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A comparative study of USG guided fascia iliaca compartment block and femoral nerve block to assist the technique of spinal anaesthesia

Spinal anestezi tekniğine yardımcı olmak amacıyla USG rehberliğinde fasya iliaka kompartman bloğu ve femoral sinir bloğunun karşılaştırmalı çalışması

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Abstract

Background: Proximal femur fractures are very painful, making positioning for regional anaesthesia a challenge. Peripheral nerve blocks are safe and effective for analgesia, and have the advantage of opioid-sparing effects. This study compares the analgesic efficacy of ultrasound-guided fascia iliac compartment block (FICB) and femoral nerve block (FNB) for optimal positioning during spinal anaesthesia for proximal femur fracture surgeries.

Materials and Methods: Ninety patients belonging to ASA I, II, and III, who were posted for surgery on proximal femur fractures, were randomly allocated into two groups of 45 each. Group A patients received USG-guided fascia iliaca block, and Group B patients received USG-guided femoral nerve block. Pain during positioning for spinal anaesthesia was the primary outcome and was assessed using the Numerical Rating Scale (NRS) scores.

Results: Time to onset of block was 4.3 ± 0.9 mins in the FICB group and 2.8 ± 0.6 mins in the FNB group ($p < 0.001$). Time to perform the block was 8.52 ± 2.32 mins in the FICB group and 5.12 ± 1.22 mins in the FNB group ($p < 0.001$). A statistically significant difference was seen between the study groups at 10, 15, and 30 mins after the intervention in terms of NRS pain scores.

Conclusions: We conclude that both the femoral nerve block (FNB) and the fascia iliaca compartment block (FICB) using ultrasound guidance are simple and effective. In our study, patients in Group B had lower NRS scores compared to Group A. The ultrasound-guided FNB may offer faster onset of block and better pain relief than FICB for assisting in positioning for spinal anaesthesia in patients with proximal femur fractures.

Keywords: bupivacaine, femoral nerve block, fascia iliaca compartment block, femur fractures, spinal anaesthesia.

Öz

Amaç: Proksimal femur kırıkları oldukça ağrılıdır ve bu durum spinal anestezi için pozisyon vermeyi zorlaştırır. Periferik sinir blokları, analjezi sağlama açısından güvenli ve etkili yöntemler olup, opioid kullanımını azaltma gibi avantajlara sahiptir. Bu çalışma, proksimal femur kırığı cerrahileri sırasında spinal anestezi öncesi optimal pozisyonlama için ultrason eşliğinde yapılan fascia iliaca kompartman bloğu (FICB) ile femoral sinir bloğunun (FNB) analjezik etkinliğini karşılaştırmaktadır.

Gereç ve Yöntem: ASA I, II ve III sınıfına dahil edilen ve proksimal femur kırığı nedeniyle ameliyat planlanan 90 hasta rastgele iki gruba ayrıldı, her grupta 45 hasta yer aldı. Grup A'daki hastalara ultrason rehberliğinde fascia iliaca bloğu uygulandı; Grup B'deki hastalara ise ultrason rehberliğinde femoral sinir bloğu uygulandı. Spinal anestezi için pozisyonlama sırasındaki ağrı birincil sonuç olarak belirlendi ve Sayısal Ağrı Skalası (NRS) ile değerlendirildi.

Bulgular: Blok başlama süresi FICB grubunda 4,3±0,9 dakika, FNB grubunda ise 2,8±0,6 dakika idi ($p<0,001$). Bloğun uygulanma süresi FICB grubunda 8,52 ± 2,32 dakika, FNB grubunda ise 5,12 ± 1,22 dakika idi ($p<0,001$). Müdahale sonrası 10, 15 ve 30. dakikalarda NRS ağrı skorları açısından gruplar arasında istatistiksel olarak anlamlı fark görüldü. **Sonuç:** Hem femoral sinir bloğu (FNB) hem de fascia iliaca kompartman bloğu (FICB), ultrason rehberliğinde uygulandığında basit ve etkili yöntemlerdir. Çalışmamızda, Grup B'deki (FNB) hastaların NRS ağrı skorları, Grup A'daki (FICB) hastalara kıyasla daha düşüktü. Ultrason eşliğinde uygulanan FNB, proksimal femur kırığı olan hastalarda spinal anestezi öncesi pozisyonlandırma için FICB'ye göre daha hızlı etki başlangıcı ve daha iyi ağrı kontrolü sağlayabilir.

Anahtar Kelimeler: bupivakain, femoral sinir bloğu, fascia iliaca kompartman bloğu, femur kırıkları, spinal anestezi.

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Highlights

- The objective of this study was to compare the analgesic efficacy of ultrasound-guided fascia iliaca compartment block (FICB) vs. femoral nerve block (FNB) for positioning patients with proximal femur fractures during spinal anaesthesia.
- Both blocks are effective, but ultrasound-guided FNB is superior in terms of quicker onset and better analgesia for positioning patients during spinal anaesthesia

Introduction

Spinal and epidural anaesthesia are the most common regional anaesthesia techniques used for traumatic orthopedic lower limb surgeries (1,2). A major hindrance to the performance of central neuraxial blockade in patients with femur fractures is the lack of optimal positioning of patients due to the acute, painful fractures. Minor movements and even slight changes in position cause excruciating pain. Sympathetic activation due to pain leads to tachycardia and hypertension, which can be detrimental in elderly patients who are at high risk of ischemic heart disease (3,4,5). Systemic use of NSAIDs, opioids, and paracetamol for pain relief is often insufficient for optimal positioning for central neuraxial blockade. Peripheral nerve block provides a safe and reliable substitute for systemic analgesia, with an opioid-sparing effect (6,7,8). Ultrasound-guided approaches reduce the local anesthetic (LA) quantity and adverse effects of LA (9,10,11). Regional anaesthesia techniques are considered preferable to minimise the use of systemic opioids. The use of USG-guided peripheral nerve blocks has revolutionised regional anaesthesia. The need for an effective and safe method to assist patient positioning during spinal anaesthesia in patients with painful fractures is of utmost value. The present study was done to compare the efficacy of ultrasound (USG)-guided femoral nerve block (FNB) and fascia iliaca compartment block (FICB) for patient positioning during the performance of the central neuraxial blockade technique. The primary objective was the assessment of pain during positioning for spinal anaesthesia by the Numerical Rating Scale (NRS). Secondary objectives were the assessment of patient satisfaction, quality of patient positioning, adverse effects, and complications.

Material and Methods

During the pre-operative visit, patients were assessed for eligibility for the study and informed about the study interventions and Numerical rating scale (NRS) scores for pain assessment. Written Informed consent for participation in the study was obtained. Patients belonging to ASA class I, II & III, aged between 18 and 80 years, of either gender who were scheduled to undergo elective surgery for proximal femur fractures under spinal anaesthesia were included in the study. Patients with history of allergy to study drugs, infections at site of injection, polytrauma, head injury, morbid obesity and impaired cognition were excluded from the study. Computer-generated random numbers were used to allocate patients into two groups. All patients underwent thorough preoperative evaluation and followed the standard pre-operative fasting guidelines. In the preoperative room, intravenous line was secured and base line vital parameters were recorded with pulse-oximetry, noninvasive blood pressure (NIBP) and electrocardiography (ECG).A linear 7-13 MHz ultrasound-guided probe (Sonosite M-Turbo, USA) was used to view anatomical structures. The block procedures were done by an Anaesthesiologist with an experience of more than five years in USG guided peripheral nerve block techniques. FICB and FNB were carried out in supine position under aseptic conditions. The FICB was given for patients in Group A. Fascia lata and fascia iliaca are located as two hyper-echoic lines with the Ultrasound transducer placed transversely on the thigh below the inguinal ligament at the junction of medial one third and lateral two thirds of the line joining pubic tubercle and anterior superior iliac spine. Femoral artery is identified and then, the iliacus muscle covered by fascia iliaca is identified. The needle is advanced by in plane technique beneath the fascia iliaca and after negative aspiration, local anaesthetic is injected.FNB was given to patients in Group B. The femoral nerve was identified via the ultrasound probe placed at the level of the femoral crease distal to the inguinal ligament. The femoral nerve is found as a triangular hyper echoeic areas located lateral to the femoral artery, deep to the fascia iliaca on the anterior aspect of iliopsoas muscle. The femoral artery, being superficial is very easily visualized on ultrasound. In both groups, after identification of the targeted nerve and plane identification by ultrasound guidance, needle was advanced by in-plane technique. Initially 2 ml of local anaesthetic was injected to observe the spread of the drug. A total of 30 ml of 0.25% bupivacaine was injected after identification of needle tip and careful aspiration to rule out intravascular injection. Numerical rating scale (NRS) scores were used to assess

the pain. The NRS scale consists of a horizontal line with 0-10 markings, where score 0 is no pain, score 1-3 is mild pain, score 4-6 is moderate pain and score 7-10 is severe pain. The time interval between injection of local anaesthetic for FICB//FNB block and decrease in the pain scores to <3 was considered as onset of analgesia. The NRS pain scores at rest were recorded immediately before the study interventions and then at 3 mins, 5 mins, 10 mins, 15 mins and 30 mins after the block. Patients were monitored and observed for adverse effects and complications. Patients were then shifted to the operative room for anaesthetic and surgical management. Spinal anaesthesia was performed in sitting position 30 minutes after the study interventions i.e. FICB/FNB. The patient was blinded to the group allocation and the type of block technique they would undergo. The Anaesthesiologist performing the block tecnique as per group allocation was not further involved in the patient management and data collection. The anesthesiologist performing the spinal anaesthesia was blinded to the study drug and assessed the quality of patient positioning given scores as not satisfactory-0, satisfactory-1, good-2 and optimal-3. Data Analysis was done with assistance of Statistical expert. In patients who had pain with NRS pain scores >4 during positioning for spinal anaesthesia, supplemental analgesia was given with single dose of inj.fentanyl 50 μg IV.

Sample size calculation

The sample size calculation was based on a two-sample independent t-test, 90% power and a 5% two-sided significance level to demonstrate at least 25% differences in the NRS pain scores between the study groups based on a previous similar stud**y (** (12). Total sample size required for the study was 90 (45 in each group).

Statistical analysis

The data were entered into an excel worksheet, and SPSS 20 was used for the analysis. Descriptive statistics were used**.** Data from categorical variables were provided in number (%) and results from continuous variables were presented as mean and SD. To determine the association between two categorical variables and continuous variables, chi-square test, paired t test, fischer's exact test, ANOVA, Mann –Whitney U test and independent t test were used. A p value of 0.05 or lower was regarded as statistically significant.

Ethical Approval

This was a randomized clinical study conducted at a tertiary care teaching hospital. The ethical committee of BLDEDU Shri BM Patil Medical College Hospital and Research Centre, Vijayapura was obtained (number: 09/2021 date:22/10/2021). The study was registered under the clinical trial registry of India-CTRI/2022/07/044334. The declaration of Helsinki recommendations was followed for the conduct of the study. Informed consent was obtained from all participants.

Results

The study was conducted on patients between 18-80 years who were undergoing elective surgery for proximal femur fractures. The two study groups were comparable in terms of demographic variables and no statistically significant differences were observed **(Table 1).**

Table 1. Demographic Data

Variables	Group A FICB (n=45)	Group B FNB (n=45)	p
Age (years) mean ± SD	53.76 ± 12.23	55.27 ± 11.37	0.54
Gender (Male: Female)	25:20	25:20	0.58
Weight (kg)	60.5 ± 9.1	60.6 ± 8.7	0.97
BMI (kg/m²)	25.89 ± 3.05	25.40 ± 2.34	0.41
ASA I/II/III	5/30/10	4/32/9	1.11
Intertrochanteric fracture,(%)	26 (57.77)	28 (62.22)	0.27
Neck of femur fracture,(%)	8 (17.77)	12 (26.66)	
Subtrochanteric fracture,(%)	2 (4.44)	2 (4.44)	
Proximal femur fracture,(%)	9 (20)	3 (6.66)	

Abbreviations: Data is represented by numbers and percentage (%), p value <0.05 is significance.

Time taken to perform the block was 8.52 ± 2.32 mins in Group A and 5.12 ± 1.22 mins in Group B **(**p < 0.001). The time taken was shorter in Group B and was statistically significant **(**Table 2). The onset of block was 4.3 ± 0.9 mins

in Group A and 2.8 ± 0.6 mins in Group B ($p < 0.001$). The onset of block was faster in Group B and was statistically significant **(Table 2).**

Table 2. Time required for block performance and onset of block

Variables	Group A FICB (n=45)	Group B FNB (n=45)	p
Time taken to perform USG block (minutes)	8.52 ± 2.32	5.12 ± 1.22	<0.001*
Time of Onset of block (minutes)	4.3±0.9	2.8±0.6	<0.001*

Patients who underwent blocks in group B had significant pain reduction during positioning. There was a statistically significant difference between the groups in terms of quality of patient positioning score with a p value of <0.001 (**Table 4).**

A score of 0 i.e. unsatisfactory positioning was observed in 5 (11.11%) patients in group A but none in group B. Best positioning with a score of 3 was observed in 15 (33.33%) patients in group A and in 32 (71.11%) patients in group B (**Table-3)**.

Table 3. Score for Quality of patient positioning

Score for Quality of patient positioning	Group A FICB (n=45), n(%)	Group B FNB (n=45), n(%)	p
0 (Not satisfactory)	5 (11.11)	0 (0)	<0.001*
1(Satisfactory)	6 (13.33)	1(2.22)	
2 (Good)	19 (42.22)	12 (26.67)	
3 (Optimal)	15 (33.33)	32(71.11)	

Abbeviations: Data is represented by numbers and percentages (%), p value <0.05* is significant

In study groups, NRS pain scores were recorded before the study intervention, at 3 mins, and 5 mins, and p-values were 0.919, 0.925, and 0.611, respectively, showing no statistically significant difference between the groups**.** At 10 minutes, NRS pain scores of 4–6 were seen in 11 patients in Group A and 2 patients in Group B. Severe pain with NRS scores of 7–10 were seen in 3 patients of Group A, whereas none in Group B. At 15 minutes, NRS scores of 4–6 were seen in 7 patients of Group A and none in Group B. Severe pain with NRS scores of 7–10 was seen in 1 patient of Group A and none in Group B. At 30 minutes, NRS scores of 4–6 were seen in 4 patients of Group A and none in Group B. Severe pain with NRS scores of 7–10 was seen in 1 patient of Group A and none in Group B. NRS pain scores between the study groups at 10 mins, 15 mins, and 30 mins after intervention showed a statistically significant difference between the groups**,** with p-values of 0.018, 0.02, and 0.02, respectively **(Table 4)**.

Table 4. NRS Pain scores

Time	NRS scores	Group A FICB (n=45) n(%)	Group B FNB (n=45) n(%)	p
Before block	0	1 (2.22)	1 (2.22)	0.919
	1-3	8 (17.78)	10 (22.22)	
	4-6	11 (24.44)	13 (28.89)	
	7-10	25 (55.56)	21 (46.67)	
3 mins	0	5 (11.11)	4 (8.89)	0.925
	1-3	11 (24.44)	15 (33.33)	
	4-6	19 (42.22)	17 (37.78)	
	7-10	10 (22.22)	9 (20)	
5 mins	0	11 (24.44)	15 (33.33)	0.611
	1-3	19 (42.22)	17 (37.78)	
	4-6	10 (22.22)	9 (20)	
	7-10	5 (11.11)	4 (8.89)	
10 mins	0	20 (44.44)	24 (53.33)	0.018
	1-3	11 (24.44)	15 (33.33)	
	4-6	11 (24.44)	2 (4.44)	
	7-10	3 (6.67)	0	
15 mins	0	30 (66.67)	40 (88.89)	0.021
	1-3	7 (15.56)	5 (11.11)	
	4-6	7 (15.56)	0	

	7-10	1 (2.22)	0	
30 mins	0	30 (66.66)	40 (88.88)	0.022
	1-3	10 (19.55)	5 (22.22)	
	4-6	4 (10.55)	0	
	7-10	1 (2.22)	0	

There were no incidences of complications such as bleeding/hematoma at the site of the block, adverse systemic toxicity, nausea, vomiting, hypotension, bradycardia, or respiratory depression in either of the two study groups. Supplemental analgesia with fentanyl was not given to 40 patients in Group A and all patients in Group B. In five patients in Group A, fentanyl 50 μg IV was given prior to positioning for spinal anaesthesia..

Discussion

Proximal femur fractures cause significant distress to patients during positioning for spinal anaesthesia. Regional nerve blocks like FNB and FICB can be used as adjuvant techniques for reducing pain, thereby helping to optimize patient positioning for successful spinal anaesthesia. Fan X et al. (8) in a meta-analysis compared the efficacy of Fascia iliaca compartment block and femoral nerve block for pain management in hip surgeries. They observed that these regional anaesthesia techniques were effective for pain control for proximal femur fractures.USG guided peripheral nerve blocks have the advantages of direct visualization of the nerve or neuraxial structures, surrounding vascular structures, needle tip position and spread of local anaesthetic solution thus allowing optimal placement of the local anaesthetic and minimising the procedure related complications, especially the devastating intravascular injections (13,14). Commonly used systemic analgesics are opioids, paracetamol and non-steroidal anti-inflammatory drugs (NSAIDs). Safe and effective doses of opioids and NSAIDs are difficult to titrate in the post- traumatic patients, especially the geriatric population (15,16,17). Femoral nerve block (FNB) is being used for analgesia in femur fractures in the emergency department. The femoral nerve is a terminal branch of the lumbar plexus arising from the ventral rami of the second, third and fourth lumbar nerves.

Femoral nerve block results in anaesthesia of the skin of the antero-medial thigh, knee and the medial border of the leg. (18,19). The muscles innervated by the femoral nerve are the sartorius, quadriceps femoris, iliopsoas and pectineus muscles. The femoral nerve innervates the anterior aspects of the hip joint, the anterior aspect of the femur and the anteromedial aspects of the knee joint (20). The femoral nerve can be easily located at the level of inguinal crease where it is superficially situated. Femoral nerve blockades by landmark technique lateral to the femoral artery pulsations have high failure rates and complications. Spinal anaesthesia is a commonly preferred technique by anaesthesologists worldwide for lower limb orthopedic surgeries. Positioning a patient with hip and femur fractures for spinal anaesthesia causes excruciating pain. Adverse effects of pain include tachycardia, hypertension and compromised myocardial blood flow. Mismanagement of acute pain is an independent risk factor for chronic persistent post-surgical pain (21,22). Our present study was to compare the analgesic efficacy of ultrasound-guided FNB and FICB in patients with proximal femur fractures to minimise pain associated with positioning for spinal anaesthesia. Sandby-Thomas et al. (15) in their research on perioperative care of femur fractures observed that during patients' positioning for subarachnoid block, midazolam, ketamine and propofol were the commonly used systemic agents.

They reported that to aid positioning, nerve blocks were used very infrequently and any sedation or analgesia was not being given in around 15.1% of patients. National Institute for Health and Clinical Excellence regulations recommend that nerve blocks be taken into account to minimize opioid dose and provide additional analgesia (21). Newman et al (22) used a nerve stimulator guided nerve blocks and observed a mean post-block VAS score of 4.4 for FNB and a score of 5.4 for FICB using 0.5% levobupivacaine with a statistically significant difference. In our study with ultrasound guidance block we observed effective analgesia with FNB and FICB and both blocks were equally efficacious and an 8- 10-minute interval after the block was sufficient to provide adequate analgesia to proceed to spinal anaesthesia in all the patients. Callear et al (16) in a non-comparative study, using landmark technique observed that the FICB, using 30 mL of 0.25% bupivacaine, reduced pain considerably 15 minutes after the block was given. Similarly, Kumar et al (23) in their study observed that using 30 mL of 0.5% ropivacaine given to a FICB to relieve pain before positioning for spinal anaesthesia was assessed 20 minutes after the block, VAS score was reduced to 2.94 with ~~a~~ $p < 0.01$, which showed significance statistically. Jain N et al. (12) also observed that FNB had better pain reduction with significantly less VAS score than FIB post block. Ultrasound-guided

bupivacaine deposition in the vicinity of the femoral nerve which also innervates the hip and femur joint increases the possibility of nerve blockage. This might explain why FNB is more effective in providing analgesia than FICB.
In the present study, we observed that with FNB there was improved patient positioning in comparison to FICB. In the FNB group, there were 32 (71.11%) patients who had optimal positioning while in the FICB group only 15 (33.33%) patients had optimal positioning. Statistically, FNB group patients had better positioning scores than patients in the FICB group.
There were no incidences of complications like bleeding/hematoma at the site of the block, adverse systemic toxicity, nausea, vomiting, hypotension, bradycardia, or respiratory depression either of the two study groups. This can be attributed to the use of an ultrasound-guided block in comparison to the anatomical landmark approach. Previous studies also suggested that ultrasound-guided blocks are safe, have decreased onset time and are more effective than the anatomical landmark approach or nerve stimulator approach. Ultrasound guidance is a better tool for visualizing anatomical features during nerve block administration and may be utilized for performing FNB and FICB (20).

Limitations

Larger sample size and multicenter trials are required to validate the findings and improve the generalizability of the study. NRS score was used for pain score which is subjective and pain threshold may vary in each individual.

Conclusion

Both the FNB and the FICB using ultrasound guidance are simple and effective techniques. In our study patients in the group B (FNB) had lower NRS scores compared to group A(FICB). Ultrasound-guided FNB may offer faster onset of block and better pain relief than FICB for assisting with optimum positioning for spinal anaesthesia in patients with proximal femur fractures.

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