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Posterior quadratus lumborum versus caudal epidural block for perioperative analgesia in pediatric patients undergoing upper abdominal surgeries: Arandomized, double-blind trial

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ABSTRACT

Background: Ultrasound-guided Quadratus Lumborum block (QLB) has become an established modality for perioperative analgesia in lower abdominal surgeries. However, its efficacy in upper abdominal surgeries is still understudied.
Objectives: The study aimed to determine QLB2 efficacy as a perioperative analgesic modality in upper abdominal surgeries, compared to caudal epidural block (CEB), regarding FLACC score, the time to the first rescue analgesia, the amount of fentanyl consumed intraoperatively, amount of rescue analgesia administered, parents' satisfaction, as well as the incidence of complications.
Study design: A randomized, prospective, double-blind, and single-center study.
Setting: Ain Shams University Hospitals
Methods/patients/interventions/measurements: Fifty-two pediatric patients scheduled for upper abdominal surgeries under general anesthesia were assigned randomly to undergo CEB or ultrasound guided QLB 2. As assessed by FLACC, postoperative pain scores were the primary outcome. The secondary outcomes included the amount of fentanyl consumed intraoperatively, the time to first rescue analgesia, the amount of rescue analgesia given, parents' satisfaction, and the incidence of complications.
Results: The QLB cohort demonstrated decreased FLACC scores than the CEB group. Total fentanyl consumption was significantly lower (33.4 ± 14.9 µg vs. 56.5 ± 17.0 µg, p-value of 0.003), time to first rescue analgesia was more prolonged (14.4 ± 1.3hrs vs. 1.8 ± 1.2 hr, p-value <0.001), and parents' satisfaction was significantly higher. Postoperative nausea incidence was significantly alleviated (11 (42.3%) vs. 22 (84.6%), p-value 0.002), whereas vomiting was substantially decreased (0 (0.0%) vs. 15 (57.7%), p-value <0.001).
Conclusion: Perioperative analgesia in pediatric patients can be effectively achieved using QLB type 2. Compared to CEB, it provides more stable hemodynamics, lower FLACC scores, less need for rescue analgesia, and higher parent satisfaction.

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KEYWORDS
Pediatric; pain; caudal; quadratus lumborum; ultrasound; FLACC

1. Introduction

For many years, children have been believed to be insensitive to pain. Consequently, pediatric pain has consistently been underestimated. However, the last decade has witnessed a paradigm shift in understanding pediatric pain and its devastating long-term sequelae [1].

In the case of upper abdominal surgeries, untreated or inadequately treated pain can lead to respiratory dysfunction, atelectasis, chest infection, and even pneumonia [2] in contrast, this can be aggravated by intravenous narcotics causing respiratory depression, among other side effects [3].

CEB is one of the oldest and most well-established neuraxial blocks in pediatrics. Single-shot CEB is still considered a safe method for providing perioperative analgesia in the lower limb, perineal, lower, and even upper abdominal surgeries, particularly in settings with limited resources [2].

The rise of ultrasound utilization coincides with the increased use of interfascial blocks in abdominal and thoracic surgeries, owing to their safer profile compared to neuraxial blocks [4]

QLB is an emerging fascial plane block that has rapidly attracted significant interest as an ideal method for managing perioperative pain in various surgeries, including lower abdominal, gynecological, obstetric, laparoscopic, and hip surgeries [5–8]. Aksu and Gürkan [9] were the first to use ultrasound guided QLB in pediatric anesthesia practice to provide postoperative analgesia for ambulatory surgeries. Nevertheless, QLB analgesic efficacy in alleviating perioperative upper abdominal surgery pain is still understudied.

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Our objective was to study posterior QLB analgesic efficacy in pediatric patients undergoing upper abdominal surgeries compared to CEB.

2. Sample size calculation

İPEK et al [10] reported a large effect size comparing pain scores between posterior QL vs. CEB in the first four hours postoperatively. Based on the two-sided equal variance t-test, a group sample size of 24 has 80 power to reject the null hypothesis (of zero effect size) when the significance level (alpha) is 0.050 and the population effect size is 0.83. Further 2 patients were added to each group to overcome possible dropouts or escape.

3. Methods

3.1. Ethics

Following the approval of the Research Ethical Committee of the Faculty of Medicine, Ain Shams University (FMASU R 69/2022), this study was registered prospectively at ClinicalTrials.gov (NCT05493085) following the Helsinki Declaration-2013. The study was performed at Ain-Shams University Hospitals from NaN Invalid Date NaN, to NaN Invalid Date NaN. After fully explaining the procedures, all patients' guardians provided informed consent and were blinded to the block performed. The study design and procedures followed the guidelines of Consolidated Standards of Reporting Trials (CONSORT) (Figure 2).

3.2. Study population

Fifty-two patients aged between 2 and 8 with American Society of Anesthesiologists risk class I-II physical status and scheduled for upper abdominal surgery were included in the trial. Cases with a history of local anesthetics allergy, abnormal coagulation profile, injection site local infection, or chronic renal or hepatic diseases were excluded from the study.

3.3. Study settings

The study was carried out at the Pediatrics' Hospital, Ain Shams University Hospitals, from June 2022 till March 2023.

3.4. Randomization and blinding

Patients' randomization was done utilizing a computer-generated random allocation sequence into two groups (26 each): the QL or CEB groups. The patient's parents were blinded to group categorization. Following group allocation, a letter with standardized instructions for the study drug preparation was given to an experienced anesthetist who was not involved in the study. The anesthetist prepared the study solution and subsequently conducted the block.

3.5. Study protocol

All participants were subjected to the following procedures: evaluation of surgical and medical history, renal and liver functions, clinical examination, and evaluation of complete blood picture and bleeding/clotting time. Patients were premedicated with oral midazolam (0.5 mg/kg) 30 min prior to surgery.

After standard monitoring of anesthesia by noninvasive blood pressure, peripheral oxygen saturation (SpO_2), and electrocardiogram, induction of anesthesia was performed with sevoflurane inhalation (8%) in 50% air in oxygen, under spontaneous ventilation, and a peripheral venous access was established to administer propofol (2 mg/kg) as well as fentanyl (1 µg/kg). A proper-sized, cuffed endotracheal tube was inserted in order to secure the upper airway, and cis-atracurium (0.15 mg/kg) was administered to facilitate placement. All blocks were administrated following endotracheal tube placement and prior to initiating surgery.

Surgery was initiated about 15 min following block administration. In the event of inadequate analgesia, defined as elevation of mean arterial blood pressure (MAP) or an elevation in heart rate (HR) of over twenty percent beyond the preoperative values, fentanyl 0.5 µg/kg was administered. Subsequently, the calculation of total intraoperative fentanyl consumption (µg) was done. MAP and HR were recorded preoperatively and every 15 minutes during surgery until the conclusion of the procedure. After the end of the operation, patients were transferred to the Post Anesthesia Care Unit PACU. FLACC score (Face, leg, activity, cry, consolability) [1] was utilized for evaluating postoperative pain upon PACU admission as well as at 1,2,4,6,8,12,18 and 24 h postoperative. FLACC score evaluation was performed by another anesthetist and nurses who were blinded to the block technique. In children with a FLACC score > 3, 1 µg/kg fentanyl was intravenously administered. Bradycardia, hypotension, vomiting, nausea, as well as other complications were recorded and managed. Fentanyl's total dose in the first 24 h postoperative was calculated. The time to the first dose required of fentanyl was recorded. Following home discharge, parents were reached by phone to obtain information regarding their satisfaction based on the following scale: 1, unsatisfied; 2, fair and 3, satisfied.

3.6. Study intervention

3.6.1. Quadratus lumborum (QL) group

QLB was performed unilaterally on the operated upon site, the patient was initially positioned in

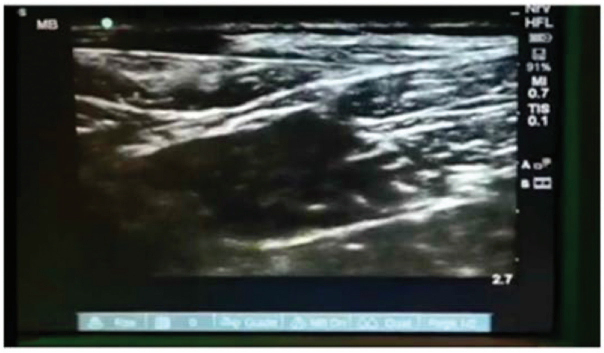

Figure 1. The needle advanced from anterolateral to posteromedial and situated between QL and thoracolumbar fascia.

the lateral decubitus position. A high-frequency (13–6 MHz) linear ultrasound transducer (SonoSite S-nerve-San Diego-CA-USA) was placed on the iliac crest and covered with an antiseptic sheath in order to visualize three abdominal wall muscles in three dimensions. Moving the instrument posteriorly enabled visualization of the external and internal oblique muscles. The probe was subsequently turned at the point where these two muscles' fascia overlaid the QL to visualize the intermediate layer of the thoracolumbar fascia. Afterward, utilizing an in-plane technique, a 22-gauge, 50 or 80-mm Sonoplex (Pajunk-Germany) needle tip was advanced in an anteroposterior direction through the abdominal wall muscle layer, aiming to the lumbar interfascial triangle on the posterolateral aspect of the QL muscle. Following a negative aspiration, saline administration (0.5 mL) and hydro-dissection were carried out. Figure 1 depicts the needle introduction just before the administration of 0.7 mL/kg of 0.25% bupivacaine between the thoracolumbar fascia as well as the QL muscle [11].

3.6.2. Caudal epidural block (CEB) group

Patients were placed in the lateral decubitus position, and a single-dose caudal block was performed using a 23-G needle and taking aseptic precautions. The placement of the needle was confirmed by the characteristic "pop" that signifies the penetration of the sacrococcygeal ligament. After negative aspiration for blood and cerebrospinal fluid, a Whoosh test was performed to determine the correct placement in the caudal canal, and then 1.2 ml/kg of 0.25% bupivacaine was slowly injected to guarantee upper abdominal segment coverage. The local anesthetic's successful deposition was indicated by the absence of edema, tumefaction, and elevated resistance at the insertion site [2].

3.7. Outcomes

Our **Primary outcome** was the assessment of postoperative pain scores as evaluated by FLACC score. **Secondary outcomes** were the amount of fentanyl consumed intraoperatively, the time to first rescue analgesia, the amount of rescue analgesia given, parents' satisfaction, and the incidence of complications.

4. Data analysis

Data collection, coding, tabulation, and statistical analysis were done utilizing the 28th version of the IBM SPSS software (IBM Corp.-Chicago-USA-2021). Quantitative data normality was tested utilizing the

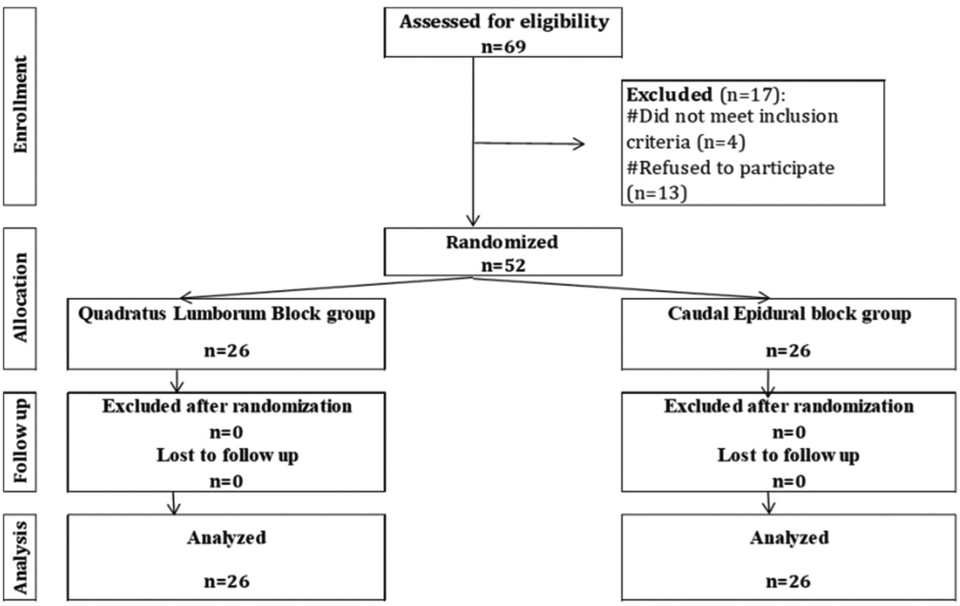

Figure 2. CONSORT flow chart of the studied cases.

Shapiro-Wilk test, then described in groups as Mean ±SE (standard error) and 95% confidence interval in relative effects, before comparison utilizing the independent t-test. Qualitative data expression was done utilizing percentages and numbers and then compared utilizing the Chi-square test as well as Fisher's Exact test for variables with small, expected numbers. Post-hoc comparisons were made using the Bonferroni test. Rescue analgesia rates were done utilizing the Log-rank test. The significance level was determined at (p-value <0.050).

5. Results

Table 1 shows no significant difference between the studied groups regarding age, sex, weight, procedure type, and operation duration. Regarding intraoperative hemodynamics (Table 2 and Figures 3 and 4), an abrupt decrease in Heart rate was noticed in the CEB group at minute-15, then it stabilized progressively throughout the operation. In contrast, a relatively stable heart rate was noticed in the QLB group. There was no significant difference between the studied groups regarding pre-induction level, then it became significantly lower in the CEB group at minute-15 intraoperatively, and then became non-significantly different at minutes 30 and 45, and finally became significantly higher in the CEB group from minute-60 intraoperative until 15 minutes postoperatively.

As for Mean arterial pressure, CEB patients suffered an abrupt decrease at minute-15, and the decline continued till minute-60, and then it increased from minute-75 intraoperatively until 15 minutes postoperatively, compared to a relatively stable MAP in QLB patients. No significant differences were detected between the studied groups regarding pre-induction level. Then, it became significantly lower in the CEB group from minute-15 to minute-60 intraoperatively and then became significantly higher in the CEB group from minute-75 intraoperatively to minute-15 postoperatively. As for intraoperative outcomes, none of the QLB patients had any episodes

Table 1. Comparison of baseline characteristics.

Variables		QLB (Total = 26)	CEB (Total = 26)	p-value
Age (years), Mean±SD		5.3 ± 2.0	5.7 ± 2.4	^0.529
Weight (kg)		18.4 ± 4.2	19.4 ± 4.8	^0.467
Sex (n, %)	Male	18 (69.2%)	19 (73.1%)	#0.760
	Female	8 (30.8%)	7 (26.9%)	
Procedure (n, %)	Splenectomy	8 (30.8%)	7 (26.9%)	§0.780
	Nephrectomy	6 (23.1%)	4 (15.4%)	
	Pyeloplasty	4 (15.4%)	3 (11.5%)	
	Mesenteric mass excision	4 (15.4%)	8 (30.8%)	
	Cyst excision	4 (15.4%)	4 (15.4%)	
Operation duration (minutes), Mean±SD		134.6 ± 33.3	125.7 ± 37.1	^0.364

#Chi square test. ^Independent t-test. § Fisher's Exact test.

Table 2. Comparison of intraoperative findings.

Time points	QLB (Total = 26)	CEB (Total = 26)	p-value	Relative effect⌂ Mean±SE	Relative effect⌂ 95% CI
Heart Rate (beat/minute)					
Pre-induction	103.4 ± 17.7	106.1 ± 24.4	^0.646	−2.7 ± 5.9	−14.6–9.1
IO-minute-15	96.3 ± 16.6	73.6 ± 30.6	^0.002*	22.7 ± 6.8	9.0–36.4
IO-minute-30	86.5 ± 5.8	78.5 ± 28.4	^0.163	8.0 ± 5.7	−3.4–19.4
IO-minute-45	83.2 ± 8.0	89.8 ± 26.5	^0.234	−6.5 ± 5.4	−17.4–4.4
IO-minute-60	81.5 ± 7.1	92.3 ± 26.2	^0.048*	−10.8 ± 5.3	−21.5–-0.1
IO-minute-75	80.7 ± 6.5	102.6 ± 25.4	^<0.001*	−21.9 ± 5.1	−32.2–-11.5
IO-minute-90	81.2 ± 7.3	106.0 ± 22.1	^<0.001*	−24.8 ± 4.6	−34.0–-15.7
Operation end	83.8 ± 7.1	109.7 ± 22.2	^<0.001*	−26.0 ± 4.6	−35.1–-16.8
PO-minute-15	83.8 ± 5.9	110.2 ± 22.8	^<0.001*	−26.3 ± 4.6	−35.6–-17.1
Mean Arterial Pressure (mmHg)					
Pre-induction	82.7 ± 7.3	82.6 ± 11.8	^0.966	0.1 ± 2.7	−5.3–5.6
IO-minute-15	78.7 ± 6.4	65.4 ± 18.1	^0.001*	13.3 ± 3.8	5.7–20.8
IO-minute-30	76.0 ± 6.2	59.8 ± 11.3	^<0.001*	16.2 ± 2.5	11.1–21.3
IO-minute-45	72.5 ± 5.9	59.8 ± 10.3	^<0.001*	12.7 ± 2.3	8.0–17.3
IO-minute-60	68.4 ± 5.9	62.2 ± 5.1	^<0.001*	6.2 ± 1.5	3.2–9.3
IO-minute-75	69.5 ± 7.6	76.4 ± 11.6	^0.013*	−7.0 ± 2.7	−12.4–-1.5
IO-minute-90	68.4 ± 7.0	81.8 ± 9.8	^<0.001*	−13.5 ± 2.4	−18.2–-8.7
Operation end	69.7 ± 8.4	85.3 ± 9.6	^<0.001*	−15.7 ± 2.5	−20.7–-10.6
PO-minute-15	70.5 ± 10.3	85.9 ± 8.6	^<0.001*	−15.3 ± 2.6	−20.6–-10.1
Intraoperative outcomes					
IO bradycardia	0 (0.0%)	10 (38.5%)	#<0.001*	NA	NA
IO hypotension	0 (0.0%)	14 (53.8%)	#<0.001*	NA	NA
IO fentanyl	0 (0.0%)	26 (100.0%)	#<0.001*	NA	NA
Total fentanyl induction and IO (μg)	20.6 ± 4.4	55.1 ± 25.3	^<0.001*	−34.5 ± 5.0	−44.6–-24.4

IO: Intraoperative. PO: Postoperative. ⌂Relative effect: Effect in QLB group relative to that in CEB group. NA: Not applicable. #Chi square test. ^Independent t-test. *Significant. SE: Standard error. Results are presented as mean±SE (standard error).

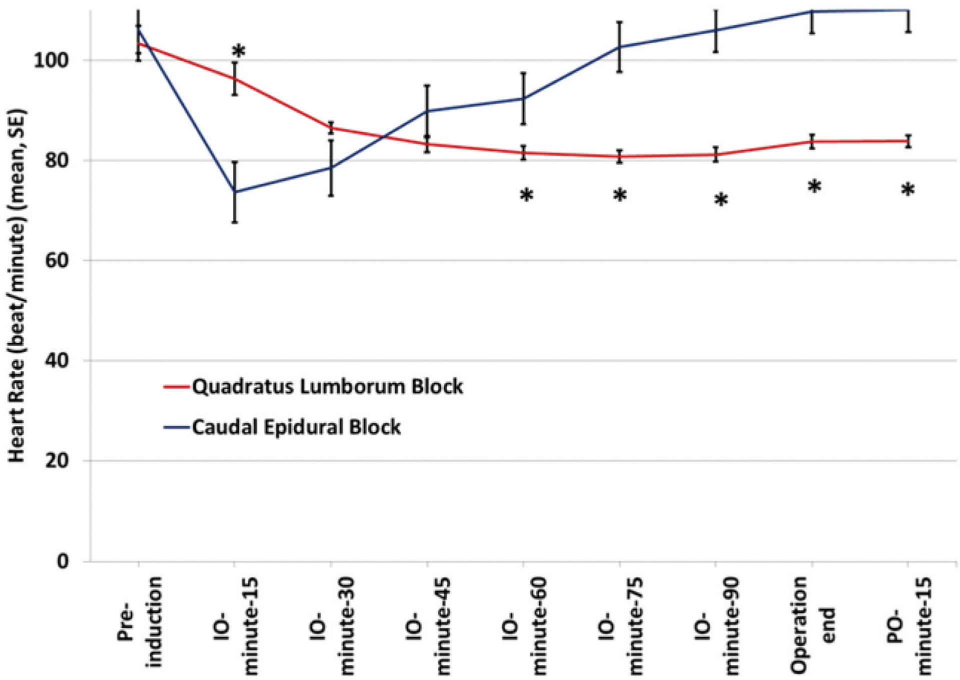

Figure 3. Comparison regarding heart rate (* significant).

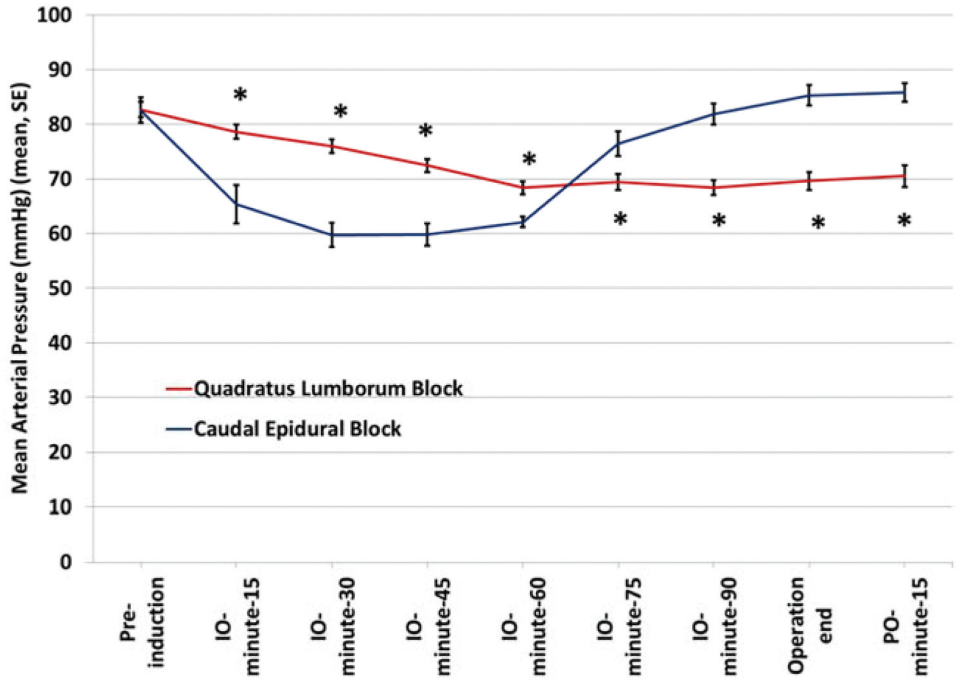

Figure 4. The comparison regarding mean arterial blood pressure (*significant).

of bradycardia or hypotension, while 10 and 14 of the CEB patients out of 26, suffered from bradycardia and hypotension respectively, with a statistically significant difference. None of the QLB patients needed additional intraoperative fentanyl, while all CEB patients needed an extra dose, making the total intraoperative fentanyl consumption between the 2 groups statistically significant.

Postoperative FLACC (Table 3 and Figure 5) showed significantly lower scores from hour-1 until hour 24 postoperatively, favoring the QLB group. This was reflected in a significantly lower total fentanyl consumption in 24 hours postoperatively, a significantly longer Time to the first rescue analgesia, and significantly higher Parents' satisfaction in the QLB group. Finally, Postoperative nausea, vomiting, hypotension, and the need for rescue analgesia were less frequent in the QLB group, and the difference was significant except in hypotension. Finally, Figure 6 showed that the rate of need to first rescue analgesia was significantly slower in the QLB group.

Table 3. Comparison of postoperative findings.

Time points	QLB (Total = 26)	CEB (Total = 26)	p-value	Relative effect⌂ Mean±SE	Relative effect⌂ 95% CI
FLACC score					
PACU admission	0.6 ± 1.0	3.3 ± 2.4	^<0.001*	−2.7 ± 0.5	−3.7–-1.7
PO-hour-1	1.3 ± 0.5	3.9 ± 1.8	^<0.001*	−2.7 ± 0.4	−3.4–-1.9
PO-hour-2	1.4 ± 0.5	4.0 ± 1.6	^<0.001*	−2.5 ± 0.3	−3.2–-1.9
PO-hour-4	1.7 ± 0.5	4.4 ± 1.1	^<0.001*	−2.7 ± 0.2	−3.1–-2.2
PO-hour-6	1.8 ± 0.7	5.0 ± 1.0	^<0.001*	−3.1 ± 0.2	−3.6–-2.7
PO-hour-8	2.4 ± 0.5	5.0 ± 0.5	^<0.001*	−2.6 ± 0.1	−2.9–-2.3
PO-hour-12	3.5 ± 0.5	5.5 ± 1.4	^<0.001*	−1.9 ± 0.3	−2.5–-1.3
PO-hour-18	3.1 ± 0.9	5.7 ± 1.8	^<0.001*	−2.5 ± 0.4	−3.3–-1.8
PO-hour-24	2.6 ± 0.8	5.1 ± 1.4	^<0.001*	−2.5 ± 0.3	−3.1–-1.9
Postoperative outcomes					
				RR	**95% CI**
Nausea	11 (42.3%)	22 (84.6%)	#0.002*	0.50	0.31–0.81
Vomiting	0 (0.0%)	15 (57.7%)	#<0.001*	NA	NA
Hypotension	0 (0.0%)	4 (15.4%)	§0.110	NA	NA
PO fentanyl	7 (26.9%)	26 (100.0%)	#<0.001*	NA	NA
	Total = 7	**Total = 26**		**Mean±SE**	**95% CI**
Total fentanyl in 24 hrs PO (μg)	33.4 ± 14.9	56.5 ± 17.0	^0.003*	−23.1 ± 7.1	−37.5–-8.6
Time to first fentanyl dose (hours)	14.4 ± 1.3	1.8 ± 1.2	^<0.001*	12.7 ± 0.5	11.6–13.7
Satisfaction	**Total = 26**	**Total = 26**			
• Satisfied	18 (69.2%)a	0 (0.0%)b	#<0.001*	NA	NA
• Fair	8 (30.8%)a	4 (15.4%)a			
• Unsatisfied	0 (0.0%)a	22 (84.6%)b			

PO: Postoperative. ⌂Relative effect: Effect in QLB group relative to that in CEB group. NA: Not applicable. ^Independent t-test. *Significant. RR: Relative risk. SE: Standard error. Homogenous categories had the similar symbol "a,b" based on post hoc Bonferroni test. Results are presented as mean±SE (standard error).

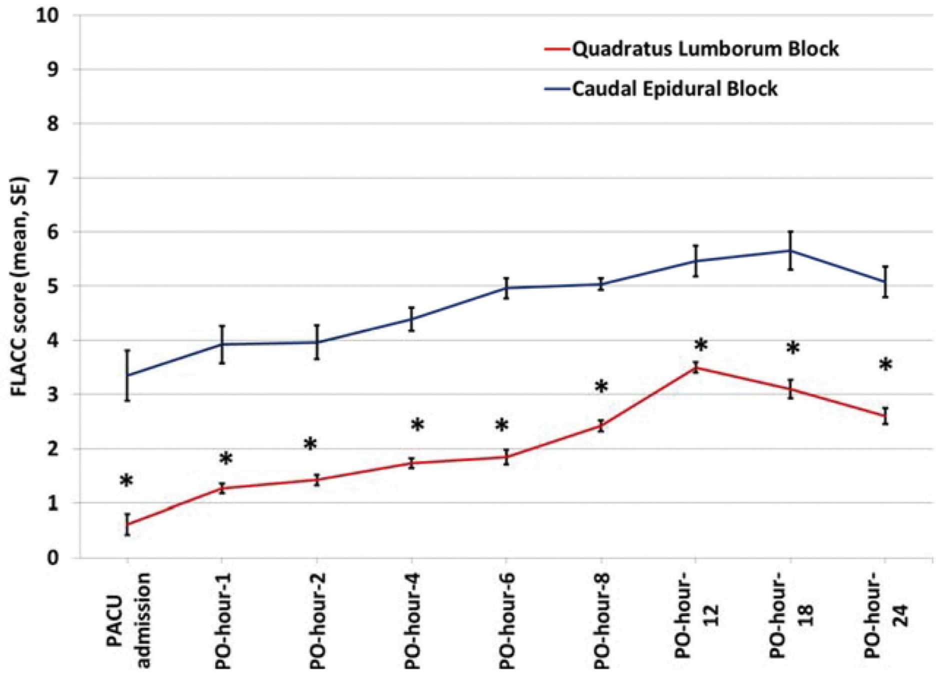

Figure 5. Comparison regarding postoperative FLACC scores (* significant).

6. Discussion

To our knowledge, this is the first study to examine the analgesic effect of posterior QL block (type 2) in a variety of open upper abdominal surgeries in pediatrics, compared to CEB. We tested QL on patients undergoing pyeloplasty, splenectomy, nephrectomy, mesenteric mass excision, and renal cyst excision, all through upper abdominal/subcostal incisions. Compared to CEB, which is the go-to regional technique in our institution, QL offered more stable hemodynamics intraoperatively, less need for intraoperative narcotics, better postoperative analgesia, lower FLACC scores, lower need for rescue narcotics, and a lower incidence of postoperative complications.

Several studies have established the analgesic efficacy and safety of QLB as opposed to CEB in lower abdominal surgery. Öksüz et al [11] compared the effect of posterior QLB and CEB in pediatric patients undergoing inguinal hernia repair and orchiopexy, QLB patients had lower FLACC scores, required less rescue

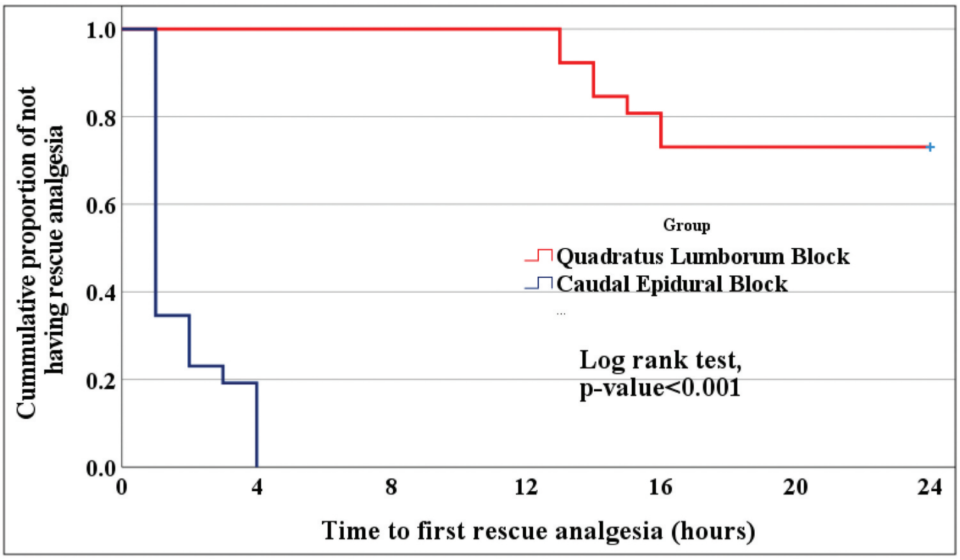

Figure 6. Kaplan- Meier curve for the rate of need to first rescue analgesia among the study groups (*Significant).

analgesia, and had more satisfied parents. Ashoor et al [12] compared posterior QLB to caudal bupivacaine and neostigmine in pediatric lower abdominal surgeries and reported comparable results.

One of the most significant benefits of CEB is the ability to achieve different levels of the neuraxial block by increasing the volume injected. Typically, weight-based formulas are used. Forestier et al [13] suggested volumes of 1.3, 1.57, and 1.78 ml/kg to reach L1, T10, as well as T6 levels as epidural space volume increases from caudal to cranial. However, Lee et al [14] reported an increase in optic nerve diameter at 1.5 ml/kg, denoting an increase in intracranial tension. Therefore, we opted to use the well-established Armitage formula, where upper abdominal/mid thoracic dermatomal block can be achieved by a 1.25 ml/kg volume [15,16] One of the limitations of CEB is its short duration of action, owing to the high vascularity of the epidural space, leading to increased absorption of local anesthetics [17]

Multiple techniques have been employed to extend the duration of action of CEBs. For instance, additives such as morphine, ketamine, and clonidine have been utilized. Additionally, continuous caudal catheterization has been attempted, which was successful but with some limitations [18–20]. We decided not to use additives or catheterization [21] to avoid these side effects as well as to better assess both blocks. In addition to the nature of our institute as a tertiary center with a high flow of cases, we try to advocate for Enhanced Recovery After Surgery (ERAS) as much as possible.

Common side effects of epidural blocks include hypotension and bradycardia due to lumbar sympathectomy and blocking of thoracic accelerator fibers. However, CEB in the pediatric population, especially those younger than eight years old, causes fewer hemodynamic disturbances than in adults. This may be due to a lack of blood pooling in their legs and immature sympathetic nervous system (SNS) function. CEB can still induce decreases in HR, MAP, and cardiac output (CO), with maximal hemodynamic changes typically reported 10 minutes after administration. These changes are most pronounced in children aged 3–8 years old [22] and those receiving plain local anesthetics [23], which is very similar to our results concerning intraoperative hemodynamic changes.

In 2007, Blanco [24,25] first described the QLB as a posterior extension of the TAB block. As demonstrated by Carline et al [26], who examined three techniques of QLB in terms of dye spread and nerve involvement using cadavers, these variants have significantly different impacts in terms of block area and analgesic effect. With posterior QLB, they demonstrated that the injected dye spread anteriorly to the transversus abdominis plane and posteriorly to the subcutaneous tissue of the abdominal flank over the latissimus dorsi. Consequently, our choice of posterior (type 2) QLB provided adequate, long-lasting analgesic coverage from T4 to L1 [25,27]

The point of injection between the QL and thoracolumbar fascia is relatively superficial, focused, and easily positioned, allowing for real-time ultrasound guidance, which is another advantage of posterior QLB over other types, particularly in pediatric patients [28] Therefore, we preferred the utilization of posterior QLB over other types.

QL blocks are the only interfascial blocks capable of blocking both somatic and visceral pain. This can be attributed to the thoracolumbar fascia (TLF), a sheet of fused aponeuroses and fascial layers that covers the muscles of the back, through which the infiltrated local anesthetics spread into the thoracic paravertebral space [4] and to the celiac ganglion and sympathetic trunk via the splanchnic nerves [29]. Additionally, it contains a high-density network of sympathetic fibers and mechanoreceptors responsible for the block effects. These receptors are sensitive to the effects of local anesthetics and have been implicated in both acute and chronic pain development [30]

The superiority of QLB over other interfascial block has been demonstrated in multiple studies [10,31–33], where intraoperative narcotics consumption, postoperative pain scores, and the need for rescue analgesia, were significantly lower in patients receiving QLB.

As previously demonstrated, the analgesic efficacy of QLB in general and posterior QLB (type 2) in pediatric upper abdominal surgeries is still under-studied. Hoffmann et al [34] reported a case series of five pediatric patients undergoing upper tract urosurgical procedures who received posterior QL pre-incision or before extubation. Patients' pain scores ranged from 0 to 3 during their hospitalization; neither rescue analgesia nor complications were reported. Lai et al [28] compared posterior QL to intravenous analgesia in adult patients undergoing robot-assisted partial nephrectomy (RAPN). QL patients had significantly lower VAS scores and less morphine consumption intra and postoperatively and throughout their hospital stay.

Conversely, Chisolm et al [35] found no difference in the efficacy of posterior QLB in infants ≤12 months old undergoing pyeloplasty compared to intravenous analgesia. QL patients consumed fewer narcotics intraoperatively and postoperatively, but the difference was not statistically significant. In addition, there was no difference in hemodynamics or postoperative pain scores.

Other variants of QLB were used in upper abdominal surgeries. Xue et al [31] compared the analgesic efficacy of anterior QLB (type 3), TAB block, and IV analgesia in laparoscopic gastric sleeve surgery. Both QL and TAB were equally efficient regarding intraoperative remifentanil consumption and postoperative VAS scores, while QLB was superior as regards the first rescue analgesia request, total rescue analgesia in 24 hours, and fewer PCA requirements. In contrast, Srivastava et al. [36] found anterior QLB more effective than port site infiltration in adult patients undergoing pyeloplasty, regarding VAS scores and the number of patients requiring rescue analgesia.

Nie et al [32] also tested the analgesic efficacy of Anterior QLB versus TAB block in radical gastrectomy surgeries. QLB had a more favorable analgesic profile, as evidenced by a decrease in intraoperative and postoperative narcotic consumption and VAS scores. Similar results were obtained by Saleh et al [33], who compared trans-muscular QLB to TAB in adult patients undergoing open nephrectomy. Subcostal trans-muscular QLB had equally favorable results in laparoscopic nephrectomy [37]. Continuous anterior QLB was also successfully used in patients undergoing liver resection [38] A recent study [39] comparing CEB to trans-incisional ultrasound guided QLB in open renal surgery found QLB to be superior in terms of pain scores, time for first rescue analgesia, and postoperative ketorolac consumption.

7. Limitations

The current study has a number of limitations, such as the blind caudal technique, but we felt compelled to use the modality in which we are most proficient, as evidenced by the 0% failure rate. In addition, the blind caudal technique is the most frequently utilized regional anesthesia technique at our institution. We hoped to induce a paradigm shift by replacing old guards with new ones. Theoretically, US-guided QLB is more difficult to learn and master than CEB, but our study demonstrates its clinical and statistical superiority. In addition, we did not evaluate the dermatomal level of either block because both were administered under general anesthesia. We would also like to emphasize the difficulty in distinguishing pain from emergency agitation and delirium in children. Incorporating the PAED score [40] into the assessment of pediatric patients could improve postoperative pain diagnosis and management.

8. Conclusion

QLB type 2 can provide perioperative analgesia to pediatric patients safely and effectively. In addition, it provides more stable intraoperative hemodynamics, less need for intraoperative narcotics, lower FLACC scores postoperatively, less need for rescue analgesia, and greater parental satisfaction in comparison to CEB. Incorporating ultrasound-guided techniques into our routine practice can improve patient outcomes and reduce adverse effects and complications.

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Availability of data and materials

The datasets generated and analyzed for this study are available in the manuscript.

Amr Kasem visualization, supervision, reviewing and editing.

Mohamad TolbaData curation, methodology, investigation, software, writing.

All authors have approved the final version to be published. All authors agree to being accountable for all aspects of the work, ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Authors' contributions

Based on CRediT criteria: **Aya Hisham** conceptualization, methodology, writing- original draft preparation.

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