Comparison between Ultrasound-Guided Pericapsular Nerve Group Block versus Fascia Iliaca Compartment Block for Early Mobilization after Hip Surgeries: Single Blinded Randomized Intervention Clinical Trial

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Abstract

Background: Hip fracture is an evident public health issue that requires surgical intervention in almost all cases. This study aimed to improve the quality of postoperative recovery in patients undergoing hip surgeries by allowing early mobilization and rehabilitation through perioperative local analgesic techniques that spare motor function. **Methods:** This single blinded randomized intervention clinical trial was carried out on 30 patients aged from 40 to 80 years old, both sexes, Body mass index 18-40 kg\m2 with unilateral hip osteoporosis or stable trochanteric fracture requiring arthroplasty or fixation, and I to III American society of Anesthesiologists physiological status. Patients were randomly allocated using computer generated randomization into two equal groups: pericapsular nerve group (PENG) group had PENG block, and fascia iliaca compartment block (FICB) group. had FICB Block. **Results:** there was statistically significant difference regarding the quadriceps muscle strength 6 hours postoperative, the elapsed time after spinal anesthesia cessation and mobilization, time taken to complete Timed-Up-and-Go test in postoperative day 1 in favour of PENG block, NRS at rest, and NRS during passive knee extension in favour of PENG block at 12 hours ($p<0.001$). **Conclusions:** PENG block is more effective than FICB in shortening the time to first postoperative walk and preservation of Quadriceps muscle power after hip surgeries while providing better postoperative analgesia with reduced consumption of rescue opioids, which makes it the block of choice to enhanced recovery programs following hip surgeries.

Key words: Ultrasound-Guided; Pericapsular Nerve Group Block; Fascia Iliaca Compartment Block; Mobilization; Hip Surgeries.

Introduction

Hip fracture is now considered a global health issue. It is estimated that the number of patients with hip fractures worldwide will increase to 2.6-7.3 million by 2025 and 4.5-21.3 million by 2050 [1]. The mortality rate one year after hip fracture is reported as high as 19.7–34.8% and that makes it an evident public health issue [2].

There are many patient-dependent factors affecting postoperative morbidity and mortality following hip fractures, such as old age, as it was proved that it increases mortality 5-8 times in the first 3 months following hip fracture. Other factors include functional status, male gender, high risk for anesthesia, abnormal Electrocardiogram (ECG), cognitive impairment, pre-fracture mobility, time to surgery, fracture type and transfer of patient [3].

Early mobilization and rapid recovery through proper analgesia and postoperative pain management are vital to eliminate those complications and reduce morbidity and mortality rates. Early mobilization is an essential factor to prevent prolonged stay in the hospital. And it is defined as the ability to ambulate between 3-3.5 hours after spinal placement [4]. The fascia iliaca compartment block (FICB) is a well-established analgesia method for hip procedures. The analgesic efficacy of this technique is based on the spread of the local anesthetic beneath the fascia iliaca to reach the femoral, and lateral femoral cutaneous nerves. The obturator nerve proximally can also be blocked [5].

Overall, complications of the FICB are low. Intravascular injections or neurologic injury are uncommon. The most reported complications include hematoma at the injection point and local anesthetic systemic toxicity. The FICB doesn’t cover the obturator and accessory obturator nerves which innervate the medial aspect of the hip capsule. Moreover, this technique results in motor weakness of the quadriceps muscle [6].

The pericapsular nerve group (PENG) blocks are novel motor sparing blocks, which could have an impact on early mobilization. PENG blocks were initially proposed for the treatment of hip joint pain, as alternative interventional analgesia modalities to provide a selective articular sensory block [7]. The technique and its various modifications consist of an injection of local anesthetics around the acetabulum. The injection plane is between the iliopsoas muscle and the proximal insertion of the anterior hip capsule targeting the articular branches of the femoral, obturator, and accessory obturator nerves [8].

One of PENG block risks and limitations is femoral nerve, lateral femoral cutaneous and artery punctures. Also, large volumes of local anesthetic may reach motor branches of the femoral nerve, resulting in motor block [9].

There are many studies that show the efficacy of PENG block and FICB concerning postoperative pain control. However, Studies regarding early ambulation and effect of both blocks on Quadriceps muscle strength aren't well established. So, we are studying the effectiveness of PENG block and FICB regarding early mobilization and analgesic efficacy.

The aim of this work was to improve the quality of postoperative recovery in patients undergoing hip surgeries by allowing early mobilization and rehabilitation through perioperative local analgesic techniques that spare motor function.

Patients and Methods

This single blinded randomized intervention clinical trial was carried out on 30 patients aged from 40 to 80 years old, both sexes, Body mass index (BMI) 18-40 kg\m2 with unilateral hip osteoporosis or stable trochanteric fracture requiring arthroplasty or fixation, and I to III American society of Anesthesiologists physiological status (ASA).

An informed written consent was obtained from the patient. The study was done after approval from the Ethical Committee Suez Canal university hospital operative theatres (approval code: 4902).

Exclusion criteria were patient refusal to participate, chronic opioid usage, neurological or neuromuscular disease, allergy to opioids or local anesthetics, patient admitted to Intensive care unit (ICU) postoperative, with cognitive impairment, psychiatric illness, unable to communicate verbally, failure of spinal anesthesia and/or conversion from spinal anesthesia to general anesthesia, type of hip surgeries that mandate late mobilization according to surgical recommendations e.g., comminuted fractures, unstable trochanteric fractures, and cementless bipolar hip arthroplasty, change of surgical plan or orthopedic complications during surgery, and duration of surgery more than 3 hours.

Randomization and grouping:

Randomization was done by computer-generated system. The list was concealed in sealed envelopes that were numbered and opened sequentially after obtaining patient's consent. Patients were randomly allocated using computer generated randomization into two equal groups: PENG group had Pericapsular Nerve Group block**,** and FICB group had Fascia Iliaca Compartment Block.

All patients were subjected to medical history [Medical disorders such as diabetes mellitus, cardiovascular diseases, renal diseases or hepatic disorders, past history of operations or hospitalization, and past anesthetic history with impact on previous hypersensitivity to anesthetic drugs and any previous postoperative complications that could be attributed to anesthesia], physical examination [General examination, vital signs including (blood pressure, heart rate, respiratory rate and temperature), and chest, heart and abdominal examination], anesthetic

assessment [Airway assessment including thyro-mental distance, mobility of the neck and temporomandibular joint, mouth opening, and mallampati Class], laboratory investigations and imaging [Complete blood count, prothrombin time, international Normalized Ratio, random Blood Glucose, other investigations according to patient's condition such as kidney function test or liver function test, electrocardiogram and Chest X-ray].

Anesthetic Management:

Pre-induction period: After entering the anesthesia preparation room, patients were monitored with electrocardiography, non-invasive arterial blood pressure, and pulse oximetry. An 18 -gauge peripheral venous cannula was inserted, and Ringer Acetate solution started. The blocks were performed by the same anesthesiologist (researcher) who was trained and supervised first then performed one of the two blocks before anesthesia induction by himself.

Administration of Block: Midazolam 0.1 mg/kg was given to patients for sedation before administration of any of the two blocks. Philips InnoSight® Ultrasound machine was used to perform the blocks.

In PENG group, the block was performed while patient placed in supine position. Povidone-iodine antiseptic solution was used for skin disinfection through a fenestrated sterile drape that was left to dry. A low-frequency curvilinear ultrasound probe was placed in a longitudinal plane over the ASIS and then aligned with the public ramus by rotating the probe 45°. In this view the ASIS, iliopubic eminence, iliopsoas muscle and tendon were observed. Skin infiltration with 2 ml of 2% lidocaine was done at site of needle insertion. A 20-gauage 80 mm nerve block needle was inserted from lateral to medial at an angle of approximately 45° to 60° depending on the size of the patient, in an in-plane approach to place the tip in the musculofascial plane between the psoas muscle anteriorly and the pubic ramus posteriorly. Once the ostium was contacted, the

needle was rotated to ensure complete penetration through the fascia of the iliopsoas muscle. After negative aspiration, the local anesthetic solution was injected in 5 ml increments while observing for adequate lift and fluid spread in this plane for a total volume of 20 ml of 0.25% Bupivacaine.

In FICB group, the block was administered while patient was in supine position. Povidone-iodine antiseptic solution was used for skin disinfection. Initially, the high frequency linear ultrasonographic probe was placed transversely at the inguinal ligament crease to identify the femoral artery and sartorius muscle by short axis scanning and then the probe was moved cranially to the anterior superior iliac spine level. Rotating the probe 90 to 120° counterclockwise, the external oblique muscle, internal oblique muscle, transverse abdominal muscle aponeurosis, psoas major, and iliac fascia covering the iliac muscle was visualized; the latter was the final probe position. Skin infiltration with 2 ml of 2% lidocaine at site of needle insertion was done. A 20-gauge 80 mm nerve block needle was advanced in an in-plane technique to the point that the fascia iliaca was penetrated. Once tip position security was confirmed, 20 ml of 0.25% Bupivacaine was injected incrementally into the surface of the iliacus muscle and hydro-separation was done.

Post-block assessment

Pinprick sensation test: Thirty minutes after performing the blocks, the block effect was evaluated by a masked investigator with pinprick sensation using the jagged edges of a broken tongue depressor applied to the skin over anterior, medial and lateral aspects of the mid-thigh within sensory distribution of the femoral, obturator and lateral femoral cutaneous nerve. For each territory, blockade was evaluated using a 3-point scale: 0=anesthesia (patient cannot feel touch), 1=analgesia (patient can feel touch, not cold), and 2=no block (normal sensation).

If the three branches of the innervated area were less than or equal to 1 point, the block was considered effective. Block Failure was defined as there was no sensory decrease in either the anterior, medial, or lateral region of the thigh, 50 microgram (mcg) fentanyl was given to the patient and was excluded from the study.

Afterwards assessment of baseline Quadriceps muscle strength was assessed by asking the patients to flex their hip and knee first, then finish knee extension. The outcome assessor gave resistance to the motion of knee extension by opposing knee extension. Quadriceps muscle strength was scored as: 0 point, no muscle contraction, 1 point, muscle contraction but no joint movement, 2 points, joint movement but no gravity resistance, 3 points, gravity resistance, 4 points, gravity resistance, and partial counterforce resistance, and 5 points, normal joint function. The quadriceps strength of the operative leg then was compared to the contralateral leg. If quadriceps strength ≤ 3, it was defined as quadriceps muscle weakness.

The patient was positioned in the sitting position. Povidone-iodine antiseptic solution was used for skin disinfection through a fenestrated sterile drape that was applied on the patient's back. After the preparation solution had dried, a skin wheal was raised at the L3/4 interspaces (alternatively at the L3\4 or L4/5 interspaces) with 2 ml Lidocaine 2% using a small (25-gauge) needle. Then Spinal needle was advanced from skin through the deeper structures, successful dural puncture was confirmed by withdrawing the stylet to verify free flow of Cerebrospinal fluid (CSF). When free flow occurred, 3.5-4 ml 0.5% hyperbaric bupivacaine (according to the calculated dose) was injected. Then the patient lay supine, and the level of the blockade was tested using pinprick sensation test over the next few minutes.

Postoperative recordings and measurements:

The quadriceps muscle strength was assessed at 2, 6, 12, 24, and 48 hours after surgery using the same score used preoperative.

Numerical Rating Scale (NRS): Pain assessments on the operative limb was made at 2, 4, 6 12, 24 and 48 hours postoperatively at rest and during 45-degree passive extension of the knee at 24 and 48 hours postoperative. The NRS is an 11-point scale from 0 (no pain) to 10 (worst pain imaginable) for patient self-reporting of pain. If NRS score ≥5, 5 mg morphine was given to the patient.

Patients' morphine consumption was assessed upon 1st analgesia request and total morphine consumption on postoperative day 1 and 2.

Mobilization ability was assessed with a validated ambulation test, the Timed-Up-and-Go (TUG) test. For the TUG test, patients were asked to stand up from a chair, walk with their assistive devices at a comfortable pace to a 3-meters marked line, then return to the chair, and sit down. Time taken to complete the test was recorded in seconds using a stopwatch on postoperative day 1 and 2.

Block related complications including nausea, vomiting, block failure, hematoma, neuropraxia, local anesthetic systemic toxicity (LAST), venous thrombotic events, femoral nerve and artery puncture, wound complications, falls after surgery and perforation of peritoneal cavity contents and bladder puncture were recorded.

The primary outcome was to compare the effectiveness of Ultrasound-guided PENG and Ultrasound-guided FICB regarding early mobilization. The secondary outcomes were comparison between PENG and FICB regarding their effect on Quadriceps muscle strength, and comparison between PENG and FICB regarding postoperative pain management.

Sample Size Calculation:

Pilot trial sample size calculation was done based on the primary objective of our research to estimate the standard deviation and the mean of the time elapsed till mobilization after spinal placement to be used for the main trial sample size calculation, 12 patients were recruited according to the inclusion criteria and divided to two groups PENG group and FICB randomly to generate the mean and standard deviation of the primary outcome to calculate the sample size of our study. So, by calculation, the sample size was equal to 15 per group, after the addition of a drop-out proportion of 10%.

Statistical analysis

Statistical analysis was done by SPSS v28 (IBM©, Armonk, NY, USA). Shapiro-Wilks test and histograms were used to evaluate the normality of the distribution of data. Quantitative parametric data were presented as mean and standard deviation (SD) and were analysed by unpaired student t-test. Quantitative non-parametric data were presented as the median and interquartile range (IQR) and were analysed by Mann Whitney-test. Qualitative variables were presented as frequency and percentage (%) and analysed using the Chi-square test or Fisher's exact test when appropriate. A two-tailed P value < 0.05 was considered statistically significant.

Results

In this study, 49 patients were assessed for eligibility, 11 patients did not meet the criteria and 8 patients refused to participate in the study. The remaining 30 patients were randomly allocated into two groups (15 patients in each). All allocated patients were followed-up and analysed statistically. **Figure 1**

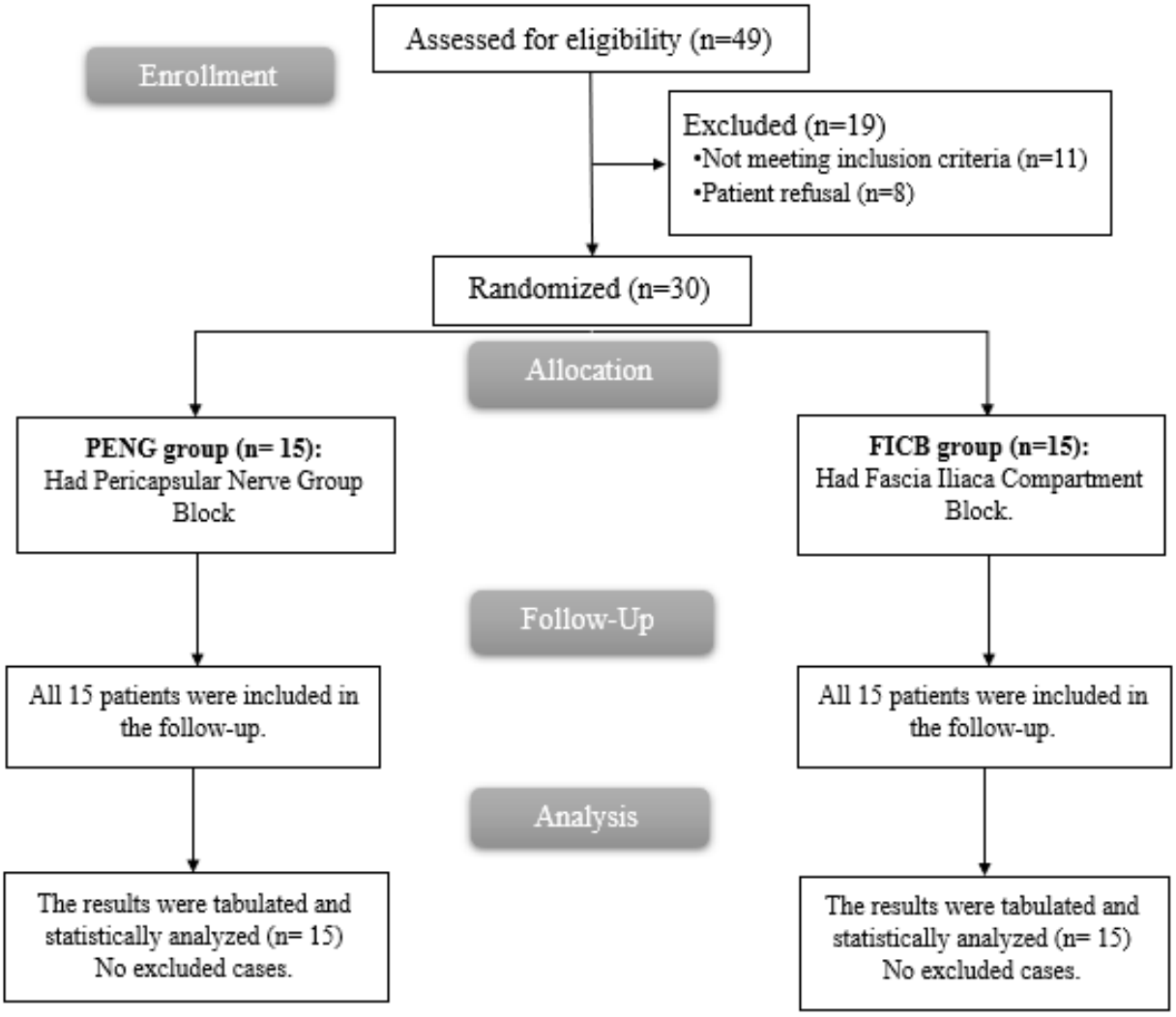

Figure 1: CONSORT flowchart of the studied patients

There was statistically significant difference between the two groups in favour of FICB regarding disappearance of fracture pain. 5 patients of FICB group claimed that they can't feel touch (Anesthesia) 30 minutes post block. Analgesia was achieved in 10 patients of FICB group and in all patients of PENG group (p=0.042). There was no statistically significant difference between both groups regarding age, sex, BMI, ASA score, chronic illness, diagnosis, type of surgery, and block performance time. **Table 1**

Table 1: Comparison between the two studied groups according to age, sex, BMI, ASA score, chronic illness, diagnosis, type of surgery, block performance time, and pinprick sensation score 30 minutes post block. (n = 30)

		PENG (n = 15)	FICB (n = 15)	P Value
Age (years)		68.87 ± 4.45	67.07 ± 4.96	0.304
BMI (kg/m^2)		27.13 ± 2.42	27.47 ± 2.72	0.725
Sex	**Male**	7 (46.7%)	10 (66.7%)	0.269
	Female	8 (53.3%)	5 (33.3%)	
ASA score	**I**	6 (40.0%)	4 (26.7%)	0.450
	II	8 (53.3%)	11 (73.3%)	
	III	1 (6.7%)	0 (0.0%)	
Chronic illness	**DM**	5 (33.3%)	6 (40.0%)	0.705
	HTN	6 (40.0%)	7 (46.7%)	0.713
	CKD	1 (6.7%)	0 (0.0%)	^{FE}p=1.000
	Asthmatic	1 (6.7%)	1 (6.7%)	^{FE}p=1.000
	RA	0 (0.0%)	1 (6.7%)	^{FE}p=1.000
Diagnosis	**Fracture head of femur**	4 (26.7%)	3 (20.0%)	^{FE}p=1.000
	Fracture neck of femur	8 (53.3%)	10 (66.7%)	^{FE}p=0.456
	Osteoarthritis	3 (20.0%)	2 (13.3%)	^{FE}p=1.000
Operations	**Bipolar hip hemiarthroplasty**	11 (73.3%)	12 (80.0%)	^{FE}p=1.000
	THR	4 (26.7%)	3 (20.0%)	
Block performance time (minutes)		11.13 ± 2.29	11.73 ± 1.75	0.428
Pinprick sensation score	**Patient can't feel touch (Anesthesia)**	0 (0.0%)	5 (33.3%)	**0.042***
	Patient can feel touch, not cold (Analgesia)	15 (100.0%)	10 (66.7%)	
	Normal Sensation (No Block)	0 (0.0%)	0 (0.0%)	

Data are presented as mean ± SD or frequency (%). PENG: pericapsular nerve group, FICB: fascia iliaca compartment block, BMI: body mass index, ASA: American society of Anesthesiologists, DM: Diabetes Mellitus, HTN: Hypertensive, CKD: Chronic kidney disease, RA: Rheumatoid Arthritis, THR: Total Hip Replacement, *: significant as P value < 0.05.

Table 2 shows that there was statistically significant difference regarding the quadriceps muscle strength 6 hours postoperative, the elapsed time after spinal anesthesia cessation and mobilization, and time taken to complete TUG test in postoperative day 1 in favour of PENG block (p<0.001). There was no statistical significance between the two blocks in quadriceps muscle strength preoperative, postoperative day 2at 2, 12, 24 and 48 hours, and time taken to complete TUG test in postoperative day 2.

Table 2: Comparison between the two studied groups according to Quadriceps muscle strength score, time elapsed after spinal anesthesia cessation and mobilization,

		PENG (n = 15)	FICB (n = 15)	P Value
Quadriceps muscle strength score				
Pre–operative				
Affected leg	**Mean ± SD.**	1.80 ± 1.66	1.53 ± 1.41	0.775
	Median (IQR)	1.0 (1.0 –1.0)	1.0 (1.0 –1.0)	
Contralateral leg	**Mean ± SD.**	5.0 ± 0.0	5.0 ± 0.0	1.000
	Median (IQR)	5.0 (5.0 – 5.0)	5.0 (5.0 – 5.0)	
Postoperative				
2hr.	**Mean ± SD.**	2.73 ± 0.70	2.43 ± 0.52	0.539
	Median (IQR)	3.0 (2.0 –3.0)	3.0 (2.0 –3.0)	
6hr.	**Mean ± SD.**	5.0 ± 0.0	2.47 ± 0.52	**<0.001***
	Median (IQR)	5.0 (5.0 – 5.0)	2.0 (2.0 – 4.0)	
12hr.	**Mean ± SD.**	5.0 ± 0.0	5.0 ± 0.0	1.000
	Median (IQR)	5.0 (5.0 – 5.0)	5.0 (5.0 – 5.0)	
24hr.	**Mean ± SD.**	5.0 ± 0.0	5.0 ± 0.0	1.000
	Median (IQR)	5.0 (5.0 – 5.0)	5.0 (5.0 – 5.0)	
48hr.	**Mean ± SD.**	5.0 ± 0.0	5.0 ± 0.0	1.000
	Median (IQR)	5.0 (5.0 – 5.0)	5.0 (5.0 – 5.0)	
Time elapsed after spinal anesthesia cessation and mobilization (hours)		2.50 ± 0.46	4.83 ± 0.49	**<0.001***
Time taken to complete TUG test (sec.)				
Postoperative day 1		20.20 ± 2.54	23.60 ± 1.96	**<0.001***
Postoperative day 2		17.33 ± 2.23	18.73 ± 1.79	0.068

Data are presented as mean ± SD, median, or frequency (%). PENG: pericapsular nerve group, FICB: fascia iliaca compartment block, IQR: interquartile range, *: significant as P value < 0.05.

Table 3 shows statistically significant difference in the NRS at rest, and NRS during passive knee extension in favour of PENG block at 12 hours (p=0.001), while there was no statistically significant difference in NRS at rest, and NRS during passive knee extension at 2, 4, 6, 24 and 48 hours postoperative.

Table 3: Comparison between the two studied groups according to NRS at rest, NRS during passive knee extension, time of 1st analgesia request postoperative, and analgesic consumption

		PENG (n = 15)	FICB (n = 15)	P Value
NRS (at rest)				
2hr.	**Mean ± SD.**	0.40 ± 0.51	0.40 ± 0.51	1.000
	Median (IQR)	0.0 (0.0 – 1.0)	0.0 (0.0 – 1.0)	
4hr.	**Mean ± SD.**	1.0 ± 0.76	0.53 ± 0.52	0.116
	Median (IQR)	1.0 (0.50 – 1.50)	1.0 (0.0 – 1.0)	
6hr.	**Mean ± SD.**	1.13 ± 0.83	0.73 ± 0.46	0.233
	Median (IQR)	1.0 (1.0 – 1.50)	1.0 (0.50 – 1.0)	
12hr.	**Mean ± SD.**	3.27 ± 1.58	5.53 ± 1.25	**0.001***
	Median (IQR)	4.0 (2.0–5.0)	5.0 (5.0–6.50)	
24hr.	**Mean ± SD.**	7.27 ± 1.03	7.67 ± 0.98	0.217
	Median (IQR)	7.0 (7.0–8.0)	8.0 (7.0–8.0)	
48hr.	**Mean ± SD.**	6.13 ± 0.74	6.27 ± 0.88	0.744
	Median (IQR)	5.0 (5.0–6.0)	6.0 (6.0–7.0)	
NRS during passive knee extension				
2hr.	**Mean ± SD.**	2.27 ± 0.59	1.80 ± 0.68	0.089
	Median (IQR)	2.0 (2.0–3.0)	2.0 (1.0–2.0)	
4hr.	**Mean ± SD.**	2.67 ± 0.49	2.47 ± 0.64	0.486
	Median (IQR)	3.0 (2.0–3.0)	3.0 (2.0–3.0)	
6hr.	**Mean ± SD.**	2.80 ± 0.56	2.27 ± 0.88	0.089
	Median (IQR)	3.0 (2.50–3.0)	2.0 (2.0–3.0)	
12hr.	**Mean ± SD.**	6.27 ± 1.10	7.60 ± 0.74	**0.001***
	Median (IQR)	6.0 (6.0–7.0)	8.0 (7.0–8.0)	
24hr.	**Mean ± SD.**	8.27 ± 0.88	8.73 ± 1.16	0.250
	Median (IQR)	8.0 (8.0–9.0)	9.0 (8.0–10.0)	
48hr.	**Mean ± SD.**	7.27 ± 0.88	7.87 ± 1.06	0.116
	Median (IQR)	7.0 (7.0–8.0)	8.0 (7.0–9.0)	
Time of 1st analgesia request postoperative (hours)		11.83 ± 0.45	9.57 ± 0.46	**<0.001***
Morphine consumption (in mg)				
Postoperative day 1		3.60 ± 0.76	4.47 ± 1.19	**0.021***
Postoperative day 2		8.47 ± 1.36	8.33 ± 1.72	0.815

Data are presented as mean ± SD, median, or frequency (%). PENG: pericapsular nerve group, FICB: fascia iliaca compartment block, NRS: Numerical Rating Scale, IQR: interquartile range, *: significant as P value < 0.05.

There were no significant differences between both groups regarding complications, as 4 out of 15 patients (26.7%) had complications in PENG group and 6 out of 15 patients (40%) had

complications in FICB group. 4 of the 15 patients in PENG group had nausea and only 2 vomited, while 4 of the 15 patients in the FICB group had nausea and 5 vomited. **Table 4**

	PENG (n = 15)	FICB (n = 15)	P Value
Presence of complications	4 (26.7%)	6 (40.0%)	0.439
Nausea	4 (26.7%)	5 (33.3%)	^{FE}p=1.000
Vomiting	2 (13.3%)	5 (33.3%)	^{FE}p=1.000

Data are presented as mean ± SD, median, or frequency (%). PENG: pericapsular nerve group, FICB: fascia iliaca compartment block.

Discussion

PENG block is a relatively new peripheral nerve block used for postoperative analgesia for hip surgeries. In the PENG block, only the articular branches of the femoral nerve, obturator nerve, and accessory obturator nerve supplying the anterior hip capsule, are blocked [10].

The current study reported that the mean age of patients in the PENG group was 68.87 ± 4.45, meanwhile, in the FICB group, the mean age was 67.07 ± 4.96. Preoperative characteristics (age, gender, ASA, BMI, co-morbidities) were comparable in both groups. The majority of patients recruited for both study groups had fracture neck of femur. Surgical characteristics and diagnosis in each group were also comparable where 73.3% of the patients in the PENG group had bipolar hemiarthroplasty and 26.7% had THR. In the FICB group, 80% had bipolar hemiarthroplasty and 20% had THR.

Aliste et al., [11] defined block performance time as the temporal interval between the start of skin disinfection and the end of LA injection through the block needle.

Our Study showed that the mean time taken for block performance was 11.13 ± 2.29 minutes for PENG block and 11.73 ± 1.75 minutes for FICB. That duration was longer than the duration of block performance found by ***Keskes et al., [12]*** (4.32 ± 0.98 min for the PENG group and 4.2 ± 1.42 min for the FICB group). ***Chung et al., [13]*** found that the mean time taken for PENG block

performance is 5.04 ± 0.89 minutes. This difference might be due to the level of experience of the block performer.

In our study, we tested the 2 blocks using the pinprick sensation test. Compared with FICB, PENG block was associated with decreased sensory block of the anterior and medial thighs, which was consistent with what ***Aliste et al.,*** [11] and ***Chung et al.,*** ***[13]*** found.

Patients involved in our study were mobilized early postoperative after cessation of spinal anesthesia and approval of the orthopedic surgeon and under his supervision. Patients in the PENG group were mobilized before patients in the FICB group with a mean of 2.50 ± 0.46 hours in the PENG group versus a mean of 4.83 ± 0.49 hours in the FICB group with (P< 0.001). Those findings are consistent with what ***Liang et al.,*** ***[14]*** found, where the time to first walk in the PENG + lateral femoral cutaneous nerve group was 8 hours earlier than that in the FICB group (19.6 ± 9.6 hours vs 26.5 ± 8.2 hours, P < 0.01). The authors observed that the decision of the surgeons and the intention of the patient greatly interfered with the results.

The preservation of quadriceps muscle strength is beneficial for early restoration of daily function, as well as for minimizing the risk of falls during postoperative exercises. As revealed in our study, there was no statistical significance between the two groups in the quadriceps muscle strength preoperative in the affected leg (*p=0.775*), or at 2, 12, 24, and 48 hours postoperative (*P= 0.539, 1.000, 1.000, 1,000 respectively*). The only difference found was on 6 hours postoperative in quadriceps muscle strength in favor of PENG block with a mean score of 5.0 ± 0.0 versus 2.47 ± 0.52 for fascia iliaca block (*p< 0.001).*

This might be due to the effect of spinal anesthesia at 2 hours postoperative may persist, causing motor power weakness or block while on 12, 24, and 48 hours postoperative the local anesthetic effect used has resulted in normal muscle power.

Vamshi et al., [15] stated that PENG block had a lower incidence of quadriceps motor weakness than FICB.

On the other hand, ***Choi et al.,*** [16] detected no difference in quadriceps muscle strength between the PENG and FICB groups. In their study, they used a dynamometer to accurately quantify the quadriceps muscle strength. Our hospital could not provide a dynamometer due to the need for costly or specialized equipment, limited muscle groups that can be tested, and limited testing equipment available to us. Instead, we measured the quadriceps muscle strength by The Medical Research Council Manual Muscle Testing method. Although it is very common, easy to perform, and does not require any specialized equipment, it also has its limitations.

TUG test results were in favor of the PENG block on postoperative day 1 with a mean of 20.20 ± 2.54 seconds and a mean of 23.60 ± 1.96 seconds for FICB ($P<0.001$). The time taken to complete the TUG test on postoperative day 2 in the two groups was comparable. Those results are consistent with results found by ***Carella et al.,*** [17]. They stated that the PENG block is superior to FICB regarding early walking ability.

Aliste et al., [11] disagreed with our findings, as there was no statistically significant difference between PENG and FICB concerning the ability to perform physiotherapy on postoperative day 1 or 2 either due to motor blockade or pain. This might be due to two factors. First, the ability to perform physiotherapy was a secondary objective thus, the study may have been underpowered to detect significant differences in this outcome. More importantly, the first session of physiotherapy only which was 24 hours post operative may have been inadequate to fully reap the motor-sparing benefits of PENG blocks.

We compared the effectiveness of PENG block and FICB regarding postoperative NRS at rest and on passive knee extension on 2nd, 4th, 6th, 12th, 24th and 48th hour postoperative.

In ***Jadon et al.,*** [18], NRS scores were assessed and recorded at rest and on movement at 4, 6, 12, and 24 hours in both groups. The NRS scores at rest and on movement were comparable except at 12 and 24 hours where the PENG group scored less scores in pain than FICB.

Our study found that the difference in postoperative static and dynamic postoperative pain scores between the two groups was only statistically significant at 12 hours post-operative ($p=0.001$). this might be due to the duration of the block, as was concluded from the 1st time of analgesia request in our study where the PENG block lasted longer than the FICB (with mean 11.83 ± 0.45 hours and 9.57 ± 0.46 hours respectively, $p<0.001$). The pain scores findings are consistent with what ***Daun et al.,*** [19]***, Keskes et al.,*** [12] ***and Liang et al.,*** [14] found.

Raiger et al. [20] found that time of 1st analgesia request in FICB group receiving 30 ml bupivacaine 0.25% was 845.33 ± 379.997 minutes (14 ± 6.3 hours) compared to 9.57 ± 0.46 hours in FICB group in our study, where we used 20 ml bupivacaine 0.25%.

Age-related physiologic changes in the central and peripheral nervous systems may have a direct effect on the clinical duration of peripheral nerve blocks. Clinically, this was supported by ***Paqueron et al.*** [21]***,*** who compared the duration of a brachial plexus block using a small volume of 0.75% ropivacaine in older (mean age, 77 year) and younger (mean age, 39 yeaer) populations and reported that the duration of complete motor and sensory block was approximately 2.5 times longer in the older group.

The analgesic consumption in the PENG group was less than in FICB with a mean of 3.60 ± 0.76 mg morphine for the PENG group and 4.47 ± 1.19 mg morphine for the FICB group in postoperative day 1 ($p=0.021$). ***Mosaffa et al.,*** [22] agreed with our findings on postoperative day 1, as the total dose of morphine consumption during 24 hours was significantly reduced in the PENG block compared with the FICB group ($p = 0.008$).

This may be because they are using FICB with a supra-inguinal approach and we are using an infra-inguinal approach. The supra-inguinal technique (S-FICB) blocks the three nerves more consistently than the infra-inguinal technique [18].

On postoperative day 2, there is no difference in opioid consumption between the two groups as the effect of the two blocks has worn off. And this finding is consistent with what **Daun et al., [19]**, ***Liang et al., [14]*** and ***Keskes et al., [12]*** found.

Complications related to nerve blocking such as local anesthetic systemic toxicity, nerve injury, hematoma, infection, and deep venous thrombosis of lower extremities were not reported in the two groups. We did not detect significant differences in the incidences of postoperative nausea and vomiting between the two groups. These findings are consistent with ***Aliste et al.,*** [11], ***Choi et al., [16]***, ***Chung et al., [13]***, ***Kong et al., [23]***, ***Natrajan et al.,[24]***, ***Vamshi et al., [15]***, ***Daun et al., [19]*** and ***Liang et al., [14]*.**

We Recommended that future studies must be planned with adequate sample size and more accurate assessment of Quadriceps motor power, having the same surgeon operating on all patients is important, as different surgeons may have slightly different intraoperative techniques and approaches, as well as postoperative recovery strategies, which could have resulted in variability in the outcomes, and different volumes and concentrations of local anesthetics used in PENG block and FICB should be compared in the upcoming studies.

Limitations: The lateral femoral cutaneous nerve that innervates the lateral side of thigh (Common area of hip surgeries incision) wasn't covered in PENG block. However, the use of morphine may have masked this insufficiency. We chose 20 ml 0.25% Bupivacaine for FICB to avoid motor branches block in for better assessment of quadriceps motor power and early mobilization, However, it affected the block's analgesic effect and duration. The decisions made by the

surgeons affect the postoperative outcomes. Surgeons sometimes require patients to stay in bed or perform rehabilitation exercises only in bed for the first 24 h after surgery due to concerns that early walking may lead to hip dislocation or affect the surgical outcome. Also, the first postoperative walk must be supervised by an orthopedic surgeon. This may result in differences between the time when orthopedic doctors arrive at the ward to guide patients to walk and the time when patients can walk.

Conclusions

PENG block is more effective than FICB in shortening the time to first postoperative walk and preservation of Quadriceps muscle power after hip surgeries while providing comparable but longer postoperative analgesia with reduced opioid consumption, which makes it the block of choice to enhanced recovery programs following hip surgeries.

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