



A Comparative Study on the Effect of Femoral Nerve Block (FNB) Versus Fascia Iliaca Compartment Block (FIC) on Analgesia of Patients with Isolated Femoral Shaft Fracture Under Spinal Anesthesia

Seyed Hamid Reza Faiz¹, Pooya Derakhshan², Farnad Imani³, Mahmoud Reza Alebouyeh², Poupak Rahimzadeh^{3,*} and Arash Memarian²

¹Associated Professor of Anesthesiology, Endometriosis Research Center, Iran University of Medical Sciences, Tehran, IR Iran

²Department of Anesthesiology, Rasoul Akram Hospital, Iran University of Medical Sciences, Tehran, IR Iran

³Pain Research Center, Iran University of Medical Sciences, Tehran, IR Iran

*Corresponding author: Poupak Rahimzadeh, Pain Research Center, Iran University of Medical Sciences, Tehran, IR Iran. E-mail:poupak_rah@hotmail.com

Received 2017 January 28; Revised 2017 April 28; Accepted 2017 May 31.

Abstract

Background and Objective: A local nerve block is used to relieve pain and improve the positioning of patients during spinal anesthesia. This study attempted to compare femoral nerve block (FNB) versus fascia iliaca compartment (FIC) block.

Methods: In this clinical trial, a total of 68 patients undergoing surgery for femoral shaft fractures were divided randomly to 2 groups of FNB and FIC. The patients' pain was recorded by the visual analogue scale (VAS) before and during administration of femoral nerve block. Satisfaction of positioning for spinal anesthesia and duration of the procedure were also recorded in the 2 groups.

Results: During the nerve block, the pain score of FIC was significantly lower than that of the FNB group (2.5 ± 0.6 , 3.6 ± 0.8 and $P = 0.001$). During the administration of spinal anesthesia, the mean pain in the FNB group was significantly lower than that of FIC (2.7 ± 1.1 , 3.4 ± 0.6 and $P = 0.001$). The satisfaction of patients with positioning in the FNB group was reported to be excellent by 40.7% of patients, whereas none in the FIC group reported satisfaction. The completion time of sensory block was significantly lower in the FNB group than the FIC group ($P = 0.001$).

Conclusions: The FNB seems to provide better analgesia during spinal anesthesia for the patient, even though the administration of FIC tends to be easier and less painful than the FNB. Shorter completion time of sensory and motor block in the FNB group could be indicative of the superiority of this method for providing the appropriate conditions for spinal anesthesia in an emergency setting.

Keywords: Fascia Iliaca Block, Femoral Nerve Block, Femoral Fracture, Pain, Pain Control

1. Background

Femoral fracture is one of the most common and the most important problems of orthopedic patients arising from trauma or falling, in all age groups, especially the elderly. Many of these patients are elderly and often female (1).

The pain complications could be a result of the release of catecholamines and metabolic hormones, which lead to stress responses, such as water and sodium retention and hemodynamic disorders (such as increase or decrease in blood pressure and tachycardia), which sometimes leads to increased bleeding and heart attack in elderly patients (2). Therefore, the application of proper anesthesia and analgesia methods in these patients, who often experience a variety of underlying diseases, is not only a humanitarian

duty but also facilitates the ease of operation, placement and positioning of patients, and reduces health costs and morbidity (3).

Nowadays, a variety of methods have been proposed to control pain and provide numbness and anesthesia in surgery. Physicians have been focusing on local anesthesia and spinal anesthesia in elderly patients due to the side effects of general anesthesia. In patients with femoral fractures, it has been more common to administer local nerve block for effective analgesia prior to positioning, which is crucial for spinal anesthesia (4).

The commonly adopted nerve blocks in these patients include Femoral Nerve Block (FNB) and Fascia Iliaca Compartment (FIC) block. So far, the 2 techniques have not been compared in previous studies. Several studies have shown various results about pain control methods, drugs

selection, dosage and their effectiveness (5-11). This study aimed at comparing the 2 block methods in patients with isolated femur fractures in terms of administration speed, effectiveness, and side effects.

2. Methods

This was a double-blind clinical trial, where the patients undergoing surgery for femoral shaft fractures, referred to Rasoul Akram hospital, were examined. This study was registered in the Iranian registry of clinical trials with the following code: IRCT2015102712642N19. This study was conducted between years 2014 and 2016. The sample size calculation formula was: $n = [(Z_{\alpha/2} + Z_{\beta})^2 \times 2(\text{standard deviation})^2 / (\mu_1 - \mu_2)^2]$, where n = sample size required in each group, μ_1 = mean pain score in femoral nerve block group, μ_2 = mean pain score in FIC block group, $\mu_1 - \mu_2$ = clinically significant difference, $Z_{\alpha/2}$: 5% level of significance (1.96), Z_{β} : 95% power (1.96) and standard deviation = 1.195 (12). Since no previous study was available on this subject, a pilot study was performed on 10 patients (5 in each group), in which μ_1 was measured as 4.25 and μ_2 as 5. Therefore, n was calculated as 30 for each group, which gave a total sample size of 60. Furthermore, to account for a 10% drop among patients, the final sample size was decided to be 68 (34 in each group). Inclusion criteria were as follows, signing an informed consent form, isolated femur fracture only, cardiopulmonary functional class I to III, age of 20 to 75 years, body mass index (BMI) of less than 30, no current or history of addiction to drugs, no sensitivity to amide anesthetics, no psychiatric disorder, and no history of seizures. Exclusion criteria were as follows, coagulation disorders, peripheral neuropathy, and incomplete block after 20 minutes, seizures, nausea or vomiting after injection of anesthetic nerve block drugs, high incidence of hematoma or bleeding during nerve block, unwillingness to participate or inability to respond to the questionnaire. From the total of 79 available patients during the study period, 68 were selected according to the study criteria (11 excluded). Informed written consent was obtained from all patients and the ethical committee of Rasoul Akram hospital approved the study (ethical code: IR.IUMS.REC.1394.9111174027). All patients were informed of the objectives and procedure of pain assessment based on the VAS. The patients were then randomly divided to 2 equal groups, using computer software, which uses a 2×2 contingency table. One group received femoral nerve block (FNB) while the other group received Fascia Iliaca compartment (FIC) block. When transferred to the recovery room, pink IV lines were installed for the patients and they were monitored by Noninvasive Blood Pressure Amplifier (NIBP), pulse oximetry, and Electrocardiography

(ECG). Before the administration of nerve block, ringer lactate serum was prescribed as much as 5 mL/kg. For the administration of femoral nerve block, the patients were placed in supine position. The accuracy and quality of the nerve block was enhanced through a nerve stimulator. The optimum position of the needle was based on the observation of quadriceps twitch and patella contraction at 0.2 to 0.4 mA. The femoral nerve was detected on the sonogram as a bundle of flat fascicle between the hypoechoic subcutaneous tissue and the hyperechoic iliopsoas muscle. Ultrasound transducer should be placed proximally near the femoral crack so that the femoral nerve could be observed prior to division to its terminal branches. For Fascia Iliaca compartment (FIC) block, the block pin was driven forward guided by cross-sectional imaging from the lateral end until it pierced the fascia iliaca accompanied by a "pop" sound. The needle position was optimized to allow the release of 30 mL of 1.5% lidocaine all around the femoral nerve. In administration of FIC, the patients were placed in the supine position similar to the FNB group. The ultrasound-guided needle was inserted through one-third of the lateral line between pubic tubercle and ASIS as in-plane. When the fascia lata and fascia iliaca (double pop) passed through, 30 mL of 1.5% lidocaine was injected. The drug was released in medial direction towards the lateral femoral nerve to the superficial femoral nerve guided by ultrasound. The patients were asked to rate their pain using VAS before and during nerve block and spinal anesthesia positioning. The nerve block was evaluated every one-minute using pinprick and cotton alcohol on anterior, inside and outside of the knee. In case of a VAS > 4, 50 mg of fentanyl was prescribed. The time intervals for completion of nerve block were measured, recorded, and compared in the 2 groups. The quality of positioning was recorded and compared based on 4 categories; not satisfactory (0), satisfactory (1), good (2), and optimal (3). The study was conducted as a double-blinded clinical trial. The shape, size, and color of the syringes used for blocks were all the same and also the site of injection was nearly the same, therefore, the patients were blind to their group. In addition, the anesthesiologist, who collected the data, was also blind to the group of the patients and all blocks were done by a specialist in pain. For data analysis, descriptive statistics were used to summarize data. Frequencies and percentages were reported for the qualitative variable, while means and standard deviations were reported for quantitative variables. Moreover, the Student's t-test and chi-square test were used to analyze the data, as appropriate, using IBM SPSS 16. The significance level was set at 0.05.

3. Results

This study involved 79 patients undergoing surgery for femoral shaft fracture; 11 of these patients were excluded according to exclusion criteria and from the remaining, 68 patients were randomly selected. The patients were randomized to 2 groups of FNB and FIC, each including 34 subjects (Figure 1). All the demographic characteristics of patients were normally distributed. As illustrated in Table 1, there were no statistically significant differences between the 2 groups in terms of age, gender, and weight ($P > 0.05$).

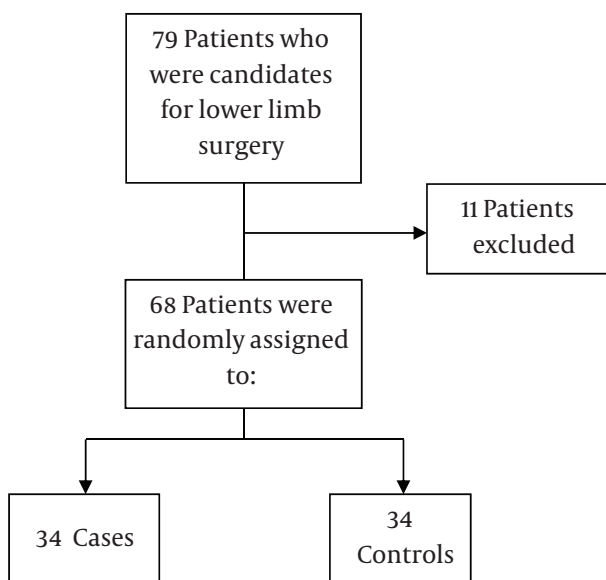


Figure 1. The Study Participant's Selection Flowchart

The pain level was measured by VAS before and during nerve blocks and spinal anesthesia, and then compared between the 2 groups, as shown in Table 2, separately for different interventions. The mean pain score before the administration of nerve blocks was 8.1 ± 1.1 in the FNB group and 8.6 ± 1.01 in the FIC group, indicating no significant difference ($P = 0.1$).

Moreover, the mean pain score during the administration of nerve blocks was 3.6 ± 0.8 in the FNB group and 2.5 ± 0.6 in the FIC group, which was significantly lower in FIC ($P = 0.001$).

In addition, the mean pain score during the administration of spinal anesthesia was 2.7 ± 1.1 in the FNB group and 3.4 ± 0.6 in the FIC group, which was significantly lower in FNB ($P = 0.001$) (Table 2). The satisfaction of patients with positioning prior to spinal anesthesia was compared in the 2 groups as shown in Table 2. Satisfaction in the FNB group was reported to be excellent by 40.7% of patients. Conversely, none of the subjects in the FIC group

reported satisfaction. The completion time of sensory and motor block was significantly lower in the FNB group than the FIC group (Table 2).

4. Discussion

In the recent years, the number of elderly patients with multiple comorbidity and femoral fractures has grown, thus escalating the need for surgical repair in patients, which requires anesthesia. Several studies have demonstrated the superiority of regional anesthesia techniques for most of such patients. Particularly, Urwin et al. compared general anesthesia and regional anesthesia over a month after surgery in patients with multiple comorbidity and femoral fractures; finding out that the DVT and mortality were lower in the regional anesthesia group. In addition, the ambulatory time of these patients tended to be shorter than patients receiving general anesthesia (13).

Nonetheless, spinal regional anesthesia needs certain prerequisites essential for positioning before spinal procedure, which is accompanied by extreme pain and other complications.

The pain reduction techniques include midazolam + ketamine, propofol, opioids, such as fentanyl, remifentanyl, morphine sulfate, nitrous oxide, and sevoflurane. Unlike the above methods, the nerve block has been adopted for pain relief. In this respect, the FNB and FIC could be employed. Several studies have so far compared the nerve blocks with opioids, which have shown promising results in favor of nerve block (14-16). Sia et al. compared FNB and fentanyl during the positioning of patients from supine to sitting. The VAS level was significantly lower in the FIC group than the FNB group (17). Mosaffa et al. compared FNB and fentanyl, determining that VAS was significantly lower in patients receiving FIC (18).

The current study compared the FNB and FIC in terms of pain (using VAS), completion time for nerve block, and quality of patient's positioning. Given the results of this clinical trial, it seems that FNB provides better analgesic effect during the administration of spinal anesthesia. However, the administration of FIC was easier and less painful leading to lower complications compared to FNB. Shorter completion time of sensory and motor block in the FNB group could be indicative of its superiority in rapidly providing the appropriate conditions for spinal anesthesia. On the other hand, the satisfaction with positioning prior to spinal anesthesia was reported to be excellent by 40.7% of patients with FNB, while no patient answered "excellent" in the FIC group. The possible reasons for the superiority of FNB over FIC could be the 20-minute time limit applied on FIC. Otherwise, longer time could yield other results considering the limitations of the operating schedule and etc.

Table 1. Demographic Variables Examined Separately for the Two Treatment Groups^a

	Variable	FIC Group	FNB Group	P Value
Gender	Male	25 (75)	23 (63.8)	0.5
	Female	9 (25)	11 (36.2)	
Age, y		43.8 ± 16.9	47.9 ± 17.1	0.3
Range		19 - 63	18 - 67	
Weight, kg		70.3 ± 8.1	70.8 ± 7.3	0.7

^aValues are expressed as mean ± SD or No. (%).**Table 2.** Comparison of Pain, Physician Satisfaction With the Positioning of Patients, Completion of Sensory and Motor Nerve Blocks in the Two Groups^a

Variable	FNB Group	FIC Group	P Value
Pain score before nerve block (VAS)	8.1 ± 1.1	8.6 ± 1.01	0.1
Pain score during nerve block (VAS)	3.6 ± 0.8	2.5 ± 0.6	0.001 ^b
Pain score during spinal anesthesia (VAS)	2.7 ± 1.1	3.4 ± 0.6	0.001 ^b
Satisfaction with positioning of patient			
Dissatisfied (0)	0 (0)	0 (0)	0.001 ^b
Relative satisfaction (1)	12 (35.2)	5 (15.6)	
Good (2)	22 (64.8)	14 (43.7)	
Excellent (3)	13 (40.7)	0 (0)	
Completion time of nerve blocks	1.9 ± 5.8	2.5 ± 14.2	0.001 ^b

^aValues are expressed as mean ± SD or No. (%).^bStatistically significant.

The femur fracture site may have left a significant impact on the results of the current study. Despite the fact that all the subjects in this study had femoral shaft fracture, the fracture site (e.g. distal mid-proximal) could have affected the results.

In a successful FIC, the expected effect was approximately 80% for lateral femoral nerve block and 70% for obturator nerve, which leads to conflicting statistical results in multiple studies. The admission time of patients to OR for surgery was another important factor to be considered. The time between fractures and treatment may have a significant impact on the results of the blocking techniques. As seen in a study by Orosz et al. surgery within 24 hours of admission lowered severe pain before and around the operation (19). Since the 2 nerve blocks have not been compared yet, it is crucial to design further studies with a focus on more homogeneous groups in terms of weight, fracture zone, and time of surgery, while providing a longer time to complete the procedure.

4.1. Conclusions

Accordingly, the regional nerve block could seemingly be effective in improving the patient's positioning during spinal anesthesia and providing adequate analgesia with minimal side effects (respiratory, cardiovascular, etc.). Moreover, it gives rise to minimal incidence of disorientation and uncooperative patients. The analgesia and completion time in the FNB tended to be more ideal. The patients' satisfaction and the quality of positioning were better in the FNB. Nonetheless, it is essential to carry out further studies to examine factors contributing to the patient's positioning when it comes to spinal anesthesia. Owing to the simplicity and safety of FNB and patients' higher satisfaction, employment of this procedure at various stages will be highly effective for pain relief in the patients.

References

- Sahota O, Rowlands M, Bradley J, Van de Walt G, Bedforth N, Armstrong S, et al. Femoral nerve block Intervention in Neck of Femur fracture (FINOF): study protocol for a randomized controlled trial. *Trials*. 2014;**15**:189. doi: [10.1186/1745-6215-15-189](https://doi.org/10.1186/1745-6215-15-189). [PubMed: [24885267](https://pubmed.ncbi.nlm.nih.gov/24885267/)].
- Sedlar M, Kvasnicka J, Krska Z, Tomankova T, Linhart A. Early and subacute inflammatory response and long-term survival after hip trauma and surgery. *Arch Gerontol Geriatr*. 2015;**60**(3):431-6. doi: [10.1016/j.archger.2015.02.002](https://doi.org/10.1016/j.archger.2015.02.002). [PubMed: [25704919](https://pubmed.ncbi.nlm.nih.gov/25704919/)].
- Warwick R, Williams PL. *Gray's anatomy*. **1302**. Edinburgh: Longman; 1973.
- Grant S, Aitchison T, Henderson E, Christie J, Zare S, McMurray J, et al. A comparison of the reproducibility and the sensitivity to change of visual analogue scales, Borg scales, and Likert scales in normal subjects during submaximal exercise. *Chest*. 1999;**116**(5):1208-17. [PubMed: [10559077](https://pubmed.ncbi.nlm.nih.gov/10559077/)].
- Parker MJ, Griffiths R, Appadu B. Nerve blocks (subcostal, lateral cutaneous, femoral, triple, psoas) for hip fractures. *Cochrane Lib*. 2002.
- Black KJ, Bevan CA, Murphy NG, Howard JJ. Nerve blocks for initial pain management of femoral fractures in children. *Cochrane Database Syst Rev*. 2013;(12). CD009587. doi: [10.1002/14651858.CD009587.pub2](https://doi.org/10.1002/14651858.CD009587.pub2). [PubMed: [24343768](https://pubmed.ncbi.nlm.nih.gov/24343768/)].
- Foss NB, Kristensen BB, Bundgaard M, Bak M, Heiring C, Virkelyst C, et al. Fascia iliaca compartment blockade for acute pain control in hip fracture patients: a randomized, placebo-controlled trial. *Anesthesiology*. 2007;**106**(4):773-8. doi: [10.1097/01.anes.0000264764.56544.d2](https://doi.org/10.1097/01.anes.0000264764.56544.d2). [PubMed: [17413915](https://pubmed.ncbi.nlm.nih.gov/17413915/)].

8. Abou-Setta AM, Beupre LA, Jones CA, Rashid S, Hamm MP, Sadowski CA, et al. Pain Management Interventions for Hip Fracture. *AHRQ Comparative Effectiveness Reviews*. Rockville (MD); 2011.
9. Hauritz RW, Gerlif C, Ronholm E. [Fascia iliaca block performed by emergency department physician trainees in hip fractures]. *Ugeskr Laeger*. 2009;**171**(7):515–8. [PubMed: [19210934](#)].
10. Godoy Monzon D, Iserson KV, Vazquez JA. Single fascia iliaca compartment block for post-hip fracture pain relief. *J Emerg Med*. 2007;**32**(3):257–62. doi: [10.1016/j.jemermed.2006.08.011](#). [PubMed: [17394987](#)].
11. Chesters A, Atkinson P. Fascia iliaca block for pain relief from proximal femoral fracture in the emergency department: a review of the literature. *Emerg Med J*. 2014;**31**(e1):84–7. doi: [10.1136/emmermed-2013-203073](#). [PubMed: [24389648](#)].
12. Sakpal TV. Sample size estimation in clinical trial. *Perspect Clin Res*. 2010;**1**(2):67–9. [PubMed: [21829786](#)].
13. Urwin SC, Parker MJ, Griffiths R. General versus regional anaesthesia for hip fracture surgery: a meta-analysis of randomized trials. *Br J Anaesth*. 2000;**84**(4):450–5. [PubMed: [10823094](#)].
14. Haines L, Dickman E, Ayvazyan S, Pearl M, Wu S, Rosenblum D, et al. Ultrasound-guided fascia iliaca compartment block for hip fractures in the emergency department. *J Emerg Med*. 2012;**43**(4):692–7. doi: [10.1016/j.jemermed.2012.01.050](#). [PubMed: [22494596](#)].
15. Chan EY, Fransen M, Parker DA, Assam PN, Chua N. Femoral nerve blocks for acute postoperative pain after knee replacement surgery. *Cochrane Database Syst Rev*. 2014;(5). CD009941. doi: [10.1002/14651858.CD009941.pub2](#). [PubMed: [24825360](#)].
16. Szucs S, Iohom G, O'Donnell B, Sajgalik P, Ahmad I, Salah N, et al. Analgesic efficacy of continuous femoral nerve block commenced prior to operative fixation of fractured neck of femur. *Perioper Med (Lond)*. 2012;**1**:4. doi: [10.1186/2047-0525-1-4](#). [PubMed: [24764520](#)].
17. Sia S, Pelusio F, Barbagli R, Rivituso C. Analgesia before performing a spinal block in the sitting position in patients with femoral shaft fracture: a comparison between femoral nerve block and intravenous fentanyl. *Anesth Analg*. 2004;**99**(4):1221–4. table of contents. doi: [10.1213/01.ANE.0000134812.00471.44](#). [PubMed: [15385380](#)].
18. Mosaffa F, Esmailijah A, Khoshnevis H. Analgesia before performing a spinal block in the lateral decubitus position in patients with femoral neck fracture: A comparison between fascia iliaca block and IV fentanyl. *Reg Anesth Pain Med*. 2005;**30**(5):61.
19. Orosz GM, Magaziner J, Hannan EL, Morrison RS, Koval K, Gilbert M, et al. Association of timing of surgery for hip fracture and patient outcomes. *JAMA*. 2004;**291**(14):1738–43. doi: [10.1001/jama.291.14.1738](#). [PubMed: [15082701](#)].