Ultrasound-Guided Quadratus Lumborum plain Block versus Fascia Iliaca Block for Postoperative Pain Relief in patients undergoing Hip Surgery under spinal anesthesia: Randomized Comparative Study

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Abstract

Background: After hip surgery, effective pain management boosts patient satisfaction, enables faster mobilization, reduces the need for pain medications, and improves outcomes.

Objectives: This research compared the analgesic benefits of fascia iliaca block (FIB) to quadratus lumborum block (QLB) performed on individuals scheduled for hip surgery.

Patients and methods: this prospective, randomized, double-blind, controlled study conducted on 60 cases of both sexes, aged from 18 to 70 years old undergoing hip surgery in Minia university hospital. Patients were divided into three groups: group A had a single-shot preoperative QLB, group B received a single-shot preoperative FIB, and group C received no preoperative block at all (Control group). Spinal anesthesia was given to all patients. Our primary finding was the evaluation of the cumulative postoperative analgesic requirement in 24 hours. Our secondary results were the time to the first analgesic request, postoperative VAS, qudricepes power and block-related complications.

Results: in comparison to the FIB group, patients getting a QLB had substantial increase in the first analgesic request time 6.4±2.2 and 6.8±3.2 h respectively ($p=0.05^*$), reduced total opioid needs 8.3±2.4 and 6.7±2.7 mg respectively ($p=0.01^*$), and better qudricepes motor power at 2h ($p=0.006^*$) and considerably lower VAS at 2h ($p<0.001^*$) and 4h ($p=0.5^*$) with no significant side effect.

Conclusion: The use of both QLB and FIB was efficient and safe for postoperative analgesia. Both lowered the score VAS, although QLB had a significantly longer analgesic duration and less opioid consumption than FIB and revealed better quadriceps motor power.

Keywords: Total hip replacement; Postoperative pain; Fascia iliaca block; Quadratus lumborum block.

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Introduction

Following surgery on the hip, adequate pain management is associated with higher patient satisfaction, quicker recovery, fewer requests for medication of pain, and enhanced overall results (**Green et al., 2018; Kukreja et al., 2019**). Despite this, managing pain after hip surgery can be challenging. The superior gluteal, obturator, sciatic, femoral, and quadratus femoris nerves all contribute to the hip joint's sensory innervation (**Shin et al., 2018**).

Regional anesthetics with pre- or postoperative nerve blocks have grown increasingly and became widespread in orthopedic surgeries in recent years. Hip surgery is regularly done with the utilization of fascia iliaca, lumbar plexus, and blocked femoral nerves (**Ward et al., 2012; Xing et al., 2015**). QLB is described as local anesthetics injected into the thoracolumbar fascia around the QL muscle and disseminated across the paravertebral region as far cephalic as T6 and caudal as L3 (**Blackwell et al., 2021**).

The FIB, which includes injecting local anesthetics to the side of the femoral arteries and behind the fascia iliaca, was first described in 1989. According to reports, it anesthetizes the lateral cutaneous, femoral, and obturator nerves (**Hebbard et al., 2011**).

Patients and methods

After approval from the Minia University Hospital's institutional ethics committee (160/2021), registration in the clinical trial no; NCT05920265 and the patients' signed informed consent. This research included 60 male and female patients undergoing hip surgery between February 2021 and September 2022, ranging in age from 18 to 70 ASA class I to II.

Exclusion criteria: Patient rejection (refusing the block technique), mental illness, coagulation deficiencies and/or bleeding issues, allergies to medications under investigation, infection at the block site, patients addicted to opioids. Patients who had undergone general anesthesia were excluded and replaced.

Sample population: Prior to the experiment, a power calculation using data from the Pilot study was used to establish the number of individuals needed in each group (6 patients within each division). Using G Power 9.2 software, it was determined that a sample size of 20 people per group would provide 80% power for a one-way ANOVA test at the 0.05 significance level.

Patients' Grouping: Utilizing a computer-generated table, the division of the patients was performed into three parallel, equal groups in random manner, each with 20 patients. Each patient received a random ID when they were admitted to the unit. The closed envelope approach was used to perform simple randomization in the operating room to choose which group the patient would be appointed to. All patient information on the ward was gathered postoperatively using the random ID provided to each participant.

Preoperative management: The patient had a thorough general examination to look for any CNS, chest, heart, or abdominal anomalies. In order to look for any medical conditions, therapeutic anticoagulants, allergy or addiction histories, a thorough medical history was obtained from the patient. The full range of laboratory tests, including a

coagulation profile, complete blood count, liver function tests, serum electrolyte levels, and renal function tests, were done. A spine abnormality or disorder at the block location was checked on the back. Using a 10-point linear visual analog scale (VAS), **(Fig.1),** which is scored from 0 to 10 (where 0 represents no pain and 10 denotes the most severe pain), we demonstrated to the cases how to assess the degree of their own postoperative discomfort. The VAS score is calculated by measuring the distance (mm) on the 10-cm line between the cases mark and the anchor of "no pain" using a ruler.

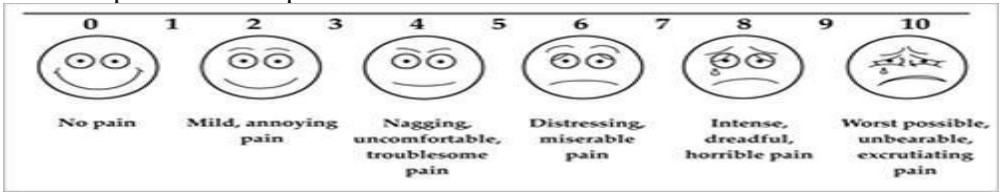

Fig.1. Visual Analogue Scale.

Anesthetic management: As each patient entered the operating room, they were all monitored using basic anesthetic monitor including pulse oximetry, non-invasive arterial blood pressure monitoring, and a five-lead ECG. The patients received 250 ml fluid loading using a 20-gauge IV cannula and 0.9 percent normal saline before receiving spinal anesthesia. Sterilization was done and a subarachnoid injection was then administered utilizing a midline approach with a 25-gauge needle at level L3-4 or L4-5 interspace. After that, 3ml (15mg) of hyperbaric bupivacaine was injected. After the spinal anesthesia was provided, stabilizing the patient's hemodynamics was done.

All patients received Paracetamol (1 gram IV every 6 hours) as postoperative analgesia and when VAS≥4 patients received i.v nalbuphine 0.1 mg/kg as a rescue analgesia with minimum 6 hours between rescue analgesia request, and the first time to rescue analgesia and total analgesic consumption were recorded.

Quadratus lumborum block group: The transverse process (TP) of L4 is where the QL muscle is located, and it is viewed as a superior leaf of the Shamrock.

The patient is placed in the lateral decubitus position for the Single-shot, ultrasound-guided posterior QLB, which was performed with a low frequency curvilinear probe (transducer, 60N multi-frequency, 5-2 MHz). When the probe was positioned in the mid-axillary line, directly above the iliac crest, the "Shamrock sign" became clearly visible. The QL muscle serves as the superior leaf, at the summit of L4's transverse process. The posterior leaf is made up of the erector spinae muscles, the anterior leaf is made up of the psoas major (PM) muscle, and the transverse process is the stem that connects the three leaves **(Fig.2).** An insertion of a 22 mm gauge German-made spinal needle was inserted from the probe's posterior end into muscle of QL directed to the fascial plane separating the PM and QL muscles, after correct location of the needle and repeated negative aspiration of blood, 20 to 30 ml of LA were delivered. After the QL block, the surgical intervention started 15 minutes later (**Et and Korkusuz , 2023).**

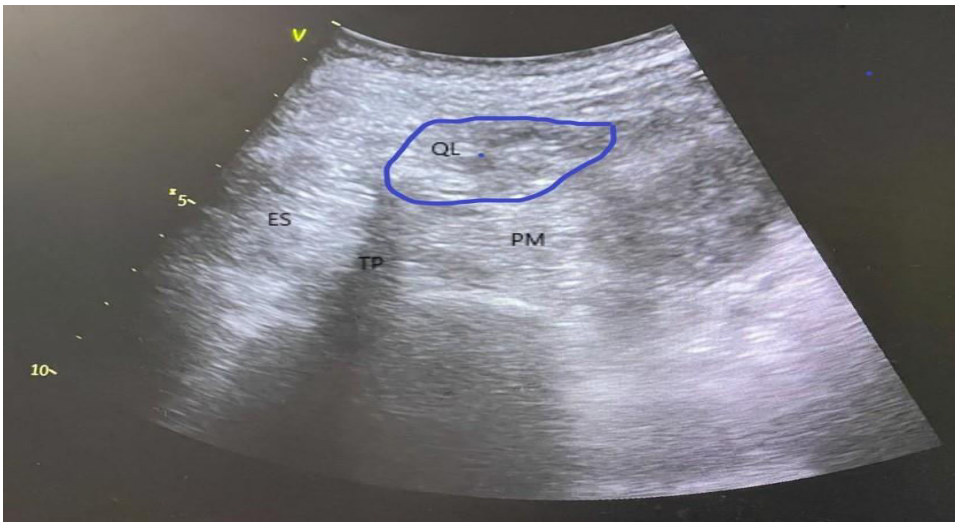

Fig.2.Ultrasound image of QLB (shamrock sign). QL: quadratus lumborum muscle ES: erector spinae muscle; TP: transverse process; PS: psoas muscle

Fascia iliaca block group: Following spinal anesthesia, in sterile conditions, prior to the surgical operation, while the patient is supine, the femoral artery at the inguinal crease is located by transversely inserting a high-frequency (6–14 MHz) linear probe. The iliopsoas muscle and its underlying fascia iliaca are also identified, and the hyperechoic femoral nerve is visualized. The femoral nerve is usually located 2-4 cm deep, lateral to the femoral artery, between the iliopsoas and fascia iliaca **(Fig.3).**

The probe can be tilted caudally or cranially to provide the clearest images of the femoral nerve and fascia iliaca.

When the probe is moved laterally, the anterior superior iliac spine and the triangle-shaped sartorius muscle are visible. After skin disinfection and LA infiltration, an in-plane technique is used to insert a 50- to 100-mm 22G blunt-ended echogenic needle, advancing the needle's tip to beneath the fascia iliaca around the lateral third of a line between the anterior superior iliac spine and pubic tubercle.

Aspiration was done before administering 1-2 milliliters of local anesthetic to detect the separation of the fascia iliaca from the iliopsoas muscle, with LA spreading medially towards the femoral nerve and laterally towards the iliac crest, this confirms correct needle placement to promote optimum distribution, volumes of 20 – 30 ml that assure adherence to acceptable dosage limits for the LA are frequently employed (**Abd Elmaksoud et al., 2022)**.

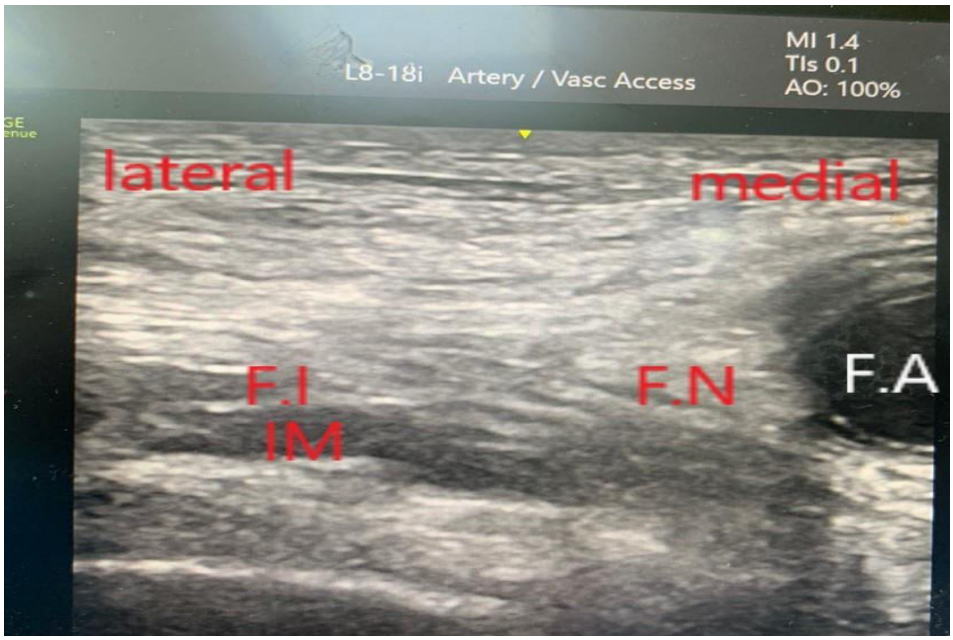

Fig.3. Outlines of fascia iliaca compartment. FA: femoral artery FN: femoral nerve ; FI: fascia iliaca; IM: iliacus muscle

Parameters assessed

Primary Outcome: Our primary outcome was the cumulative post-operative analgesic requirement in the first 24 hours.

Secondary outcomes: VAS within 1, 2, 4, 6, 8, 12-, 16-, 20-, and 24-hours following surgery. The time for initial analgesics request. Quadreceps power (grade 0: normal muscle power, grade 1: motor weakness, grade 3: complete motor paralysis). Any complication from the procedure was documented in the form of hematoma formation or damage to the underlying structures, post-operative vomiting and nausea, Hypotension and bradycardia as well as any other complications.

Statistical analysis

Coding, tabulating, and the statistical package for social sciences (SPSS) version 25 program, were used to analyze the data that had been gathered. For parametric quantitative data, descriptive statistics were calculated using the range's minimum, maximum, standard deviation, and mean; for non-parametric quantitative data, they were calculated using the median and interquartile range; and for categorical data, they were calculated using the number and percentage. Analyses were conducted using the One Way ANOVA test, Post Hoc Tukey correction, and Kruskal Wallis test for parametric quantitative data between the three groups and the Mann Whitney test for non-parametric quantitative data between the three groups. The test of paired sample T was used to examine parametric quantitative data within each group, the test of Wilcoxon signed rank was used to study non-parametric quantitative data, and the test of Fisher Exact was used to analyze the qualitative data. The significance level was set at (P value 0.05).

Results

66 patients were enrolled in this study. 4 patients were refused to participate, and 2 patients had coagulopathy. 60 patients were randomly allocated into three parallel equal groups (QLB group, FIB group and control group) **(Fig.4).**

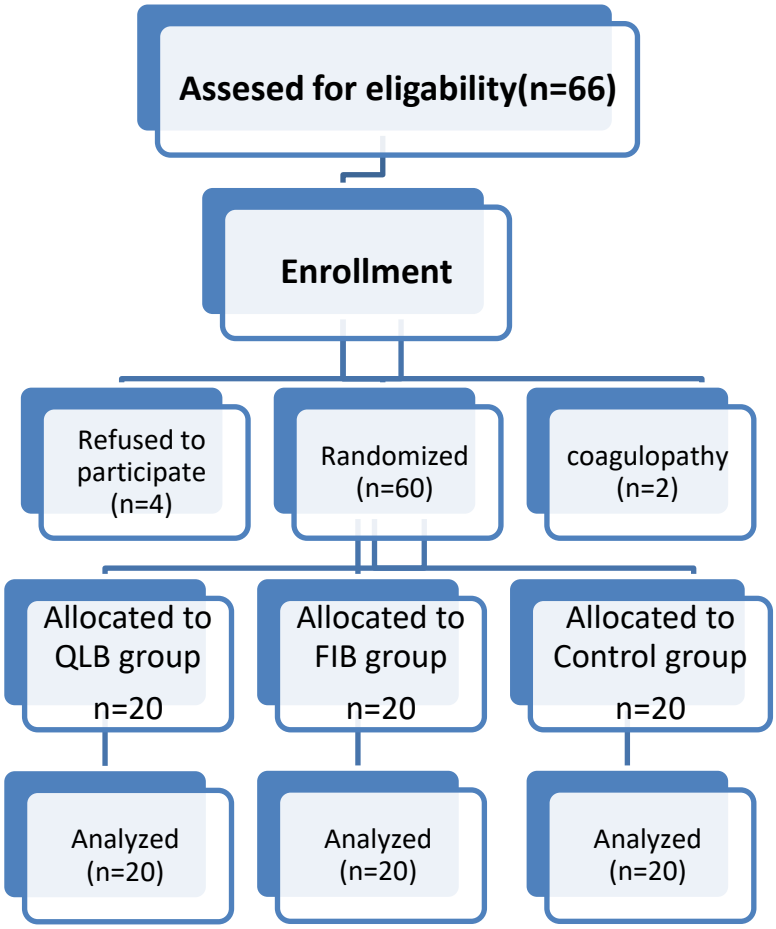

Fig.4.Flowchart of the study

Regarding the comparison of age and sex between studied groups, the results were non-statistically significant (P value>0.05) as shown in (**Table .1).**

Table 1. Age, sex and ASA status

Variables	**Group 1 (FIB)**	**Group 2 (Q;B)**	**Group 3 (control)**	**p value**
	(N=20)	**(N=20)**	**(N=20)**	
Age (y) Mean ±SD (Range)	63.8±3.2 (58-69)	63.6±3.3 (57-69)	63.6±3.5 (58-69)	0.98
Sex				
Male	10(50%)	9(45%)	8(40%)	0.81
Female	10(50%)	11(55%)	12(60%)	

Data presented as mean + SD and range or number and percentage

Regarding the intergroup comparison of VAS for pain score among studied cases at PACU, after 1h, 2h, 4h, 6h and 24 hours, the results were statistically significant (p value <0.05).

As median pain score was significantly lower among cases of QLB group and FIB group than control group. However, the QLB group is significantly lower at 2h, and 4h than FIB group.

While there is a non-significant difference between studied groups regarding VAS score after 8h, 12h and 18 hours (p value >0.05)

For intragroup comparison of pain score between different times interval for each group separately, the results were as follow:

For FIB group, there is a significant increase was found in pain score after 1hour and continued till 18h compared to PACU then slight decrease occurred after 24 hours but pain score was still significantly higher compared to PACU (p value <0.05),

For QLB group, there is a significant increase was found in pain score after 1hour and continued till 18h compared to PACU then slight decrease occurred after 24 hours but pain score was still significantly higher compared to PACU (p value <0.05),

For control group, there is a significant increase was found in pain score after 1hour and continued till 24h compared to PACU (p value <0.05) as demonstrated in **(Table.2, Fig.5).**

Table 2. Postoperative VAS

VAS	FIB group (N=20)	QLB group (N=20)	Control group (N=20)	p value		
VAS at PACU				0.002*		
median (IQR)	0(0-1)	0(0-0)	1(0-1)	**P1**	**P2**	**P3**
mean ± SD	0.35±0.48	0.2±0.41	0.8±0.61	0.36	0.01*	0.001*
VAS after 1h				<0.001*		
median (IQR)	1(0-1)#	1(0-1)#	3(2-3)#	**P1**	**P2**	**P3**
mean ± SD	0.85±0.67	0.7±0.65	2.6±0.93	0.60	<0.001*	<0.001*
VAS after 2h				<0.001*		
median (IQR)	2(1-2)#	1(1-2)#	4(3-4.75)#	**P1**	**P2**	**P3**
mean ± SD	1.9±0.85	1.5±0.4	3.8±0.87	<0.001*	<0.001*	<0.001*
VAS after 4h				0.007*		
median (IQR)	2.5(2-4)#	2(1-3)#	3(3-4)#	**P1**	**P2**	**P3**
mean ± SD	2.7±0.97	2.1±0.5	3.2±0.89	0.05*	0.14	0.002*
VAS after 6h				0.003*		
median (IQR)	3.5(2.25-4)#	3(2-4)#	4(4-4.75)#	**P1**	**P2**	**P3**
mean ± SD	3.25±0.85	3.1±0.91	4±0.68	0.64	0.006*	0.001*
VAS after 8h						
median (IQR)	3(2-3)#	2.5(2-3)#	3(2-4)#			
mean ± SD	2.7±0.78	2.7±0.86	3±0.79	0.37		
VAS after 12h						
median (IQR)	3(2.25-4)#	3(3-4)#	3.5(2.5-4)#			
mean ± SD	3.25±0.85	3.2±0.78	3.25±0.96	0.98		
VAS after 18h						
median (IQR)	3(2-4)#	3(2-3.75)#	3(2-3.73)#			
mean ± SD	3±0.79	2.8±0.83	2.8±0.93	0.67		
VAS after 24h				0.002*		
median (IQR)	2(1-2)#	1.5(1-2)#	2(2-3)#	**P1**	**P2**	**P3**
mean ± SD	1.75±0.7	1.65±0.74	2.4±0.50	0.65	0.005*	0.001*
P value	**<0.001***	**<0.001***	**<0.001***			

* p-value considered significant at <0.05, p1=p value between group 1 and II; p2= p value between group 1 and III, p3= p value between group II and III , _# significant; difference with VAS at PACU

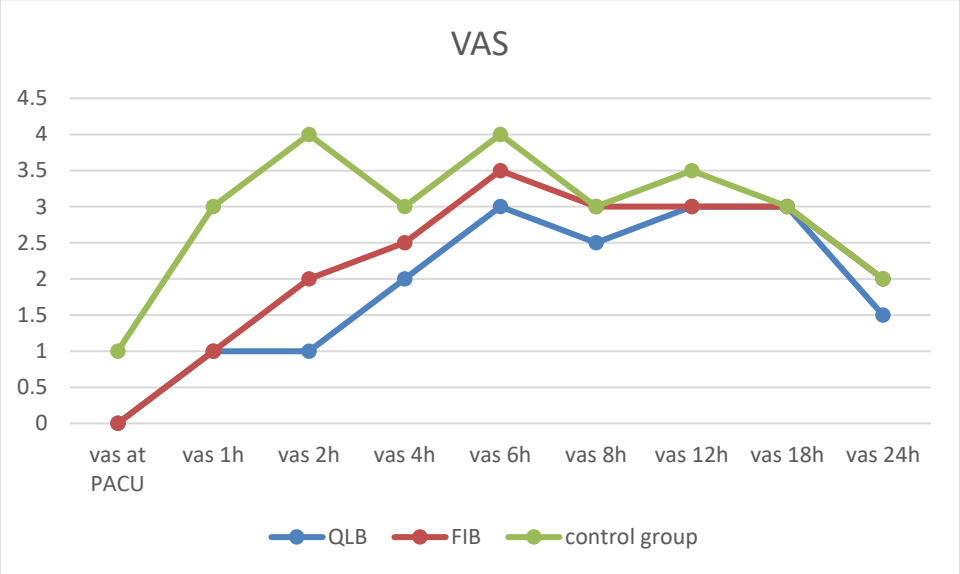

Fig.5. Line chart represent comparison between studied groups regarding median VAS

Regarding the comparison between studied groups regarding Time to first analgesic request (h) and Total nalufin requirement (mg), the results were statistically significant (p value <0.05) as QLB takes longer time to request analgesia than FIB (P=0.05), also QLB consumed less narcotics than FIB group (p0.01) and both were significantly consumed less opioid and had longer analgesic duration than control group as shown in **(Table.3, Fig.6).**

Table 3. The time of first analgesic request and the total analgesic requirement:

Variables	FIB (N=20)	QLB (N=20)	control (N=20)	p value		
Time to first analgesic request (h) Mean ±SD (Range)	6.4±2.2 3-13	8.6±3.2 4-18	2.1±0.9 1-4	<0.001*		
				P1	**P2**	**P3**
				0.05*	<0.001*	<0.001*
Total nalufin requirement (mg) Mean ±SD (Range)	8.3±2.4 3.5-12	6.7±2.7 3.5-13	14.8±3.1 9-21	<0.001*		
				P1	**P2**	**P3**
				0.01*	<0.001*	<0.010*

*p-value considered significant at <0.05, p1=p value between group 1 and II; p2= p value between group 1 and III, p3= p value between group II and III

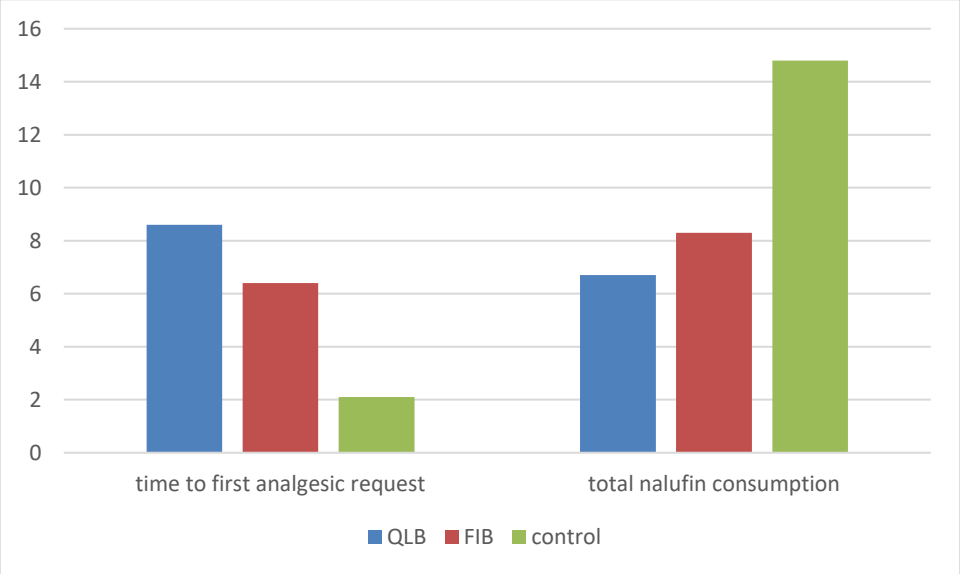

Fig.6. Bar chart represent comparison between studied groups regarding time to first analgesic request (h) and Total nalufin requirement (mg)

Regarding the intergroup comparison of quadriceps power grade among studied cases immediately postoperative, after 4 hours, after 6 hours, after 8 hours and after 12 hours, the results were non-statistically significant (p value >0.05), as 15% among all groups had grade 0 immediately postoperative then increased to 100% in all cases at 8 hours and 12 hours post-operatively

While there is significant difference between studied groups regarding quadriceps power grade 2 hours postoperatively (p value <0.05) as all cases among control group had grade 0 compared to 65% and 60% among QLB and FIB group

For intragroup comparison of quadriceps power grade between different times interval for each group separately, the results were as follow;

For QLB group, there is a significant increase in percentage of cases with grade 0 from 15% immediately post operative to 65% after 2 hours then to 90% after 4 hours, finally to 100% after 6 hours (p value <0.05),

For FIB group, there is a significant increase in percentage of cases with grade 0 from 15% immediately post operative to 60% after 2 hours then to 90% after 6 hours, finally to 100% after 8 hours (p value <0.05),

For control group, here is a significant increase in percentage of cases with grade 0 from 15% immediately post operative to 100% after 2 hours (p value <0.05), as illustrated in (**Table .4).**

Table 4. Comparison between studied groups regarding quadriceps power grade

Quadriceps power grade	(FIB) (N=20)	(QLB) (N=20)	(cont2ol) (N=60)	p value
Immediate postoperative				
grade 0	3(15%)	3(15%)	3(15%)	
Grade 1	4(20%)	6(30%)	7(35%)	0.87
Grade 2	13(65%)	11(55%)	10(50%)	

2 h postoperative grade 0 Grade 1	12(60%) # 8(40%)	13(65%) # 7(35%)	20(100%) # 0(0%)	0.006*
4 h postoperative grade 0 Grade 1	17(85%) # 3(15%)	18(90%) # 2(10%)	20(100%) # 0(0%)	0.21
6 h postoperative grade 0 Grade 1	18(90%) # 2(10%)	20(100%) # 0(0%)	20(100%) # 0(0%)	0.12
8 h postoperative grade 0 Grade 1	20(100%) # 0(0%)	20(100%) # 0(0%)	20(100%) # 0(0%)	----
12 h postoperative grade 0 Grade 1	20(100%) # 0(0%)	20(100%) # 0(0%)	20(100%) # 0(0%)	----
P value	<0.001*	<0.001*	<0.001*	

* p-value considered significant at <0.05; # significant difference with baseline

Regarding the comparison of complications between studied groups, the results were non-statistically significant (P value>0.05). 60% of cases in QLB group had no complication compared to 50% among FIB group and 45% among control group **(Table.5).**

Table 5. Comparison between studied groups regarding complication

Complication	**Group 1 (QLB)**	**Group 2 (FIB)**	**Group 3 (control)**	**p value**
	(N=60)	**(N=60)**	**(N=60)**	
No	12(60%)	10(50%)	9(45%)	
Hypotension	3(15%)	2(10%)	1(5%)	
Bradycardia	0(0%)	1(5%)	2(10%)	
Hypotemsion+bradycardia	2(10%)	2(10%)	2(10%)	0.89
Hypotension +vomiting	1(5%)	3(15%)	3(15%)	
Nausea +vomiting	2(10%)	2(10%)	3(15%)	

Discussion

The current study evaluated the effectiveness of ultrasound-guided FIB versus ultrasound-guided trans-muscular QLB in providing analgesia to patients undergoing hip operations.

As evidenced by a lower VAS score, a delayed request and reduced need for analgesics and a higher level of safety compared to other analgesic techniques, our study suggested that both ultrasound-guided QLB and FIB were effective techniques for reducing post-operative pain following hip surgeries. The group that got QLB was shown to have a longer analgesic duration, less opioid consumption and better quadriceps power. **Mirkheshti et al. (2024)** in line with our result. They compared QLB versus FICB for Acetabular Fracture Surgery. Forty-six patients were randomly allocated into two group: QLB (n=24) and FICB (n=22) scheduled for acetabular fracture surgery under spinal anesthesia. They found that QLB significantly decreased morphine demand in the first 24 h postoperative. While no significant difference regarding visual analogue pain score between the two groups.

Also, **Nassar et al. (2021)** agreed with our results who conducted randomized, double blind, controlled study to investigate the analgesic efficacy and motor block of transmuscular QLB and FICB for patients scheduled hip arthroplasty. They concluded that QLB showed better quadriceps motor power which in line with our result, but FICB demonstrated slightly lower opioid consumption 24 h postoperative this needs further investigation with larger sample size and different volume of local anesthetic.

The results of this research are consistent with those of **Stuart Green et al. (2018)** which included 20 patients having elective total hip arthroplasty surgeries while under general anesthesia. Ultrasonography was used to guide a preoperative transmuscular QLB using 30 cc of 0.5 percent ropivacaine. The length of hospital stays was the main result. The length of the procedure, the use of fentanyl both during and after surgery, and the average postoperative visual analog pain scores were the secondary outcomes. 2.9 days was the average length of stay for individuals who had a QL block vs 5.1 days for those who did not (P value 0.0146). Less fentanyl was utilized intraoperatively by cases receiving a QL block (183.5 mcg) compared to those not receiving a QL block (240 mcg) (P value 0.0376).

Blackwell et al. (2021) examined the impacts on the need for perioperative opioids, subjective pain scores, and time to discharge between single-shot QLB and preoperative femoral nerve and FIB. Retrospective evaluations were performed on 101 individuals. 43 cases had preoperative QL blocks, while 58 cases received preoperative femoral nerve and FIB. The amount of total morphine required by indivaduals with a QL block was significantly decreased (63.1 vs. 87.0, P .001). QLB recipients spent less time in the PACU (Minutes: 116 versus 148, P.001) and reported less subjective discomfort after discharge compared to the other group (3.27 vs 4.98, P .001). When looked at separately, the usage of opioids in the PACU (20.7 vs. 28.7) and intraoperative (42.1 vs. 58.4, P.001) also decreased considerably. The results of their research demonstrated that in terms of reducing pain scores, reduction of the time needed to discharge patients after hip arthroscopy and reduction of perioperative consumption of opioid, the QL block showed more efficiency than femoral nerve and fascia iliaca blocks.

Furthermore, **Abd Elmaksoud et al. (2022)** evaluated postoperative analgesia between anterior QLB and infrainguinal FIB in persons with femoral neck fractures; both blocks were given after the procedure. They discovered that people who received QLB later on experienced reduced VAS pain in the initial postoperative hours, a decreased requirement for analgesics during the first 24 hours and were mobile sooner than those who underwent infrainguinal FIB.

We believe that the improved analgesia provided by QLB was due to its transmuscular mechanism, which has a better impact on the lumbar plexus than FIB.

According to study by **Kukreja et al. (2019)** and **Hebbard et al. (2011)** efficiency in terms of lowering requirements of opioid in the initial 48 hours postoperatively was revealed by both anterior and posterior QL blocks. Two separate experiments were conducted to find this. A comparative study found that following total hip replacement, patients who had a QLB had much shorter hospital stays than those who did not.

However, **Hashmi et al. (2022)** disagree with our result who studied fifty patients scheduled for elective hip surgery. Patients randomly allocated into 2 groups: FICB and QLB. They received 20 ml of 0.25% bupivacaine under US guidance after spinal anesthesia. They concluded that transmuscular QLB didn't decrease morphine consumption or motor weakness when compared to FICB and this may be the lower dose of bupivacaine they used when compared with the dose we used.

Also, in **Brixel et al. (2021**) prospective, randomized, double-blind, placebo-controlled study which included 100 participating cases planned for elective total hip arthroplasty who received injection of a 30-ml shot placed behind the quadratus lumborum back before general anesthesia showed no appreciable difference in their 24-hour total morphine intake. The scores of pains did not differ across the groups. A statistically significant difference was not existent in the intraoperative morphine and sufentanil consumption between the two groups.

A study via **Kinjo et al. (2019)** concluded that QLB did not provide adequate analgesia for femoro-acetabular impingement during hip arthroscopy, comparing 54 patients in the control category with 15 patients who underwent a QLB. They admit that a limitation existed which was their relatively small size of sample in the experimental group and hypothesized that slight modifications in block area might have different effects on the anesthetic's diffusion.

It seems that comparable parts of the disciplines are covered by both QLB and FIB. Studies on cadavers and on people have shown that QLB consistently blocks the superior cluneal, ilioinguinal, iliohypogastric, and lateral femoral cutaneous nerve branches as well as intermittently anesthetizes the lumbar sympathetic trunk, femoral nerve, and obturator (**Carline et al., 2016**).

FIB may result in a continuous sensory block of the lateral femoral cutaneous nerves, obturator, and femoral. When QLB and FIB are combined in high and low ratios, the effects of nerve block from the degree and range of the block are maximized (**Elsharkawy et al., 2019**).

Recommendation: Future research with a much larger sample size is needed for a more comprehensive assessment of their efficacy.

Conclusion

Both QLB and FIB were effective and safe for decreasing postoperative analgesia and the VAS score, although QLB had a longer analgesic duration than FIB, delayed 1st analgesic request time, lower overall analgesia consumption within 24 hours and better quadreceps motor power.

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