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ORIGINAL RESEARCH **REGIONAL ANESTHESIA**

Comparison of pre-spinal regional analgesic techniques for positioning in proximal femur fractures

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ABSTRACT

Background: Proximal femur fractures are very painful. Positioning of these patients for subarachnoid block causes lot of discomfort to them. Various modes of analgesia have been used to alleviate this pain. We compared 2 such modalities – femoral nerve block (FNB) and fascia iliaca compartment block (FICB), guided by ultrasound in 50 patients randomly assigned to the two groups, FNB and FICB.

Methodology: Group FNB received an in-plane USG-FNB with 15 mL of a 1:1 mixture of 0.25% levobupivacaine and 2% lignocaine with adrenaline (1:200000). Group FICB received an in-plane USG-FICB with 30 mL of a 1:1 mixture of 0.25% levobupivacaine and 2% lignocaine with adrenaline (1:200000). After fifteen minutes of the analgesic intervention, the patient was positioned for subarachnoid block. Pain was assessed using the Numerical Pain Rating Score (NPRS), along with time to loss of pin prick sensation, number of pricks, and time taken for subarachnoid block. Patient satisfaction scores were also noted.

Results: The NPRS scores at positioning, the total reduction in the NPRS scores, time at loss of pin-prick sensation, and the number of subjects requiring rescue analgesia were similar in both groups with P-value of 0.641, 0.376, 0.243, 0.167 and 0.305 respectively. NPRS score at 5 minutes in Group FNB was 4 and in Group FICB was 5 with p - value of 0.03 and at 10 minutes, score was 3 and 4 in Group FNB and Group FICB respectively with P-value of 0.01. However, during patient positioning, the analgesic effects were comparable. Patient satisfaction was also comparable in both groups.

Conclusion: Although both USG-FNB and USG-FICB have comparable total reduction in the NPRS scores, the reduction in pain is faster with the femoral nerve block.

Abbreviations: FNB: femoral nerve block, FICB: fascia iliaca compartment block, NPRS: Numerical Pain Rating Score

Keywords: Proximal femur fractures; Regional analgesia; Ultrasound-guided nerve block; Patient positioning; Patient satisfaction; Spinal anesthesia

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1. INTRODUCTION

Proximal femur fractures are a common orthopedic condition that needs to be treated immediately in the elderly population.[1]
The greatest age at which proximal femur fractures occurred was between 60 and 70 years old, according to a study that included 1393 individuals.[2]

These fractures have been linked to both morbidity and death. In more than 90% of these cases, surgical repair is frequently the preferred course of treatment. For these individuals, regional anesthesia is the preferred method for surgery.[3] A subarachnoid block (SAB) is frequently used during these procedures. Proper placement makes subarachnoid blocks easier to apply and guarantees sufficient regional anesthesia, preventing general anesthesia-related problems.[4] Because of the concomitant pain, it can be difficult to position these patients to get subarachnoid blocks while seated.[5] To overcome the pain during the positioning of the patient for spinal anesthesia, pre-spinal analgesia can be achieved with a variety of techniques, including nerve blocks and intravenous opioids, with varying degrees of success.[6]

For pre-analgesia, regional blocks such fascia iliaca compartment block (FICB) and femoral nerve block (FNB) offer effective analgesia.[7] The fascia iliaca block (FIB) was initially described by Sharrock in 1980. In 1973, Winnie et al. provided the first illustration of the femoral nerve block (FNB).[8] The greatest branch of the lumbar plexus is the femoral nerve, which emerges from L2-L4 and makes its way to the femoral artery beneath the inguinal ligament.[9] The anteromedial thigh, knee, hip joint, femur, and medial side of the leg from the knee to foot are all innervated by it. It is crucial to remember that the lateral femoral cutaneous nerve is not located in this area.[10] The fascia iliaca compartment is a possible space that is bounded by the iliopsoas on the back and the fascia iliaca on the front. Three vital nerves are located inside this area: the lateral cutaneous nerve, the obturator nerve, and the femoral nerve. Therefore, it is theoretically possible to anesthetize all three nerves by placing local anesthetic behind the fascia iliaca.[11] The anesthetist can now view the nerve, needle, and drug distribution by the use of ultrasonography in anesthesia, which increases the likelihood that the nerve block will go well.[12]

The variations in results between the FNB and FICB nerve block treatments have not yet been examined, despite the fact that they are two frequently used pain management strategies for proximal femur fractures. Few studies have compared the two methods under ultrasound guidance to facilitate patient positioning for spinal anesthesia, even though both blocks have been examined separately.

Hence, we have compared FNB and FINB techniques of regional analgesia for patient positioning using a mixture of local anesthetics to ensure faster onset and longer duration of analgesia. Along with improving the comfort of the anesthesiologist for the procedure, we aimed at providing better patient satisfaction while performing spinal anesthesia.

2. METHODOLOGY

A prospective, randomised, double-blinded study was conducted after obtaining clearance from the Institutional Ethics Committee (IEC number: 2020/826) and the Clinical Trials Registry India (CTRI/2021/07/034977). Informed written consent was obtained from all the participants.

This study was conducted among 50 adult patients of both sexes, aged 18-75 years, ASAPS (American Society for Aesthetic Plastic Surgery) I-III, with proximal femur fractures undergoing surgery under subarachnoid block at Kasturba Medical College, Manipal, from March 6, 2021, to September 30, 2022.

Exclusion criteria were: patient's refusal, allergy to the drugs involved in the study, any contraindication to central neuraxial anesthesia (including coagulopathy and local infection), infection at the site of block, use of pain medications 8 hours before the administration of the block, pre-existing peripheral sensorineural deficits and patients with poor cognitive function which might lead to difficulties in assessing pain scores.

2.1. Sample size

To detect a statistically significant difference between the means of the NPRS (Numerical Pain Rating Score) score reductions in the two groups, with 90% power and a 95% confidence level, 25 subjects were required in each group. Assuming an attrition rate of about 15%, the total sample size required was set to be 60.

2.2. Randomization

A computer-generated randomisation table was used to assign patients into one of the two groups – group FNB(who received femoral nerve block) and group FICB (who received fascia iliaca nerve block), and serially numbered opaque envelopes were used, which had the details regarding the group allotment, the nerve block to be administered, and the drug volumes required.

2.3. Study procedure

The primary anesthesiologist (Observer 1), who did the pre-anesthetic evaluation, enrolled the subjects as per the inclusion and exclusion criteria, obtained the written informed consent, and recorded the observations during the study. Observer 1 was blinded to the group allocation. Observer 2, an anesthesiology consultant experienced in USG-FNB and USG-FICB, who administered the block as per the randomisation. And an observer 3, an anesthesiologist consultant in the operating room who administered the subarachnoid block.

Table 1: Comparative demographic data

Parameters	Group FNB (n = 25)	Group FICB (n = 25)	P-value
Age (years)	63.56 ± 11.58	63.12 ± 12.12	0.896[$]
Gender; M/F	9/16	15/10	0.089429[#]
ASA PS II/III	14/11	13/12	0.668524[#]

[$]Independent t-test; [#]Chi-square test; P < 0.05 considered as significant

In the premedication area, the presence of a patent intravenous access was confirmed. The following were monitored: non-invasive blood pressure (NIBP), oxygen saturation (SpO2), heart rate (HR), and electrocardiogram (ECG). The affected limb was moved passively, and the patient's NPRS score was noted, along with the vital parameters noted as baseline. With the patient in supine position, the inguinal region on the affected side was adequately exposed and cleaned with povidone-iodine and denatured ethanol.

Group FNB received an in-plane USG-FNB. The patient was positioned supine, and the transducer was placed over the femoral crease to identify the femoral vessels. Just lateral to the femoral artery, the femoral nerve is identified and blocked with 15 mL of a 1:1 mixture of 0.25% levobupivacaine and 2% lignocaine with adrenaline (1:200000).

Group FICB received an in-plane USG-FICB (infra-inguinal approach) with 30 mL of a 1:1 mixture of 0.25% levobupivacaine and 2% lignocaine with adrenaline (1:200000). With the patient in supine position and the transducer over the femoral crease, the femoral vessels, iliopsoas muscle, and sartorius muscle were identified. The fascia iliaca was then identified, and the drug was deposited just beneath the fascia and observed for spread.

The blocks were performed with a linear high frequency (13-6 MHz) transducer [Sonosite SII® (*FUJIFILM Sono Site, Inc)* ultrasound machine] and a 22G 5cm, short bevelled Stimuplex D needle. Pain was assessed upon passively moving the affected limb using NPRS 0-10 along with vital parameters at 1, 3, 5, and 10 minutes after block administration. Pin prick sensation was also assessed simultaneously using a blunted toothpick along the anterolateral aspect of the thigh.

After 15 minutes of the block administration, the patient was shifted to the operating table and made to sit up with both legs extended on the front and positioned for SAB administration. The NPRS score was recorded once the patient was positioned. If the NPRS score was more than 4, fentanyl 1.5 micrograms/kg was administered via the intravenous route as rescue analgesia. The SAB was performed by the anesthesiology consultant under aseptic precautions. The time from when the spinal needle was first pierced into the skin till completion of the drug administration was noted. If the spinal needle had to be reinserted, the number of attempts at needle insertion was also recorded. Patient satisfaction with pain relief achieved with the block during positioning was also recorded using the 5-point Likert scale, once they were made to lie supine after the SAB. Once the required level of sensory block was achieved with the SAB, the patient was handed over to the attending anesthesia team.

2.4. Statistical analysis

The data collected was analyzed using IBM SPSS Statistics ver.29. An Independent t-test was used for normally distributed interval/ratio data. Mann-Whitney U test was used to compare independent ordinal data. Chi-square test was used for nominal data. Spearman's rho test for correlation was used for non-parametric data. A P-value of <0.05 was considered statistically significant.

3. RESULTS

Of the sixty patients enrolled in the study, fifty patients, received the block and were analysed.
The age, sex, and ASA-PS classes were similar in the two groups (Table 1). There was no statistically significant difference noted in fracture type distribution in the two groups.

As shown in Table 2, no statistically significant difference noted in fracture type distribution in the two groups (P > 0.05).

The initial NPRS scores and vital parameters were comparable in the two groups. The difference between the means of the baseline diastolic blood pressure in the two groups was significant (p- value = 0.032) (Table 3).

Table 2: Comparative types of fractures in the groups

Diagnosis	Group FNB (n = 25)	Group FICB (n = 25)	P-value
Neck of femur fracture	9 (36)	11 (44)	0.701453#
Intertrochanteric fracture	13 (52)	10 (40)	
Subtrochanteric fracture	3 (12)	2 (8)	
Proximal femur shaft fracture	0 (0)	2 (8)	

Data presented as n (%); #Chi-square test; P < 0.05 considered as significant

Table 3. Baseline NPRS score and baseline vital parameters

Parameters	Group FNB (n = 25)	Group FICB (n = 25)	P- value
Initial NPRS score (0-10)	8 (8-7)	7 (8-7)	0.641*
Heart rate (beats per minute)	84.52 ± 13.175	85.00 ± 17.854	0.914$
Systolic blood pressure (mmHg)	138.56 ± 11.85	145.13 ± 42	0.052$
Diastolic blood pressure (mmHg)	83.06 ± 8.77	88.16 ± 7.50	0.032$
Oxygen saturation (%)	97.80 ± 1.26	98.36 ± 1.15	0.10748$

Data presentad as Median (IQR) or mean ± SD;
*$Independent t-test *Mann-Whitney U test; P < 0.05 considered as significant*

Table 4: Characteristics of pain relief

Parameters	Group FNB	Group FICB	P-value
Initial NPRS score (0-10)	8 (8-7)	7 (8-7)	0.641*
NPRS Score at positioning	3 (4-3)	4 (5-3)	0.376 *
Total Reduction in the NPRS score	4 (4-3)	4 (4-2)	0.243*
Time at loss of pin prick sensation (min)	3 (3-3)	3 (5-3)	0.167*
Number of subjects who required rescue analgesia	4	7	0.305749#

Data presented as mean (IQR)
**Mann-Whitney U test; #Chi-square test; P < 0.05 considered as significant*

The initial NPRS scores were comparable in the two groups. The NPRS scores at positioning, the total reduction in the NPRS scores, time at loss of pin-prick sensation, and the number of subjects requiring rescue analgesia were similar in both groups with P-value of 0.641, 0.376, 0.243, 0.167 and 0.305 respectively (Table 4).

A Mann-Whitney-U test showed that the NPRS scores at 5 minutes and 10 minutes after the block were better in group FNB than group FICB (P = 0.035 and 0.010, respectively). The P-values are > 0.05 at other time points, which indicates no significant differences in the medians between the two groups (Table 5).

Patients in both groups received either one or two pricks, taking a time of 76.29 ± 9.86 seconds in group FNB and 82.28 ± 19.012 seconds in group FICB for administration of SAB, making them comparable in terms of ease of performing SAB. Patients in both groups were equally satisfied with the procedure. A Spearman's rho coefficient test showed no significant correlation between the time taken and the patient satisfaction scores in both groups.

4. DISCUSSION

Proximal femur fractures are associated with significant pain and discomfort. A systematic review revealed that about seventy-two per cent of patients with hip fractures did not receive any form of prehospital analgesia.[12] Transit within the hospital, shifting to the surgery table, and positioning for administering a subarachnoid block may cause distress to the patient due to pain. Pain management for patients with hip fractures should ideally start immediately upon presentation to the hospital. Multimodal analgesic techniques are necessary for such patients. [13]

Per the NICE ("National Institute for Health and Care Excellence") guidelines 2011, paracetamol may be administered perioperatively every six hours unless contraindicated.[14] Intravenous (IV) paracetamol may also reduce the need to administer breakthrough pain medications. [12]

However, per the revised WHO analgesic ladder, the administration of paracetamol alone may not be sufficient, given the severity of the pain.[14] Intravenous

Table 5: NPRS scores at various time points

Group	Baseline	1 min	3 min	5 min	10 min	At positioning (>15 min)
FNB	8 (8-7)	7 (8-6)	5 (6-5)	**4 (5-3)**	**3 (4-3)**	3 (4-3)
FICB	7 (8-7)	7 (8-6)	5 (6-5)	**5 (5-4)**	**4 (5-3)**	4 (5-3)
P-value*	0.64100	0.62200	0.41000	**0.035**	**0.010**	0.37600

*Data presented as Median (IQR); *Mann-Whitney U test; P < 0.05 considered as significant*

(IV) opioids such as morphine and fentanyl can be administered if the pain relief achieved with IV paracetamol is inadequate. NICE also recommends the administration of regional nerve blocks if the analgesia provided by opioids is insufficient or if the total opioid consumption is desired to be low.[15] When used alone or in combination, these techniques will also aid in positioning the patients for an SAB.[16] A study conducted by Bantie et al demonstrated the superiority of regional nerve blocks over intravenous opioids during patient positioning for subarachnoid blocks.[17]

With improved access to more advanced, relatively portable ultrasound machines, the use of PNBs for perioperative analgesia has become easier and safer, thanks to enhanced visualization of anatomical structures. Administration of such blocks in patients with hip fractures has already become standard of care in some centres .[14]

Our study aimed to compare the analgesic quality during positioning for the SAB between the FNB and FICB groups. Although the NPRS scores at positioning for the SAB were comparable in both groups, there was a faster onset of analgesia in group FNB, with the NPRS scores being significantly better at the 5-minute mark. A similar finding was noted by Gupta et al. However, they observed substantially better pain scores starting at the 3-minute mark.[18] Additionally, the study by Jain et al. noted better pain scores in the group that received FNB than in the group that received FICB.[19] The reduction in NPRS scores from baseline to positioning was comparable in both groups in our study [median (IQR): 4 (4-3) vs 4 (5-3)]. A recent Cochrane review also noted no significant differences in the analgesia provided by FNB and FICB, with an average reduction in pain on movement at 30 minutes after block administration being 2.5 on an 11-point scale .[20]

The number of subjects who required rescue analgesia was similar in both FNB and FICB groups [(n); 4 vs 7].

The patient satisfaction scores in both groups were similar. The study conducted by Ghimire et al. noted that the time taken for SAB administration was lower with FICB than with FNB. [21] In our study, the time taken for SAB administration was comparable between the groups. Ghimire et al. also noted better patient acceptance with FICB. No such differences were noted in our study.

5. Main points

- Surgical management of proximal femur fractures requires subarachnoid blocks. And the positioning of the patient with these fractures is challenging due to severe pain.
- For pre-analgesia, regional blocks such fascia iliaca compartment block (FICB) and femoral nerve block (FNB) offer effective analgesia.
- FNB and FICB were found to be comparable in providing pre-analgesia.
- Femoral nerve block (FNB) is associated with more patient satisfaction.

6. LIMITATIONS

One of the limitations of this study was that other factors that may affect the difficulty of administering spinal anesthesia, such as needle gauge, type of spinal needle used, body mass index (BMI), and ease of palpability of anatomical landmarks, were not assessed. The weight of the participants was not recorded as they were unable to bear weight, and we lacked the necessary equipment that would be required to weigh a bedridden patient.

7. CONCLUSION

The initial NPRS scores were comparable in the two groups. The NPRS scores at positioning, the total reduction in the NPRS scores, time at loss of pin-prick sensation, and the number of subjects requiring rescue analgesia were similar in both groups Although both USG-FNB and USG-FICB have comparable total reduction in the NPRS scores, the reduction in pain is faster with the femoral nerve block.

8. Ethical considerations

This study was approved by the institutional Research Ethics Committee, Kasturba Medical College and Kasturba Hospital, in a meeting held on 23rd December 2022. (IEC number: 2020/826) Clearance from the Clinical Trials Registry India was also obtained. (CTRI number: CTRI/2021/07/034977).

The authors declare that the procedures followed were by the regulations of the relevant clinical research ethics committee and with those of the Code of Ethics of the World Medical Association (Declaration of Helsinki).

The authors have obtained the written informed consent of the patients or subjects mentioned in the article.

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10. Presentations

1st prize in paper presentation at the GANGA Anaesthesia Refresher Course 2023

11. Authors' contributions

APP study planning, data collection, interpretation of results, and writing of the manuscript.

RRKB conception of original project, study planning, interpretation of results, data analysis, and final writing of the manuscript.

MK. Study planning, interpretation of results, literature search, writing, and approval of the manuscript.

STK data analysis, and final writing of the manuscript

LS final writing and review of the manuscript.

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