Review Article

Ultrasound-guided procedures for postoperative pain management in pediatric patients undergoing abdominal surgeries: A systematic review

ABSTRACT

Many ultrasound-guided procedures are available for administering analgesia via peripheral nerve blockade. This systematic review aims to compare different ultrasound-guided procedures to determine which procedure is better suited for pediatric abdominal surgeries. The objective is to understand the efficacy of ultrasound-guided procedures for postoperative pain management in children undergoing abdominal surgeries and to identify which procedure takes less time and is better suited for a particular surgery. A systematic literature search was performed in PubMed, SCOPUS, Central Cochrane Registry of Controlled Trials (The Cochrane Library), and ScienceDirect databases for pediatric abdominal surgeries conducted with ultrasound-guided procedures for administering analgesia. We included studies involving randomized controlled trials (RCTs). Quasi-randomized controlled studies, prospective, retrospective observational studies, case series, case reports, letters, editorials, comments, animal studies, and studies from non-English literature were excluded. We reviewed 13 articles with 910 patients included. Age groups varied from 6 months to 21 years. The most common block used was the transversus abdominis block (47.76%), and the most common surgery performed was hernia and hydrocele (52.10%). Quadratus lumborum block was used in 26.92%, erector spinae block in 8.97%, modified transversus abdominus block and rectus sheath block in 9.62%, and ilioinguinal block in 6.73% of the patients. No complications were reported in any of the studies. Transversus abdominus block is less effective in two of the studies. Each procedure for pediatric postoperative analgesia has specific advantages and limitations, highlighting the complexity of tailoring interventions. Our review focuses on the advancements in ultrasound-guided analgesia for lower abdominal surgeries in pediatric patients while also emphasizing the need for future randomized controlled trials (RCTs) to compare efficacy, standardize practices, and improve patient outcomes.

Key words: Erector spinae block, ilio-inguinal block, quadratus lumborum block, rectus abdominis block, transversus abdominus plane block, ultrasound-guided procedures, USG

Access this article online	
Website: https://journals.lww.com/sjan	**Quick Response Code**
DOI: 10.4103/sja.sja_951_23	

How to cite this article: Thanneeru SK, Kiran M, Padala SR, Gupta A, Ahmad R, Chanchlani R, *et al.* Ultrasound-guided procedures for postoperative pain management in pediatric patients undergoing abdominal surgeries: A systematic review. Saudi J Anaesth 2024;18:240-8.

Suresh K. Thanneeru, Molli Kiran[1], Sri R. A. N. Padala[1], Amit Gupta, Reyaz Ahmad, Roshan Chanchlani, Vidhya Gunasekaran, Amit Agarwal[2], Pramod K Sharma

Departments of Pediatric Surgery, [1]Anaesthesia and [2]Neurosurgery, All India Institute of Medical Sciences, Bhopal, Madhya Pradesh, India

Address for correspondence: Dr. Pramod K Sharma, Department of Pediatric Surgery, All India Institute of Medical Sciences, Bhopal - 462 020, Madhya Pradesh, India.
E-mail: drsharmapramod@gmail.com

Submitted: 11-Dec-2023, **Accepted:** 25-Dec-2023, **Published:** 14-Mar-2024

Introduction

Postoperative pain management is crucial for successful surgical outcomes. The current trend involves reducing the dose and potential toxicity of oral/IV analgesics and supplementing with regional or peripheral analgesia techniques. Peripheral analgesia is preferable over regional analgesia due to its specificity to the area of interest, avoiding unnecessary side effects such as urinary retention, motor paresis, and inadvertent injury to the dura.[1] With the growing use of ultrasound guidance for these procedures and an increasing learning curve, peripheral analgesia has become a standard practice for all surgical procedures in children. However, there is an ongoing debate on which technique yields better results, is less time-consuming, and requires the appropriate dosage of analgesics during these procedures. This systematic review and analysis were conducted to identify gaps in these areas.

Methods

We used the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines for conducting the present review.[2]

PICO question

We examined articles featuring pediatric patients under 21 years of age who underwent abdominal surgeries involving ultrasound-guided procedures for analgesia administration. Our objective was to compare various blocks used for postoperative analgesia, assessing their efficiency and identifying potential complications.

Search strategy

A systematic literature search was conducted across PubMed, SCOPUS, Central Cochrane Registry of Controlled Trials (The Cochrane Library), and ScienceDirect databases, using the search terms outlined in Table 1. Additionally, the reference lists of included studies were reviewed for potentially relevant studies. Four investigators independently screened abstracts, with selected articles undergoing full-text evaluation. Conflicts were resolved through consensus, resulting in a final list of studies.

Eligibility criteria

Randomized controlled trials (RCTs) meeting the inclusion criteria, which focused on ultrasound-guided procedures for postoperative analgesia in pediatric abdominal surgeries, were included. Quasi-randomized controlled studies, prospective and retrospective observational studies, case series, case reports, letters, editorials, comments, animal studies, and non-English literature studies were excluded.

Table 1: Details of search strategy

Database	Search
PubMed	((“pain, postoperative”[MeSH Terms] OR (“pain”[All Fields] AND “postoperative”[All Fields]) OR “postoperative pain”[All Fields] OR (“postoperative”[All Fields] AND “pain”[All Fields])) AND (“analgesic s”[All Fields] OR “analgesically”[All Fields] OR “analgesics”[Pharmacological Action] OR “analgesics”[MeSH Terms] OR “analgesics”[All Fields] OR “analgesic”[All Fields]) AND (“paediatrics”[All Fields] OR “pediatrics”[MeSH Terms] OR “pediatrics”[All Fields] OR “paediatric”[All Fields] OR “pediatric”[All Fields]) AND (“diagnostic imaging”[MeSH Subheading] OR (“diagnostic”[All Fields] AND “imaging”[All Fields]) OR “diagnostic imaging”[All Fields] OR “ultrasound”[All Fields] OR “ultrasonography”[MeSH Terms] OR “ultrasonography”[All Fields] OR “ultrasonics”[MeSH Terms] OR “ultrasonics”[All Fields] OR “ultrasounds”[All Fields] OR “ultrasound s”[All Fields]) AND (“abdomen”[MeSH Terms] OR “abdomen”[All Fields] OR “abdomens”[All Fields] OR “abdominal cavity”[MeSH Terms] OR (“abdominal”[All Fields] AND “cavity”[All Fields]) OR “abdominal cavity”[All Fields])) AND (1000/1/1:2023/11/16[pdat])
COCHRANE	7 Trials matching postoperative pain analgesics pediatric ultrasound abdomen in Title Abstract Keyword
SCOPUS	TITLE-ABS-KEY (postoperative AND pain AND analgesics AND pediatric AND ultrasound AND abdomen)
ScienceDirect	Title, abstract, keywords: postoperative pain analgesics pediatric ultrasound abdomen

Data extraction

Four investigators independently assessed studies and extracted data using a pre-designed pro forma based on inclusion criteria. Extracted details included study author, publication year, country, sample size, type of block, type of surgery, reported outcomes, and any complications. Authors were contacted for missing data, and discrepancies were resolved through consensus. The PRISMA flowchart illustrating the study selection process is presented in Figure 1. We employed the revised JBI critical appraisal tool to assess the risk of bias in randomized controlled trials.[3]

Results

A total of 13 studies met our eligibility and inclusion criteria, comprising 7 randomized controlled trials (RCTs), 1 prospective study, and 3 retrospective studies. The characteristics of the included studies are described in Table 2. The age groups included in these studies varied from 6 months to 21 years, with a combined total sample size of 910. Six studies were excluded, and the reasons are detailed in Tables 3 and 4. The distribution of patients receiving a specific type of block is presented in Figure 2, and the distribution of patients undergoing different surgeries is illustrated in Figure 3. JBI critical appraisal tool details are shown in Table 5. In our review, the ilioinguinal block (IIB) was utilized in 7% of the patients.[4] This block was primarily employed for inguinal surgery, with the most common procedure being inguinal herniotomy (75%). Fredrickson, *et al*.[4] highlighted the difficulty in visualizing

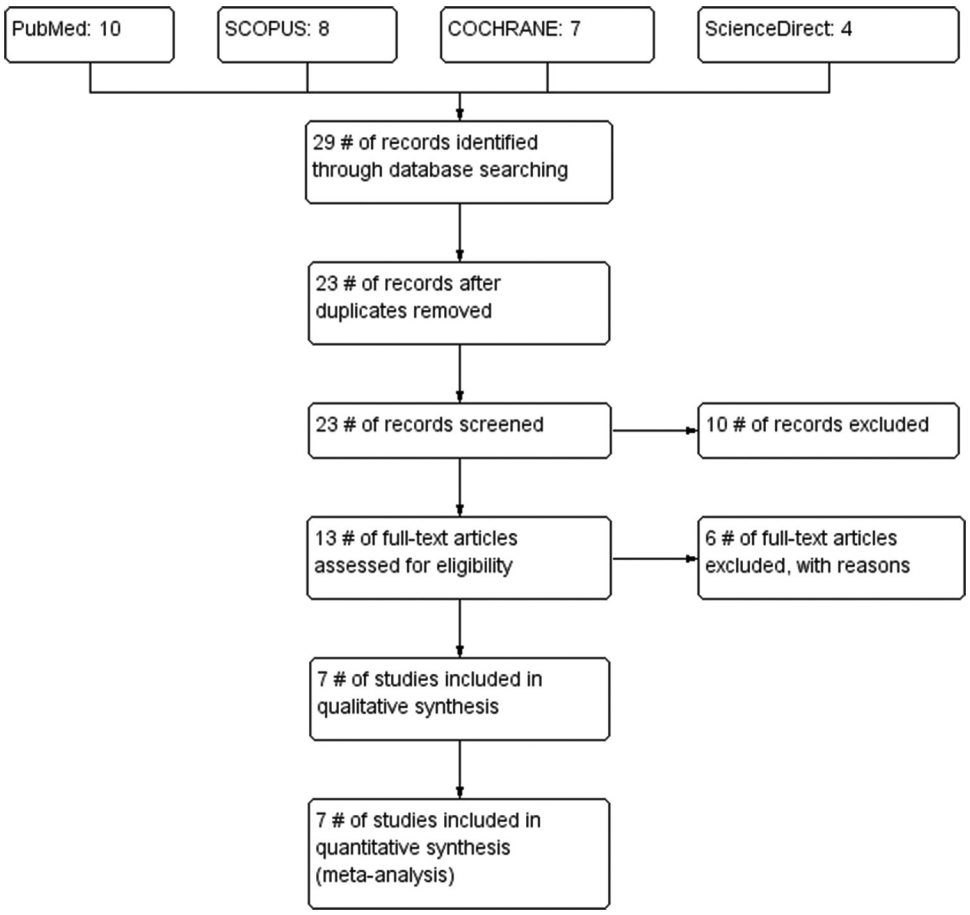

Figure 1: PRISMA flow diagram

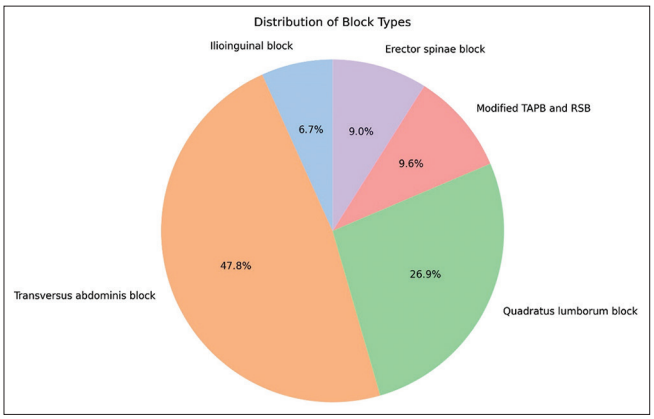

Figure 2: Distribution of the number of patients received a particular type of block

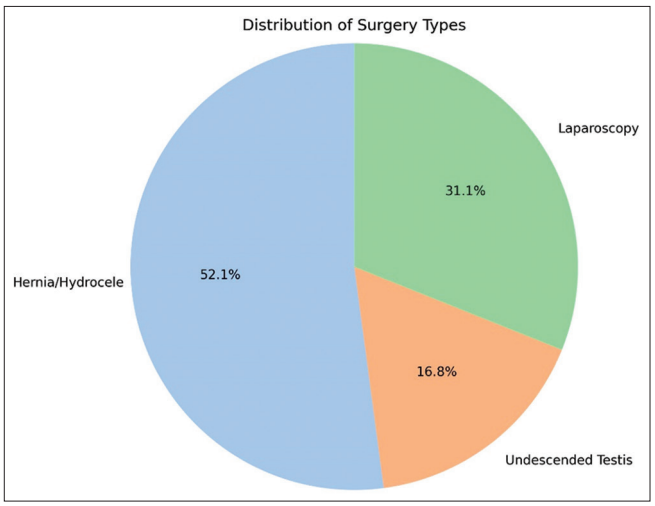

Figure 3: Distribution of number of patients underwent different surgeries

planes with ultrasound for this procedure, leading to increased scan time ranging from 20 to 65 seconds, compared to the transversus abdominus plane block (TAP block), which took less time. However, the postoperative ibuprofen requirement was much lower compared to the TAP block.

In most cases, the TAP block (48%) was used.[1,4-6,9] Al-Sadek *et al*.[6] administered the TAP block posterior to the mid-axillary line for laparoscopic orchidopexy, resulting in significantly lower intraoperative fentanyl requirements and a prolonged time to the first analgesic requirement. Fredrickson *et al*.[4] used the TAP block for open inguinal surgeries, with hernias being the most common (81%). They applied the block at the anterior axillary line and found that this block had poor efficacy compared with the ilioinguinal block, as mentioned earlier. Ipek *et al*.[1] used the anterior variety of the TAP block

Table 2: Characteristics of included studies

Study Author (Year)	Place	Type of study	Age	Age	Gender M/F	Sample	Results	number of patients in each group	outcome variable	OT time	surgeries	Time period for the first dose of rescue analgesia	post op analgesic medication dose
Aksu, 2019[5]	Turkey	RCT	1-7	E-3.1 +/-1.4 Q- 3.6 +/-1.9	E- 21/7 Q-23/6	57	ESPB provides similar postoperative analgesia to the QLB. 0.25% bupivacaine inguinal hernia repair, orchiopexy and hydrocelectomy	ESP block at L1 vertebral level - 0.5 ml/kg 0.25% bupivacaine (max 20 ml) – 30- analyzed 28 QLB block with transmuscular approach 0.5 ml/kg 0.25% bupivacaine (max 20 ml).- 30 – analyzed 29	FLACC scores at 0, 1, 3 or 6 h postoperatively ($P>0.05$). No significant difference was also E-5, Q 6 – required additional analgesics	ESPB- 48+/- 10 min QLB- 44+/-10 min	Hernia repair, Orchidopexy, Hydrocele		FACC score is 0 at 6hr for all
Al-Sadek, 2019[6]	Egypt	RCT	3-7	Tap – 5.8+/-2.1	No data	108	TAP block under ultrasound guidance- easy, safe, reliable and effective 0.5 ml/kg of ropivacaine 0.375% UDT- lap ?Mid-axillary TAP	TAP mid axillary- 54 Control – 54	Children's Hospital Eastern Ontario Pain Scale (CHEOPS)[14] and Objective behavioral pain score (OPS)[15] scores. Total intra op fenta dose- (less in TAP)	TAP- 47+/-26.8 min, Control- 44.9+/-30.4	Lap orchidopexy	TAP- 67.3 +/- 62.3 min, control- 36.3+/- 51.2	
Fredrickson, 2010[4]	Newzeland	RCT	6 m-12	4.4 (3.7)-i 3.9 (2.7)-T	17/3-i 14/7-T	41	pediatric inguinal surgery, ilioinguinal block provides more effective analgesia than the TAP block.	TAP ant axillary line – 20 Ilioinguinal block- 21	Scan time I/T– 46/23 Needle time- 81/46 Intra op fenta No: pat reporting pain I – 45% T- 76% Brufen require- I -30% T-62%	Scan time I/T– 46/23 Needle time- 81/46	Hernia Hydrocele Orchidopexy		The number of patients reporting pain (76% vs 45%, $P=0.04$) and requiring ibuprofen (62% vs 30%, $P=0.037$) in the day-stay unit was higher in the TAP group
Genc Moralar, 2020[7]	Turkey	RCT	3-6	O- 6.6 +/-3.7, B- 6.10+/- 2.3	O- 19:1, B-17:3	40	QIB1 provides effective analgesia in the postoperative period for lower abdominal.	O – 20, Q- 20 (QLB1)	The Wong-Baker facial pain scale was used to assess pain (1: no pain, 10: worst possible pain).	O- 36+/-9, B- 33.9+/- 7.2	unilateral undescended testis and unilateral hydrocele operations.	Q- 8 hr, O-3.5	

Contd...

Table 2: Contd...

Study Author (Year)	Place	Type of study	Age	Age	Gender M/F	Sample	Results	number of patients in each group	outcome variable	OT time	surgeries	Time period for the first dose of rescue analgesia	post op analgesic medication dose
							surgery in pediatric patients		Post op tramadol use, paracetamol use.				
Han, 2022[8]	China	RCT	1-6	SGA- 3.1+/-1.0, LAI- 3.5+/-1.5, AWNB- 3.4+/-1.6	SGA- 28/2, LAI- 27/3, AWNB- 28/2	90	AWNB is associated with a lower intraoperative remifentanil requirement and a lower postoperative FLACC pain score compared with LAI in children undergoing laparoscopic inguinal hernia repair with propofol-remifentanil based general anesthesia.	30 each group- no local, local, Nerve block- modified combined TAP+RSB	intra op remifentanil infusion, post op FLACC score	SGA- 40+/-9 min, LAI- 39+/-7 min, AWNB- 43+/-9 min	lap inguinal hernia		
Ipek, 2019[1]	Turkey	RCT	6 m-12	Q-3.8 +/-3.2, T- 4.1 +/-2.5, C- 2.9 +/-2.6	Q- 28/7, T- 19/10, C-27/3	94	ultrasound-guided QL block should be considered as an option for perioperative analgesia in pediatric patients	lateral QLB -35, lateral TAPB-29, caudal- 30	Pediatric Objective Pain Scale (POAS) till 24 hr	?Q- 5.6+/-1.3 min, T- 6.4+/-2.8, C-8.4+/-3.4	Hydrocele, hernia, orchidopexy, combined procedures		more in TAP>QL>C
Sandeman, 2011[9]	Australia	RCT	7–16	LAI-11.2, RSB- 11.6	LAI-86/139, RSB- 84/136	93	TAP blocks (anterior) increased anesthesia time by 14 min on average but offered no clinically important benefit over local anesthetic port-site infiltration 0.5 ml/kg of 0.2% ropivacaine Lap appendicectomy	LAI- 139, RSB- 136	total opioid administration. Time to rescue analgesia. Pain scores FACES/ VAS	LAI-33.8, RSB- 32.8	single port lap appendix	LAI- 41 min (mean 40.8) RSB-59.6 (69.5)	

Table 3: Studies excluded with reasons

Study Author (Year)	Reason for exclusion
Hernandez, 2017[10]	Retrospective
Lapmahapaisan, 2015[11]	Surgeon was giving block, no ultrasound
Maloney, 2018[12]	Retrospective case control study
Sato, 2017[13]	Retrospective case control study
Scarpa, 2021[14]	Case report
Sola, 2014[15]	Prospective interventional (no randomization)

for lower abdominal procedures, with inguinal hernia repair being the most common surgery (65%). They highlighted that the TAP block was less effective compared to the quadratus lumborum block and caudal epidural block. Postoperative analgesic requirements were high in patients who received the TAP block. Sandeman *et al*.[9] used the TAP block for laparoscopic appendicectomy, employing the anterior variety of the TAP block, and showed no benefit compared to controls. They demonstrated that surgery time increased with the procedure without any clear benefit.

Quadratus lumborum block (QLB) was used in 27% of the patients.[5] Aksu *et al*.[5] used the transmuscular approach to this block for lower abdominal surgeries. The most common surgery performed was open orchidopexy (55%). They found the results comparable to the erector spinae block (ESB), which is effective in decreasing postoperative analgesic requirements. Ipek.[1] used the lateral QL block approach for 35 patients, with the most common surgery being open inguinal hernia repair (63%). They demonstrated that the QL block was much more effective compared to the TAP block and caudal epidural block in terms of postoperative pain scores and length of hospital stay.[1] Genc Moralar *et al*.[7] used the QLB lateral approach for 20 patients, of which inguinal hernia repair (65%) was the most common procedure. They showed better results with the QLB in terms of the time for the first analgesic requirement and the total analgesic requirement in the first 24 hours.[7] Modified TAP block and rectus sheath block (RSB) were used in 10% of the patients.[8] Han *et al*.[8] used this modified block in 30 patients with inguinal hernia, both unilateral and bilateral. They demonstrated better results with this block in terms of intraoperative remifentanil use and postoperative FLACC scores.[7] ESB was used in 9% of the patients.[5] Aksu *et al*.[5] employed this procedure in 28 patients, with the most common surgery being orchidopexy (50%). They demonstrated better efficacy with this block, with comparable results to the QLB block in terms of postoperative FLACC scores and time to the first analgesia.

Discussion

Pre-procedural analgesia is considered the optimal approach for managing postoperative pain. According to our review, nine distinct techniques were employed for this purpose, each with its unique set of benefits and drawbacks. These procedures include (1) rectus sheath block, (2) Ilioinguinal nerve block or anterior TAP block, Transversus abdominis Plane block – (3) subcostal, (4) mid-axillary, and (5) posterior or transversus fascial block, quadratus lumborum block - (6) lateral, (7) posterior, and (8) transmuscular, and (9) Erector Spinae block. Notably, these procedures are not universally applicable across all abdominal surgeries. Surgeons prioritize blocks that do not excessively extend operating room time, have fewer complications, and do not interfere with surgical planes. Given the dermatomal distribution of the abdomen from T6 to L1, various blocks are designed to target specific dermatomes.[10] The selection of a block needs to be tailored to the individual patient's needs.

Most blocks are administered for lower abdominal surgeries, with inguinal hernia and hydrocele procedures comprising 52% of cases. The average duration of these surgeries is 30 minutes, with patients often discharged on the same day. In our review, the most used procedure for these surgeries was the quadratus lumborum block (QLB), demonstrating superior efficacy. The transversus abdominis plane (TAP) block followed as the next commonly used procedure, showing mixed results. It is worth noting that different authors have employed various techniques of QLB and TAP blocks, adding complexity to the choice.

In our review, the TAP block emerged as the most used procedure. The anatomical peculiarities of the TAP plexus at the triangle of Petit, featuring extensive branching and communication of T9-L1 nerves, make it well-suited to cover the extensive area of the lower abdomen.[16] Notably, the TAP block was the exclusive procedure used for laparoscopic surgeries in our review. The ESB, typically used for thoracic surgeries, was employed by Aksu, *et al*.,[5] for abdominal surgeries (hernia, hydrocele, and orchidopexy) and demonstrated comparable results with the QLB. This trans-fascial block is dose-dependent with a mechanism of action possibly depending on the trans-fascial spread of local anesthetic to the paravertebral and epidural space and has the potential to spread up to T6 with action on visceral pain.[17] Despite its positive outcomes, the main disadvantage is the need to position the patient laterally or prone, which can consume time, pose risks such as endotracheal tube dislodgement and requiring expertise.

QLB has three approaches. The lateral QLB approach, in which LA is injected at the junction of Transversus abdominis and quadratus lumborum. In posterior approach QLB, LA is injected posterior to the quadratus lumborum

Table 4: Characteristics of non-randomized excluded studies

Study Author (Year)	Place	Type of study	Age	Age	Gender M/F	Sample	Results	number of patients in each group	outcome variable	OT time	surgeries	Time period for the first dose of rescue analgesia	post op analgesic medication dose
Hernandez, 2017[10]	France	Retrospective	<21	Mean- 15 yr (range 5-20),	no data	10/15 blocks	Good coverage with post TAP block, mid axillary is unpredictable. Ropivacaine 0.2% - 0.5 ml/kg Cholecystectomy, Ileostomy closure, Laparoscopic appendectomy, Laparoscopic G tube, Splenectomy, Ureteral implant	10 - post TAP block	Dermatome levels achieved, post opioid - morphine equivalents, pain scores	no data	Cholecystectomy 2 Ileostomy closure 3 Laparoscopic appendectomy 1 Laparoscopic G tube 1 Splenectomy 1 Ureteral implant		
Maloney, 2018[12]	New York	Retrospective case control study	4-17			275	total narcotic administration was significantly reduced in patients that underwent preincision RSB 0.5 mlkg□1 of 0.5% bupivacaine appendicectomy- single site.						
Sato, 2017[13]	Japan	Retrospective case control study	1	TAP-11, control -11		21	no significant difference caudal -0.02–0.05 mg/kg morphine in 0.8-2.0 ml/kg of 0.1–0.2% ropivacaine, para vertebral cath- 0.5–3 mg/kg of 0.2–0.25% ropivacaine or 0.125-0.25% levobupivacaine Liver tumor, Congenital biliary atresia Congenital biliary dilatation Kidney tumor, Ureteropelvic junction stenosis	? lateral TAP-46, control -47	morphine consumption in first 16 hr, PCA morphine from 0-8 hr, >8-16, pain score with VAS scale	TAP- 111 min, Control- 45	lap appendicectomy	first PCA- TAP- 50 min, control- 26. Mean time for first non-pca analgesia- TAP- 483, control 580.	
Sola, 2014[15]	France	Prospective interventional	1-5	S-3, F-2.5	S-12/5, F-5/5	27	0.2 ml kg1 of 0.2% levobupivacaine provides successful perioperative analgesia in 95% of children hernia	success- 17, failed- 10	The mean effective dose of levobupivacaine resulting in an effective TAP block in 50% of cases (ED50) obtained by using Dixon's up-and-down sequential method. The ED50 and ED95 were further estimated by bootstrapping.	S- 20 min, F-16	hernia		Thirty-five percent of children in the success group received additional rescue analgesia.

Table 5: JBI critical appraisal checklist for RCT studies

Study ID	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13
Aksu, 2019[5]	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Al-Sadek, 2019[7]	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fredrickson, 2010[4]	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Genc Moralar, 2020[7]	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Han, 2022[8]	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ipek, 2019[1]	Unclear	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sandeman, 2011[9]	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Internal validity													
Bias related to selection and allocation													
1Was true randomization used for assignment of participants to treatment groups?													
2 Was allocation to treatment groups concealed?													
3 Were treatment groups similar at the baseline?													
Bias related to administration of intervention/exposure													
4 Were participants blind to treatment assignment?													
5 Were those delivering the treatment blind to treatment assignment?													
6 Were treatment groups treated identically other than the intervention of interest?													
Bias related to assessment, detection, and measurement of the outcome													
7 Were outcome assessors blind to treatment assignment?													
8 Were outcomes measured in the same way for treatment groups?													
9 Were outcomes measured in a reliable way													
Bias related to participant retention													
10 Was follow up complete and if not, were differences between groups in terms of their follow up adequately described and analyzed?													
Statistical Conclusion Validity													
11 Were participants analyzed in the groups to which they were randomized?													
12 Was appropriate statistical analysis used?													
13 Was the trial design appropriate and any deviations from the standard RCT design (individual randomization, parallel groups) accounted for in the conduct and analysis of the trial?													

muscle within the middle layer of Thoracolumbar fascia. Anterior approach Trans-muscular QLB, in which LA is injected anterior to the quadratus lumborum muscle close to the tip of the transverse process. The mechanism of analgesia may be due to subendothoracic fascial spread and direct spread to the lumbar plexus branches. This block has the potential to spread up to T6 with action on visceral pain also and hence can be used for abdominal surgeries.[18] Aksu *et al*.[5] used the Transmuscular technique. Genc Moralar, *et al*.,[9] and Ipek *et al*.[1] used the lateral QLB approach. There were no reported complications in our review, but the potential complications expected with this procedure are injury to intra-abdominal organs like the kidney, liver, and spleen, spread to the lumbar plexus, lower limb weakness, etc., The main disadvantage with this procedure is to position the patient laterally or prone which can consume time and risk of Endotracheal tube dislodgement, etc., and the need for expertise, especially for the trans-muscular variety.

The TAP block-subcostal approach is mainly used for upper abdominal surgery (covering T6 to T10), the lateral approach is used for lower abdominal surgery (covering T10 to T12 and inconsistently L1), and the posterior approach covers T9 to T12 and L1.[16] Ilioinguinal nerve and iliohypogastric nerve block, classified under the anterior TAP block, mainly cover L1. Studies by Ipek *et al*.[1] and Fredrickson *et al*.[4] indicated that the lateral approach had less time for the first analgesic requirement and more total analgesic requirement compared to other techniques. Al-Sadek *et al*.[6] did not clearly mention the approach used, but the injection point being posterior to the mid-axillary line and injected between the internal oblique and transversus abdominis muscles showed better results in laparoscopic appendectomy cases. Fredrickson, *et al*.[4] used ilioinguinal block and showed better results compared to TAP block (lateral approach). There has been confusion in the technique used in the name of TAP block in many studies. This block does not require a change in the patient's position.

Rectus sheath block, usually given bilaterally under the lateral border of the rectus abdominis muscle and over the rectus fascia, covers the anterior cutaneous branches of intercostal nerves. Han *et al*.[8] modified this technique with a TAP block (subcostal approach) and achieved better results in lower abdominal surgeries. Due to the wide heterogeneity in usage, technique, and outcome comparison methods, our review may not comprehensively compare all blocks. However, this review provides valuable insights into the necessity for reporting outcomes in a comparable manner like time required for the first analgesia, total analgesic requirement, etc., and the need for further RCTs and meta-analyses of individual procedures and their variations.

Conclusions

Each procedure has its distinct advantages and limitations, reflecting the complexity of tailoring analgesic interventions to the unique demands of pediatric patients. Our review illuminates the progress made in ultrasound-guided postoperative analgesia for pediatric patients undergoing lower abdominal surgeries. However, it equally accentuates the avenues for future RCTs to compare efficacy, standardize practices, and enhance patient outcomes in this specialized domain.

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

References

1. Ipek CB, Kara D, Yılmaz S, Yeşiltaş S, Esen A, Dooply SSSL, *et al*. Comparison of ultrasound-guided transversus abdominis plane block, quadratus lumborum block, and caudal epidural block for perioperative analgesia in pediatric lower abdominal surgery. Turk J Med Sci 2019;49:1395-402.
2. Matthew JP, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, *et al*. The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71.
3. Barker TH, Stone JC, Sears K, Klugar M, Tufanaru C, Leonardi-Bee J, *et al*. The revised JBI critical appraisal tool for the assessment of risk of bias for randomized controlled trials. JBI Evid Synth 2023;21:494-506.
4. Fredrickson MJ, Paine C, Hamill J. Improved analgesia with the ilioinguinal block compared to the transversus abdominis plane block after pediatric inguinal surgery: A prospective randomized trial. Paediatr Anaesth 2010;20:1022-7.
5. Aksu C, Şen MC, Akay MA, Baydemir C, Gürkan Y. Erector spinae plane block vs quadratus lumborum block for pediatric lower abdominal surgery: A double blinded, prospective, and randomized trial. J Clin Anesth 2019;57:24-8.
6. Al-Sadek WM, Rizk SN, Selim MA. Ultrasound guided transversus abdominis plane block in pediatric patients undergoing laparoscopic surgery. Egypt J Anaesth 2019;30:273-8.
7. Genc Moralar D, Tok Cekmecelioglu B, Aslan M, Hergünsel GO. Effect of quadratus lumborum block on postoperative analgesic requirements in pediatric patients: A randomized controlled double-blinded study. Minerva Anestesiol 2020;86:150-6.
8. Han D, Pan S. Comparison of analgesic efficacy of local anesthetic infiltration and ultrasound-guided abdominal wall nerve block in children undergoing ambulatory inguinal hernia repair. J Perianesth Nurs 2022;37:699-705.
9. Sandeman DJ, Bennett M, Dilley AV, Perczuk A, Lim S, Kelly KJ. Ultrasound-guided transversus abdominis plane blocks for laparoscopic appendicectomy in children: A prospective randomized trial. Br J Anaesth 2011;106:882-6.
10. Hernandez MA, Vecchione T, Boretsky K. Dermatomal spread following posterior transversus abdominis plane block in pediatric patients: Our initial experience. Paediatr Anaesth 2017;27:300-4.
11. Lapmahapaisan S, Tantemsapya N, Aroonpruksakul N, Maisat W, Suraseranivongse S. Efficacy of surgical transversus abdominis plane block for postoperative pain relief following abdominal surgery in pediatric patients. Paediatr Anaesth 2015;25:614-20.
12. Maloney C, Kallis M, El-Shafy IA, Lipskar AM, Hagen J, Kars M. Ultrasound-guided bilateral rectus sheath block vs. conventional local analgesia in single port laparoscopic appendectomy for children with nonperforated appendicitis. J Pediatr Surg 2018;53:431-6.
13. Sato M, Iida T, Kikuchi C, Sasakawa T, Kunisawa T. Comparison of caudal ropivacaine-morphine and paravertebral catheter for major upper abdominal surgery in infants. Paediatr Anaesth 2017;27:524-30.
14. Scarpa MG, Iaquinto M, Codrich D, Schleef J. Bilateral sactosalphinx and congenital adrenal hyperplasia: Case report on two rare conditions in two virgin girls. Ital J Pediatr 2021;47:141.
15. Sola C, Menace C, Rochette A, Raux O, Bringuier S, Molinari N, *et al*. Ultrasound-guided tranversus abdominis plane block for herniorrhaphy in children: What is the optimal dose of levobupivacaine? Eur J Anaesthesiol 2014;31:327-32.
16. Mavarez AC, Hendrix JM, Ahmed AA. Transabdominal plane block. In StatPearls. StatPearls Publishing: Treasure Island (FL); 2023.
17. Chin KJ, El-Boghdadly K. Mechanisms of action of the erector spinae plane (ESP) block: A narrative review. Can J Anaesth 2021;68:387-408.
18. Elsharkawy H, El-Boghdadly K, Barrington M. Quadratus lumborum block: Anatomical concepts, mechanisms, and techniques. Anesthesiology 2019;130:322-35.