Analgesic Efficacy of Fascia Iliaca Compartment Block for Positioning During Spinal Anesthesia in Patients with Femur Fractures

Jha A,[1] Khatiwada S,[2] Pokharel K,[2] Ghimire A,[2] Singh SN,[2] Prasad JN[2]

[1]Department of Anesthesiology and Critical Care,

Rapti Academy of Health Sciences (RAHS),

Ghorahi, Dang, Nepal.

[2]Department of Anesthesiology and Critical Care,

B.P. Koirala Institute of Health Sciences

Ghopa, Dharan, Nepal.

Corresponding Author

Ajit Jha

Department of Anesthesiology and Critical Care,

Rapti Academy of Health Sciences (RAHS),

Ghorahi, Dang, Nepal.

E-mail: Ajit_ac@hotmail.com

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ABSTRACT

Background

Positioning patients with femur fractures for spinal anesthesia is associated with excruciating pain. Fascia iliaca compartment block has the potential to block all nerves supplying the femur and therefore may provide effective analgesia during positioning these patients for spinal anesthesia.

Objective

To assess the analgesic efficacy of Fascia iliaca compartment block, during positioning patients with femur fracture for spinal anesthesia. We also assessed the duration of analgesia and the requirement for rescue analgesics in the postoperative period.

Method

Seventy adult patients with fracture femurs were randomly divided into two equal groups (A and B). Patients in both groups received fentanyl one mcg/kg intravenously, 20 minutes before positioning them for spinal anesthesia. Patients of group B additionally, received ultrasound-guided Fascia iliaca compartment block with 40 ml of 0.25% Ropivacaine, immediately after intravenous fentanyl. Numerical rating score (0-10) was used for the assessment of pain at five, 10, and 20 minutes after the block and immediately after positioning patients for spinal anesthesia.

Result

Immediately after positioning patients for spinal anesthesia, the numerical rating score of pain was 5.06±1.5 in group A and 2.49±1.2 in group B ($p<0.001$). The duration of analgesia was 799.7±62.1 minutes in group B and 314.65±118.9 minutes in group A ($p<0.001$). One (2.8%) patient of group B and 18(51.4%) patients of group A required rescue analgesics within four to twelve hours in the postoperative period ($p=0.001$). In group A, seven patients were satisfied with the analgesia technique while in group B, 17 were satisfied and eight patients were strongly satisfied ($p<0.001$).

Conclusion

Ultrasound-guided Fascia iliaca compartment block is effective in reducing pain during positioning patients with femur fractures for spinal anesthesia. Patients receiving this block had a prolonged duration of analgesia, required lesser analgesics, and were more satisfied in the postoperative period as compared to patients not receiving the block.

KEY WORDS

Fascia Iliaca compartment block, Positioning, Postoperative analgesia

INTRODUCTION

Fractures involving the femur are common. Positioning patients with femur fractures for spinal anesthesia is associated with excruciating pain, sympathetic overactivity, increased morbidity, and stay.[1,2] Intravenous analgesics mainly opioid has been the mainstay of therapy to alleviate pain and create a favorable environment during positioning these patients for spinal anesthesia (SA). However, the adverse effects like nausea, vomiting, sedation and even respiratory depression associated with the use of these analgesics may pose problems both to the patient and the anesthesiologist.[3]

Regional nerve blocks could be an attractive alternative to systemic analgesics for addressing the pain associated with positioning patients with a femur fracture. Nerve blocks have the advantage of providing better quality and prolonged duration of analgesia and also lack the aforementioned adverse effects. The Fascia iliaca compartment has a fascial connection to all the nerves supplying the femur and thus when blocked, has the potential to provide effective analgesia during positing patients with femur fractures for spinal anesthesia.[4]

We aimed to assess the analgesic efficacy of ultrasound-guided Fascia iliaca compartment block (FICB) with 40 ml of 0.25% of Ropivacaine, during positioning patients with femur fractures for spinal anesthesia. Assessment of the number of attempts required for successful spinal anesthesia, duration of analgesia, the requirement of rescue analgesics in the postoperative period, and the level of patient satisfaction regarding pain management in the perioperative period were our secondary objectives.

METHODS

This was a randomized clinical trial, performed in the department of anesthesiology and critical care at B.P. Koirala Institute of Health Sciences (BPKIHS), Dharan from February 2019 to February 2020 after obtaining ethical clearance from the institutional review committee (IRC no: IRC/1369/018) and informed consent from all eligible patient. The sample size was calculated using STATA software using the reference article by Diakomi et al.[5] Fascia iliaca compartment block reduced the numeric rating scale (NRS) by 40% from the baseline. Considering the 40% difference in reduction of NRS between groups, with power 90%, alpha error 0.05 and possible dropouts the sample size calculated was 35 in each group. Computer generated table was used to randomize the patient into two groups. The anesthesiologist analyzing the data was blinded but the patient and block performer could not be blinded due to ethical concerns.

Patients aged 18 years and above of American Society of Anesthesiologists physical status (ASA PS) I, II, and III who were willing to participate in the study were enrolled. Patients with a height less than 5 feet, painful conditions like neuropathies, allergies or contraindication to medication to be used and contraindication to Subarachnoid or Fascia iliaca compartment block were excluded.

All patients were assessed preoperatively a night prior and were explained the use of NRS for pain assessment and the Likert scale for assessing the level of satisfaction. The NRS for pain ranged from 0 to 10, 0: no pain, one to three: mild pain, four to six: moderate pain, and seven to 10: severe pain.[6] Similarly, the Likert scale for satisfaction ranged from one to five, one: strongly dissatisfied, two: dissatisfied, three: neutral, four: satisfied, and five: strongly satisfied.[7] Patients were premedicated with Tab. Lorazepam 1 mg (< 50 kg) and 2 mg (> 50 kg) orally. On the day of operation after establishing standard monitoring baseline NRS at rest and movement was recorded. The movement is defined as a vertical active movement of the limb by 5 cm. After this patient in group A received an injection of fentanyl one mcg/kg. While patients in group B received an Ultrasound-guided Fascia iliaca compartment block with 40 ml of 0.25% ropivacaine in addition to the injection fentanyl one mcg/kg. The NRS for the patient was then recorded at various time intervals. After this patient was transferred to the operating table and laid down in a supine position. NRS was recorded again in the supine position and the patient was subsequently placed in a sitting position and the time taken to do so was recorded. The patient then received spinal anesthesia with bupivacaine heavy 0.5% 3 ml at L3-L4 space. The number of attempts for successful spinal anesthesia was recorded. The patient's level of analgesia after the completion of positioning was also recorded.

After completion of the surgery, all patients received one gm paracetamol intravenously. Injection Ketorolac 30 mg along with injection paracetamol one gm intravenous was used six hours apart as rescue analgesic if the patient requested. Adverse events like hypotension, bradycardia, nausea, vomiting, pruritus, and desaturation were recorded for each case. The complete duration of analgesia, requirement for rescue analgesics, and level of satisfaction were recorded at end of 24 hours. The complete duration of analgesia was defined as the time from the injection of intravenous fentanyl to the first request for rescue analgesics in the postoperative period. Data collected were assessed for normality using the Shapiro-Wilk test or histogram. Mean and standard deviation was calculated for normally distributed data and was compared using an independent t-test. Qualitative data were analyzed using the chi-square test.

RESULTS

A total of 70 patients, 35 in each group, were analyzed and the demographic parameters including age, sex, height, weight, and the baseline hemodynamic parameters were comparable in each group without any significant

difference. We found both intravenous fentanyl and fascia iliaca compartment block reduced pain scores significantly both at rest and at movement ($p < 0.01$). Similarly, when comparing group A to group B the reduction in NRS was significantly more in group B suggesting FICB is more efficacious than injection fentanyl only for reducing pain associated with positioning the patient in a fractured femur. The NRS for pain, immediately after posting patients sitting from supine was 5.06±1.5 in group A and 2.49±1.2 in group B ($p<0.001$) (Figure 1, Table 1).

While placing the patient from supine to sitting position for subarachnoid block, patients receiving FICB required

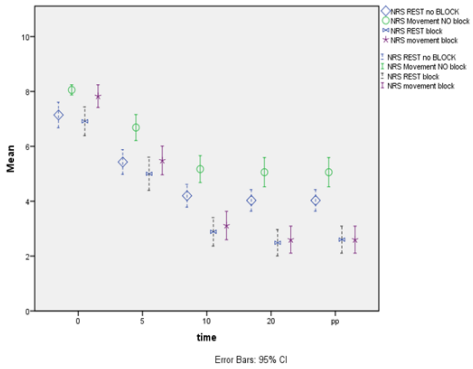

Figure 3. Distribution of patient according to number of vessel having ≥ 50% stenosis, SVD (single vessel disease), DVD (double vessel disease, TVD (triple vessel disease).

Table 1. Comparison of pain score at rest and at movement

NRS at various time	Group A (n=35)	Group B (n=35)	P value (Intergroup comparison)
0 minutes at rest	7.14±1.35	6.91±1.52	0.308
0 minutes at movement	8.06±0.54	7.83±1.2	0.509
5 minutes at rest	5.43±1.31	4.91±1.74	0.167
5 minutes at movement	6.69±1.39	5.40±1.52	0.001*
10 minutes at rest	4.2±1.21	2.7±1.33	0.001*
10 minutes at movement	5.17±1.42	3.00±1.35	0.001*
20 minutes at rest	4.03±1.21	2.37±1.17	0.001*
20 minutes at movement	5.06±1.55	2.49±1.22	0.001*
After positioning at rest	5.06±1.55	2.49±1.22	0.001*
p-value (Intragroup comparison)	0.001*	0.001*	

Variables are expressed as mean ± standard deviation

significantly less time 3.91±1.12 minutes when compared to 4.9±1.54 minutes for patients receiving an injection fentanyl only. This reduction in NRS and reduced time to position led to greater satisfaction during positioning (Table 2). The number of attempts required for successful SA was similar in both groups. In 17(49%) patients of group A and in 15(43%) patients of group B, SA was successful in the first attempt, whereas in 18(51%) patients of group A and in 20(57%) patients of group B, more than one attempt was required for successful SA (p=0.16).

We also compared the complete duration of analgesia conferred by these two modalities and found that in the patient given FICB the complete duration of analgesia was much longer at around 799±62.18 min or 13.3 hours compared to only 314.6±11 minutes or 5.2 hours in those patients receiving only injection fentanyl ($p < 0.001$). This increased duration of analgesia in the FICB group meant that a lower number of patients in this group required rescue analgesics. In the first four-hour, one patient in the injection fentanyl group asked for rescue analgesic while in the fourth to twelfth hour 18 patients received rescue analgesics in the injection fentanyl group compared to only one patient in the FICB group ($p < 0.001$). From the twelfth to the twenty-fourth hour the demand for rescue analgesics increased with 28 patients in group A and 24 patients in group B requiring rescue analgesics (p=0.287) (Figure 2). This increased duration of analgesia and less requirement of rescue analgesics in the block group led to greater overall satisfaction (Table 2) and these patients were more willing to receive the same analgesic technique in the future if required. Out of 35 patients in the block group, 17 were satisfied and eight were strongly satisfied compared to only seven and none respectively in the injection fentanyl-only group ($p < 0.001$).

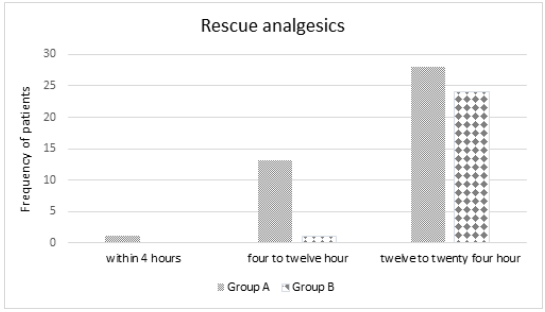

Figure 3. Frequency of patients requiring rescue analgesia

Table 2. Level of satisfaction during positioning for spinal anesthesia and overall technique

Level of satisfaction during positioning	Group A (N=35)	Group B (N=35)	Total	P value
Strongly dissatisfied	0(0)	0(0)	0(0)	
Dissatisfied	0(0)	0(0)	0(0)	
Neutral	28(80)	5(14.3)	33(47.1)	0.001*
Satisfied	7(20.0)	23(65.7)	30(42.9)	
Strongly Satisfied	0(0)	7(20.0)	7(10.0)	
Total	35(100.0)	35(100.0)	70(100.0)	
Overall satisfaction at 24 hours				
Strongly dissatisfied	0 (0)	0 (0)	0 (0)	
Dissatisfied	7 (20)	0 (0)	0 (0)	
Neutral	21 (60.0)	10 (28.6)	33 (47.1)	0.001*
Satisfied	7(20.0)	17(48.5)	29(41.4)	
Strongly Satisfied	0(0)	8(22.9)	8(11.4)	
Total	35(100.0)	35(100.0)	70(100.0)	

Values presented as the frequency of patients and percentage

All 35 patients were willing to repeat the technique in the block group as compared to only 26 patients in the injection fentanyl-only group ($p < 0.001$). The occurrence of adverse in each group was statistically insignificant with two hypotension, two desaturations in group A, and four hypotension in group B (p=0.29).

DISCUSSION

Femur fracture is a debilitating condition with high morbidity from the excruciating pain that impacts the physical and psychological aspects of a patient. The incidence of femur fracture is high in the elderly and coexisting comorbidities related to the cardiovascular, renal, and respiratory systems further complicate the management.[8] Nerve blocks have emerged as an alternative to the administration of systemic analgesics as they have better quality analgesia and fewer adverse systemic effects. Various blocks namely Fascia iliaca compartment block, Femoral nerve block, and three-in-one block are applied for pain management in a femur fracture. We chose to study the efficacy of Fascia iliaca compartment block by assessing the NRS because of its simplicity and safety in reducing pain associated with positioning patients with fracture femur. The anatomy of Fascia iliaca is such that a single injection at a safe distance from the major vessel and nerve can block multiple nerves that innervate the upper thigh and with the addition of ultrasound guidance we can increase the accuracy and success of the block.[9,10] We chose Ropivacaine for our study because of the prolonged duration of analgesia and better safety profile compared to Bupivacaine.[11]

In our study pain scores started reducing in both groups as early as 5 minutes which is in unison with the fact that Fentanyl has early-onset analgesia and is thus used in pain management via a variety of routes like intravenous, intrathecal, and even intranasal route.[12] In the Fascia iliaca group the block could have augmented the analgesia as ropivacaine can confer analgesia as early as 50 seconds.[13] In contrast to our finding, the study of Diakomi et al. did not find a significant reduction in pain scores after injection of fentanyl even at doses of 1.5 µg/kg which was higher than the one µg/kg used in our study.[5] In their study, the pain score of 7.5 after positioning the patients with femur fractures was nearly the same as the baseline score of around 7.6. The reduction in pain scores continued to augment and had fallen significantly in both groups at around the 20-minute mark and during positioning suggesting the efficacy of both intravenous fentanyl and FICB group in reducing positioning pain in patients with fracture femur.

When we made a comparison between the two groups, we found that the Fascia iliaca compartment block is more effective for providing analgesia during positioning patients for subarachnoid block as compared to injection fentanyl. We found that pain scores were significantly less at rest and movement in the Fascia iliaca compartment group than in the intravenous fentanyl group and the reduction in pain was earlier on movement. These results stand in agreement with the works of Kumar et al., Diakomi et al., and Madabushi et al.[9,14,15] The fact that the pain scores differed significantly only after 5 minutes of movement could be explained by the difference in the pharmacokinetics of these two drugs. Ropivacaine may require as long as one hour for its peak effect to be seen, while Intravenous fentanyl is in seconds after administration.[16] This significant reduction in pain led to less time required to position the patient for a subarachnoid block in the FICB group.[14]

The number of attempts required to successfully place the spinal anesthesia did not differ significantly as it was not performed by the same anesthetist in all cases and could be subject to different skill sets.

We found that FICB conferred analgesia for a longer time up to about 13 hours compared to only 5.2 hours in patients receiving only injection fentanyl before the subarachnoid block. A similar duration of analgesia was reported by Casati et al.[17] We observed that the requirement for rescue analgesia started differing significantly only from the fourth to the twelfth hour. We could argue that in the first four hours, the residual effects of the subarachnoid block could have masked the effects of the block and thus Fascia iliaca compartment block was not able to provide superior analgesia.

Overall, FICB conferred greater satisfaction about the whole process and the patients were more willing to repeat the process in the future if required as suggested by the Likert scale, similar findings are observed by others.[9,18]

In our study 6 patients (2 in group A and 4 in group B) developed hypotension and one patient developed bradycardia in the intraoperative period. Hypotension occurred after the application of spinal anesthesia and thus spinal anesthesia could be implicated in this. Bradycardia occurred after the episode of hypotension after the subarachnoid block. Bradycardia could be the consequence of hypotension with blocked cardio-accelerator fibers from a high level of block in spinal anesthesia.

Two patients who were desaturated in the post-anesthetic care unit required oxygen supplementation by face mask. As patients in both groups had received intravenous fentanyl we couldn't ascertain if desaturation had occurred due to FICB with Ropivacaine or Intravenous fentanyl. But inferring from the works of Ricardo et al. we can say that Fentanyl may well be the cause as fentanyl can cause respiratory depression leading to desaturation.[3]

Another shortcoming of our study was our inability to classify fracture femur. As we know that nerve supply differs in different regions of the femur. Anatomical stratification of femur fracture would have helped us to identify which patient would benefit more from the Fascia iliaca compartment block. Diakomi et al., Madabushi et al.,

and Ritcey et al., all conducted their studies in proximal femur fractures i.e., intertrochanteric or neck femur fractures.[5,14,19] We included all femur fractures in our study.

The main limitation of our study was, patients were not blinded. To blind them, patients receiving only Fentanyl had to be given a sham block with an equivalent volume of physiological saline, which raised the concerns of subjecting our patients to unnecessary intervention and pain.

CONCLUSION

Ultrasound-guided Fascia iliaca compartment block with 40 ml of 0.25% Ropivacaine is effective in reducing the pain associated with positioning patients with femur fractures for spinal anesthesia. Fascia iliaca compartment block increases the duration of analgesia and the level of patient satisfaction regarding pain management and reduces the requirement for rescue analgesics in the postoperative period.

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