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Research Article

Pericapsular Nerve Group Block (PENG) and Fascia Iliaca Compartment Block (FICB) for Positioning Patients with Hip Fractures for Spinal Anaesthesia: A Comparative Study between The Two Blocks

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ABSTRACT

Background: Hip fractures are a common and disabling injury caused by osteoporosis of the joints, and they have a significant socioeconomic impact. Any movement at the hip joint, whether during the transfer to the hospital or during a radiological procedure followed by OT, causes excruciating pain. Multiple comorbidities increase the need for regional analgesia and anaesthesia in elderly people. The primary purpose was to compare the analgesic efficacy of ultrasound guided supra inguinal FICB to that of PENG block for positioning during spinal anaesthesia. Comfort of anaesthetist while giving spinal anaesthesia and patient's acceptance score were secondary objectives.

Methods: The 60 patients in this prospective, double-blinded, randomized controlled research were scheduled to undergo elective surgery for hip fractures under spinal anaesthesia. They were allotted in two groups- group FICB(n=30) and group PENG(n=30). Ultrasound guided Supra inguinal FICB was performed in FICB group and PENG block was performed in the PENG group with 20ml of 0.25% bupivacaine in each group. Evaluation of pain before intervention, just before positioning and while positioning patients for spinal anaesthesia was done using NRS score. Comfort of the anaesthetist while positioning for spinal anaesthesia and patient acceptance was also assessed.

Results: The NRS score did not differ significantly between the two groups (p= 0.853). On a scale of 0 to 3, the anaesthetist's comfort delivering spinal anaesthesia did not differ significantly between the two groups (p= 0.553). There was no statistically significant link between anaesthesia acceptance and group preference (p= 0.504)

Conclusion: The newly invented PENG block to facilitate sitting positioning in fracture hip joint patients for spinal anaesthesia was equally effective to supra inguinal FICB.

Fascia Iliaca plane is the compartment containing the femoral nerve (FN) and the lateral femoral cutaneous nerve (LFCN) between the fascia iliaca and the underlying iliacus muscle [1]. As a result, depositing a local anaesthetic agent in this compartment will give anaesthesia for the hip, knee, and thigh with a success rate of 67-90 %.

Ultrasound guided fascia iliaca compartment block (FICB) which is given conventionally with infra inguinal approach requires larger volume of local anaesthetic agent to block LFCN and articular branches of femoral nerve which are placed proximal to inguinal ligament [2-3]. As a result, in order to block these nerves, the drug

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must move superiorly from the thigh, necessitating a larger volume.

In our study, we used an ultrasound-guided Supra-inguinal approach to FICB, in which local anaesthetic is directly injected into the iliac fossa by placing the needle beneath the fascia iliaca from below the inguinal ligament, blocking the LFCN and branches of the FN that are close to the iliac fossa with a smaller volume of injection and can aid in positioning of hip fracture for spinal anaesthesia [4].

Hip joint is innervated not only by the FN and its branches, but also by the Obturator Nerve (ON) and Accessory Obturator Nerve (AON), notably the anterior hip capsule. Between the Anterior Inferior Iliac Spine (AIIS) and the iliopubic eminence, high articular branches of FN and AON are located, while ON is adjacent to the Inferomedial Acetabulum [5]. A newly designed ultrasound guided Pericapsular Nerve Group (PENG) block has been found to give rapid pain relief in fracture neck femur or intertrochanteric femur fractures using this information. However, no comparison of S - FICB to PENG block in terms of sitting position before SA has been done so far. To assess the analgesic efficacy of ultrasound guided Supra inguinal FICB and PENG Block for positioning patients before spinal anaesthesia, we conducted this prospective randomized controlled experiment.

Assessment of pain during placement in sitting position was the primary goal. Comfort of anaesthetist while giving spinal anaesthesia and patient's acceptance score were secondary objectives.

Methods

This 12-month randomized; double-blinded clinical trial was carried out in strict conformity with the Helsinki principles. After receiving clearance from the institutional ethical committee (SKNMC/Ethics/App/2020/801), all patients scheduled for elective hip fracture surgery under spinal anaesthesia were informed about the study and those who agreed to participate were enrolled. Patients with American Society of Anaesthesiologists (ASA) I and II, aged 45-65 years, and a body mass index (BMI) between 18kg/m2 and 35kg/m2 met the inclusion criteria. Patients with bleeding diathesis or coagulopathy, infection at the injection site, alcohol or drug misuse, renal impairment, ASA physical status greater than II, BMI greater than 35, and local anaesthetic sensitivity were excluded from the study. On the basis of a computer-generated randomization list, participants were assigned to either the FICB Group or the PENG Group (1:1 allocation).

The numerical rating scale (NRS) for pain evaluation was explained to all patients. Standard monitors and an intravenous line were attached in the operating room. Lactated Ringer's solution (15 ml/kg) was used for preloading. In the FICB group, supra inguinal FICB was conducted with a low frequency curvilinear ultrasound probe (2-5 MHz) in the supine position, following all aseptic precautions. The anterior superior iliac spine was imaged using a probe in the sagittal plane. By sliding the probe medially, the fascia iliaca, sartorius, iliopsoas, and internal oblique muscles were found. A 22G needle was inserted 1 cm cephalad into the inguinal ligament using an in-plane method. After negative aspiration, 20 mL of 0.25 % bupivacaine was administered; upward movement of the femoral artery during injection was employed as a sign of successful fascia iliaca penetration.

In the PENG group, a low frequency curvilinear ultrasound probe is first put in the transverse plane over the AIIS, then rotated 45 degrees counter clockwise to align with the pubic ramus. The IPE, iliopsoas tendon, femoral artery, and pectineus muscle were all identified in this view. In an in-plane technique, a 24-gauge spinal needle was introduced from the lateral to medial plane, with the tip between the psoas tendon anterior and the pubic ramus posterior. A total of 20ml of 0.25 % bupivacaine was injected after negative aspiration.

Fifteen minutes after intervention the patients were placed in sitting position. A median approach was used for spinal anaesthesia. Conventional spinal anaesthesia was given by the anaesthetist who was not involved in the block procedures. Post intervention, patients heart rate, blood pressure, oxygen saturation and ECG were monitored till patient was shifted to ward for recovery.

Primary objective: Pain was assessed by NRS score, which was recorded before, after and while placement in sitting position.

Secondary objectives:

1) Comfort of anaesthetist while giving spinal anaesthesia was assessed by quality of position obtained for spinal anaesthesia.

0-Not satisfactory
1-Satisfactory
2-Good
3-Optimum.

2) Patient's acceptance score was evaluated for 24 hours after surgery by using two-point score.

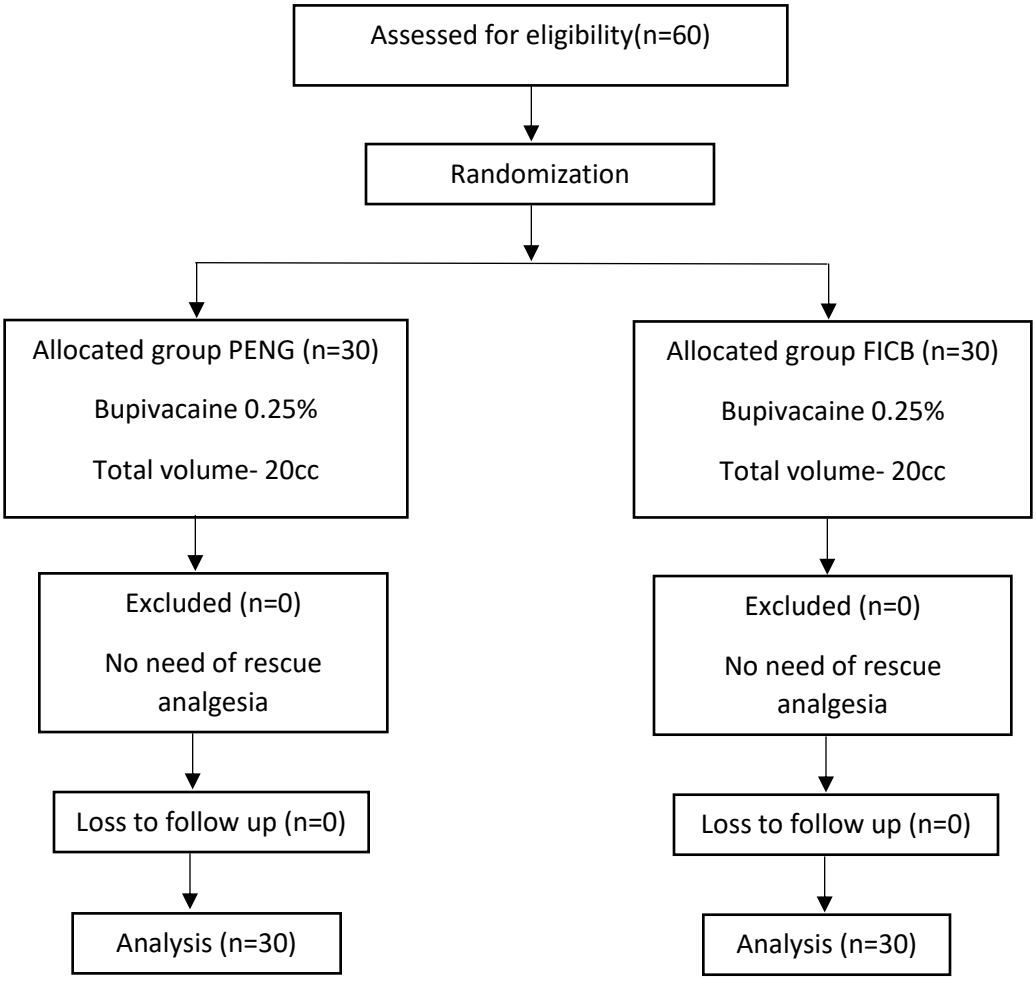
1-Good
2- Bad.

Post intervention, patients heart rate, blood pressure, oxygen saturation and ECG were monitored till patients were shifted to ward for recovery.

Sample Size

To identify a clinically significant difference in EOSP score of 0.5 between the two groups, we determined that 56 individuals were needed [7]. To reduce the impact of dropouts from the trial, we divided the participants into two groups, each with 30 patients. A computer-generated randomization list was used to assign patients. The student t test was used to examine demographic characteristics such as age, gender, and ASA status.

Figure 1- Consort chart



Results

The study enlisted the participation of 60 patients. In both groups, demographic factors were comparable. (Table 1).

Table 1- Comparison of demographic profile between two groups

Variable	FICB group	PENG group	P value
Age (years)	59.17 ± 5.45	58.43 ± 6.17	0.627
Gender (M/F)	18/12	15/15	Not significant
ASA (I/II)	19/11	16/14	Not significant
BMI (kg/m²)	27.62 ± 2.48	28.13 ± 2.36	0.418

There was significant decline in NRS score over the timeline in comparison with before intervention score in both the groups (Wilks' Lambda = 0.120, p = 0.00) while there was no discernible difference in the rate of decrease between the two groups. (Wilks' Lambda= 0.994, p = 0.853) (Table2,3).

Table 2- Comparison of NRS Scores between two groups

Variable	Group	Mean	SD
Before intervention	FICB	6.63	1.450
	PENG	6.03	1.402
Just before positioning	FICB	3.40	1.522
	PENG	2.90	1.094
While positioning	FICB	2.23	0.935
	PENG	1.87	0.819

Table 3- Multivariate analysis comparison of NRS Score between two groups

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Timeline	Pillai's Trace	0.880	2.100E2a	2.000	57.000	0.000	0.880
	Wilks' Lambda	0.120	2.100E2a	2.000	57.000	0.000	0.880
	Hotelling's Trace	7.367	2.100E2a	2.000	57.000	0.000	0.880
	Roy's Largest Root	7.367	2.100E2a	2.000	57.000	0.000	0.880
Timeline * GROUP	Pillai's Trace	0.006	0.159a	2.000	57.000	0.853	0.006
	Wilks' Lambda	0.994	0.159a	2.000	57.000	0.853	0.006
	Hotelling's Trace	0.006	0.159a	2.000	57.000	0.853	0.006
	Roy's Largest Root	0.006	0.159a	2.000	57.000	0.853	0.006

The anesthetist comfort for spinal anesthesia between the two groups on a scale of 0-3 was also comparable (unpaired t test, p = 0.553) (Table 4).

Table 4- Anaesthetist comfort comparison between two groups

Variable	Group	N	Mean	Std. Deviation	Std. Error Mean	P value
Comfort	FICB	30	2.47	0.629	0.115	0.553
	PENG	30	2.37	0.669	0.122	

There was no significant relationship between anaesthesia acceptance by patients favouring distinct groups in each group. (chi-square statistic with Yates correction = 0.4453, p=0.504) (Table 5).

Table 5- Patient acceptance of anaesthesia comparison between two groups

Variable	Patient acceptance		Total	P value
	Bad	Good		
FICB	7	23	30	
PENG	4	26	30	0.504
Total	11	23	60	

Discussion

In this prospective randomized study, we compared ultrasound guided supra inguinal approach of FICB with newly invented PENG block to facilitate sitting positioning in fracture hip joint patients for spinal anaesthesia. In our study we observed that, both modified supra inguinal FICB and PENG provide effective and comparable analgesia.

Fractures of the hip joint are a common and disabling injury in elderly people due to osteoporosis of the joints, which has a significant socioeconomic impact [6]. Any movement at the hip joint, whether during the transfer to the hospital or the radiological procedure followed by OT, produces excruciating pain. In these weak people, pain is always underestimated. All these factors will add risk to cardiac status in elderly patients. Multiple comorbidities increase the need for regional analgesia and anaesthesia in elderly people. [6]. Moreover, chances of early ambulation and lesser risk of DVT tend to be more with the use of regional anaesthesia [7-8]. But the major obstacle to regional anaesthesia is the positioning

for spinal, which is associated with extreme pain and other complications.

Several studies have so far compared the efficacy of nerve blocks to that of systemic drugs, showing promising results in favour of nerve blocks [9-11]. Parenteral drug treatment, which was used conventionally will have undesirable impact on cardio respiratory function, liver and kidney function and on gastric mucosa which were already impaired because of age [18]. The major pain pathway, in cases of fracture hip joint involves FN, LFCN, ON, AON [12]. Femoral nerve block and FICB with infra inguinal approach were the two traditional anaesthesia techniques used. Various studies have shown that traditional FICB is more effective in providing analgesia than isolated Femoral nerve block and three-in-one nerve block [12-14].

But again, the conventional FICB (infra inguinal) required larger volume of local anaesthetic agents to simultaneously block FN and LFCN, as LFCN is located proximal to inguinal ligament, hence the drug must pass superiorly from the thigh to block it [12,15]. Moreover, FICB doesn't block the ON or AON due to anatomical limitations. Hence in this study, we used the ultrasound guided supra inguinal approach to FICB, which showed the higher cephalad spread of local anaesthetic, by depositing same volume above the inguinal ligament and thus more effective blockade of lumbar plexus. Recently few studies also showed the similar results. K. Kumar et, al. suggested that supra inguinal FICB provides superior analgesia compared to conventional FICB, with significantly less morphine consumption [3]. Vermeylen K et, al. in their study demonstrated more reliable spread of local anaesthetic to targeted nerves of lumbar plexus with S-FICB than with I-FICB [16]. A study by Qian, Yuying MD et, al. compared the efficacy of supra inguinal versus infra inguinal FICB by using electromyography and quantification of total opioid consumption during the 24 hrs after TKR, showing decreased opioid consumption in S-FICB than I-FICB [17].

A recent anatomical study of hip joint innervation revealed the existence of articular branches of the femoral nerve and the AON that are not covered by FICB [4]. Using this information, novel ultrasound guided approach for blocking these articular branches to hip and AON, the PENG block was developed by Giron-Arago - L et, al. PENG block, is proposed to block FN, articular branches of FN, AON consistently [5].

The analgesic efficacy of Ultrasound guided supra inguinal FICB was compared to that of PENG block in this study. Both are relatively new blocks under investigation. The primary objective of our study was assessment of pain before intervention, just before positioning and while positioning patients for spinal anaesthesia, which was measured by NRS scale. In terms of pain, there was no significant difference between the two groups. Except in smaller group of patients, particularly in fracture neck femur, PENG block showed the better NRS score than S-FICB although not statistically significant. The reason behind, maybe due to involvement of anterior hip joint capsule in fracture neck femur, which is richly innervated by FN, ON, AON [18]. As the PENG specifically targets all these nerves, better results may be seen [7,19-22]. Besides that, the pain relief in both groups was comparable. In another comparative study by Jadon et al. the NRS score was better with PENG group [18].

The secondary outcome of the study, was to assess the comfort of anaesthetist for position of spinal anaesthesia. We have observed comparable results in both the groups. The final sitting position achieved was graded into optimal and good and the difference between the two groups was statistically insignificant. Also, patient's satisfaction and acceptance were equal in both the groups. Similar results were seen in the previous studies [18,21].

There are certain limitations to our research. Due to spinal anaesthesia, we were unable to assess the motor blockage; hence motor sparing effect of PENG was not demonstrated. Also, we studied only sitting position for subarachnoid block though it can be given in lateral position as well.

Conclusion

To conclude, the newly invented PENG block to facilitate sitting positioning in fracture hip joint patients for spinal anaesthesia was equally effective to supra inguinal FICB.

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