ORIGINAL ARTICLE

Analgesic Efficacy of Suprainguinal Fascia Iliaca Compartment Block (SFICB) vs Combined Pericapsular Nerve Group (PENG) Block with Lateral Femoral Cutaneous Nerve Block (LFCN) in Hip Surgery

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DOI:https://doi.org/10.62848/bjpain.v3i2.7073

Received: 05, January, 2023
Accepted: 07, July, 2023

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Abstract

Background: Pain management for hip fracture is challenging due to complex anatomical variations and patient positioning during surgery. Though various modalities of regional techniques are being used for pain management, none of them has proven superiority. Recently fascia iliaca compartment block and pericapsular nerve group block have drawn lots of attention due to simplicity and superior pain control. In this study suprainguinal fascia iliaca compartment block (SFICB) was compared with pericapsular nerve group (PENG) block in combination with lateral femoral cutaneous nerve (LFCN) block to evaluate the analgesic efficacy and utility in fracture neck femur patients.

Methods: This prospective study was conducted from January 2022 to December 2022. Total 40 patients were allocated in two groups, suprainguinal fascia iliaca compartment block (Gr-F) or PENG with LFCN block (Gr-P) group. 30 minutes after performing the block, pain was assessed with NPRS scale during positioning for combined epidural anaesthesia. Then pain assessment was done 2 hour for first 12 hours followed by 4 hour in following 12 hours. Haemodynamic profile, duration of analgesia and requirement of rescue analgesics were recorded.

Results: During positioning of the patient for central neuraxial block, NPRS was (2.5 ± 0.3) for Gr-P and (4.5 ± 0.6) for Gr-F with $p = 0.039$. For Gr-F, 20% patient required Dexmedetomidine infusion during positioning. The onset of analgesia in Gr-P was (10.56 ± 3.46) minutes and in Gr-F was (15.86 ± 3.3) minutes with $p < 0.05$. Duration of analgesia during active movement was 14.6 (±1.09) hours for Gr-P and 10.2 (±2.06) hours for Gr-F with p value < 0.05.

Conclusion: Combination of PENG with LFCN block provides a superior analgesia characterised by early onset action, less pain score at rest and on movement during positioning of the patient and prolong duration of action on active movement postoperatively.

Keywords: Ultrasound guided regional blocks, suprainguinal fascia iliaca compartment block, pericapsular nerve group block, Analgesia, Hip Surgery

Citation: Uddin MA, Azad SUA, Nimmi NP, Mitra SP, Aziz L. Analgesic Efficacy of Suprainguinal Fascia Iliaca Compartment Block (SFICB) vs Combined Pericapsular Nerve Group (PENG) Block with Lateral Femoral Cutaneous Nerve Block (LFCN) in Hip Surgery. Bangladesh J. Pain 2023; 3(2): 04-11. doi.org/10.62848/bjpain.v3i2.7073

Introduction

Hip fracture is associated with severe perioperative pain which complicates total patient management. There is a significant association between pain and perioperative mortality and morbidity with low levels of patient satisfaction. Pain in hip surgery results in increased incidence of anxiety, cognitive impairment, and sleep disturbance, complicated postoperative physical recovery, delayed mobilization with augmented risk of thrombo-embolism, prolongs hospital stays, and increased expenses of medical services[1,2].

Many techniques have been used for acute pain management in hip fracture. Not a single technique is superior to others, but a multimodal approach is advocated in ERAS protocol. In most of the instances, there is frequent use of systemic opioid and NSAIDs in emergency department and perioperative period. Opioid may cause respiratory depression, nausea, vomiting, immune suppression, ileus, and itching. Some Patients receive epidural analgesia but may be associated with hypotension and urinary retention. Moreover, it's difficult to establish epidural in emergency due to severe pain on movement. Above all, a multimodal analgesic approach consisting peripheral nerve block is considered the gold standard for pain control[3].

Now a days, central neuraxial block is the choice of anaesthetic modality for hip fracture surgery. Positioning before central neuraxial block is the most important concern for establishing anaesthesia. Adequate positioning requires a high degree of analgesia of the hip joint during movement.

Due to complexity of hip joint innervation[4], it is challenging to deliver effective nerve block with single technique. The frequently used techniques fascia iliaca compartment block (FICB), femoral nerve block (FNB), and 3-in-1 block are unpredictable[5] and frequently associated with reduction in muscle power and delayed discharge[6]. But pericapsular nerve group (PENG) block has motor sparing effect[7] and blocks all the sensory branches of hip joint[8] but doesn't cover lateral femoral cutaneous nerve (LFCN) area and most of the surgical incision line is in the area provided by LFCN. So, it's reasonable to use combination of blocks for ensuring complete analgesia.

Keeping this in mind, in our study we performed a combination of PENG with LFCN block and compared with suprainguinal fascia iliaca compartment block (SFICB) to evaluate and compare with suprainguinal fascia iliaca compartment block (SFICB) regarding the analgesic efficacy during positioning of the patient for central neuraxial block, haemodynamic variability, requirement of supplemental analgesics and postoperative analgesia.

Methods

This is a prospective observational study. The study was conducted from January 2022 to December 2022 in Evercare Hospitals Dhaka, Bangladesh. After obtaining the ethical clearance from the ethical committee of the hospital, total 40 patients were allocated in this study.

Patients with ASA 1 & 2 with body weight 50 to 90 Kg were included in the study. Participants were divided into two groups, either for suprainguinal fascia iliaca compartment block (Gr-F) or PENG with LFCN block (Gr-P) group. A total of 20 patients in each group.

The exclusion criteria were, patients who can perform posture change comfortably, refusing to participate in the study, local anaesthetic allergy, coagulopathy, infection at the site of block, neurological deficits, on other analgesics up to 8 hours before performing nerve block, neuropsychiatric disorders, patients on opioids for chronic pain.

Peripheral nerve blocks were performed on the allocated patients in the preoperative room, before performing combined spinal epidural anaesthesia (CSE) for the hip fracture surgery. The anaesthetist performing the block was not blinded to the procedure, the patient and assessor of pain score were blinded to group allocation. Regional block was performed in supine position.

Drugs mixture for the block procedure was constituted with equal volume of 0.8% Lidocaine in

adrenalin and 0.2% bupivacaine (plain) with 10 mg dexamethasone, in a total volume mixture of 60ml. Block was performed with 30ml of drug mixture for (Gr-F) and 25ml for (Gr-P) with additional 5ml for LFCN blocks.

A linear high-frequency ultrasound probe (7 –15 MHz) was used. For SFICB, first anterior superior iliac spine (ASIS) was identified, then USG probe was placed in a parasagittal orientation, sliding the probe infero-medially along the course of the inguinal ligament, the anterior inferior iliac spine (AIIS) was identified. At this level, the 'bow tie' sign was identified which is formed by the sartorius muscle caudally and the transverse abdominus and internal oblique muscles cranially. Deep to the 'bow tie' drug was delivered after identifying the deep circumflex iliac artery (DCIA) above iliopsoas muscle at the level of hyperechoic fascia iliaca.
For the PENG block, curvilinear probe (2 – 5 MHz) was used. The block was performed at the level of anterior inferior iliac spine and ilio-pubic eminence. The point of injection was musculofascial plane between the psoas tendon and ilio-pubic eminence.

For LFCN block, high frequency probe (7 – 15 MHz) was used. The block was performed at the 1–2 cm medial and inferior to the anterior superior iliac spine (ASIS) on the medial edge of the superficial fascia of the Sartorius muscle.

The pain assessment was done using numerical pain rating scale (NPRS, 0 = no pain, 10 = maximum pain). NPRS was recorded before performing the block at rest, 30 minutes after the block procedure at rest and during positioning, 2 hourly after completion of the surgery for first 12 hours in postoperative period, then 4 hourly in next 12 hours.

All patients received combined spinal epidural (CSE) neuraxial block, at the L3/4 or L4/5 level, with bupivacaine 0.5 % heavy 2.5 ml (12.5 mg) for the fracture hip surgery, 30 minutes after block procedure, if numerical pain rating score (NPRS) was <4. All neuraxial blocks were performed in lateral decubitus position. If the NPRS was ≥ 4 during positioning, IV infusion of Dexmedetomidine at 0.5 mcg/kg/hr was given by infusion until the pain score is <4. Patients who could not achieve pain score < 4 were excluded from the study.

Efficacy of Analgesia, haemodynamic profile, any complications & requirement of rescue analgesia were recorded from the positioning of the patient for central neuraxial block to 24 hours after the surgery in recovery. Duration of analgesia was calculated from the time of giving the block till NPRS was ≥ 4.

Rescue epidural analgesia was provided with 2 mcg fentanyl/ml in 0.0625% bupivacaine continuous infusion at 10 ml/hr following a bolus dose 0.25 % bupivacaine 8 ml.

Students T test was applied for the data analysis. All the analysis was performed in Microsoft Excel.

Results

The demographic data of both the groups are presented in Table I. There was no statistically significant difference in both groups with respect to demographic characteristics.

Table I: Demographic data

	Group P (n = 20) Mean (± SE)	Group F (n = 20) Mean (± SE)	P Value
Age (year)	80.3 ± 1.2	79.7 ± 0.7	0.589
Weight (kg)	73.2 ± 2.3	74.1 ± 1.5	0.623
Male	9	12	0.342
Female	11	8	0.128

Data expressed as mean ±SD & number

Numerical pain rating scale (NPRS) for pain is presented in **Fig I**.

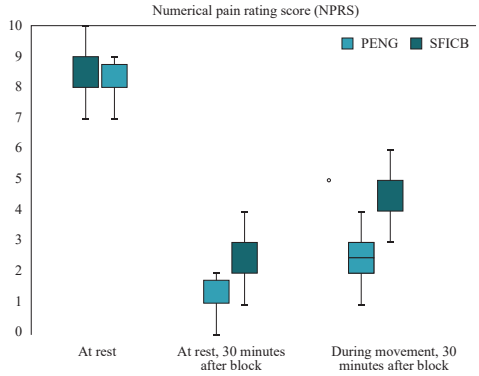

Fig I: mean NPRS (Numerical pain rating scale) of pain before and 30 minutes after block at rest and during positioning

NPRS before nerve block was (8.14 ± 0.9) for Gr-P and (7.95 ± 0.7) for Group F with p = 0.485.
NPRS at 30min in rest was (1.15 ± 0.344) for Gr-P and (2.2 ± 0.589) for Gr-F, with p = 0.025.
During positioning of the patient for central neuraxial block, NPRS was (2.5 ± 0.3) for Gr-P and (4.5 ± 0.6) for Gr-F with p = 0.039.

NPRS, 30minutes after performing the block at rest and during positioning before central neuraxial block were significantly less in Group P when compared to Group F.

The onset of analgesia is shown in figure 2, which was defined as time taken for NPRS value < 5.

The onset of analgesia in Gr-P mean was (10.56 ± 3.46) minutes and in Gr-F was mean (15.86 ± 3.3) minutes with p < 0.05.

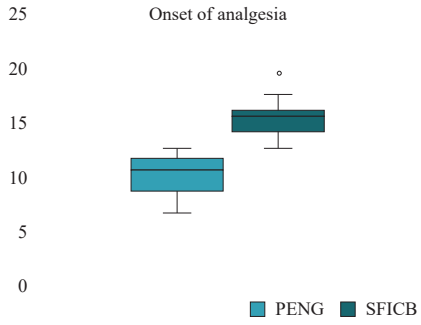

Fig II: Onset of analgesia in the studied groups.

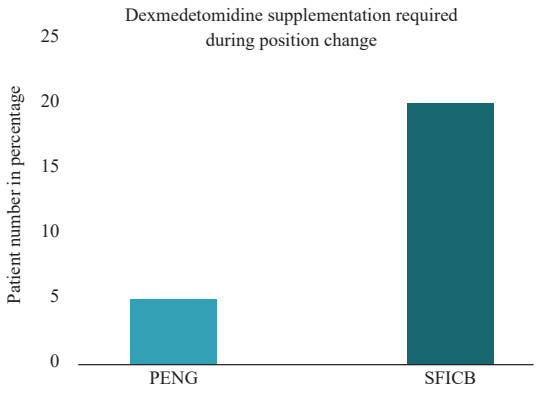

Fig III: Percentage of patients required Dexmedetomidine infusion supplementation during positioning

The percentage of patients required Dexmedetomidine infusion supplementation during positioning of central neuraxial block is shown in figure 3. For Gr-P 5% patients and Gr-F 20% required the infusion.

Peroperative hemodynamic response is presented in fig IV and there was no significant difference.

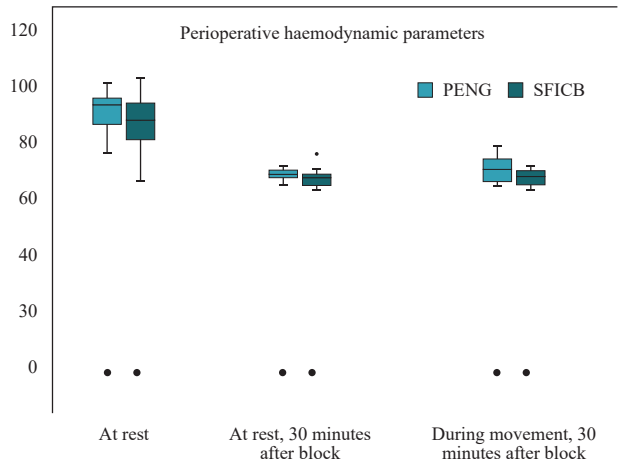

Fig IV: Perioperative haemodynamic data - before block and 30 minutes after block at rest and during positioning

Duration of analgesia is presented in fig V. For Gr-P it was 16.96 (± 1.86) hours and Gr-F 13.69 (± 1.04) hours with P value = 0.293, with no active movement of the limb. During active movement it was 14.6 (±1.09) for Gr-P and 10.2 (±2.06) for Gr-F with p value < 0.05.

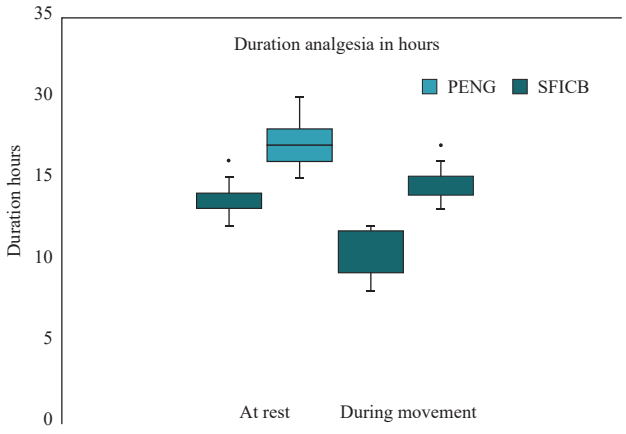

Fig V: Duration of analgesia of blocks at rest and movement

Discussion

Early management of hip fracture is essential to prevent fat embolism, sepsis and other long-term complications. Following the ERAS (enhanced recovery after anaesthesia) protocol in modern times is the norm and its success rate in hip surgery is highly promising[9].

Following the ERAS protocol, central neuraxial anaesthesia without intrathecal long-acting opioid, is the most used technique and advisable modality for providing anaesthesia during fracture hip surgery. But the provision of successful anaesthesia depends on adequate positioning of the patient which is very painful for the patient. Moreover, the severe pain during positioning impedes total patient management and associated with cardiovascular and neuroendocrine adverse outcome. In this instance, peripheral nerve block can facilitate the performance of central neuraxial block.

The postoperative pain after hip surgery is also severe and there is increased requirement of systemic analgesia without supplemental regional anaesthesia. Epidural analgesia is one of the options for postoperative analgesia, but it is associated with motor weakness and delayed hospital discharge. As NSAIDs has relative contraindication in these cases, the high opioid consumption in postoperative period is not without its subsequent consequences. Particularly in geriatric group of patients, it increases the risk of delayed mobilization, sepsis, pneumonia, prolong hospital stay and financial burden.

Most of the peripheral nerve block techniques for hip surgery provide only moderate analgesia as the articular branches of hip capsule are inconsistently blocked. No single block has yet provided the complete analgesia as the presence of divergence of nerve supply in this region.

The nerve distribution for hip joint must be considered before performing regional anaesthesia. The anterior hip capsule is innervated by articular branches of femoral nerve, obturator nerve and accessory obturator nerve. Femoral nerve gives away two articular branches by nerve to pectineus and iliopsoas muscle, which arises from the suprainguinal level. Obturator provides articular branch on the anteromedial and inferior aspect of the joint. The posteromedial portion of the joint capsule has contributions from the nerve to the quadratus femoris and sciatic nerves. Gerhart et al.[10] found a high density of nociceptors within the superior portion of the anterior capsule with a gradient that decreases in density medially and laterally[11]. Tomlinson et al. also noted that the deeper layers of capsule tended to have more nociceptors than the superficial layers did[12].

Currently, growing bodies are using suprainguinal fascia iliaca compartment block (SFICB) and pericapsular nerve group (PENG) block for hip procedures. Both the techniques are new and there is insufficient comparative data to draw a conclusion regarding the superiority. From anatomical point of view, anterior capsule innervations can be blocked by both PENG block and SFICB. As these 'high' branches of the femoral nerve are cranial to the inguinal ligament, these are difficult to block with infra-inguinal techniques[13]. Moreover, infrainguinal Fascia iliaca block often fails to adequately block the obturator nerve[14].

In our study, we used a combination of PENG and LFCN block. As the PENG block doesn't provide coverage at the surgical incision line on the lateral aspect of hip joint and thigh for hip surgery, it is reasonable to use separate LFCN block in combination with PENG block to cover the whole area.

In most of the studies, for the FICB, 40–60 ml of local anaesthetics has been used in infra- inguinal approach[15]. However, regarding the SFICB there are differing opinions about the effective volume. One cadaveric study of SFICB suggested that 40 ml of drug volume is effective to reach the FN, ON, and LFCN[16]. Other clinical studies have suggested lower volumes. Yamada et al.[17] suggested that the EV50 and EV95 of 0.25% ropivacaine for SFICB is 15.01 ml and 26.99 ml, respectively. Bhattacharya et al.[18] used 20 ml of 0.25% levobupivacaine in SFICB and PENG block successfully.

In our study we used total 50ml of drug mixture for the block procedure.

The drugs mixture for the block procedure was constituted with equal volume of 0.8% Lidocaine in

adrenalin and 0.2% bupivacaine (plain) with 10 mg dexamethasone, in a volume mixture of 50ml. SFICB was done with 50ml of drug mixture and for PENG block 25ml drug mixture was used with additional 25ml for LFCN blocks.

Giron-Arango et al. described the (PENG) block in 2018. They demonstrated that PENG block in hip fractures reduced pain scores by a median of 7 points on 10-point numerical pain rating scale (NPRS), without causing motor block[8]. Bhattacharya et al. In their study comparing PENG and SFICB in fracture neck femur surgery concluded that, the PENG block is associated with quicker onset of action with numerical pain rating score (NPRS) to 5 by 13.6 minutes compared to 22 minutes with SFICB[18].

In our observation we found that, for the combination of PENG and LFCN blocks, the mean pain score was 1.15 points in 10-point NPRS, 30 minutes after the block performance during positioning of the patient and it was 2.2 points for SFICB.
The mean time to reduce pain score to < 5 for PENG group was (10.56 ± 3.46) minutes whereas it was (15.86 ± 3.3) minutes for SFICB group. The rapid onset of analgesia in PENG group may be due to deposition of local anaesthetic solution in a compact space between psoas muscle and superior pubic ramus.

Both the groups were haemodynamically stable without any significant difference in heart rate, blood pressure and oxygen saturation.

It is postulated that with SFICB, femoral nerve (FN), lateral femoral cutaneous nerve (LFCN) and obturator nerve (ON) are blocked[19]. However, the results were inconsistent, due to variability of the volume of local anaesthetic or the technique[20,21]. But SFICB has a superior postoperative analgesic efficacy compared to infra-inguinal approach of FICB as the proximal spreading of local anaesthetic (LA) is not achieved in infra-inguinal technique, variability in the volume of local anaesthetic or the technique used[22,23]. The results are inconsistent regarding the superiority between PENG block and SFICB but many studies agree that the difference in analgesic duration in postoperative period is insignificant[24].

In our study, 20% patients in Gr-F required Dexmedetomodine infusion during positioning for central neuraxial block and 5% of patients in Gr-P required the infusion. The duration of analgesia at rest, in PENG group it was 16.96 (±1.86) hours and in SFICB group 13.69 (± 1.04) hours, which was not significantly different but during active movement, it was 14.6 (±1.09) for Gr-P and 10.2 (±2.06) for Gr-F with p value < 0.05. In active movement Gr-F experienced less duration may be due to sparing of Obturator nerve with SFICB.

We administered epidural infusion in postoperative period after getting the NPRS > 4 for pain management which precluded the assessment for the preservation of motor block but there are reports that PENG block preserves better motor function than SFICB.

Our study has several limitations. In postoperative period we did not assess motor function and the effect of SFICB on motor function. We also used Epidural bolus followed by infusion when the patient complained pain of grade 4 in the scale of 10. All our patients were geriatric and there is altered pharmacokinetics of regional anaesthesia in this group of patients. We did not measure postoperative total analgesic requirements for each group to conclude in superiority.

Conclusion

Both PENG and SFICB are effective for providing analgesia in fracture neck of femur. But PENG provides a superior analgesia due to early onset action, less pain score at rest and on movement during positioning of the patient and prolong duration of action on active movement postoperatively.

Declaration

Ethics approval

The study was approved by the ethical committee of Evercare Hospital Dhaka

Author contributions

Conception and development of the idea *MAU, LA*
Data collection *MAU, SUAA, NPN*
Data analysis *SUAA, MAU*
Writing - Original Draft Preparation *MAU, SPM*
Review & Editing *SUAA, NPN, SPM*

Funding No funding from any external sources

Conflict of interests None

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