound-guided) consistently showed lower mean VAS scores compared to Group B, the difference was not statistically significant at most time intervals. However, at 4 hours, the difference became statistically significant (p = 0.028), indicating better sustained analgesic effect in the ultrasound-guided group.

DISCUSSION

Pain management in patients presenting with femur fractures remains a critical component of emergency care, as inadequate analgesia can lead to complications such as delirium, hemodynamic instability, and delayed recovery.[1] In the present study, we compared the efficacy of ultrasound-

ISSN (O): 2687-5365; ISSN (P): 2753-6556

guided and anatomically guided femoral nerve block for pain control in such patients.

The study included 60 patients who were equally divided into two groups, ensuring uniform distribution and comparability between intervention arms, as shown in [Table 1]. This balanced allocation minimized selection bias and allowed for a reliable comparison of outcomes. Furthermore, the baseline demographic characteristics, including age and gender distribution, were comparable between both groups [Table 2 and 3], with no statistically significant differences ($p > 0.05$). This indicates that the observed outcomes were not influenced by demographic confounders.

Femoral nerve block has been recognized as an effective modality for pain relief in femur fractures due to its ability to block nociceptive input from the periosteum, which is primarily innervated by branches of the femoral nerve.[14] In our study, both groups demonstrated a marked reduction in pain scores following administration of femoral nerve block, highlighting its effectiveness as a primary analgesic technique in the emergency department.

At rest, as depicted in [Table 4], the baseline VAS scores were comparable between Group A and Group B. Following administration of the block, both groups showed a rapid and significant reduction in pain scores within 10 minutes, which persisted up to 2 hours. This rapid onset of analgesia can be attributed to the use of lignocaine with adrenaline, which is known for its fast onset of action.[14] However, a gradual increase in pain scores was observed after 3 hours, corresponding to the waning effect of the local anesthetic. Although Group A consistently demonstrated slightly lower VAS scores compared to Group B, the difference was not statistically significant ($p > 0.05$). This suggests that both ultrasound-guided and anatomical techniques are equally effective in providing pain relief at rest.

During movement, pain scores were initially higher in both groups due to mechanical stimulation of the fracture site, as shown in [Table 5]. Following femoral nerve block, there was a substantial reduction in VAS scores in both groups up to 2 hours. Similar to findings at rest, pain scores gradually increased after 3 hours due to the diminishing effect of the anesthetic. Notably, at 4 hours, Group A showed significantly lower VAS scores compared to Group B ($p = 0.028$), indicating a better sustained analgesic effect with ultrasound guidance. This finding may be attributed to more accurate deposition of local anesthetic around the nerve under ultrasound visualization, resulting in improved spread and efficacy.[12,13]

The findings of the present study are consistent with previous studies. McGlone et al. demonstrated that femoral nerve block using lignocaine provides effective analgesia with rapid onset and duration of approximately 3–4 hours.[15] Similarly, Mutty et al. reported that femoral nerve block significantly reduces acute pain in femoral fractures and can be safely administered in emergency settings.[16] Reid et al. also observed that ultrasound-guided techniques offer better accuracy and improved quality of blockade compared to landmark-based methods, although both techniques were effective.[12]

In our study, although ultrasound-guided femoral nerve block showed slightly superior analgesic outcomes compared to the anatomical technique, the differences were not statistically significant at most time intervals. This may be due to the use of a fast-acting anesthetic such as lignocaine, which provides rapid onset of analgesia in both techniques. However, the statistically significant difference observed at 4 hours during movement suggests that ultrasound guidance may offer better sustained analgesia.

Another important observation was the low requirement for rescue analgesia in both groups, indicating the effectiveness of femoral nerve block as a primary analgesic modality. Similar findings have been reported by Riddell et al., who concluded that femoral nerve block is a safe and effective method for managing acute pain in femur fractures with minimal complications.[17] In the present study, no major complications or hemodynamic instability were observed, further supporting the safety profile of both techniques.

Overall, the findings of this study suggest that femoral nerve block is an effective method for pain control in femur fractures, providing rapid and adequate analgesia that facilitates patient transport, imaging, and immobilization. While both techniques are effective, ultrasound-guided femoral nerve block offers a slight advantage in terms of sustained analgesia and accuracy, particularly in challenging anatomical conditions.

CONCLUSION

The present study highlights that femoral nerve block is an effective and safe modality for pain management in patients with femur fractures in the emergency department. Both ultrasound-guided and anatomically guided techniques provided rapid onset and excellent analgesia, facilitating patient comfort during transportation, radiological evaluation, and immobilization of the affected limb. No significant complications or hemodynamic instability were observed in either group, confirming the safety of both approaches.

Although the overall analgesic efficacy of both techniques was comparable, ultrasound-guided femoral nerve block demonstrated slightly lower pain scores and a higher success rate, particularly in sustained analgesia during movement. However, this difference was not statistically significant in most parameters. Anatomical femoral nerve block remains a useful alternative in resource-limited settings despite a steeper learning curve.

Thus, both techniques can be effectively incorporated into routine emergency practice to improve patient care and reduce reliance on systemic analgesics.

ISSN (O): 2687-5365; ISSN (P): 2753-6556

Limitations of the study

The present study has certain limitations. Firstly, the use of lignocaine with adrenaline, which has a rapid onset of action, along with the first observation recorded at 10 minutes, limited the ability to accurately compare the onset time of analgesia between the two techniques. Secondly, no significant difference in onset of action could be established between the groups due to this limitation.

Additionally, in busy emergency department settings, the duration of action of lignocaine may not be sufficient if procedures such as imaging and immobilization are delayed beyond three hours. In such scenarios, the analgesic effect may wear off, necessitating the use of longer-acting agents such as bupivacaine, which was not evaluated in this study.

Further randomized controlled trials using longer-acting anesthetics are recommended to overcome these limitations and enhance applicability in real-world emergency settings.

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ISSN (O): 2687-5365; ISSN (P): 2753-6556