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"A PROSPECTIVE OBSERVATIONAL STUDY TO ASSESS THE EFFICACY OF FEMORAL NERVE BLOCK FOR POSITIONAL PAIN IN HIP FRACTURE"

Anaesthesiology

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ABSTRACT

Background: With the advancement in the field of regional anaesthesia, femoral nerve block has been studied as a mode of analgesia to alleviate pain during positioning for spinal anaesthesia. the two techniques peripheral nerve stimulator guided versus ultrasound guided have been studied extensively for the same with respect to their effect and complications. **Material And Methods:** A group of 70 patients were allocated in two groups by randomisation – Group 1: FNB-U (n=35) and Group 2 : FNB -P (n=35). Femoral nerve block was performed in both the groups using ultrasound and peripheral nerve stimulator respectively with inj. Lignocaine 1% 10ml as local anaesthetic of choice before positioning for spinal anaesthesia. The block execution time, time of onset of analgesia, time of complete achievement of analgesia, no. of pricks, grades of positioning, hemodynamic stability, success rate and complication were recorded in both the groups. **Results :** The patients in the two groups were similar in demographic background and initial pain severity (p = 0.65). The visual analog scale (VAS) scores within the groups were markedly reduced at 15 minutes in both the groups (p = 0.000) and between the two groups pain relief was more in group US than group NS at 5 and 10 minutes but, was comparable at 20 minutes. The ease of positioning was observed in 35 patients in group FNB-Uvs 35 patientsFNB-P (p = 0.33) as grade-I (comfortable) 26 vs 22, whereas grade II (discomfort) present in 8 vs 9 patients , and grade III (uncomfortable) was seen in 1 vs 4 patients in group NS. The number of pricks and block execution time were significantly less in FNB-U vs FNB-P group (p=0.000). Furthermore it was found that success rate was 100% for FNB-U than FNB-P (97%). Minimal minor complications were observed in both the groups. **Conclusion:** Both the techniques of FNB provided adequate analgesia for fracture femur pain, but the ultrasound technique provided early onset, better patient comfort, lesser number of attempts while performing the block and better success rate.

KEYWORDS

Lignocaine, Femoral Nerve , Ultrasound, Peripheral Nerve Stimulator

INTRODUCTION

"It became at once apparent to all the world that surgical anaesthesia had become a reality and that pain was no longer the master but the servant of the body."

-J Collins Warren,

The International Association of the study of pain defines pain as "an unpleasant sensory or emotional experience associated with actual or potential tissue damage or described in terms of such damage." Hip fractures are common among the elderly and are associated with moderate to severe pain accompanied by systemic effects. Poor management of acute pain due to hip fracture can prolong the length of stay in hospital and increase healthcare costs. Therefore, pain assessment should be performed on hospital admission for elderly patients with hip fracture, and the appropriate level of analgesic therapy should begin as soon as possible. Different methods of pain management such as analgesics in form of IV opioids and tranquilizers have been tried for so many years but they have their own pharmacological side effects and affect each patient differently due to their associated co-morbidities. However, development of peripheral regional block has been shown to be beneficial in such situations since it is proved to be associated with negligible side effects and maintains haemodynamic stability when compared to traditional methods of analgesia. A lumbar plexus block dates back to 50 years which was first described by **Winnie et al**. in **1973** alternatively referred to as "3 in 1" block. He proposed that a large volume of local anesthetic injected into femoral nerve sheath could spread proximally to produce blockade of femoral nerve. This modality has been practised over the years with the use of peripheral nerve stimulator (PNS). However with the advent of ultrasound (US), PNS being the gold standard has been questioned. Various studies have been performed comparing the ease of two techniques. Considering these studies we decided to assess and compare femoral nerve block under peripheral nerve stimulator guidance and ultrasound guidance to conclude the use of better technique for future analgesic procedures with least complications and high success rate.

Aims And Objectives

The aim was to study the efficacy of technique of femoral block using ultrasound and peripheral nerve stimulator for positional pain in hip fracture.

Primary objective was to study and compare the efficacy of technique in terms of block execution time, number of pricks for the block achievement, time of onset of analgesia, time of complete achievement of analgesia, success rate of the block and the quality of positioning for spinal anesthesia whereas the secondary objective was to study and compare the efficacy of technique in terms of hemodynamic stability and any associated complications

MATERIAL AND METHODS

The present study protocol was approved by the Institutional Ethics Committee (IEC) and was carried out in Department of Anaesthesiology in a tertiary care hospital after getting approval from ethics committee of institution during period September 2020 – September 2022. Total 70 patients were studied prospectively. The patients were included in the study by applying the following inclusion and exclusion criteria.

1) Inclusion Criteria

I. Patients undergoing surgical procedure for hip fracture
II. Patients giving consent for the procedure
III. ASA GRADE 1 or 2
IV. Age between 18 to 70 years
V. Patients of either gender
VI. Weight between 30 to 80kg

2) Exclusion Criteria

I. Patients who do not give consent for regional anesthesia
II. ASA GRADE 3 or 4
III. Patients with coagulation disorders or local infection
IV. History of hypersensitivity reaction to local anesthetic
V. History of cardiovascular disorders like ischemic heart disease, arrhythmias and valvular heart disease
VI. Patients with peripheral neuropathy, sepsis or skin lesion at the site of injection
VII. No pain during positioning for spinal anaesthesia

Patients were selected by alternate selection technique. There was a single assessor throughout the study who came into the operating room after the procedure got completed by the team. USG machine was kept for every patient but on standby mode for the PNS group, to avoid patient bias. The volume and concentration of lignocaine (1% and 10 ml) were kept constant for all the patients to avoid further bias. Patients were divided into two groups of 35 each FNB – U (n=35) patients received US guided femoral nerve block FNB – P (n=35) patients received PNS guided femoral nerve block. The Primary Investigations included, Blood grouping and cross matching, Complete blood count: HB%, TLC, DLC, ESR, PCV, Random blood sugar., Bleeding time,

Clotting time, Coagulation profile, Liver function tests [as per requirement] Kidney function tests, Electrocardiography (ECG). Chest X ray postero-anterior (PA) view were noted, specialized investigations, according to the patients for further evaluation, if required. Following which, the patients were deemed fit for the surgery.

The patient was kept in the supine position with ipsilateral extremity abducted 10–20 degrees and slightly externally rotated with the lateral side of the foot resting on the table. In the FNB- P group the inguinal ligament was identified between the anterior superior iliac spine and pubic tubercle. The femoral artery was palpated just below the femoral crease. A nerve stimulator was then connected to a stimulating block needle to help identify the femoral nerve. The stimulator was set to a current density of 0.8 to 1 mA with a frequency of 2 Hz and a pulse duration of 0.1 milliseconds. The needle enters at an angle of 30 to 45 degrees to the skin in a cephalad direction. Once the expected patellar twitch was confirmed, the current was slowly decreased. If the motor response was obliterated between 0.3 to 0.5 mA, then the needle tip was likely near the nerve without being intraneural, and the investigator then inject local anesthetic after confirming negative aspiration. In FNB-U group Ultrasonography-guided FNB was given with a high-frequency linear probe (4–12 MHz) (sonosite US) placed in the middle of the inguinal ligament, and after setting the optimal gain, depth, and focal point of the ultrasound femoral artery got visualized. The probe was then moved laterally, medially, and back and forth till a clear femoral nerve seen as a hyperechoic triangular-shaped structure immediately lateral to the femoral artery. Using the in-plane technique, the needle was inserted from the lateral side until it reached the femoral nerve. After identifying the nerve using either of the study techniques, a local anesthetic (lignocaine1% 10 ml) was administered after negative aspiration for blood. In the ultrasound method, we could see the spread of the drug around the nerve.Visual analogue scale consists of a 10 cm line, marked at 1 cm each. The patient makes a mark on the line that represents the intensity of pain he or she experienced. Mark "0" represents no pain and mark "10" represents worst possible pain. The numbers marked by the patient was taken as units of pain intensity. Along with VAS score, Haemodynamic parameters noted pre- procedure, at 0min, 5 min,10min,15min and 20 min after the block execution were: HR, BP (SBP, DBP, MAP) and SPO_2.

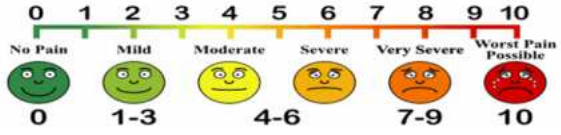


Figure 1. Visual Analog Scale

Patients were then given sitting position for spinal anaesthesia at the end of 20 min and ease of positioning in terms of grades of positioning was observed as described below. Following parameters were observed in both the group- Block execution time: The time duration (min) from placement of USG probe or the needle to the completion of drug administration. No. of pricks : The total number of skin pricks taken for giving the block. Onset of analgesia : The time (min) when VAS score starts decreasing to less than 7 after the execution of block. Complete achievement of analgesia : The time (min) when VAS score decreases to less than 4 after the execution of block. Success of the block : Adequate decrease in VAS score to less than 7 after 20 min of block execution. Grades of positioning : Depending on quality of positioning for spinal anaesthesia I- Good flexion : sitting at angle more than 90 degree. II- Average flexion :sitting at angle less than 90 degree without twisting. III- Poor flexion :sitting with twisting or hand support. Complications happening immediate or within 24 hr was taken note of accidental vascular puncture, intraneural, intravascular injection, local site bruising and bleeding and adverse drug reaction of local anaesthetic.

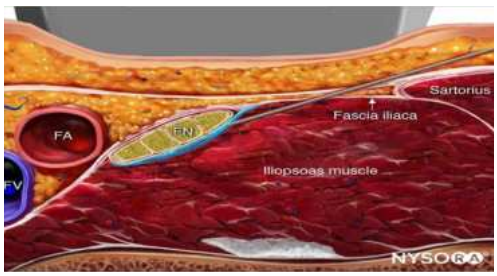


Figure 2. Anatomical location of femoral nerve

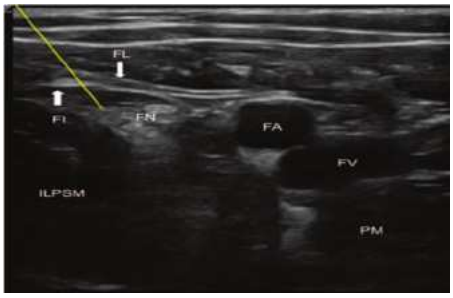


Figure 3. Sonological appearance of femoral nerve anatomical location

OBSERVATIONS AND RESULTS

Data were analyzed for 35 patients in group NS and 35 patients in group US. Both the groups were comparable in terms of age, gender, ASA status, BMI, type of surgery (Table 1). The number of patients under ASA grade I and II were comparable in both the groups. In both the groups diagnosis was most commonly Intertrochanteric (IT) femur fracture and the most common procedure done was Proximal Femur Nailing (PFN).

From the observations of the present study we concluded that success rate of the femoral nerve block in FNB-U group was 100% whereas in the FNB-P group it was 97.15%. This difference was statistically not significant (p=1.00). Despite no statistical significant difference between the two, US provided better clinical results than PNS.

TABLE 1. DEMOGRAPHIC CHARACTERISTICS OF THE PATIENTS

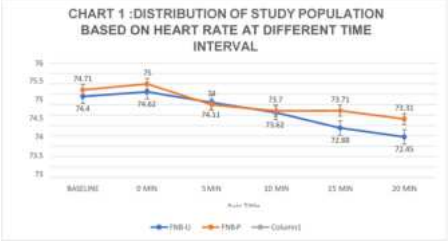
AGE GROUP (YEARS)	GROUP FNB-U(N=35)		GROUP FNB-P(N=35)		P VALUE
	NO[R]	%	NO[R]	%	
18 - 30	0	0	0	0	0.68[B]
31 - 40	0	0	1	2.85	
41 -50	1	2.85	0	0	
51 - 60	16	45.7	15	42.8	
61-70	18	51.4	19	54.2	
TOTAL	35	100	35	100	
GENDER					
FEMALES	14	40	12	34	0.62[A]
MALES	21	60	23	65	
ASA GRADES					
GRADE 1	13	37.14	17	48.57	0.33[A]
GRADE 2	22	62.85	18	51.42	
BMI	25.77± 2.12		25.47± 2.21		0.55[B]
DIAGNOSIS					
IT FEMUR FRACTURE	29	82.85	28	80	1.000[C]
ST FEMUR FRACTURE	2	5.71	3	8.57	
AVN OF HIP JOINT	2	5.71	2	5.71	
NOF FRACTURE	2	5.71	2	5.71	
OPERATIVE PROCEDURE					
PFN	29	82.85	28	80	1.000[C]
LONG PFN	2	5.71	3	8.57	
BIPOLAR SURGERY	2	5.71	2	5.71	
TOTAL HIP REPLACEMENT	2	5.71	2	5.71	

NO[R]-NUMBER; %-PERCENTAGE; A-CHI SQUARE TEST; B-STUDENT T TEST APPLIED; C- FISHER'S EXACT TEST APPLIED SD- STANDARD DEVIATION

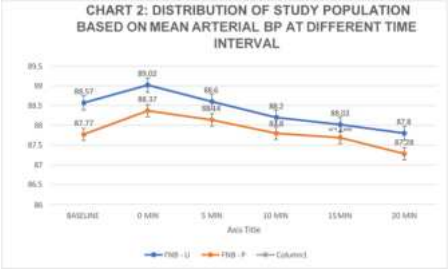
TABLE 2. PROPERTIES OF THE TWO BLOCKS

	GROUP FNB-U(N=35)		GROUP FNB-P(N=35)		P VALUE
	MEAN	SD	MEAN	SD	
NO. OF PRICKS	1.48	0.56	3.05	0.8	0.0001[B]
BLOCK	7.34	1.08	12.45	0.98	0.0001[B]

EXECUTION TIME					
VAS SCORE					
BASELINE	8.25	1.14	8.37	1.00	0.65[B]
0 MINUTE	8.25	1.14	8.37	1.00	0.65[B]
5 MINUTE	5.57	1.59	6.8	1.07	0.00[B]
10 MINUTE	4.45	1.44	5.8	1.14	0.00[B]
15 MINUTE	2.88	0.83	3.74	1.01	0.00[B]
20 MINUTE	2.08	1.03	2.74	1.24	0.01[B]
GRADES OF POSITIONING					
GRADE I	26	74.28	22	62.8	0.33[A]
GRADE II	8	22.85	9	25.71	
GRADE III	1	2.85	4	11.42	
SUCCESS OF THE BLOCK					
NO	0	0	1	2.85	1.0000
YES	35	100.00	34	97.15	
COMPLICATIONS					
LOCAL SITE BRUISING	1	2.85	2	5.71	0.55
VASCULAR PUNCTURE	0	0	1	2.85	0.31
NO[R]-NUMBER; %-PERCENTAGE; A-CHI SQUARE TEST; B-STUDENT T TEST APPLIED; SD- STANDARD DEVIATION					



Heart rate, Systolic blood pressure, Diastolic blood pressure, Mean arterial blood pressure and SpO_2 was noted in patients in both the groups before the administration of the block considered as baseline and at 0min, 5min, 10min, 15min and 20min. And it was observed that there was no clinically significant difference in hemodynamic parameters readings between the two groups.



DISCUSSION

Peripheral nerve stimulators allowed for better nerve plexus localization, but they are also a blind technique with a persistent risk of injury to surrounding structures, particularly vascular structures. On the other hand, the ultrasound technique aids in identifying the target nerve, surrounding structures, and determining the best approach to the target nerve. It also provides real-time guidance with visualisation of local anesthetic distribution, resulting in a faster onset of block as the drug is deposited very close to the target nerve while avoiding intra-neural injections, resulting in a higher success rate, less failure, and complication. Our study results were coherent to several studies[1,2,3] that have been conducted over the last two decades to compare the USG versus PNS approach to femoral nerve block.

We found that under ultrasound guidance required shorter block execution time, less number of attempts of pricks during the block execution, had early onset of analgesia, less time was required for complete achievement of analgesia, furthermore had minimal complications and better success rate than under peripheral nerve stimulator (PNS) guidance. Arash Forouzan et al [2] and Abhijit Karmakar et al[3] used lignocaine with various dilutions ;10 ml 0f 1% Lignocaine and 15ml of 2% Lignocaine respectively so as to obtain the minimum amount effective for achievement of the block. In the present study 10 ml of 1% lignocaine was used and was found effective in achievement of analgesic effect thus reducing the drug requirement.

In the present study, the mean of number of pricks taken for the execution of block was 1.48 ± 0.56 in FNB-U group whereas it was 3.05 ± 0.8 in the FNB-P group thereby reducing the mean time taken for execution of the block in US (7.34 ± 1.08 min) versus PNS (12.45 ± 0.98 min). This difference was statistically significant ($p<0.05$) adding to better patient satisfaction and decrease in procedural time. Zainab Hamed Sawan et al[4] in 2020 and Sanjaya Behera et al[5]. in 2022 conducted studies showing significant decrease in attempts at the block using US and hence the procedural time using US than PNS owing to its efficacy and patient's comfort.

Gupta et al[6] reported significant VAS reduction after 5 minutes in a group receiving US-guided FNB in fracture femur surgeries.5 Similarly, in the present study we found earlier pain relief at 5 and 10 minutes in US-guided FNB as compared to NS-guided FNB. This was probably because of accurate drug deposition around the femoral nerve compared to blind placement in the case of group NS. However, by 15 minutes the VAS reduction was comparable between the groups. From the observations of this study we found that the baseline VAS score was similar in both the groups and the mean time of onset of analgesia in FNB-U group was 5 minwhereas in FNB-P group was 10 min. However, at the end of 20 min the VAS score in both the groups were comparable.

Forouzan et al[2] , found the success rate of the NS technique to be 92% at 30 minutes as compared to 100% with the US technique of FNB in fracture femur patients whereas Duncan and et al[8] in 2013 in their study found failure rate of 10% in USG and 20% in PNS group was observed, however this difference was statistically insignificant (P = 0.278), it may be due to real time visualisation of the drug spread.

Most of the patients reported the ease of positioning as comfortable in both the groups after FNB, but, the number of patients with grade I ease was significantly more in group US compared to group NS, again due to better pain relief. Few patients in group NS complained of some discomfort while being positioned for spinal anesthesia compared to group US. Our results coincide with the study conducted by Avneet Janagal et al[1] where positioning was graded as I, II, and III, most of the patients 27 (94%) in group US were comfortable (grade I), probably due to early and good pain relief, followed by 3 (10%) patients with grade II, and none with grade III, vs grade I in 20 (67%) patients in group NS, 9 (30%) patients had some discomfort (grade II), and 1 (3%) had severe pain with uncomfortable posture (grade III). Most of the patients reported the ease of positioning as comfortable in both the groups after FNB, but the number of patients with grade I ease was significantly more in group US compared to group NS.

Complications observed due to FNB in our study were mainly vascular puncture and skin bruising in the case of NS technique due to blind execution. Various authors have quoted the incidence of vascular puncture to vary between 15% and 56.4% after nerve stimulation technique of peripheral nerve blocks vs 5% by ultrasound modality.13–16 NS technique does not guarantee avoidance of intraneural placement of the needle. Nerve injuries have also been reported without major adverse sequelae even with ultrasound technique by Schafhalter- Zoppoth et al[7]., but, we did not have any such complication in any patient in our study. Both nerve stimulation and ultrasound technique of FNB has its advantages and disadvantages. Both have a learning curve and are safe and easy in the hands of an experienced practitioner, therefore, one may decide to use either of them or as a combined technique for more affectivity.

CONCLUSION

It can be concluded from the present study that the femoral nerve block for positional pain in hip fracture patients under ultrasound guidance required shorter block execution time, less number of attempts of pricks during the block execution, had early onset of analgesia, less

time was required for complete achievement of analgesia, furthermore had minimal complications and better success rate than under peripheral nerve stimulator (PNS) guidance. Our study recommends US guided block to save time and inconvenience of multiple attempts leading to pain. Good quality pain relief and economical drug dosing makes it useful in patients with comorbidities. Apart from its learning curve, the high success rate and safety profile make the use of ultrasound ideal.

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