Original Article

Ultrasound-Guided Bilateral Transverses Abdominis Plane Block Versus Bilateral Quadratus Lumborum Block on Postoperative Analgesia in Women Undergoing Total Laparoscopic Hysterectomy

Jayanth Midathala[1], Vijetha Devaram[1*], Swapna VK[1], Vemuru Krishna Chaitanya[1], Hari Prasad Reddy Basireddy[1]

1. Department of Anaesthesia, Narayana Medical College, Nellore, India

Corresponding Author: Dr. Vijetha Devaram, MD., Department of Anaesthesia, Narayana Medical College, Nellore, India.
Email: kkameswaramma@rediffmail.com

Abstract

Background: No trials compared two methods of bilateral quadratus lumborum (QL) block and transverses abdominis plane (TAP) block in patients undergoing laparoscopic hysterectomy. Hence the present study compared the ultrasound-guided bilateral TAP and QL blocks and measured the pain score, rescue anesthesia requirement, adverse events, and patient satisfaction.

Materials and Methods: This prospective randomized, open-labeled study was conducted on 140 adult female patients (ASA I-II) scheduled for total laparoscopic hysterectomy. Patients were randomized into two equal groups of 70 each (group TAP and group QL). Each patient received an Ultrasound-guided bilateral TAP or QL block after completion of laparoscopic hysterectomy under general anesthesia. Patients were monitored for visual analog scale (VAS) scores postoperatively, time for first analgesic requirement, and any adverse effects. Independent t-test and Chi-square test were used for statistical analysis.

Results: The QL group showed significantly better VAS scores up to 24 hr postoperatively. VAS scores were significantly higher in the TAP group than in the QL group at all intervals postoperatively (P<0.05). The duration of postoperative analgesia was significantly shorter in the TAP group (P<0.05), and the total analgesic requirement was lesser in the QL group (P<0.05). The first request for rescue analgesia was significantly longer in the QL group (497.774±35.45 vs. 247.55±11.71min, P<0.001), and its consumption was significantly lesser in the QL group (72.1428±18.328 vs. 138.57±25.77mg). The time for the first analgesic demand (Tramadol) was prolonged in the QL group (15.1± 2.12 vs. 4.35 ±5 hours). The sensory level was higher in the QL group, with a significant difference (7.92±0.51 vs. 5.97±0.35, P<0.001). Three patients (4.28%) in the QL group experienced vomiting versus 6 (8.57%) in the TAP group. Patient satisfaction score was comparable between groups (4.78 ± 0.45 vs. 4.22 ± 0.42).

Conclusion: Bilateral QL block provided a better postoperative analgesia technique in women undergoing laparoscopic hysterectomy.

Keywords: Postoperative analgesia, Quadratus lumborum, Transverses abdominis, Laparoscopic hysterectomy, Visual analog score

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Introduction

A multimodal pain management program is essential to control severe pain after laparoscopic hysterectomy (one of the major abdominal surgeries). This multimodal perioperative management promotes the preoperative organ function and avoids the stress response through surgical trauma to achieve fast recovery (1). Opioids, the analgesic of choice, have many adverse effects such as sedation, nausea, and vomiting. Hence, there was a need to search for methods to control postoperative pain and avoid side effects (2-4).

The transversus abdominis plane (TAP) block can block the sensory afferent nerves which run between the abdominal muscles and controls postoperative incisional pain (5). Blanco was the first person who described the quadratus lumborum block (QL) (6). Somatic pain after upper and lower abdominal surgery can be controlled by QL block (7). QL block can be performed for all generations (adult, pediatric and pregnant) (8,9). QL block is considered an easy technique to learn as it is easy to get the key sonographic-anatomic markers for QL block.

The novice can learn this block after a few procedure performances (10). The analgesic effect of QL block lasts for 48 hrs. While some reports inserted catheters for continuous infusion of the local anesthetic drug to extend the duration of postoperative analgesia, some studies added dexmedetomidine to local anesthetic to extend the effect of local anesthetic drugs (11,12).

Yousef et al. in 2018 compared the ultrasound-guided bilateral transverse abdominis plane block and bilateral QL block in patients undergoing total abdominal hysterectomy (13). Alansary et al. in 2022 compared the effect of ultrasound-guided bilateral QLB versus bilateral ultrasound-guided TAP block on intraoperative and postoperative analgesia in patients undergoing total abdominal hysterectomy under general anesthesia (14).

No trials compared the bilateral QL block versus TAP block in patients undergoing laparoscopic hysterectomy under general anesthesia. Hence, the current study aimed to compare the effect of ultrasound-guided bilateral QLB versus bilateral ultrasound-guided TAP block on postoperative analgesia in patients undergoing total laparoscopic hysterectomy under general anesthesia, compare the sensory level between groups TAP and group QL, and compare the incidence of postoperative adverse events if any. The present study compares both techniques.

Methods

This randomized, prospective, and open-labeled study was carried out in the Department of Anesthesia, Narayana Medical College and Hospital. A total of 140 healthy females with the American Society of anaesthesiologists (ASA) physical status class I and II, aged between 45 to 60 years, were scheduled for total laparoscopic hysterectomy surgery.

Consent was obtained from all participants in this study. Narayana Medical College Institutional Ethics Committee issued approval of this study protocol [IEC.no-IEC/NMC/2021/Anesth]. Trial registered number: CTRI/2021/03/031947.

All patients were healthy, and none had confounding health issues or underlying diseases, data retrieved from the clinical and laboratory investigations.

Randomization: Patient randomization was done using a computer-generated random number table in opaque sealed envelopes with a 1:1 allocation ratio by an anesthesiologist who was not involved in the study. Block randomization was used to ensure the equality of the groups. Each number was sealed in an opaque envelope. Then, each patient was asked to select one of the envelopes and give it to an anesthesiologist who compared it to the computer-generated list and assigned her to one of the two groups.

The total dose of rescue analgesia used/patient was used to calculate the sample size. The sample size was 70 patients in each group, assuming a standard deviation of 75 mg of Tramadol as a rescue analgesic with α error of 0.05, β error of 0.2, and a power of 80% (15). The study had two groups (TAP: received a bilateral TAP block and QL: received a bilateral QL block). Each group had 70 participants.

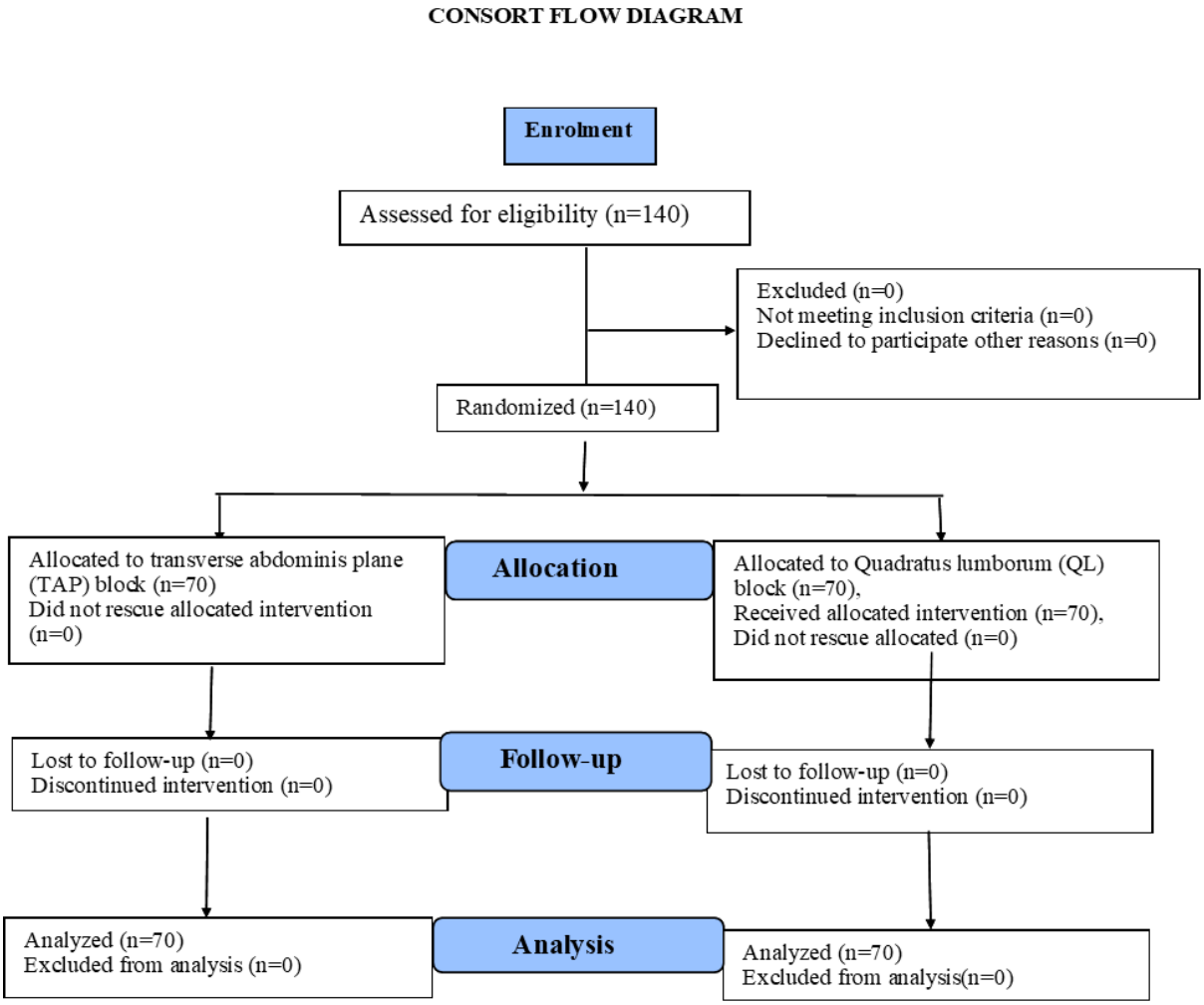

Figure 1. CONSORT Flow Diagram of the Study

Selection of patients: Females were aged 45-60 years, with ASA class I and II. They were scheduled for laparoscopic hysterectomy under general anesthesia and were included in the study.

Exclusion criteria were allergy to local anesthetics, coagulation disorders, severe obesity, physical or mental diseases that could interfere with the evaluation of pain scores, or abnormal kidney function (Serum creatinine >1.5 mg/dl) or liver failure (serum alanine and aspirate aminotransferase levels more than ten times to upper limit of the normal range).

Anesthesia and surgical procedure: Patients undergo clinical history, physical examination, and laboratory evaluation preoperatively. Electrocardiography, blood pressure, pulse oximetry, and capnography were measured in the operative room, and intravenous fluids were started. General anesthesia was induced with thiopentone (3-5 mg/kg), Inj. Fentanyl 2µg/kg and inj. Vecuronium (0.1 mg/kg) was administered for endotracheal intubation. Mechanical ventilation was maintained to keep the end-expiratory CO2 levels between 34 and 36 mmHg. Anesthesia was continued with Isoflurane 1% - 2% in 50% O2. An incremental dose of Vecuronium (0.01 mg/kg) was given every 30 min or when needed. After surgery and before extubation, the anesthesiologist (blinded to the collected data until the end of the study) performed the block techniques and administered the medication. Both blocks were performed under complete aseptic precautions using an ultrasound machine with a high-frequency linear probe covered with a sterile sheath

(high-frequency linear probe) and an 18G cannula needle. In group TAP, the probe was located between the iliac crest and the lower costal margin in the anterior axillary line at the umbilicus. Layers of the abdominal wall were identified (external oblique, internal oblique, and transverse abdominis muscles). The in-plane technique was used, and a needle tip was inserted between the internal oblique and transverse abdominis muscles. After negative aspiration (to exclude intravascular injection), 20 mL of 0.25% Bupivacaine+ 20mcg of Dexmedetomidine was injected. The same was performed on the other side (Figure 2).

The patient was placed in lateral decubitus to perform the block in group QL. The transducer was placed at the anterior superior iliac spine level and moved cranially until the three abdominal wall muscles were identified. The external oblique muscle was followed posterolaterally until its posterior border was visualized (hook sign), leaving underneath the internal oblique muscle, like a roof over the QL muscle. The probe was tilted to identify a bright hyperechoic line representing the thoracolumbar fascia's middle layer. The needle was inserted in the plane from anterolateral to posteromedial. The needle tip was placed between the thoracolumbar fascia and the QL muscle. After negative aspiration, the correct position of the needle was proved by injection of 5 mL of normal saline to confirm the space with a hypoechoic image and hydro dissection. An injection of 20 mL of 0.25% Bupivacaine + Inj. Dexmedetomidine 20 µg was applied, and the same technique was performed on the other side.

Intraoperatively, Inj. Fentanyl 1-2 ug/kg was given if the heart rate, blood pressure, or both increased>20% of the baseline. About 30 minutes before the end of the surgical procedure, Isoflurane was discontinued on completion and injection. Neostigmine 0.05 mg/kg and Inj. Glycopyrrolate 10mcg/kg was administered to reverse the effect of injection of Vecuronium. After awakening from anesthesia and achieving an appropriate level of consciousness, the patient was discharged and sent from the operating room to the ward.

Tramadol 50 mg was rescue analgesia on all occasions, not only the first time the person asked for analgesia in VAS above 4 (It was given in all cases if VAS > 4). If the VAS score was not still reduced after 15 minutes, we increased it to 25mg every 15 minutes up to 100mg.

Visual Analog Scale (VAS) (zero to ten, where zero is no pain and 10 is very severe pain) was used to assess the postoperative pain at 0, 2, 4, 6, 12, 18, 20, and 24 hrs; If VAS score went beyond seven, we gave FENTANYL 50mg.

The evaluator of the VAS score was blinded to this study objective. They were blind to the study procedure. He did do the procedure, nor did he know which procedure was done to whom. Hypotension (systolic arterial pressure 90 mmHg), arrhythmia, bradycardia (heart rate (HR) 50 beats/min), nausea or vomiting, lower limb muscle weakness, or any other complications were recorded. PCA pump for acute pain service had not been used in this study and was planned for future studies.

The hemodynamic parameters such as HR, mean arterial pressure (MAP), and respiratory rate (RR) were measured after the block and monitored for up to 24 hours. The time of first analgesic demand (taken as first postoperative analgesic agent administration after application of block), the dose of analgesic required, and the dose of analgesics (Tramadol) required, the total analgesic requirement in 24 hours, and adverse events were recorded. The patient's satisfaction score was assessed using a seven-point Likert verbal rating scale after 24 hours (12).

Statistical Analysis: The anesthetist who collected the data after surgery was blind to the type of group to which the patients belonged. Quantitative data are expressed as mean±standard deviation, and Categorical data is represented as frequency or percentage. Statistical Package for the Social Sciences version 18.0 (Chicago, IL, USA) was used for statistical analysis. Student unpaired t-test was used to compare HR, MAP, onset and duration of the block, and time of first analgesic demand. The Chi-Square test was used to compare the categorical data. $P<0.05$ was considered to be statistically significant.

Ethics statement: All participants in this study obtained consent. Narayana Medical College Institutional Ethics Committee issued approval of this study protocol [IEC.no-IEC/NMC/2021/Anesth]. Trial

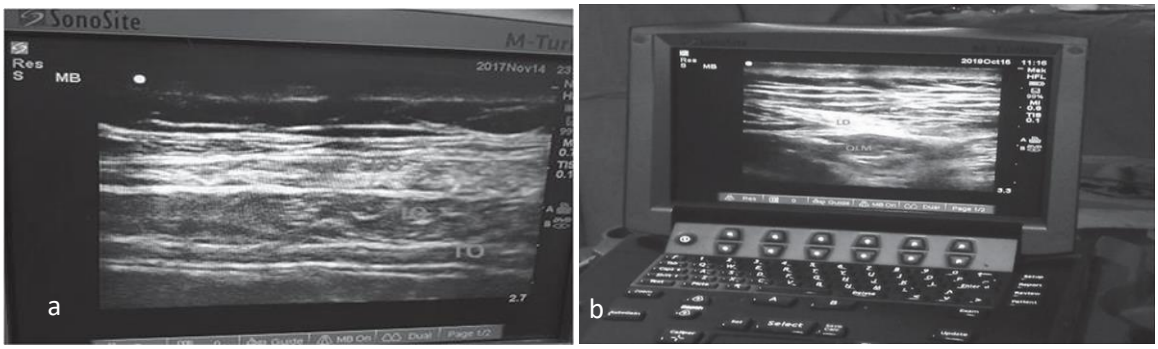

Figure 2. a.Transverses abdominis plane block, and b. Quadratus lumborum block. quadratus lumborum muscle (QLM), psoas major muscle (PMa).

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Results

Totally 140 patients (70 patients in each group) were enrolled in the study undergoing LH. No significant differences were observed between the two groups regarding age, weight, ASA physical status, or duration of surgery (Table 1).

VAS for pain was significantly higher in the TAP group at postoperatively time intervals (Figure 3). Vital data during the postoperative period, MAP, and HR were compared in the two groups, and there were no statistical differences between the groups. There was no significant difference in HR, MAP, PR, and SpO2 between the groups at all the time intervals (Table 2). There was a significant difference in Blood pressure noted at 1hr, 6hr, and 10 hr compared with baseline.

After arrival at the postoperative surgical ward, till the first 6 hours postoperative, the QL group showed fewer pain scores. The QL group showed better VAS scores with significant differences till 24 hours postoperative. The sensory level was higher in the QL group. Duration of postoperative analgesia was shorter in the TAP group (4.35± five h vs. 15.1 ± 2.12 h, p=0.001). The number of patients who requested analgesia was significantly higher in the TAP group (60 patients in the TAP group vs. 14 in the QL, P=0.001). Postoperative tramadol consumption was higher in the TAP group (P<0.001). The number of

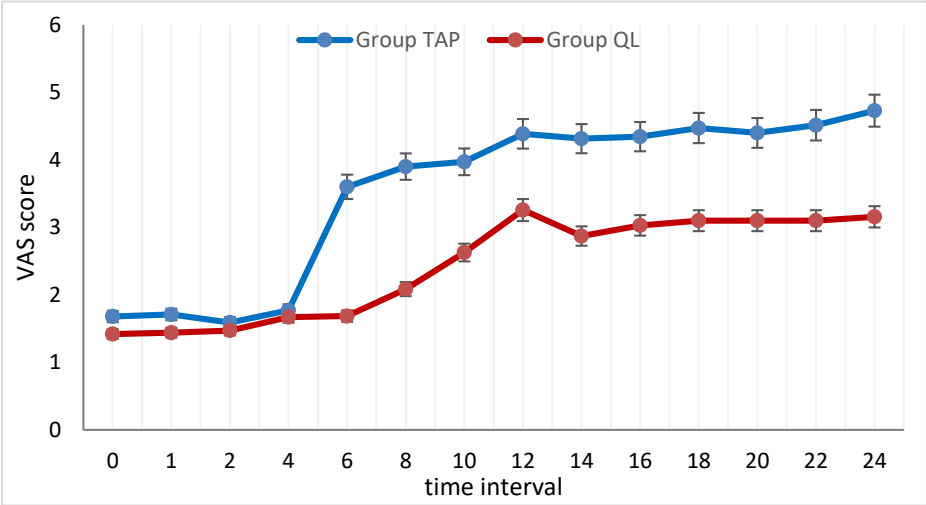

Figure 3. Changes in VAS scores between the groups' postoperative duration.

Table 1: Basic demographics and patients requiring rescue analgesia between the groups.

		Group TAP	Group QL	P value
Age (years)		49.6±3.96	49.52±3.85	0.217
Height (cm)		159.62±4.11	159.15±3.71	0.8
Weight (kg)		58.62±4.706	58.2±3.71	0.9
Duration of Surgery (min)		101.54±8.207	101.67±7.71	0.845
ASA (I/II)		18/52	22/48	0.65
Rescue analgesia time for 1st dose requirement in minutes		247.55±11.71	497.774±35.45	<0.001
Total dose of rescue analgesia Tramadol used (mg)		138.57±25.77	72.1428±18.32	<0.001
Number of patients required rescue analgesia		60	14	<0.001
Sensory segments level block achieved		5.97±0.35	7.928±0.519	<0.001
Patient satisfaction likert score 5 point*		4.78 ± 0.45	4.22 ± 0.42	0.89
	4 point	19	54	
	5 point	51	16	
Duration of postoperative analgesia (Hours)		4.35 ±5	15.1± 2.12	0.03
Vomiting		6	3	0.2
Both Nausea & vomiting		0	1	-
Nausea		0	1	-

*Likert verbal rating scale: 1- Extremely dissatisfied, 2- Dissatisfied, 3- Somewhat dissatisfied, 4 –Undecided, 5- Somewhat satisfied, 6- Satisfied, and 7-Extremely satisfied.

patients requesting tramadol as additional analgesia was higher in the TAP group. Three patients (4.28%) in the QL group experienced vomiting versus six (8.57%) in the TAP group. Patient satisfaction score was comparable between group TAP and QL (4.78 ± 0.45 vs. 4.22 ± 0.42, P=0.89). Regarding side effects, both groups are comparable, and no serious complications were detected (the patient with vomiting was treated with an Ondesteron injection).

Discussion

The longer recovery time, lesser quality of life, and patient dissatisfaction is associated with poor pain management after total laparoscopic hysterectomy (16). Unfortunately, the usage of opioids has side effects (17). Sensory nerves which run between the abdominal muscles were blocked by TAP, which may reduce the surgical incisional pain (18).

In the current study, we compared the postoperative VAS score, initial time to rescue analgesia, and the total amount of rescue anesthesia administered in the first 24 h. The number of patients who required analgesia after surgery was significantly low in group QL than in group TAP. Group TAP patients showed a higher pain scale and were the first to request rescue analgesia. QL block was more effective and superior than TAP block in terms of total rescue analgesic consumption and VAS score. There is less incidence of postoperative complications in the group of QL patients.

Our study findings were congruent with Yousef's findings regarding total opioid use and pain control duration in the first 24 h after QL block duration (13). In our study, the duration of postoperative analgesia was significantly shorter in the TAP group, and the first request for rescue analgesia was significantly longer in the QL group (497.77±35.455 vs. 247.55±11.71min, p< 0.001). Its consumption was significantly low in the QL group (72.1428±18.3281 vs. 138.57±25.77mg). The time for the first analgesic demand was prolonged in group QL with a mean duration of 15.1± 2.12 hours in the QL group and 4.35 ±5 hours in the TAP group. Similarly, a study by Amin M. Alansary et al. (14) showed that

Table 2: Comparative analysis of Heart Rate (BPM) and mean arterial pressure (mm Hg) between the groups.

Time interval	**Heart Rate (BPM)**				**Mean arterial pressure (mm Hg)**			
	Group TAP		**Group QL**		**Group TAP**		**Group QL**	
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
0	72.5	2.8	70.8	1.5	80.5	2.4	80.2	2.6
1	73.2	2.7	71.5	1.38	82.1	2.4	81.5	2.2
2	73.46	3.025	72.642	1.761	82.27	2.24	81.88	2.742
4	74.31	2.39	73.11	1.38	82.4	1.88	82.77	1.811
6	77.47	3.22	72.75	2.83	86.61	2.5	82.542	2.502
8	78.95	3.16	73.98	2.318	89.62	2.70	83.3	2.677
10	79.61	2.98	73.22	2.854	90.14	2.50	83.114	3.41
12	80.71	2.259	72.07	2.317	92.18	1.94	85.2	2.66
14	82.31	2.274	74.171	2.258	92.62	2.297	84.08	2.489
16	82.34	2.09	77.728	3.278	92.8	1.537	85.28	2.233
18	82.74	1.326	75.05	2.518	92.68	1.556	85.5	4.51
20	85.21	1.46	75.78	2.04	93.64	1.46	87.914	2.93
22	85.31	1.61	76.185	2.26	94.78	1.339	89.08	2.56
24	85.24	2.906	76.74	2.488	94.4	2.15	88.48	2.695

group QLB showed better VAS scores from 6 h to 24 h postoperative. Time for the first request for analgesia was significantly longer in the group QL block (398.3 ± 23.7 min) than in the group TAP (80.3 ± 20.7 min), and its total consumption was significantly low in group QL (68.33 ± 66.28) than in group TAP (120.0 ± 76.11).

Our study results were also in line with the result recorded by Blanco et al. They reported that QLB was better than TAP block after cesarean section as it was associated with longer analgesic time (exceeding 24 h), less opioid consumption, and a wider spread of analgesia (8).

The mechanism of the prolonged analgesic effect of QL block is still unknown. TAP block affected T10 to T12 dermatomes while QLB covered T7 to L1 dermatomes. They explained their results by spreading local anesthetic drugs into the paravertebral space or the thoracolumbar plane (which contains mechanoreceptors and a high-density network of sympathetic fibers). This extensive spread with the QLB produced analgesia for somatic and visceral pain (8). The QL block is technically easy because of its superficial fascial block between the posterior abdominal wall muscle (QL and erector spinae). QLB type 2 (posterior approach) is safer than QL block type 1 (anterolateral) or the trans-muscular approach (in between QL and psoas muscles). QL block does not aim to target a nerve but rather a fascial plane that is very bright, hyperechoic, and easily detected. A more superficial injection point is safer with a better ultrasonographic resolution (bowel injury and intraperitoneal injection are less because the QL muscle separates the needle tip from the peritoneum) (13,14). The key to the QL block's analgesic effect is identifying the thoracolumbar fascia (TLF). TLF is a complicated tubular structure made up of connective tissue. It is made up of aponeuroses and fascial layers that cover the back muscles. TLF is a ligament that connects the lumbar paravertebral region to the anterolateral abdominal wall. TLF connects cranially with the endothoracic fascia and caudally with the fascia iliaca, with its medial side attached to the thoracic and lumbar vertebrae, potentially ensuring

anesthetic spread in the craniocaudal direction (19).

The analgesic effect of QL block may be due to the spread of the local anesthetics along the TLF and the endothoracic fascia into the paravertebral space (20). Carney et al. (21) reported that a single shot QL block covered the dermatome segments from T4 to L2. They demonstrated that by injecting contrast solution posteriorly, which accumulated at the lateral border of QL. It then spread in the posterior-cranial fashion to the anterior aspect of the QL and psoas major to the paravertebral space.

In our study, the results were in line with the study done by Öksüz et al. (22), who compared TAP block and QL block in pediatric patients undergoing lower abdominal surgery. Parents' satisfaction scores were lower in the TAP block group than in the QLB group.

Furthermore, Murouchi et al. (23) investigated the relationship between the local anesthetics blood level and the efficacy of the QL block type 2 and TAP block in adults. They found that the local anesthetic blood levels in TAP block were higher than in QL block type 2, but the analgesic effect was better with QL block type 2 than with TAP block. Adipose tissue during QL block inhibits administered drug movement from the intermuscular space into the paravertebral. The local tissue perfusion of the adipose tissue is low, resulting in the low absorption speed of a local anesthetic into the blood (24).

Our result was in line with the results recorded by Baidya et al. (25). They performed a single injection QL trans muscular block between the QL and psoas major in a lateral position on five children undergoing pyeloplasty. They reported that it was associated with good postoperative analgesia. Murouchi used bilateral QL intramuscular block in pediatric patients undergoing laparoscopic appendectomy and reported that it was related to successful postoperative analgesia.

In our current study, patient satisfaction was assessed by the Likert verbal rating scale after 24 hrs. There was no difference in patient satisfaction between the two groups. The patients in group QL were more satisfied than the group TAP blocks for postoperative analgesia. Adverse effects such as nausea and vomiting in the two groups were comparable and less in group QL. These results were in line by a study of Alansary, A.M et al. (14) and Usha Shukla et al. (15).

Conclusion

This study showed that bilateral QL block provided more effective postoperative analgesia than TAP block. Group QLB patients had less postoperative pain. They needed less analgesia after surgery when compared with bilateral TAP block, which showed a shorter duration of postoperative analgesia. QL block had more time covering to rescue analgesics, and its sensory level was higher than TAP block with less incidence of postoperative nausea and vomiting.

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Conflicts of Interest

The authors declare that they have no conflict of interest.

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