



Original Article



Comparison of Mean Duration of Postoperative Analgesia Following QL2 Block Versus QL3 Block Using Ropivacaine 0.25% In Patients Undergoing Unilateral Inguinal Hernia Repair

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ABSTRACT

Effective postoperative pain management after inguinal hernia repair enhances recovery and reduces opioid use. Among quadratus lumborum block variants, evidence remains uncertain as to whether the posterior (QLB-2) or trans-muscular (QLB-3) approach provides superior analgesia. **Objectives:** To compare the mean duration of postoperative analgesia produced by posterior quadratus lumborum block (QLB-2) and trans-muscular quadratus lumborum block (QLB-3) using 0.25% ropivacaine in patients undergoing unilateral inguinal hernia repair. **Methods:** The randomised controlled trial was conducted in the Department of Anaesthesia at Bahawal Victoria Hospital, Bahawalpur, from July to December 2024. Sixty-four male patients aged 18-50 years who underwent unilateral inguinal hernia repair under general anaesthesia were included and randomly divided into two groups of 32 participants each. Group QLB-2 was given the posterior quadratus lumborum block, and Group QLB-3 was given the trans-muscular approach. Twenty millilitres of 0.25% ropivacaine was applied in both groups under ultrasound guidance. The visual analogue scale (VAS) was used to measure postoperative pain, and the duration of analgesia was defined as the time from entering the recovery room to achieving a VAS score >3. **Results:** The mean time to first analgesic request was significantly longer in QLB-3 (457.7 ± 161.3 min) than in QLB-2 (271.8 ± 94.6 min; p<0.001). Rescue analgesia was required in 40.6% of QLB-3 and 62.5% of QLB-2 patients. **Conclusions:** The trans-muscular quadratus lumborum block provided significantly longer and more effective postoperative analgesia than the posterior approach using 0.25% ropivacaine in unilateral inguinal hernia repair.

INTRODUCTION

The ultrasound-guided quadratus lumborum block (QLB) is a developing regional anaesthetic technique that provides consistent postoperative analgesia during abdominal and pelvic surgery. The procedure was originally described by Blanco and involves the placement of local anaesthetic in the fascial plane adjacent to the quadratus lumborum (QL) muscle. As such, it provides both somatic and visceral

analgesia by diffusing into the thoracolumbar space and subsequently blocking the thoracolumbar nerves. Proper management of postoperative pain in inguinal hernia repair is crucial in early mobilisation and reducing the effects of systemic opioid use that may result in complications [1, 2]. Several variants of QLB have been developed, with the primary difference being the targeted plane of anatomy



and the spread pattern. The lateral (QLB-1) and posterior (QLB-2) methods inject anaesthetic along the lateral or posterior of the QL muscle, but the trans-muscular (QLB-3) method injects the needle through the QL into the interfascial space between the QL and psoas major muscles. It is hypothesised that this increased positioning will increase cephalad drug dispersal and produce a more widespread analgesic effect. This deeper placement potentially enhances cephalad drug spread and produces more extensive analgesia [3-5]. Several randomised trials have compared QLB variants. Ahmed *et al.* reported that QLB-3 produced significantly more prolonged analgesia and lower morphine consumption than QLB-2 using 20 mL of 0.25% bupivacaine in unilateral inguinal hernia repair [6]. Bagbanci *et al.* similarly observed lower VAS scores and decreased fentanyl use in QLB-3 recipients [7]. However, most available evidence originates from international populations, with limited evaluation in local surgical settings.

Although these results exist, most evidence is based on international cohorts; no studies have yet directly compared posterior and transmuscular QLB in hernia repair in Pakistan. Ropivacaine 0.25% was used in the current study, as recommended by institutional practice guidelines and supported by previous evidence indicating its effectiveness in achieving long-term sensory blockade with a favourable safety profile. It was hypothesized that the trans-muscular method (QLB-3) would provide a much longer postoperative analgesia period than the posterior method (QLB-2) in local patients. This study aimed to compare the mean time to postoperative analgesia induced by QLB-2 and QLB-3 after administration of 0.25% ropivacaine in patients undergoing unilateral inguinal hernia repair.

METHODS

The randomised controlled trial was conducted in the Department of Anaesthesia at Bahawal Victoria Hospital in Bahawalpur from July to December 2024, vide letter number:2315/DME/QAMC issued on 14th November 2023 and trial registration number (NCT07200076). The sample size of 64 was calculated with 5% significance and 95% power, based on the mean block durations of 220.1 ± 6 hours (QLB-3) and 12.0 ± 4.8 hours (QLB-2) [6]. All patients were recruited using non-probability consecutive sampling. The random sequence was created by an independent staff member using a lottery system with identical slips of paper. To prevent bias, these slips were kept in sealed, opaque envelopes that were only opened right before the procedure, ensuring the doctors did not know the group assignment beforehand. The inclusion criteria were male patients aged 18-50 years, ASA physical status I-II, and scheduled to undergo unilateral inguinal

hernia repair under general anaesthesia. Strangulated hernia, local infection at the puncture site, hypersensitivity to local anaesthetics, or coagulation abnormality (INR>1.5) were considered as the exclusion criteria. Of 95 patients assessed, 36 were excluded, and 64 were randomized equally to the QLB-2 and QLB-3 groups; all participants in both groups were included in the final analysis (Figure 1).

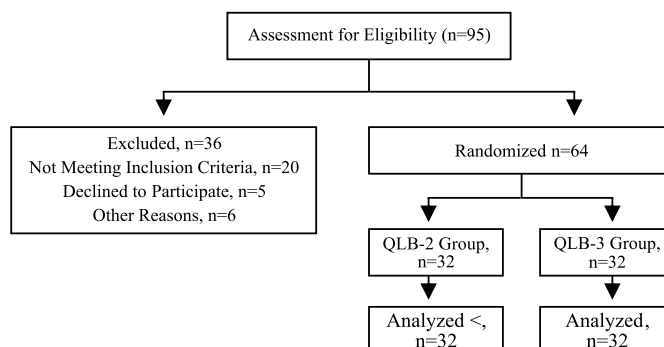


Figure 1: CONSORT Flow Diagram of Patient Enrollment, Randomization, and Analysis

All participants provided written informed consent. Standard premedication of all patients was metoclopramide 10 mg and nalbuphine 0.1mg/kg. Propofol 2 mg/kg and suxamethonium 11.5 mg/kg were used to induce. Nitrous oxide (50% oxygen) was used for anesthesia, supplemented with isoflurane (1-1.5%). Atracurium was used to relax the muscles (0.5mg/kg at the start, 0.1-0.2mg/kg). All blocks were performed by senior anesthesiologists in a sterile setting under ultrasound guidance. To ensure consistency and reduce differences in results, the technique was standardized; every practitioner used the same needle orientation and applied slow, steady injection pressure to achieve a uniform spread of the medicine. In QLB-2, 20 mL of 0.25% ropivacaine was injected into the posterior fascial plane of the QL muscle below the middle thoracolumbar fascia. The needle was placed through the QL, and 20 mL of 0.25% ropivacaine was injected between the QL and the psoas major muscles in QLB-3. Patients were put in a supine position after the block and were extubated after reversal with neostigmine and glycopyrrolate. All patients were monitored indoors and assessed at specific time points (30 minutes, 2, 4, 8, 12, and 24 hours) after surgery. Pain intensity was assessed using the Visual Analogue Scale, a 10-cm horizontal line ranging from 0 (no pain) to 10 (the worst imaginable pain) [6, 7]. The duration of analgesia was defined as the time the patient remained in the recovery room until the VAS reached a set point of 3. To minimize measurement bias, these observations were conducted by an assessor unaware of the block type. Rescue analgesia was defined as the intravenous administration of Tramadol at 1mg/kg immediately after a patient had a VAS score >3. All the data were processed with SPSS version 26.0.

Quantitative variables (age, BMI, duration of analgesia) were reported as mean $\pm$ SD; qualitative variables (ASA status, necessity to resort to rescue) were reported as frequencies and percentages. The means were compared using an independent-samples t-test after checking the normality assumptions, and the categorical associations were evaluated using a chi-square test with a p-value of 0.05 as the significance level. Post-stratification analyses for age, BMI, and ASA groups were pre-specified in the study protocol to ensure the block's efficacy was consistent across different patient characteristics.

RESULTS

The study included 64 patients, equally divided into two groups (32 patients per group). The mean age was 34.2 ± 9.4 years (range: 18-50), and the mean BMI was 22.54 ± 2.78 kg/m². Among all participants, 35 patients (54.7%) were

classified as ASA physical status I, and 29 patients (45.3%) were classified as ASA II. In the QL2 group, 20 patients (62.5%) required rescue analgesia, while 12 patients (37.5%) remained pain-free without additional medication. In the QL3 group, 13 patients (40.6%) required rescue analgesia, while 19 patients (59.4%) did not. The difference in rescue analgesia requirement between the two groups was not statistically significant ($\chi^2=3.065$, $p=0.080$, Cramér's $V=0.080$). The mean time to the first analgesic request was 457.68 ± 161.27 minutes in the QL3 group and 271.78 ± 94.59 minutes in the QL2 group ($p<0.001$). The mean difference of 185.9 minutes (95% CI: 119.83-251.97) indicated a significantly longer analgesic duration with the trans-muscular approach. The trans-muscular method (QL3) always offered a much longer average time to the first analgesic request than the posterior method (QL2) in all age groups and BMI subgroups (Table 1).

Table 1: Comparison of Mean Time to First Analgesic Request (Minutes) Between QL2 (Posterior) and QL3 (Trans-muscular) Groups According to Age, ASA Grade, and BMI Category

Variables	Categories	QL2 (Posterior)	QL3 (Trans-muscular)	t-test results (t, df, p-value)
Age Group	18-30 years	301.65 $\pm$ 75.43	427.37 $\pm$ 181.20	(t=-2.124, df=20, p=0.046)
	31-40 years	236.33 $\pm$ 62.14	500.84 $\pm$ 173.16	(t=-4.769, df=20, p<0.001)
	41-50 years	277.93 $\pm$ 132.44	443.56 $\pm$ 127.12	(t=-2.853, df=18, p=0.011)
Asa Grade	I	294.25 $\pm$ 102.22	433.37 $\pm$ 146.28	(t=-3.315, df=33, p=0.002)
	II	234.34 $\pm$ 68.72	479.14 $\pm$ 174.99	(t=-4.583, df=27, p<0.001)
BMI Category	Normal weight	270.64 $\pm$ 101.44	434.26 $\pm$ 155.63	(t=-4.5777, df=52, p<0.001)
	Overweight	277.98 $\pm$ 48.98	584.16 $\pm$ 142.93	(t=-4.531, df=8, p=0.002)

Although QL3 tended to require less rescue analgesia, these relationships were statistically significant only in specific patient groups, including those aged 31-40 years and those with ASA I status (Table 2).

Table 2: Association Between Patient Characteristics (Age, ASA Grade, And BMI Category) and the Requirement of Rescue Analgesia in QL2 (Posterior) and QL3 (Trans-muscular) Groups

Variables	Category	Rescue Analgesia	QL2 (Posterior)	QL3 (Trans-muscular)	Chi-square test (χ^2 , df, p-value)
Age Group	18-30 years	No	7 (31.8%)	5 (22.7%)	$\chi^2=0.733$, df=1, p=0.392, Cramér's V=0.392
		Yes	4 (18.2%)	6 (27.3%)	
	31-40 years	No	2 (9.1%)	7 (31.8%)	$\chi^2=4.701$, df=1
		Yes	9 (40.9%)	4 (18.2%)	
	41-50 years	No	3 (15.0%)	7 (35.0%)	$\chi^2=3.200$, df=1, p=0.074, Cramér's
		Yes	7 (35.0%)	3 (15.0%)	
ASA Grade	I	No	10 (28.6%)	10 (28.6%)	$\chi^2=0.972$, df=1
		Yes	10 (28.6%)	5 (14.3%)	
	II	No	2 (6.9%)	9 (31.0%)	$\chi^2=3.932$, df=1
		Yes	10 (34.5%)	8 (27.6%)	
BMI Category	Normal weight	No	10 (18.5%)	16 (29.6%)	$\chi^2=2.670$, df=1, p=0.102, Cramér's V=0.102
		Yes	17 (31.5%)	11 (20.4%)	
	Overweight	No	2 (20.0%)	3 (30.0%)	$\chi^2=0.400$, df=1, p=0.527, Cramér's V=0.527
		Yes	3 (30.0%)	2 (20.0%)	

DISCUSSION

This study demonstrated that the trans-muscular quadratus lumborum block (QL3) provided significantly more prolonged analgesia than the posterior method (QL2) in patients undergoing unilateral inguinal hernia repair with 0.25% ropivacaine. The analgesic time was approximately 3 hours longer with QL3, demonstrating the superiority of the trans-muscular

technique. Although fewer QL3 patients required rescue analgesia, the difference was not statistically significant, consistent with previous research by Ahmed *et al.* and Bagbanci *et al.* [6, 7]. The increased action of QL3 can be explained by the diffusion of the local anaesthetic between the QL and psoas major muscles, which can be extended to the thoracolumbar space and block thoracolumbar nerves T7-L1 [8]. Conversely, the posterior technique primarily focuses on the lateral branches, providing minimal coverage of the viscera. Similar findings have been documented in several abdominal operations [9]. Caparlar *et al.* found superiority of posterior QL3 over posterior TAP block in hernia surgery [10]. Fouad *et al.* compared the transversalis fascia plane (TFP) block with QL3 and found similar pain scores but more frequent rescue needs with TFP [11]. Mostafa *et al.* reported that QL3 provided longer-lasting pain relief than the ilioinguinal-iliohypogastric block [12]. According to a meta-analysis by Korgvee *et al.* (1,557 patients), QL3 increased the time to first rescue by 189 minutes and decreased 24-hour morphine equivalent consumption by 11 mg [1], which is nearly the same as the difference observed in our study. Similar results were reported by Gao *et al.* who found that analgesic requirements were lower with QL3 than with TAP block [13]. Kumar *et al.* compared various variants of QL3 in adult hernia patients and discovered that the trans-muscular (anterior) technique resulted in the lowest 24-hour fentanyl use and pain scores [8]. Paediatric research by El Malla *et al.* and Altinay *et al.* has demonstrated that deeper fascial injections result in longer analgesia and lower pain scores [14, 15]. Abdelbaser *et al.* reported similar effectiveness of the lateral QL3 and TFP blocks in children, indicating that tissue compliance affects the spread [16]. In hip and pelvic surgery, Gutierrez *et al.* demonstrated that QL3 was noninferior to lumbar plexus block for analgesia and associated with fewer motor deficits [17]. In their meta-analysis, Gong *et al.* also reported that QL3 reduced rest pain and opioid use following hip surgery [9]. On the other hand, Brixel *et al.* found that more fentanyl is needed with continuous QL3 than with a constant psoas compartment block, implying that more profound joint surgeries might demand plexus blockade [18]. Hung *et al.* conducted a review of paediatric trials and found that QL3 was the longest time to first rescue in inguinal surgeries among regional blocks [19]. Local evidence from Jadoon *et al.* in Pakistan confirmed that analgesic requirements were lower with QL3 than with TAP block [20]. The superior effect of the trans-muscular quadratus lumborum block Type 3 (QL3) is particularly significant in the local context of Pakistani surgical practice, where early mobilisation is actively encouraged after surgery. Although regional anatomic differences among the Pakistani population may

theoretically alter the distribution of local anaesthetics, the results for all age groups, body mass index, and American Society of Anaesthesiologists (ASA) classification groups have shown that the trans-muscular approach is effective, irrespective of these demographic factors. The analgesic advantage of approximately 3 hours offered by QL3 is incremental, consistent with findings from other meta-analyses in other countries. These studies indicate that the greater the spread of local anaesthetic offered by the technique, the greater the benefit, which is universal and can be easily applied to our clinical setting. The implementation of QL3 into local practice is a reliable approach to enhancing the postoperative recovery and preventing early opioid dependence in our patient population.

This is a single-centre study with several methodological limitations. Although the cohort size was sufficient to identify a statistically significant difference in the primary outcome of analgesia duration, it may not have had sufficient power to detect differences in secondary outcomes, including the need for rescue analgesia. The relatively small sample size did not permit the observation of rare adverse events. Possible confounding factors that might influence analgesic time, such as individual surgical factors and surgeon competence, were not controlled. The inclusion of male patients only limits the generalisability of these findings to female populations. Dermatome mapping to accurately define block spread was not done, and the analysis was limited to short-term outcomes.

CONCLUSIONS

In unilateral inguinal hernia repair, trans-muscular QL3 (QL3) provided significantly longer postoperative analgesia than posterior QL3 (QL2) with 0.25% ropivacaine, independent of age, BMI, or ASA status. Its superior analgesic duration and opioid-sparing effect support QL3 as a preferred technique for lower abdominal surgeries.

Authors' Contribution

Conceptualization: MA

Methodology: MA, AM, MH

Formal analysis: MA, AK, MU, QAA, QK

Writing and Drafting: MU, I

Review and Editing: MA, AK, AM, MU, QAA, I, QK, MH

All authors approved the final manuscript and take responsibility for the integrity of the work

Conflicts of Interest

All the authors declare no conflict of interest.

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