



Effect of adding dexmedetomidine to fascia iliaca compartment block on postoperative analgesia in patients undergoing femoral fractures surgery: A randomized double-blind clinical trial

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Abstract

Background: In this study we investigated the effect of adding dexmedetomidine to fascia iliaca compartment block on postoperative analgesia in patients undergoing femoral fracture surgery.

Methods: In this double-blind randomized clinical trial study, 70 patients aged 20–75 years, classified as American Society of Anesthesiologists physical status I and II who were scheduled to undergo femoral fracture surgery under spinal anesthesia were included. Patients were divided into intervention and control groups using the block randomization method (35 patients in each group). In the intervention group, fascia iliaca block was performed using 20 cc of 0.25% bupivacaine with 0.5 cc of 50 µg dexmedetomidine (fascia iliaca compartment block + dexmedetomidine group), and in the control group, the block was performed using 20 cc of 0.25% bupivacaine alone (fascia iliaca block group). The outcomes, including the average time to achieve sensory block, analgesia duration, number of times rescue analgesia was needed, time to first rescue analgesia, and pain severity assessed using the visual analog scale within 24 h postoperatively, were measured and compared between the two groups.

Results: The demographic data and time to reach sensory block were not significantly different between the two groups ($p > 0.05$). The mean analgesia duration in the fascia iliaca compartment

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block + dexmedetomidine group was significantly longer than that in the fascia iliaca block group (11.42 ± 1.65 vs. 9.26 ± 1.39 h; $p = 0.001$). An analgesic was prescribed for 11.4% and 31.4% of the patients 2–6 h postoperatively and for 54.3% and 77.1% at 6–12 h postoperatively in the fascia iliaca compartment block + dexmedetomidine and fascia iliaca block groups, respectively, representing a statistically significant difference between the two groups ($p = 0.03$). The visual analogue scale scores while in recovery, at 2 h postoperatively, and at 12–24 h postoperatively did not show a statistically significant difference between the two groups ($p > 0.05$); however, patients in the fascia iliaca compartment block group had significantly higher pain scores than those in the fascia iliaca compartment block + dexmedetomidine group at 2–6 h and 6–12 h postoperatively ($p < 0.05$).

Conclusion: Addition of dexmedetomidine to bupivacaine in the fascia iliaca block in femoral fracture surgeries reduces the severity of postoperative pain and need for analgesics and increases the analgesia duration.

Keywords

Femoral fractures, dexmedetomidine, fascia iliaca compartment block, analgesia, pain

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Background

Effective postoperative analgesia is essential in the management of patients undergoing femoral fracture surgery. Adequate pain control improves patient comfort, facilitates early mobilization, reduces perioperative complications, and accelerates functional recovery.¹ Effective pain management in patients undergoing hip fractures is essential for optimal recovery and rehabilitation. Inadequate pain control can result in increased postoperative complications, prolonged hospital stays, and functional decline.^{2–4} Although spinal anesthesia is commonly used for femoral fracture surgeries, patients often experience severe pain when repositioned for the procedure.⁵

Several analgesic techniques are employed in this context, including systemic opioids, paravertebral block, fascia iliaca compartment block (FICB), femoral nerve block, and spinal analgesia.¹ Intravenous opioids are commonly administered for postoperative pain relief in orthopedic procedures; however, their use is frequently associated with adverse

effects such as nausea, vomiting, and pruritus.^{6,7} The adoption of multimodal analgesia strategies, which combine agents with different mechanisms of action, can enhance analgesic efficacy while minimizing opioid-related side effects.⁸ Regional anesthesia, particularly ultrasound-guided peripheral nerve blocks, plays a pivotal role in multimodal pain management. These techniques are associated with improved safety profiles and reduced systemic toxicity.¹

Peripheral nerve blocks, including FICB, are increasingly recommended for managing postoperative pain in orthopedic procedures.^{9,10} These techniques are quick, relatively safe, and significantly enhance postoperative pain relief and patient satisfaction.¹¹ FICB, in particular, can alleviate discomfort prior to spinal anesthesia, facilitate patient positioning, and improve the success rate of spinal anesthesia.^{12–15} Additionally, FICB has been linked to reduced thromboembolic risk, shortened hospital stay, and improved postoperative outcomes.^{16–18} Its simplicity, cost-effectiveness,

and minimal requirement for advanced expertise further support its utility in routine clinical practice.^{19–21} Moreover, FICB provides prolonged analgesia compared with other regional techniques.²² Some studies on the use of local anesthetics for femoral nerve block suggest that bupivacaine offers more sustained analgesia and reduced postoperative analgesic consumption than ropivacaine.^{23–25} Bupivacaine has also been associated with shorter time to achieve spinal anesthesia and improved analgesia during patient positioning.^{26,27} Bupivacaine demonstrated superior performance in terms of block duration for both sensory and motor components.²⁵

Dexmedetomidine (DEX), a highly selective α_2 (α_2)-adrenoceptor agonist, exhibits both sedative and analgesic properties. It is increasingly utilized in perioperative practice and provides sedation without significant respiratory depression, making it particularly suitable for patients undergoing femoral fracture repair. Its opioid-sparing effect further contributes to reduced incidence of opioid-induced adverse effects such as nausea and constipation.^{28,29} When administered as an adjuvant to FICB, DEX may enhance the quality and prolong the duration of analgesia while decreasing the need for systemic opioids and their associated complications.^{8,30} Despite its potential, limited studies have evaluated the effect of using DEX in combination with FICB on postoperative analgesia in femoral fracture surgery. Furthermore, the comparative effectiveness of intravenous vs. perineural administration remains unclear.^{1,19,28,31}

Incorporating DEX into FICB protocols represents a promising strategy to improve the efficacy of postoperative analgesia. Existing evidence supports its role in lowering pain scores and extending the analgesia duration, positioning it as a valuable adjunct in multimodal pain management. Therefore, the present study aimed to evaluate the effect of adding DEX to FICB on

postoperative analgesia in patients undergoing femoral fracture surgery.

Methods

This prospective, randomized, double-blind study was conducted with the approval of the Scientific and Ethical Review Boards of Urmia University of Medical Sciences (IR. UMSU.REC.1400.268) and was registered with the Iranian Registry of Clinical Trials (IRCT) with ID: IRCT20170515033986N4. Written informed consent was obtained from all participants. In total, 70 patients scheduled for elective femoral fracture surgery under spinal anesthesia were enrolled in the study. According to the inclusion criteria, adult patients aged 25–75 years who were classified as American Society of Anesthesiologists (ASA) physical status I–II were included. Exclusion criteria included any contraindications to spinal anesthesia; morbid obesity (body mass index >35 kg/m²); infection or previous surgery at the injection site; history of addiction; use of analgesics within 2 h before surgery; mental or psychological disorders; multi trauma; significant cardiovascular, respiratory, renal, or hepatic diseases; pregnancy; and hematological disorders. Participants were randomly assigned to either the intervention or control group using a computer-generated randomization table. Each group consisted of 35 patients. Preoperative evaluation, including basic monitoring (noninvasive blood pressure measurement, pulse oximetry, and electrocardiography), was performed for all patients. An intravenous line was established, and 15–20 mL/kg of Ringer's lactate solution was administered. In the intervention group, a suprainguinal FICB was performed using 20 mL of 0.25% bupivacaine combined with 0.5 mL of DEX (50 μ g) (FICB + DEX group). In the control group, suprainguinal FICB was performed with 20 mL of 0.25% bupivacaine alone

(FICB group). The FICB procedure was performed by a regional anesthesiologist using an in-plane, ultrasound-guided approach. With the patient in the supine position, a high-frequency (6–14 MHz) linear ultrasound probe was placed transversely at the inguinal crease to identify the femoral artery. The iliopsoas muscle and fascia iliaca were identified, with the femoral nerve typically located between the iliopsoas and fascia iliaca, at a depth of 2–4 cm lateral to the femoral artery. Under sterile conditions, a 22.8-mm echogenic block needle was inserted and directed towards the fascia iliaca. The anesthesiologist, blinded to the syringe contents, injected the local anesthetic at the appropriate anatomical location. Following the FICB, spinal anesthesia was administered at the L3–L4 or L4–L5 intervertebral space using a 25-gauge Quincke needle, with 12.5 mg of 0.5% hyperbaric bupivacaine. Oxygen was administered via a face mask at a flow rate of 3 L/min. The primary outcomes included the time to reach sensory block, analgesia duration following FICB and before spinal anesthesia, and frequency and time to first request for additional analgesic agents within the 24 h postoperatively. Pain severity was assessed using a visual analogue scale (VAS) in recovery and at 2, 6, 12, and 24 h postoperatively, with a scale ranging from 0 (no pain) to 10 (worst imaginable pain). If the VAS score exceeded 3, additional analgesics were administered. Secondary outcomes included the occurrence of any technical complications, such as hematoma at the FICB injection site, and the potential for systemic drug toxicity from either the local anesthetics or DEX. All adverse events were carefully monitored during the study period. Based on the average analgesic use in a previous study¹ and 95% confidence interval ($Z_{1-\alpha/2} = 1.96$) and power of 80% ($Z_{1-\beta} = 0.84$), a sample size of 35 was

calculated for each group using the following formula:

$$n = \frac{(Z_{1-\frac{\alpha}{2}} + Z_{1-\beta})^2 \times (S_1^2 + S_2^2)}{(X_1 - X_2)^2}$$

Statistical methods

Statistical analyses were performed using Statistical Package for Social Sciences (SPSS) software (version 28). Descriptive statistics for continuous variables were presented as mean $\pm$ standard deviation (SD) values, and categorical variables were expressed as frequencies (percentages). A comparison of the mean values between the two groups was performed using an independent t-test, while categorical variables were compared using chi-square test. A p -value < 0.05 was considered statistically significant.

Results

Seventy patients classified as ASA physical status I–II were enrolled in this prospective, analytical study. Demographic and clinical characteristics were comparable between the two groups. The mean patient age in the FICB + DEX group was 43.17 ± 15.33 years, while that in the FICB group was 40.85 ± 15.78 years; the difference was not statistically significant ($p > 0.05$). The FICB + DEX group comprised 60% men and 40% women, while the FICB group included 45.7% men and 54.3% women; sex distribution was also not significantly different between the groups (Table 1).

The mean onset time for sensory block was 7.48 ± 1.52 min in the FICB + DEX group and 7.34 ± 1.39 min in the FICB group ($p = 0.74$). However, the mean time to first analgesic requirement within 2–6 h postoperatively was significantly higher in

Table 1. Comparison of the demographic data between the two groups.

Variable		FICB + DEX group (n = 35)	FICB group (n = 35)	p-value
Sex, n (%)	Male	21 (60)	16 (45.7)	0.23 ^a
	Female	14 (40)	19 (54.3)	
Age (years), mean $\pm$ SD		43.17 $\pm$ 15.33	40.85 $\pm$ 15.78	0.53 ^b
BMI (kg/m ²), mean $\pm$ SD		24.92 $\pm$ 2.82	25.31 $\pm$ 3.07	0.58 ^b

^achi-square test, ^bindependent t-test.

FICB: fascia iliaca compartment block; DEX: dexmedetomidine; BMI: body mass index; SD: standard deviation.

Table 2. Comparison of the time to reach sensory block, time to first rescue analgesic, number of rescue analgesics needed, and analgesia duration between two the groups.

Variable	Time after surgery	FICB + DEX group (n = 35)	FICB group (n = 35)	p-value
Time to reach sensory block and analgesia (min)	–	7.48 $\pm$ 1.52 ^a	7.34 $\pm$ 1.39	0.74 ^b
Time to first rescue analgesic (h)	2–6	4.25 $\pm$ 0.95	2.09 $\pm$ 1.44	0.001 ^b
	6–12	10.1 $\pm$ 1.39	8.30 $\pm$ 1.03	0.001 ^b
	12–24	19.34 $\pm$ 3.03	18.08 $\pm$ 2.41	0.06 ^b
Number of rescue analgesics needed, n (%)	2–6	4 (11.4)	11 (31.4)	0.03 ^c
	6–12	19 (54.3)	27 (77.1)	0.03 ^c
	12–24	0	0	–
Analgesia duration (h)		11.42 $\pm$ 1.65	9.26 $\pm$ 1.39	0.001 ^b

^aData was shown as mean $\pm$ SD, ^bindependent t-test, ^cchi-square test.

FICB: fascia iliaca compartment block; DEX: dexmedetomidine; SD: standard deviation.

the FICB + DEX group than in the FICB group (4.25 $\pm$ 0.95 vs. 2.09 $\pm$ 1.44 h; $p=0.001$). Similarly, during the 6–12-h postoperative period, the FICB + DEX group demonstrated a significantly longer time to analgesia request compared with the FICB group (10.1 $\pm$ 1.39 vs. 8.30 $\pm$ 1.03 h; $p=0.001$). No statistically significant difference was observed between groups during the 12–24-h period ($p=0.06$). No patients in either group requested analgesia during the recovery period or within 2 h postoperatively. During 2–6 h postoperatively, analgesic requirements were made by 4 patients (11.4%) in the FICB + DEX group and 11 patients (31.4%) from the FICB

group. During 6–12 h postoperatively, 19 patients (54.3%) in the FICB + DEX group and 27 patients (77.1%) in the FICB group requested analgesia. These differences were statistically significant ($p=0.03$). The mean duration of postoperative analgesia was significantly longer in the FICB + DEX group (11.42 $\pm$ 1.65 h) than in the FICB group (9.26 $\pm$ 1.39 h; $p=0.001$) (Table 2).

Pain severity scores, evaluated using the VAS, are summarized in Table 3. VAS scores during recovery and at 12–24 h postoperatively did not differ significantly between the groups. However, patients in the FICB group reported significantly higher pain scores than those in

Table 3. Comparison of the pain severity based on the VAS scale score between the two groups.

Timeline	Pain severity scores	FICB + DEX group (n = 35)	FICB group (n = 35)	p-value ^a
Recovery, n (%)	1	4 (44.4)	2 (25)	0.37
	2	5 (55.6)	6 (75)	
2 h postoperatively, n (%)	1	9 (30)	9 (27.3)	0.7
	2	19 (63.3)	20 (60.6)	
	3	2 (6.7)	4 (12.1)	
2–6 h postoperatively, n (%)	1	0	0	0.03
	2	1 (25)	0	
	3	3 (75)	2 (18.2)	
	4	0	5 (45.5)	
	5	0	4 (36.4)	
6–12 h postoperatively, n (%)	1	0	0	0.001
	2	3 (15.8)	0	
	3	9 (47.4)	2 (7.4)	
	4	1 (5.3)	2 (7.4)	
	5	5 (26.3)	2 (7.4)	
	6	1 (5.3)	6 (22.2)	
	7	0	6 (22.2)	
	8	0	7 (25.9)	
	9	0	1 (3.7)	
	10	0	1 (3.7)	
12–24 h postoperatively, n (%)	7	20 (57.1)	16 (45.7)	0.21
	8	14 (40)	14 (40)	
	9	1 (2.9)	5 (14.3)	

^achi-square test.
FICB: fascia iliaca compartment block; DEX: dexmedetomidine; VAS: visual analog scale.

FICB + DEX group at 2–6 and 6–12 h postoperatively ($p < 0.05$).

Discussion

This study aimed to evaluate the effects of adding DEX to FICB on postoperative analgesia in patients undergoing surgery for femoral fractures. In the present study, the FICB + DEX group demonstrated a significantly prolonged analgesia duration and longer time to first rescue analgesia request, along with significantly reduced pain severity and fewer analgesic requirements within 24 h postoperatively compared with the FICB-only group. These findings are consistent with previous reports, according to which, the combination of DEX and

bupivacaine in FICB prolongs postoperative analgesia and extends the duration of pain relief.^{1,19,28,32} Similarly, the DEX group exhibited lower pain scores and reduced analgesic consumption compared with control groups.^{16,17} The use of FICB with DEX also contributed to reduced opioid consumption, minimizing the potential for opioid-related adverse effects and offering a safer analgesic strategy for many patients.³³

In this study, the onset time of sensory blockade did not differ significantly between the FICB + DEX and FICB groups. This finding is consistent with previous studies, suggesting that $\alpha 2$ -adrenergic agonists such as DEX do not substantially influence the onset of peripheral nerve blocks when used as adjuvant to local

anesthetics, but enhance block quality and duration.^{34,35} The lack of effect on onset time may be explained by DEX's mechanism of action, which primarily involves modulation of nociceptive transmission rather than direct effects on sodium channel blockade.

In the present study, the significantly longer mean duration of postoperative analgesia observed in the FICB + DEX group further supports the analgesic-sparing effect of DEX. Previous studies evaluating DEX as an adjuvant in femoral nerve blocks, fascia iliaca blocks, and other lower-limb regional anesthesia techniques have reported similar prolongation of analgesia.^{36–39} These findings are particularly relevant in orthopedic and trauma-related surgeries, where effective regional analgesia plays a critical role in early mobilization and reduction of opioid consumption.¹⁰

The present findings showed that the pain severity, as measured using the VAS, was significantly lower in the FICB + DEX group at 2–6 h and 6–12 h postoperatively, corresponding with periods of increased analgesic requirement in the FICB group. The absence of significant differences during the immediate recovery period and late postoperative phase (12–24 h) suggests that DEX's analgesic benefit is most pronounced during the intermediate postoperative window, which is clinically meaningful as this period often coincides with waning effects of intraoperative analgesia and increasing patient discomfort.

DEX improves hemodynamic stability by maintaining blood pressure and heart rate, thereby reducing the need for additional sedatives or narcotics.^{40,41} Moreover, some studies have shown that ropivacaine used in FICB extends the duration of analgesia, reduces acute pain, and prolongs sensory block in orthopedic surgeries.^{42,43} DEX is a highly selective α_2 -adrenergic receptor agonist, primarily used for its sedative and analgesic properties in clinical settings. It acts

through both central and peripheral mechanisms, with a high selectivity ratio (1620:1) for α_2 over α_1 receptors—significantly greater than that of clonidine (220:1).⁴⁴ This high selectivity enables DEX to inhibit norepinephrine release via presynaptic α_2 -A receptor activation, reducing sympathetic outflow and subsequently lowering blood pressure and heart rate.⁴⁵ At the spinal level, DEX provides analgesia by acting on α_2 receptors, inhibiting pain transmission pathways and further enhancing its utility in perioperative pain management.^{46,47}

In addition, DEX has been used in clinical trials to reduce postoperative shivering and hemodynamic changes after general anesthesia^{48–50} and to prevent postoperative sore throat symptoms in laryngoscopy and endotracheal intubation patients.^{51–53} DEX can also be added to ropivacaine to improve sensory and motor blocks during lower abdominal surgery.⁵⁴

Taken together, the addition of DEX to FICB offers a promising approach to postoperative pain management in patients undergoing femoral fracture surgery. Its ability to prolong analgesia, reduce opioid requirements, and stabilize hemodynamic parameters highlights its value in orthopedic anesthetic protocols. Nonetheless, this study has certain limitations. A fixed dose of DEX (50 μ g) was used, based on a literature review, due to challenges in weight-based dosing. Additionally, the study did not evaluate hemodynamic changes associated with the addition of DEX.

Conclusions

The addition of DEX to bupivacaine to FICB, administered preoperatively in patients undergoing femoral fracture surgery, was associated with a significant reduction in postoperative pain intensity, decreased analgesic requirements, and prolonged duration of analgesia. This combination proved particularly advantageous in

facilitating preoperative positioning and enhancing postoperative recovery. Moreover, the reduction in opioid consumption offers the potential to minimize opioid-related adverse effects, representing a safer and more effective analgesic regimen in this patient population. Future multicenter studies with larger sample sizes should explore optimal dosing strategies and assess long-term outcomes of this analgesic technique, considering its hemodynamic effects. Assessment of opioid consumption, functional recovery, and patient satisfaction are warranted to further establish its role in multimodal analgesia protocols.

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Author contributions

Conceptualization: N.K., T.K., and H.T.; Data collection: M.GH; Formal Analysis: N.K., T.K., H.T., and M.GH; and Writing – original draft, review, and editing: N.K., T.K., and H.T. All authors approved the final article.

Consent for publication

Not applicable.

Data availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declaration of conflicting interests

The authors declare no competing interests.

Ethical approval and consent to participate

The present study has been approved by the Ethics Committee of Urmia University of Medical Sciences under the Ethics Code IR. UMSU.REC.1400.268. The study protocol has

been registered with Iranian Registry of Clinical Trials under the number IRCT20170515033986N4. This study was performed in line with the principles of the Declaration of Helsinki (1975, as revised in 2024), and consent forms were received from the parents of all participants.

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