

# Comparative Study for Evaluating Efficacy of Fascia Iliaca Compartment Block for Alleviating Pain of Positioning for Spinal Anesthesia in Patients with Hip and Proximal Femur Fractures

## Abstract

**Background:** Patient positioning for performing spinal blockade causes severe pain in hip and femur fracture. Adequate pain relief before administrating spinal blockade will increase patient's cooperation. This study was done to assess analgesic effect of fascia iliaca compartment block (FICB) for positioning for spinal anesthesia. **Materials and Methods:** This was a randomized, double blind, controlled prospective study that included 100 patients of the American Society of Anesthesiologists physical statuses I to III, of either sex, between 30 and 90 years, posted for hip or proximal femoral surgery, with visual analogue scale (VAS) >3 in preoperative period. The two groups were assigned randomly. In Group 1, FICB was given half an hour before shifting the patients in operation theater with 30 ml of 0.25% ropivacaine, and in Group 2, sham block was given with 30 ml normal saline. Each group included 50 patients. Thirty minutes after FICB, spinal anesthesia was given and patients' vitals were monitored before and after block, at the time of positioning for spinal anesthesia, intraoperative and postoperative periods. **Results:** In Group 1, mean VAS before FICB was 8.02 which reduced to 2.28, which is statistically significant ( $P = 7.8813E-50$ ), whereas in Group 2, mean VAS before sham block was 7.98 which reduced to 7.90, which is statistically nonsignificant ( $P = 0.6694$ ). Mean total duration of analgesia in Group 1 was 428.3 min after spinal anesthesia, whereas in Group 2, mean total duration of analgesia was 240.1 min. **Conclusion:** FICB effectively provides analgesia for positioning for spinal anesthesia to patients in hip and proximal femur surgeries. It also provides analgesia in postoperative period without having significant alteration in the hemodynamic profile of patients.

**Keywords:** Fascia iliaca compartment block, hip and proximal femur fractures, positioning for spinal anesthesia

**MeSH terms:** Hip fractures, femoral neck fractures, spinal anesthesia

**Nirav Jentilal Kacha,**  
**Chetna A Jadeja,**  
**Pooja J Patel,**  
**Harshda B Chaudhari,**  
**Jatin R Jivani,**  
**Vandana S Pithadia**

Department of Anesthesiology,  
 P. D. U. Medical College,  
 Rajkot, Gujarat, India

## Introduction

Pain is still a great challenge to the human kind and also the most common distressing factor which brings the patient to doctor. Pain has been defined by the International Association for Study of Pain as "An unpleasant sensory and emotional experience associated with actual or potential tissue damage or described in terms of such damage."<sup>1,2</sup>

Long bone fractures are very painful. The definitive management of most fractures is operative intervention. Preoperative analgesia is required to manage distress associated with fracture reduction and traction.<sup>3</sup> Safe and effective management of fracture-related pain and anxiety will reduce patient's distress during initial evaluation and often allows definitive management of the fracture that is operative intervention.

In the elderly population, fractures of the femur commonly affect femoral neck, intertrochanteric or subtrochanteric area of femur, which often also involve the hip joint. The spectrum of femoral fractures is wide and ranges from nondisplaced femoral fractures to severe comminuted fractures. These fractures are almost always associated with significant soft-tissue injury, causing severe pain to patients.

Most of the patients require operative intervention. Regional anesthesia is most frequently given for surgical intervention for fracture femur. Patient positioning to perform a spinal blockade causes severe pain. Adequate pain relief before administrating spinal blockade will increase patient's cooperation. These patients require analgesia for positioning for spinal

**Address for correspondence:**  
 Dr. Nirav Jentilal Kacha,  
 301, Block A, New P. G. Hostel,  
 P. D. U. Medical College,  
 Near RUDA Office, Jamnagar  
 Road, Rajkot - 360 005,  
 Gujarat, India.  
 E-mail: drkachanirav@gmail.com

### Access this article online

**Website:** www.ijoonline.com

**DOI:**  
 10.4103/ortho.IJOrtho\_298\_16

### Quick Response Code:



**How to cite this article:** Kacha NJ, Jadeja CA, Patel PJ, Chaudhari HB, Jivani JR, Pithadia VS. Comparative study for evaluating efficacy of fascia iliaca compartment block for alleviating pain of positioning for spinal anesthesia in patients with hip and proximal femur fractures. Indian J Orthop 2018;52:147-53.

This is an open access article distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 3.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as the author is credited and the new creations are licensed under the identical terms.

For reprints contact: reprints@medknow.com

block.<sup>4</sup> Analgesia can be provided in the form of systemic analgesics, local anesthesia, or femoral nerve blocks (FNBs).<sup>5,6</sup> Fascia iliaca compartment block (FICB) produces a more intense analgesic effect than intravenous (IV) administration of opiates when given to facilitate the sitting position for spinal anesthesia in patients undergoing surgery for femoral neck fractures.

FICB is devoid of side effects associated with systemic analgesics, such as nausea, vomiting, urinary retention, itching (associated with opiates) and epigastric pain, nausea, headache, dizziness, and rash (associated with nonsteroidal anti-inflammatory drugs [NSAIDs]). Complications of FICB (i.e., local anesthesia toxicity) are rare.

A wide range of local anesthetic agents are available for FICB such as lidocaine, mepivacaine, prilocaine, bupivacaine, and ropivacaine. Till date, bupivacaine is the gold standard local anesthetic agent for nerve blocks due to its longer duration of action. Ropivacaine is a newer local anesthetic agent with greater selectivity for sensory blockade. Old-aged patients have also a high incidence of cardiovascular comorbid disease and poorly tolerated hemodynamic fluctuations in comparison to young adults. Ropivacaine has lower cardiovascular and neurological toxicity, so it seems to be an attractive and alternative choice compared to bupivacaine. There are fewer studies available indicating the usefulness of ropivacaine in FICB.<sup>7,8</sup>

At our institute, all lower limb fractures are generally managed under spinal anesthesia. Hence, we decided to conduct a prospective, randomized, double-blind, comparative study using ropivacaine in FICB to observe its efficacy to provide analgesia before performing a spinal anesthesia in the sitting position in patients with hip and proximal femur fractures.

## Materials and Methods

### Sample size calculation

We took effect size (*d*) as 1.5 in visual analogue scale (VAS), standard deviation (SD) was 2.5, and power of study was 80%, so sample size was calculated as 44.44 in each group according to the following formula.

$$\frac{\text{Sample size} = 16 \times (\text{SD})^2}{(d)^2} = \frac{16 \times (2.5)^2}{(1.5)^2} = 44.44$$

Considering dropouts, it was decided to take fifty patients in each group.

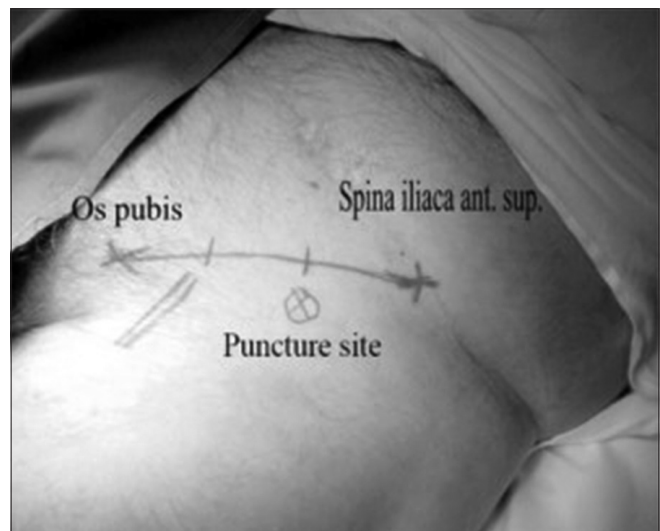
This was a randomized, double-blind, controlled prospective study. After institutional ethical committee's approval, we carefully assessed patients and included 100 patients of the American Society of Anesthesiologists physical statuses I to III, of either sex, of age group between 30 and 90 years, posted for hip or proximal femoral surgery, having VAS >3 in preoperative period in our study.

In our study, we excluded the patients who had any other bone fractures, neurological disease (Alzheimer, dementia), any contraindication to regional anesthesia (e.g., local infection, coagulation abnormality, or patient refusal), severe cardiovascular or respiratory disease, and known allergy to the study drug.

We obtained written informed consent of patients. The blinding and randomization were done by allotting random numbers to all patients, concealed by sealed opaque envelopes. All the patients scheduled to undergo either hip or femoral shaft surgery were randomly assigned to two groups.

- Group 1 - FICB was given half an hour before shifting the patients in operation theater with 30 ml of 0.25% ropivacaine
- Group 2 - Sham block was given half an hour before shifting the patient in operation theater with 30 ml normal saline.

Each group included fifty patients. FICB was performed while patients were in the supine position with all aseptic precautions. A line connecting anterior superior iliac spine and pubic symphysis was drawn on the skin and trisected. The puncture site was marked 1 cm caudal to the point at which the lateral third met the middle third of the inguinal ligament line [Figure 1].<sup>9</sup> After infiltrating local anesthetic agent (2% lignocaine) at the marked site, the block needle (18-gauge Tuohy) was inserted and advanced perpendicular to the skin surface till the "loss of resistance" was felt. The first loss of resistance was felt as the needle's tip crossed the fascia lata. The needle was advanced further at the same angle until the second loss of resistance was felt as the fascia iliaca was pierced [Figure 2].<sup>9</sup> The local anesthetic solution was injected over a 2-min period



**Figure 1:** The anatomical landmarks of fascia iliaca block. The line connects the anterior superior iliac spine and the pubic symphysis. On this line the tertiles are marked. The needle point entry is 1–2 cm caudally on the junction between the middle and lateral tertile ("x" sign on the picture). The site of the femoral artery has also been marked (Ref: Petsas D *et al.* *Greek E J Perioper Med* 2014;12:2-12.) ant. = anterior, sup. = superior

with firm pressure applied manually just distal to the puncture site. The local anesthetic solution used for all Group 1 patients in this study was ropivacaine 0.25%. Each patient was injected with 30 mL of the anesthetic solution. If there was swelling in the groin after injection, the region was massaged. Both of these manipulations (Pressure Application below injection site and Massage over local area) were to be performed to encourage the cephalad distribution of the injected solution.

Sensory block was assessed after 15 min using pin prick over the sensory distribution of the femoral nerve (anterior aspect of the thigh), lateral femoral cutaneous nerve (lateral aspect of the thigh), and obturator nerve (medial and posterior aspect of the knee), and motor blockade using a modified Bromage scale was verified. Patients' arterial blood pressure was evaluated noninvasively at regular

intervals, and electrocardiographic tracings, respiratory rate, and pulse oximetry were monitored continuously during all procedures. After 30 min, all adverse effects were noted.

Patients' pain relief was noted in the form of VAS before and after fascia iliaca block (FIB) as well as at the time of positioning for spinal anesthesia (i.e., 30 min after FIB) and in the postoperative period at regular intervals (i.e., 0 min, 30 min, 1 h, 4 h, 12 h, and 24 h). Continuous and careful observation was done to detect any symptom of CNS and cardiovascular toxicity of anesthetic agent.

We assessed the total duration of analgesia in postoperative period (i.e., from the time of onset of analgesic effect of FIB till the first use of rescue analgesic), and the total used doses of analgesics (i.e., injection diclofenac sodium 1.5 mg/kg) given in the 1<sup>st</sup> 24 h in the postoperative period were recorded.

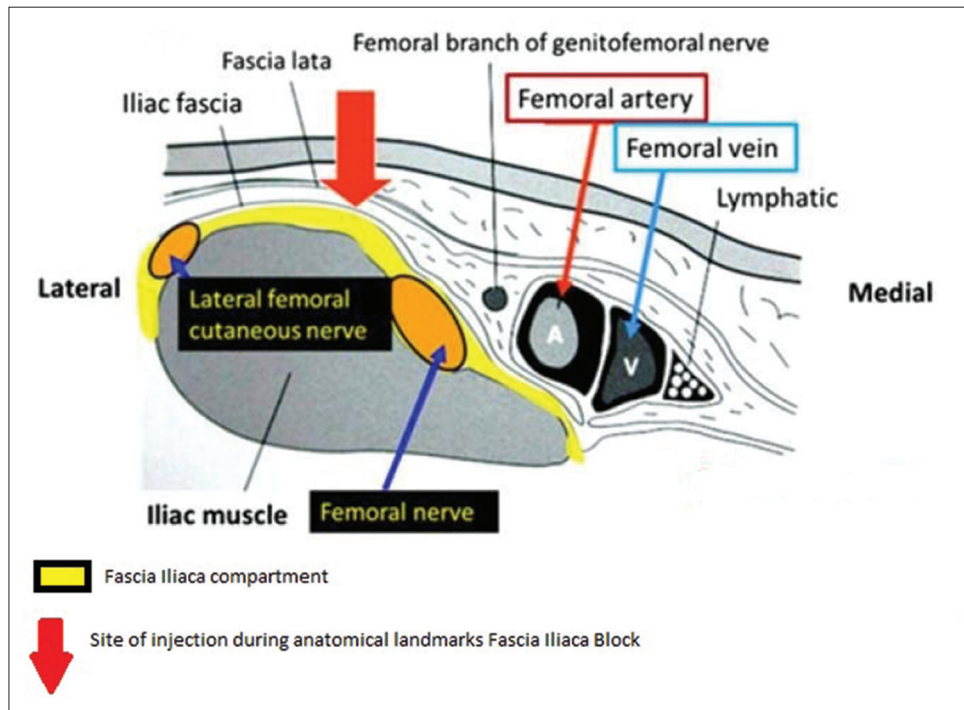


Figure 2: A line diagram of cross-section of the right thigh, just below the anterior superior iliac spine. In this drawing the fascia iliaca compartment is highlighted with the yellow color. The first loss of resistance is felt when the fascia lata is punctured and the second loss of resistance when the fascia iliaca is penetrated. This drawing also shows the relation to the femoral vessels and the site of injection (red arrow)(Ref: Petsas D et al. Greek E J Perioper Med 2014;12:2-12.)

**Table 1a: Distribution of patients according to baseline demographic profile and hemodynamic parameters before block**

| Parameter            | Mean±SD     |             | P      | Significance    |
|----------------------|-------------|-------------|--------|-----------------|
|                      | Group 1     | Group 2     |        |                 |
| Age (years)          | 65.5±14.8   | 63.92±12.8  | 0.58   | Not significant |
| Gender (male:female) | 28:22       | 28:22       | -      | -               |
| SBP (mmHg)*          | 129.08±9.63 | 129.84±9.93 | 0.7065 | Not significant |
| DBP (mmHg)*          | 71.96±7.59  | 74.88±8.23  | 0.0697 | Not significant |
| Pulse rate (mmHg)*   | 78.08±9.63  | 76.48±9.53  | 0.408  | Not significant |

\*Parameters at the time of positioning for SA. SBP=Systolic blood pressure, DBP=Diastolic blood pressure, SD=Standard deviation, SA=Spinal anesthesia

Collected data were analyzed using GraphPad Prism online calculator (GraphPad Software, Inc. USA). Mean and SD were calculated for all the variables and results were obtained by Student's *t*-test with two samples assuming unequal variances.

## Results

In our study, the demographic characteristics in terms of age and gender of all the patients were comparable in both the groups [Table 1a] ( $P > 0.05$ ). We studied 35 patients in Group 1 and 32 patients in Group 2 having intertrochanteric fracture of femur and operated for dynamic hip screw surgery. We have also included 14 patients in Group 1 and 17 patients in Group 2 having femur neck fractures and operated for Austin Moore Prosthesis or Bipolar Prosthesis. One patient having acetabular fracture and operated for acetabular plating was also included in each group.

The mean of vital parameters of both the groups at the time of positioning for spinal anesthesia is shown in Table 1b and these parameters are comparable with no significant difference [Table 1a].

We observed that in Group 1 mean VAS before FICB was 8.02 which reduced to 2.28 at positioning for spinal anesthesia, which is statistically significant ( $P < 0.05$ ). Whereas in Group 2, mean VAS before sham block was 7.98 which reduced to 7.90 at the time of positioning for spinal anesthesia, which is statistically nonsignificant ( $P > 0.05$ ) [Table 2].

At 4 h of postoperative period there was a significant difference between VAS of Group 1 and Group 2 ( $P < 0.05$ ). At other durations in postoperative period (i.e., at 0 min,

30 min, 1 h, 12 h, and 24 h), VAS of Group 1 and Group 2 was not statistically significant ( $P > 0.05$ ) [Table 3].

The mean total duration of analgesia in Group 1 was 428.3 min after spinal anesthesia, whereas in Group 2, mean total duration of analgesia was 240.1 min. Hence, there is statistically significant difference in the total duration of analgesia in postoperative period between Group 1 and Group 2 [Table 4].

We observed that mean doses of analgesic drug required by the patients of Group 1 were 2.18 in the 1<sup>st</sup> 24 h in postoperative period. Whereas Group 2 patients required 2.86 mean doses in postoperative period. Hence, there is statistically significant difference ( $P < 0.05$ ) between the total doses required in the 1<sup>st</sup> 24 h of postoperative period [Table 5].

The patients of group 1 have significantly lower VAS and total doses of analgesics required in 1<sup>st</sup> 24 hrs and longer duration of 1<sup>st</sup> demand of analgesia as compared to patients of group 2 [Table 6].

## Discussion

Fractures of the hip and femur bones are common orthopedic problems following trauma in patients of old age.<sup>10</sup> Central neuraxial block such as spinal anesthesia is the preferred technique for providing anesthesia. Correct positioning during central neuraxial block is the prerequisite for a successful procedure. However, limb immobility and extreme pain are the deterrents for an ideal positioning for this procedure. Various modalities such as IV fentanyl, FNB, or FICB with local anesthetic have been advocated to reduce the pain preoperatively and improve the positioning of these patients.<sup>11</sup>

The use of FICB has been shown to be effective in controlling pain in both hip arthroplasty and hip fracture. Multiple studies support this finding stating that FICBs following hip fractures are effective and easily learned.<sup>12-14</sup>

FIBs with continuous catheters have the potential to greatly reduce the morbidity in hip fracture patients when evaluating the influence and prevalence of side

**Table 1b: Mean systolic blood pressure, diastolic blood pressure and pulse rate at the time of positioning for spinal anesthesia**

| Parameter              | Group 1     | Group 2     | P        |
|------------------------|-------------|-------------|----------|
| Mean SBP (mmHg)        | 129.08±9.63 | 129.84±9.93 | 0.7065   |
| Mean DBP (mmHg)        | 71.96±7.59  | 74.88±8.23  | 0.069778 |
| Mean pulse rate (/min) | 78.08±9.63  | 76.48±9.53  | 0.408    |

SBP=Systolic blood pressure, DBP=Diastolic blood pressure

**Table 2: Comparisons of mean visual analogue scale**

| Group 1           |                                   |        |            | Group 2                 |                                   |        |        |
|-------------------|-----------------------------------|--------|------------|-------------------------|-----------------------------------|--------|--------|
| Before FICB given | At the time of positioning for SA | t      | P          | Before Sham block given | At the time of positioning for SA | t      | P      |
| 8.02±1.00         | 2.2±0.96                          | 1.9844 | 7.8813E-50 | 7.98±1.01               | 7.9±0.83                          | 1.9855 | 0.6694 |

FICB=Fascia iliaca compartment block, SA=Spinal anaesthesia

**Table 3: Visual analogue scale and their significance in postoperative period**

| Time         | 0 min           | 30 min          | 1 h             | 4 h         | 12 h            | 24 h            |
|--------------|-----------------|-----------------|-----------------|-------------|-----------------|-----------------|
| Group 1      | 0.06±0.24       | 0.2±0.4         | 0.46±0.75       | 1.72±0.81   | 6.14±0.95       | 6.3±0.8         |
| Group 2      | 0.08±0.27       | 0.24±0.47       | 0.52±0.73       | 2.08±0.84   | 6.44±1.01       | 6.5±0.9         |
| P            | 0.40            | 0.49            | 0.69            | 0.02        | 0.18            | 0.25            |
| Significance | Not significant | Not significant | Not significant | Significant | Not significant | Not significant |

effects from opiate medications. A large study, including the postoperative time period, would help validate the clinical and cost-effectiveness of this low-risk and highly effective compartment block. There are specific concerns regarding the elderly in the peri-operative period regarding side effects from medication. One such concern is acute delirium associated with opioid medication. Delirium has been identified as a variable that delays ambulation and necessitates placement for rehabilitation.<sup>15</sup> Other concerns include urinary retention and sedation. In summary, the concerns regarding patients with hip fractures include preoperative pain control, side effects from systemic medications, postoperative pain control, and complications. It appears from the literature that the implementation of a FICB protocol could reduce the occurrence rate of all the identified concerns.<sup>16</sup>

We observed hemodynamics in both the study groups immediately after block and at the time of positioning for spinal anesthesia. Our study results show FICB does not cause any hypotension.

From our study results, we observed that there was no statistically significant difference in systolic blood pressure, diastolic blood pressure, and mean pulse rate between Group 1 and Group 2 at the time of positioning for spinal anesthesia in patients given FICB and patients given sham block. Hence, we conclude that FICBs do not alter the hemodynamic profile of patients.

Our study results correlate with other studies done previously. Paria *et al.* studied a combination of FICB on the surgical side with sacral spinal anesthesia for hip and knee surgery. They observed hemodynamics through out perioperative period and concluded that hemodynamic profile was stable throughout the study period with FICB.<sup>8</sup>

**Table 4: Total duration of analgesia**

| Group   | Mean (min)  | t     | P         |
|---------|-------------|-------|-----------|
| Group 1 | 428.3±40.86 | 1.985 | 8.73sE-43 |
| Group 2 | 240.1±36.20 |       |           |

**Table 5: Mean total doses of analgesic required by per patient in the 1st 24 h in postoperative period**

| Group   | Mean      | t     | P        | Significance       |
|---------|-----------|-------|----------|--------------------|
| Group 1 | 2.18±0.68 | 1.984 | 4.94E-07 | Highly significant |
| Group 2 | 2.86±0.75 |       |          |                    |

**Table 6: Distribution of patients according to block characteristics**

| Parameter  | Group 1     | Group 2     | P          | Significance       |
|--|-------------|-------------|------------|--------------------|
| VAS*   | 2.2±0.96    | 7.9±0.83    | 1.9939E-50 | Highly significant |
| 1 <sup>st</sup> demand of analgesia (min)  | 428.3±40.86 | 240.1±36.20 | 8.73sE-43  | Highly significant |
| Total doses of analgesic required by per patient in the 1 <sup>st</sup> 24 h in postoperative period | 2.18±0.68   | 2.86±0.75   | 4.94E-07   | Highly significant |

\*Parameters at the time of positioning for SA. VAS=Visual analogue scale, SA=Spinal anesthesia

We used three types of pain assessment to evaluate analgesic efficacy of FICB.

1. VAS at positioning for spinal anesthesia
2. Total duration of analgesia in postoperative period
3. Total doses of analgesic drug required per patient in the 1<sup>st</sup> 24 h of postoperative period.

We observed that there was significant reduction in VAS of patients in Group 1 than patients of Group 2 at the time of positioning for spinal anesthesia. Yun *et al.* concluded that an FICB with ropivacaine is more efficacious than IV alfentanil in terms of facilitating the lateral position for spinal anesthesia in elderly patients undergoing surgery for femoral neck fractures.<sup>17</sup> Elkhodair *et al.* observed that there is reduction in pain by three points on the pain scale following a FICB by emergency department physicians using the two pop technique.<sup>18</sup> Fujihara *et al.* studied the efficacy of FICB in pain control for patients with proximal femur fractures, indicating significant pain reduction after FICB in comparison to NSAIDs alone in postoperative period.<sup>19</sup>

It has been shown that patients with higher postoperative pain have an increased length of hospital stay, delayed ambulation, and long term functional impairment.<sup>20</sup> From our study results, we observed that at 4 h of postoperative period, there was statistically significant difference between VAS of Group 1 and Group 2 ( $P < 0.05$ ), and patients in Group 2 had significantly higher VAS than patients in Group 1 at 4 h of postoperative period. The possible reason is patients of Group 1 had longer duration of analgesia than patients of Group 2 after cessation of effect of spinal anesthesia. At other durations in postoperative period (i.e., at 0 min, 30 min, 1 h, 12 h, and 24 h), VAS of Group 1 and Group 2 was statistically nonsignificant ( $P > 0.05$ ). As patients of both the groups were under the effect of spinal anesthesia in the initial hours of postoperative period, this could be the possible reason for nonsignificance of VAS of both the groups before 4 h (i.e., 0 min, 30 min, and 1 h) in postoperative period. As patients of both the groups were given analgesic drug (injection diclofenac sodium 1.5 mg/kg) after their 1<sup>st</sup> demand of analgesia, that could be the possible reason for nonsignificance of VAS of both the groups after 4 h (i.e., 12 h and 24 h) in postoperative period.

As per this study results, we observed that the mean total duration of analgesia in Group 1 was 428.3 min after spinal anesthesia, whereas in Group 2, the mean total duration

of analgesia was 240.1 min. Hence, there is statistically significant increase in total duration of analgesia in postoperative period in patients of Group 1 in comparison to patients of Group 2 ( $P < 0.05$ ).

Our study results also show that mean doses of analgesic drug (injection diclofenac sodium 1.5 mg/kg) required per patient in Group 1 were 2.18 in the 1<sup>st</sup> 24 h in postoperative period. Whereas in Group 2, 2.86 mean doses were required per patient in the 1<sup>st</sup> 24 h in postoperative period. Hence, there is statistically significant ( $P < 0.05$ ) decrease in the total doses required per patient of Group 1 in comparison to patient of Group 2 in the 1<sup>st</sup> 24 h of postoperative period. Stevens *et al.* concluded that a modified FICB has a significant morphine-sparing effect in unilateral total hip arthroplasty.<sup>21</sup> Anaraki and Mirzaei also concluded that in FICB group, the time required for the 1<sup>st</sup> need of analgesic was significantly longer and total analgesic consumption was significantly lower than that of gabapentin group. The median level of patients' satisfaction in postoperative period in FICB group was significantly higher than that of gabapentin group.<sup>22</sup>

FICB is considered as safe and effective procedure for providing analgesia with very few complications. In our study, we observed that there was no incidence of any complication, i.e., nausea or vomiting, aspiration of blood in syringe during block, hematoma formation at injection site, postprocedural neurological deficit, signs of local anesthetic agent toxicity, failure of block, or infection at local site in postprocedural period. The FICB technique is associated with minimal risk because the puncture is made at a safe distance from the femoral artery and femoral nerve. Hence, there are less chances of vascular puncture, paresthesia, or intraneural injection of drug. Paria *et al.* also observed that overall FICB is a very low-profile risky procedure to block, and the risk of intravascular injection, toxicity of local anesthetic, and mechanical nerve damage is extremely low. The chance of infection is rare with good aseptic preparation of the site.<sup>8</sup>

Ultrasound guidance if available will increase the success rate of the block. As it is not available at our institute, this technique was not used in the study and this can be considered limitation of our study.

## Conclusion

FICB effectively provides analgesia for positioning for spinal anesthesia to the patients with hip and proximal femur fractures. It also provides analgesia in postoperative period.

FICB reduces the total number of doses of analgesic agent required by patients in the 1<sup>st</sup> 24 h of postoperative period. It also maintains hemodynamic stability in perioperative period. FICB is a safe procedure for providing analgesia with remarkable safety profile.

## Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

## Financial support and sponsorship

Nil.

## Conflicts of interest

There are no conflicts of interest.

## References

1. Cervero F, Laird JM. One pain or many pains? A new look at pain mechanisms. *NIPS* 1991;6:268-73.
2. Melzack R, Wall PD. On the nature of cutaneous sensory mechanisms. *Brain* 1962;85:331-56.
3. Kennedy RM, Luhmann JD, Luhmann SJ. Emergency department management of pain and anxiety related to orthopedic fracture care: A guide to analgesic techniques and procedural sedation in children. *Paediatr Drugs* 2004;6:11-31.
4. Berry FR. Analgesia in patients with fractured shaft of femur. *Anesthesia* 1977;32:576-7.
5. Tam CW, Rainer TH. Femoral nerve block for pain management of femoral fractures in the emergency department: Evidence based topic review. *Hong Kong J Emerg Med*. 2005;12(3):178-81.
6. McGlone R, Sadhra K, Hamer DW, Priddy PE. Femoral nerve block in the initial management of femoral shaft fractures. *Arch Emerg Med* 1987;4:163-8.
7. Helayel PE, Lobo G, Vergara R, Conceição DB, Oliveira Filho GR. Effective volume of local anesthetics for fascia iliac compartment block: A double-blind, comparative study between 0.5% ropivacaine and 0.5% bupivacaine. *Rev Bras Anesthesiol* 2006;56:454-60.
8. Paria R, Surroy S, Majumder M, Paria B, Sengupta S, Das G, *et al.* Combination of fascia iliaca compartment block on the surgical side with sacral spinal anesthesia for hip to knee surgery. *IOSR J Dent Med Sci* 2014;13:46-9.
9. Petsas D, Griffiths R. Fascia iliaca block (FIB) in elderly patients outside the operating room for pain management of proximal femur fractures. *Greek E J Perioper Med* 2014;12:2-12.
10. Moore KL, Dalley AF. *Clinically Oriented Anatomy*. 5<sup>th</sup> ed. Philadelphia, PA: Lippincott Williams and Wilkins; 2006. p. 566.
11. Jadon A, Kedia SK, Dixit S, Chakraborty S. Comparative evaluation of femoral nerve block and intravenous fentanyl for positioning during spinal anaesthesia in surgery of femur fracture. *Indian J Anaesth* 2014;58:705-8.
12. 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;106:773-8.
13. Godoy Monzon D, Iserson KV, Vazquez JA. Single fascia iliaca compartment block for post-hip fracture pain relief. *J Emerg Med* 2007;32:257-62.
14. Godoy Monzón D, Vazquez J, Jauregui JR, Iserson KV. Pain treatment in posttraumatic hip fracture in the elderly: Regional

- block vs. systemic non-steroidal analgesics. *Int J Emerg Med* 2010;3:321-5.
15. Watters CL, Moran WP. Hip fractures – A joint effort. *Orthop Nurs* 2006;25:157-65.
  16. Dulaney-Cripe E, Hadaway S, Bauman R, Trame C, Smith C, Sillaman B, *et al.* A continuous infusion fascia iliaca compartment block in hip fracture patients: A pilot study. *J Clin Med Res* 2012;4:45-8.
  17. Yun MJ, Kim YH, Han MK, Kim JH, Hwang JW, Do SH. Analgesia before a spinal block for femoral neck fracture: Fascia iliaca compartment block. *Acta Anaesthesiol Scand* 2009;53:1282-7.
  18. Elkhodair S, Mortazavi J, Chester A, Pereira M. Single fascia iliaca compartment block for pain relief in patients with fractured neck of femur in the emergency department: A pilot study. *Eur J Emerg Med* 2011;18:340-3.
  19. Fujihara Y, Fukunishi S, Nishio S, Miura J, Koyanagi S, Yoshiya S. Fascia iliaca compartment block: Its efficacy in pain control for patients with proximal femoral fracture. *J Orthop Sci* 2013;18:793-7.
  20. Morrison RS, Magaziner J, McLaughlin MA, Orosz G, Silberzweig SB, Koval KJ, *et al.* The impact of postoperative pain on outcomes following hip fracture. *Pain* 2003;103:303-11.
  21. Stevens M, Harrison G, McGrail M. A modified fascia iliaca compartment block has significant morphine-sparing effect after total hip arthroplasty. *Anaesth Intensive Care* 2007;35:949-52.
  22. Anaraki AN, Mirzaei K. The effect of fascia iliaca compartment block versus gabapentin on postoperative pain and morphine consumption in femoral surgery, a prospective, randomized, double-blind study. *Indian J Pain* 2014;28:111-6.