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RESEARCH ARTICLE
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Comparative study between three approaches of ultrasound guided quadratus lumborum block for post-operative analgesia in total hip replacement with spinal anaesthesia

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ABSTRACT

Background: Early postoperative ambulation and reduction of hospital stay necessitate efficient postoperative analgesia. Quadrates Lumborum Block (QLB) has been described to provide adequate postoperative analgesia after abdominal surgery.

Objective: compare between different approaches of ultrasound guided quadratus lumborum block for post-operative analgesia in total hip replacement with spinal anaesthesia.

Patients and Methods: This study was conducted in Orthopedic surgery operating unit in Al-Azhar University Hospitals (Al-Hussein and Sayed Galal), and approved by the ethics committee from the Department of Anesthesia of Faculty of Medicine, Al-Azhar University. Patients gave written informed consents. A total of 80 patients undergoing total hip replacement with spinal anesthesia were enrolled in our study. Eligible patients were randomly classified into four groups; 20 patients had received lateral QLB (QLB-1), 20 patients had received posterior QLB (QLB-2), 20 patients had received transmuscular QLB (QLB-3). QL blocks were done using 20 ml of Bupivacaine 0.25 %. The remaining 20 patients had received spinal anaesthesia only (SAB) that served as control group.

Results: The time of requirement of first analgesia significantly prolonged in QLB-3 compared to QLB-1, QLB-2 and SAB control and prolonged in QLB-1 and QLB-2 than SAB control with insignificant differences between QLB1 and QLB-2. The total doses of rescue morphine were significantly lower in QLB-3 compared to QLB-1, QLB-2 and SAB control, and lower in QLB-1 and QLB-2 than SAB control with insignificant differences between QLB1 and QLB-2. VAS was significantly different among the four groups at 2, 12 and 24 hours ($P < 0.001$) but was insignificantly different at PACU and 6 hours. VAS at 2 hours was significantly lower in QLB-3 compared to QLB-1, QLB-2 and SAB Control but with insignificant differences among QLB1, QLB-2 and SAB control group. VAS at 12 and 24 hours were significantly lower in QLB-3 compared to QLB-1, QLB-2 and SAB Control and lower in QLB-1 and QLB-2 than SAB Control with insignificant differences between QLB1 and QLB-2.

Conclusion: Ultrasound guided postsurgical transmuscular approach of QLB (QLB-3) using 20 ml 0.25% bupivacaine produces more postoperative analgesic effect and less postoperative opioid consumption when compared to posterior QLB approach (QLB-2) in patients underwent unilateral inguinal hernia repair under general anesthesia.

Keywords: *Ultrasound-guided quadratus lumborum block; orthopedic lower limb; subarachnoid anesthesia*

INTRODUCTION

The ideal peripheral nerve block technique for hip arthroplasty should achieve adequate sensory block without affecting motor function. The sensory afferents of the hip joint arise from several branches of the lumbar plexus. Femoral nerve block, lumbar plexus block, psoas compartment block and fascia iliaca compartment block can be used for post-operative analgesia for patients undergoing hip surgeries. However, the usefulness of peripheral nerve block techniques is not well established yet. (1)

Lumbar plexus block was found to be effective in reducing opioid requirements in hip arthroplasty surgery. However, some studies suggest that the analgesic effect of femoral nerve block or lumbar plexus block after hip arthroplasty is not clearly demonstrated. Their use was not associated with a decrease in post-operative analgesic consumption. (2) Furthermore, the use of lumbar plexus block may be limited by the potential risk of bilateral spread and systemic absorption of local anaesthetics. The use of a femoral catheter also increases the risk of bacterial colonisation and localised infection (3)

Ultrasonographic-guided quadratus lumborum (QL) block has been described as an analgesic technique in abdominal surgeries (lateral or posterior QL block [QLB]). It is performed through the injection of a local anaesthetic mixture between the lateral abdominal layers and QL muscle. After that, several modifications have been made to the nomenclature, owing to modifications in the technique that have made it useful in various surgeries. Studies had demonstrated that the injectate of QLB spreads to the lumbar plexus, and thus, it can induce hip analgesia that enables its use after hip arthroplasty surgery (4)

Aim of the work to compare between different approaches of ultrasound guided quadratus lumborum block for post-operative analgesia in total hip replacement with spinal anaesthesia

PATIENTS AND METHODS

This study was conducted in Orthopedic surgery operating unit from in Al-Azhar University Hospitals (Al-Hussein and Sayed Galal), and approved by the ethics committee from the Department of Anesthesia of Faculty of Medicine, Al-Azhar University. Patients gave written informed consents.

Exclusion criteria

Patient's refusal, patients with severe cardiovascular disease, cerebrovascular insufficiency, coagulation abnormities due to liver, blood diseases or therapeutic anticoagulation, renal or hepatic insufficiency, infection at the injection site or systemic bacteremia, known hypersensitivity to the local anesthetics, preexisting neurological disorder, inability to communicate or cooperate with investigators and chronic pain patients or those receiving chronic pain medications were excluded from the study.

RESULTS

TABLE 1: Patient Characteristics and operative data (N = 80)

	QLB-1 (N = 20)	QLB-2 (N = 20)	QLB-3 (N = 20)	SAB (N=20)	P value
Age, years					
Mean ± SD	55.7 ± 6.6	56.1 ± 5.7	54.8 ± 6.4	55.9 ± 5.5	0.910
Range	50 – 65	50 – 67	50 – 67	50-66	
BMI, kg/m2					
Mean ± SD	30.7 ± 3.1	30.6 ± 3.2	30.6 ± 3.3	29.8±3.2	0.794
Range	24.9 – 34.1	26.8 – 34.3	25.7 – 34.1	24.9– 34.2	
American Society of Anesthesiologists (ASA)					
ASA score (I/II)	8/12	7/13	7/13	8/12	0.213
Comorbidities					
Hypertension	2 (10%)	1 (5%)	2 (10%)	1 (5%)	0.868
Diabetes mellitus	1 (5%)	0 (0%)	1 (5%)	1 (5%)	0.792
Chronic kidney disease	1 (5%)	1 (5%)	0 (0%)	1 (5%)	0.792
Bronchial asthma	2 (10%)	2 (10%)	1 (5%)	1 (5%)	0.868
Duration of Surgery, min					
Mean ± SD	177.2±10.6	167.9± 12.6	170.4±19.6	174.6±15.4	0.207
Range	150 – 198	160 – 190	159 – 198	150-190	

One way ANOVA test/ Chi-square test Data expressed as Mean±SD & number of patient.

Table 1 summarized basic demographic data of the 4 groups, including age, gender, BMI, the American Society of Anesthesiology (ASA) score, and associated comorbidities. No statistically significant difference was found between groups regarding demographic data (P > .05).

TABLE 2: Intra and post-operative heart rate and mean arterial blood pressure monitoring of the studied groups (N = 80)

		QLB-1 (N = 20)		QLB-2 (N = 20)		QLB-3 (N = 20)		SAB (N=20)		ANOVA
Heart rate (beat/min)		Mean	SD	Mean	SD	Mean	SD	Mean	SD	P-value
Baseline		89.2	3.2	89.1	2.5	88.1	2.3	88.3	2.3	0.438
Intra-operative	30 min	82.3	2.2	83.2	2.2	80.1*	3.1	84.1	2.1	<0.0001
	60 min	82.1	1.8	82.3	2.5	80.2*	2.3	84.1	1.6	<0.0001
	90 min	86†	1.1	86.1†	2.7	83.3*	2.1	89.9	1.9	<0.0001
	120 min	86.6†	1.2	86†	1.4	83.1	1.2	89.8	1.3	<0.0001
At recovery		87.2	2.4	87.6	1.8	86.8	1.9	88.1	2.2	0.244
Post-operative	1 hour	87.1	1.4	87.3	1.5	84.6*	2.1	88.9	2.2	<0.0001
	2 hours	89.5†	2.5	90.1†	3.6	87.1*	2.7	93.3	4.3	<0.0001
	6 hours	89.3†	1.4	91.5†	3.2	86.8*	2.3	94.4	4.2	<0.0001
	12 hours	87.4†	1.1	88.3	1.9	85.5*	1.7	89.8	1.9	<0.0001
	18 hours	87.2	2.1	87.4	2.2	84.3*	1.7	88.3	1.9	<0.0001
	24 hours	85.3†	2.8	86.2†	1.9	84.4*	2.1	88.4	1.1	<0.0001
Mean arterial pressure (mmHg)		Mean	SD	Mean	SD	Mean	SD	Mean	SD	P-value
Baseline		96.3	5.3	95.2	4.6	93.1*	4.5	94.4	5.1	0.216
Intra-operative	30 min	89.4	4.4	89.3	4.4	87.2*	5.4	92.2	4.2	0.012
	60 min	88.2	4.1	89.4	4.8	87.3#	4.7	91.1	3.9	0.046

	90 min	94.1	3.5	95.2	5.1	90.4#	4.3	95.7	3.3	<0.0001
	120 min	94.7	3.4	94.1	3.6	90.2	3.3	95.1	3.2	<0.0001
At recovery		93.1	4.5	92.7	3.1	90.1*	4.6	94.2	4.3	0.020
Post-operative	1 hour	94.2	3.1	93.1†	3.2	89.7#	4.1	96.6	4.9	<0.0001
	2 hours	96.6‡	4.6	95.2†	3.7	90.1#	4.9	100.4	4.4	<0.0001
	6 hours	96.4	3.6	96.6†	3.4	91.2#	5.9	101.5	3.4	<0.0001
	12 hours	97.5	3.7	96.4	4.5	91.6*	4.1	100.3	3.5	<0.0001
	18 hours	96.3	4.5	94.5	4.6	91.4	4.2	99.4	4.3	<0.0001
	24 hours	95.4	4.8	94.3	4.4	93.5*	5.3	97.5	3.6	0.041

One-way ANOVA test Data expressed as Mean ± SD
* P < 0.05 Group 4 vs Group 3
#p < 0.05 Group 1,2,4 vs Group 3
† p < 0.05 Group 4 vs Group 2
‡ p < 0.05 Group 4 vs Group 1

TABLE 3: Pain Characteristics and post-operative analgesics (N = 80)

		QLB-1 (N = 20)		QLB-2 (N = 20)		QLB-3 (N = 20)		SAB (N=20)		ANOVA
VAS for Pain		Mean	SD	Mean	SD	Mean	SD	Mean	SD	P-value
At recovery		2.4	0.5	2.6	0.8	2.1	0.4	3.7	0.5	0.244
Post-operative	1 hour	2.6	0.4	2.8	0.5	2.2#	0.3	3.9	0.4	<0.0001
	2 hours	3.5†	0.5	3.1†	3.6	2.4#	0.7	4.3	0.6	<0.0001
	6 hours	4.3†	1.4	4.5†	1.2	3.8#	1.3	5.4	1.7	<0.0001
	12 hours	4.4†	1.1	4.3	1.3	3.5#	1.2	4.8	1.3	<0.0001
	18 hours	3.6	1.3	3.5	1.7	2.4#	1.1	5.3	1.8	<0.0001
	24 hours	3.4†	1.6	3.3†	1.2	2.1#	0.9	4.4	1.2	<0.0001
Time to First Analgesic use		Mean	SD	Mean	SD	Mean	SD	Mean	SD	P-value
Time, hours		3.9‡	0.5	3.6†	0.6	4.5#	0.5	2.1	0.4	<0.0001
Total nalbuphine Use in 6 h Postoperatively		Mean	SD	Mean	SD	Mean	SD	Mean	SD	P-value
Dose (mg)		10.9‡	2.7	11.5†	2.9	8.6#	2.1	13.3	2.9	<0.0001
Total nalbuphine Use 6-24 h Postoperatively		Mean	SD	Mean	SD	Mean	SD	Mean	SD	P-value
Dose (mg)		16.3‡	2.4	16.5†	2.8	13.9#	2.3	20.3	3.6	<0.0001

One-way ANOVA test/ Chi-square test Data expressed as Mean±SD
* P < 0.05 Group 4 vs Group 3
#p < 0.05 Group 1,2,4 vs Group 3
† p < 0.05 Group 4 vs Group 2
‡ p < 0.05 Group 4 vs Group 1

Table 3 showed that monitoring of VAS post-operative revealed significant lower pain scores in patients who had received QLB than those who received SAB. Furthermore, patients who received transmuscular QLB had lower pain scores than those who received lateral, posterior QLB or spinal anesthesia. There is no significant difference between patient who received lateral and posterior QLB.

Time to first analgesic use was significantly longer and the total dose of analgesics were lower in patients who had received QLB than those who received SAB especially those who received transmuscular QLB.

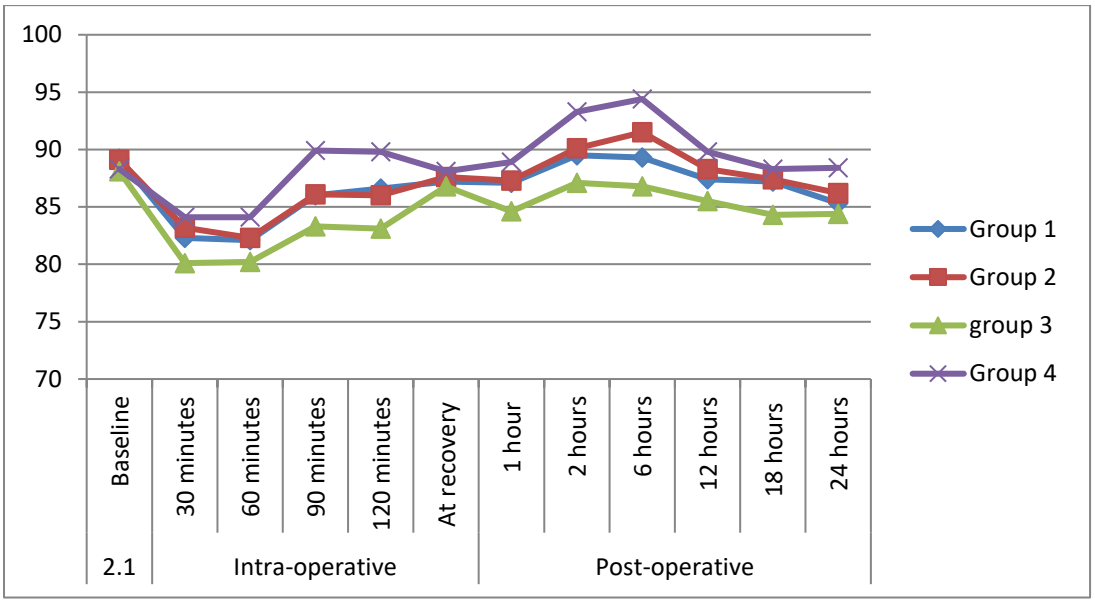

FIGURE 1: intra and post-operative monitor of mean HR among the studied groups

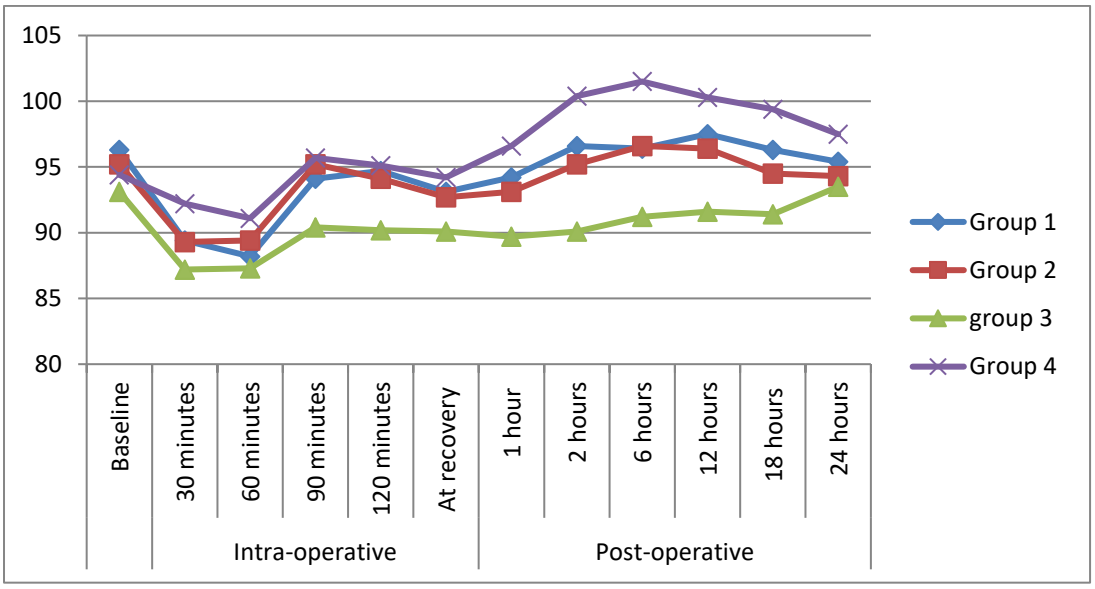

FIGURE 2: intra and post-operative monitor of mean BP among the studied groups

Figures showed that monitoring of heart rate and mean blood pressure both intra-operative and post-operative revealed significant lower HR and MBP in patients had received QLB than those who received SAB. Furthermore, patients who recieved transmuscular QLB had lower HR and MBP than those who received lateral, posterior QLB or spinal anesthesia. There is no significant difference between patient who received lateral and posterior QLB.

DISCUSSION

In our current study showed that regarding demographic data of the 4 groups, including age, gender, BMI, the American Society of Anesthesiology (ASA) score, and associated comorbidities. No statistically significant difference was found between groups regarding demographic data ($P > .05$).

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No statistically significant difference was found between groups regarding demographic data (P > .05).

Our results supported with Abduallah et al. (5) who aimed to assess the effect of transmuscular ultrasound-guided quadratus lumborum (QL) block on post-operative analgesic consumption after hip arthroplasty in elderly patients. The study included 60 patients aged 60–80 years presented for total hip replacement under unilateral spinal anaesthesia. There was no a statistical significance among groups regarding age and BMI.

Our results supported with Abduallah et al. (5) who reported that there was no a statistical significance among groups regarding duration of surgery.

Our results supported with Green et al. (6) who aimed to review the length of stay and perioperative narcotic utilization in patients receiving transmuscular quadratus lumborum blocks for total hip arthroplasty. The study included 20 patients ages 18 to 75. There was no a statistical significance regarding age, ASA and BMI.

Our results supported with Hu et al. (7) who aimed to evaluate the efficacy of ultrasound-guided transmuscular quadratus lumborum block (QLB) combined with local infiltration analgesia (LIA) for pain management and recovery in patients who have undergone total hip arthroplasty (THA) via a posterolateral approach. The study included 80 patients. There was no a statistical significance regarding age and BMI.

In our current study showed that monitoring of heart rate and mean blood pressure both intra-operative and post-operative revealed significant lower HR and MBP in patients had received QLB than those who received SAB. Furthermore, patients who recieved transmuscular QLB had lower HR and MBP than those who received lateral, posterior QLB or spinal anesthesia. There is no significant difference between patient who received lateral and posterior QLB.

Our results supported with Ahmed et al. (8) who aimed to compare the duration of analgesia provided by two different QLB approaches; the posterior QLB (QLB-2) and transmuscular QLB (QLB-3) in patients undergoing surgical repair of unilateral inguinal hernia. The study included forty patients, aged from 18 to 50 years. Patients were randomly assigned into two groups to receive either posterior QLB (Group QLB-2) or transmuscular QLB (Group QLB-3) using 20 ml 0.25% bupivacaine. Duration of block was significantly longer in QLB-3 group when compared to QLB-2 group (20.1 + 6.2 h versus 12.0 + 4.8 respectively) with P value of < 0.001. A statistically significant lower VAS score was recorded in QLB-3 group immediately and 12 h postoperative. QLB-3 group showed a statistically significant delayed time of first analgesic request and less postoperative morphine consumption with P value of < 0.001 and 0.001 respectively

Our results supported with Green et al. (6) evaluated the use of transmuscular QLB in patients undergoing hip surgeries. They concluded that its use decreases the length of hospital stay and intraoperative fentanyl consumption. However, the post-operative pain score lacked statistical significance, which may be due to the use of general anaesthesia in all patients and the small sample size. Length of stay was shorter in patients receiving QL block (2.9 days) versus patients not receiving QL block (5.1 days) with statistical significance (P value 0.0146). Intra-operative use of fentanyl was lower in patients receiving QL block (183.5 mcg) versus patients not receiving QL block (240 mcg) with statistical significance (P value 0.0376)

In our study, Time to requirement of first analgesia prolonged in patients who received QLB-3 compared to those received QLB-1, QLB-2 and patient of SAB, and prolonged in QLB-1 and QLB-2 than SAB control with no differences between QLB1 and QLB-2.

Also, total doses of I.V. nalbuphin was lower in QLB-3 patients compared to patients of QLB-1, QLB-2 and SAB, and lower in QLB-1 and QLB-2 than SAB control with no differences between QLB1 and QLB-2.

Also in our current study showed that monitoring of VAS post-operative revealed significant lower pain scores in patients who had received QLB

than those who received SAB. Furthermore, patients who received transmuscular QLB had lower pain scores than those who received lateral, posterior QLB or spinal anesthesia. There is no significant difference between patient who received lateral and posterior QLB.

He et al. (9) found morphine use was lower in patients who received QLB compared to patients who did not receive QLB during 0–24 h and during 24–48 h.

In accordance to our results, Gutierrez et al. (10) assessed that QLB type 3 (QLB3) produce a non-inferior analgesic effect compared with LPB for primary hip replacement. This double-blinded, non-inferiority trial randomized 46 patients undergoing primary hip replacement to receive either QLB3 or LPB. They found that there were no significant differences between groups in total opioid consumption at 24 hours or in time to achieve 100 feet of walking.

In agreement Hu et al. (11) reported that the results indicated that compared to the non-QL block group, (VAS) score at mobilization in the QL block group demonstrated statistical and clinical significance at all time points (12, 24, and 48 hours), but VAS score at rest failed to reach the MCID (minimal clinically important difference).

In agreement with our finding, Kukreja et al. (12) found that cumulative opioid consumption were significantly lower in the QL patients at 12, 12–24, 24, and 48 hours after surgery as compared with the control patients

In the present study, VAS was different among the four groups at 2, 12 and 24 hours, but was insignificantly different at PACU and 6 hours. VAS at 2 hours was lower in QLB-3 compared to QLB-1, QLB-2 and SAB Control but with no differences among QLB1, QLB-2 and SAB control group. VAS at 12 and 24 hours were lower in QLB-3 compared to QLB-1, QLB-2 and SAB Control and lower in QLB-1 and QLB-2 than SAB Control with differences between QLB1 and QLB-2.

In agreement Hu et al. (11) reported that opioid consumption in the QL block group only demonstrated statistical and clinical significance at 48 hours postoperatively, but did not reach the MCID at 12 or 24 hours postoperatively.

CONCLUSION

Hip joint surgery must be performed with the appropriate anesthetic considerations in mind to ensure patient comfort, appropriate utilization of resources, and improved postoperative course metrics (length of stay, narcotic usage, postoperative complications, etc). There are several peripheral nerve block techniques that can be used for hip surgery, each with their own respective advantages and disadvantages. Ultrasound guided postsurgical transmuscular approach of QLB (QLB-3) using 20 ml 0.25% bupivacaine produces more postoperative analgesic effect and less postoperative opioid consumption when compared to posterior QLB approach (QLB-2) in patients underwent unilateral inguinal hernia repair under general anesthesia.

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