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Analgesic Effectiveness of Quadratus Lumborum Block for Patients after Abdominal Surgery: A Systematic Review and Meta-Analysis

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Abstract

Background: A series of studies have reported that Quadratus Lumborum Block (QLB) can have a great postoperative analgesia for lower abdominal surgery. However, a meta-analysis of the analgesic effect of QLB in patients undergoing lower abdominal surgery has not been published.

Methods: We searched the databases of Pubmed, Embase, Cochrane Library, and Web of Science (updated to October 15, 2019). We cumulative opioid consumption at 6, 12, 24 and 48 h after surgery; pain score (rest and dynamic) at 6, 12, 24 and 48 h after surgery; occurrence of common opioid-related complications at 24 h after surgery. Opioid consumption as the main outcome.

Results: Thirteen Randomized Controlled Trials (RCTs) including 751 patients were analyzed. Compared with control group, QLB group can effectively reduce 24 h and 48 h cumulative opioid consumption 10.1 mg (95% CI: -13, -7.2; p<0.00001) and 16.22 mg (95% CI: -19.39, 13.03; p<0.00001) in patients with cesarean section, but can reduce effectively cumulative opioid consumption in patients undergoing laparoscopic surgery at 6, 12 and 24 h. Posterior QLB group and transmuscular QLB group reduced 24 h cumulative opioid consumption 4.03 mg (95% CI: -7.89, -0.19; p=0.04) and 12.44 mg (95% CI: -20.2, -4.68; p=0.002), respectively. QLB group reduced rest Visual Analogue Scale (VAS) score at 12, 24 and 48 h, however, the effective reduction of rest VAS score in patients undergoing cesarean section only occurs at 24 h after surgery.

Conclusion: QLB seems to provide better analgesia for patients undergoing laparoscopic surgery than patients undergoing cesarean section. Transmuscular QLB appears to have reduced postoperative opioid consumption compared to posterior QLB. More future RCTs are needed to support our conclusions.

Keywords: Postoperative Acute Pain; Quadratus Lumborum Block; Opioid Consumption; Abdominal Surgery; Meta-Analysis

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Abbreviations

QLB: Quadratus Lumborum Block; RCT: Randomized Controlled Trials; VAS: Visual Analogue Scale; NRS: Numerical Rating Scale; PONV: Postoperative Nausea and Vomiting; CI: Confidence Interval; OR: Odds Ratios

Background

Postoperative acute pain occurs in more than 80% of operation patients, and approximately 75% of operation patients experience the moderate or higher pain [1,2]. Evidence shows that less than half of operation patients claim that postoperative pain is effectively relieved. Inadequate negative control of pain affects the quality of life, function and function recovery, risk of postoperative complications, and risk of long-term postoperative pain [3]. Proper postoperative analgesia can reduce pain, encourage patients to cough and get out of bed, reduce the occurrence of lower extremity thrombosis and pulmonary complications and improve postoperative satisfaction [4-6]. Postoperative analgesia using traditional opioids often causes constipation, nausea, vomiting and other adverse reactions, thus limiting its clinical application. Regional analgesia techniques combined with intravenous self-controlled analgesia can effectively reduce the dosage and adverse

effects of opioids, which is conducive to rapid recovery after surgery [4].

The Quadratus Lumborum Block (QLB) was first proposed by Blanco [7] in 2007, which is suitable for perioperative analgesia in abdominal, hip and lower extremity surgery. Studies [8,9] have shown that compared with the Transversus Abdominisplane Block (TAPB), QLB can block both body and visceral pain, with better analgesic effect and longer duration. A number of studies [8-22] have also reported that the QLB can be an effective postoperative analgesia both for laparoscopic surgery and cesarean section, and the choices about the different approaches of QLB were also diverse [10,14,16,18,23-31]. However, a meta-analysis of the QLB has not been published. The purpose of this article is to report on the improvement in the analgesic effect of the QLB compared to placebo and control groups in patients undergoing lower abdominal surgery. Subgroup analyses were intended to be used to find differences in the approach of different QLB and between patients with different surgical procedures. Provide guidance for anesthesiologists to choose postoperative analgesia.

Methods

The work has been reported in line with PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) and AMSTAR (Assessing the Methodological Quality of Systematic Reviews) Guidelines.

The meta-analysis was registered on PROSPERO (CRD42019120858), Registry URL:http://www.crd.york.ac.uk/PROSPERO/display_record.php?ID=CRD42019120858.

Eligibility criteria

We included Randomized Controlled Trials (RCTs) that measured the postoperative analgesia of QLB in patients undergoing lower abdominal surgery. There were no restrictions on the language of the full text. In order to ensure that the outcome indicators would not be interfered by too many factors, the trials we included must compared QLB group with control group with sham block or without block.

Literature search

We searched the databases of Pubmed, Embase, Cochrane Library and Web of Science (updated to October 15, 2019). A total of 843 literatures about QLB were retrieved. The search was done independently by two authors (Chao Xu and He Zhu) using (quadratus lumborum) and (nerve block or block, Nerve or Blocks, Nerve or Nerve Blocks or Nerve Blockade or Blockade, Nerve or Blockades, Nerve or Nerve Blockades or Chemical Neurolysis or Chemical Neurolyses Or Neurolyses, Chemical or Neurolysis, Chemical) as the search terms.

Data collection and presentation

The characteristics and results data of the included trials were extracted independently by two authors (Chao Xu and He Zhu), and the work of quality assessment was also completed independently by two authors (Chao Xu and He Zhu) using the Cochrane risk bias tool and Review Manager 5.3 software (Cochrane, London, UK) according to the Cochrane handbook [32]. If the two authors disagree about the quality of the article, it will be decided by the third author (Tianyu Liu) to join the discussion.

To assess the effect of QLB on postoperative analgesia in patients after abdominal surgery, we extracted the following data: Cumulative opioid consumption (transformed to morphine equivalent) [33,34] at 6, 12, 24 and 48 h after surgery; time interval from the end of the surgery to the first use of additional analgesic; the number of patients who used additional analgesic after surgery; pain score (rest and dynamic) at 6, 12, 24 and 48 h after surgery; nausea and vomiting, itching, sedation, muscle weakness, and postoperative patient satisfaction at 24 h after surgery; we contacted the author to ask about the results and got some responses to complete the meta-analysis [16,18].

Meta-analysis

Two authors collaborated on data processing using the Review Manager 5.3 software (Cochrane, London, UK) for data synthesis. Considering the heterogeneity among different trials, we chose random effect modeling for the synthesis of dichotomous and continuous data. The synthesized dichotomous variables were represented by the Odds Ratios (OR) and their 95% Confidence Intervals (CI). The synthesized continuous variables were represented by the mean differences and their 95% CIs. The findings were considered statistically significant when the 95% CI of the OR excluded 1 and the 95% CI of the mean difference excluded 0.

The heterogeneity between trials was determined using an I2 test [35, 36]. If the I2 value was less than 25%, low heterogeneity was considered to exist; If I2 value was greater than 25% and less than 50%, moderate heterogeneity was considered to exist; and if I2 value was greater than 50%, high heterogeneity was considered to exist. If there was high heterogeneity (I2 value >50%), a sensitivity analysis was performed to determine the source of heterogeneity. If the included variables were excluded one by one and the I2 value was still greater than 50%, the result was considered to be reliable. If the characteristics of the included trials varied widely, subgroup analysis was performed to reduce heterogeneity.

Results

Study selection

The two authors (Chao Xu and He Zhu) retrieved a total of 843 articles, 32 of which were viewed in full text, 13 articles that met the inclusion criteria and were analyzed for data [10,14,16,18,23-31]. Figure 1 details the search, inclusion and exclusion of the literature. A total of 751 patients (372 patients underwent caesarean section and 379 patients underwent laparoscopic surgery in the lower abdomen) were finally included in the data analysis, 373 in the QLB group (215 patients were performed with posterior QLB and 130 patients were performed with transmuscular QLB, and 28 patients were performed lateral QLB) and 380 in the control group [10,14,16,18,23,24,25,37-31]. All QLB were guided by ultrasound and all included patients undergoing lower abdominal surgery were adults. Most trials had demonstrated random sequence generation and 1 trial did not demonstrate this, but there is no evidence to prove the low quality of it [14]. Strict Blinding was performed on all evaluators, ensuring minimal performance bias. However, patients in 4 trials were not blinded and may result in a detection bias of pain scores [10,17,18,22].

Table 1 presents the outcomes of included articles, Table 2 presents the results of the meta-analysis and Figure 2 presents the results of quality assessment completed by two authors; the characteristics of the included articles were presented in Table3. Sensitivity analysis was performed on all data synthesis, and no trials were found to reduce I2 to 50%. Since less than 10 articles were included, the Begg's test was not performed.

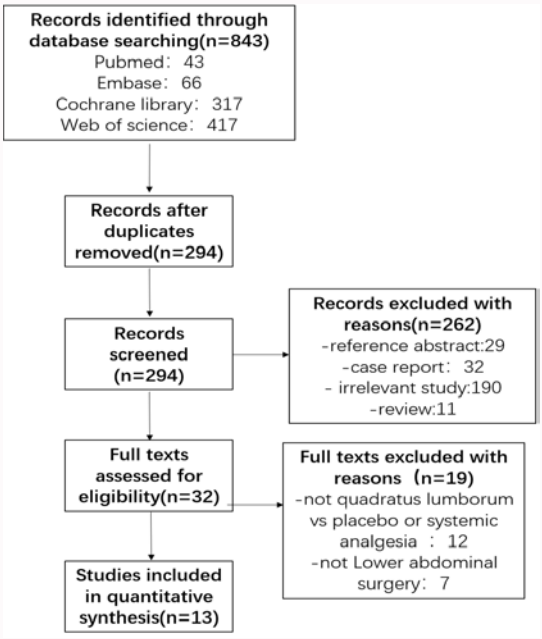

Figure 1: The search, inclusion and exclusion of the literature.

Interval opioid consumption

We synthesized the total consumption of opioids at 12, 24 and 48 h after surgery to quantitatively evaluate whether QLB could reduce the need for opioids in patients after surgery. Cumulative opioid consumption was transformed to intravenous morphine equivalents (morphine 10 mg i.v. = morphine 30 mg p.o. = tramadol 100 mg i.v. = ketobemidone 8 mg i.v. = fentanyl 1 mg i.v. = sufentanil 0.01 mg i.v.).

Compared with control group, QLB group can effectively reduce 6, 12 and 24 h cumulative opioid consumption, but the data are highly heterogeneous (I2=92%, 93% and 93%,respectively), after the subgroup analysis, we found: QLB group can effectively reduce 24 and 48 h cumulative opioid consumption 10.1 mg (95% CI: -13, -7.2; P<0.00001) and 16.22 mg (95% CI: -19.39, 13.03; P<0.00001) in patients with cesarean section, for patients underwent laparoscopic surgery, QLB group can reduce effectively cumulative opioid consumption at 6, 12 and 24 h with 4.91 mg (95% CI: -9.68, -0.14; P=0.04), 3.19 mg (95% CI: -6.23, -0.16; P=0.04) and 7.95 mg (95% CI: -15.88, -0.01; P=0.05), respectively. Posterior QLB group and transmuscular QLB group reduced 24 h cumulative opioid consumption 4.03 mg (95% CI: -7.89, -0.19; p=0.04) and 12.44 mg (95% CI: -20.2, -4.68; p=0.002), respectively (Table 2 and Figure 3).

The cumulative morphine consumption in the laparoscopic subgroup at 12 h and in the cesarean section subgroup at 24 and 48 h showed low heterogeneity (I2=41%, 18% and 0%, respectively). The rest of the morphine consumption data showed high heterogeneity, and the sensitivity analysis still could not effectively reduce the I2 value.

Rest pain

Because the included articles used Visual Analogue Scale (VAS) [10,23,26,27,30,31] or Numerical Rating Scale scoring (NRS) [14,16,18,29] to assess postoperative rest pain, we synthesized the data using the same scoring method at the same time. Because only one trial [18] evaluated the resti NRS score at 36 h after surgery, we calculated pain scores at 6, 12, 24, and 48 h postoperatively.

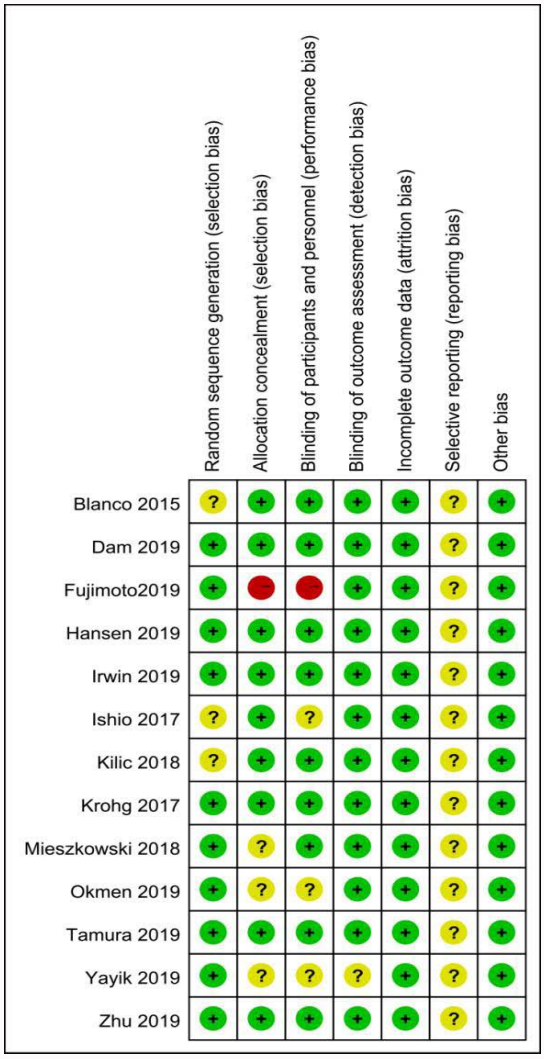

Figure 2: The results of quality assessment of the included articles.

At 6 h postoperatively, there was no statistically significant between QLB group and control group in rest VAS score.

At 12 h postoperatively, QLB can reduce rest VAS score and NRS score 1.66 cm (95% CI: -2.07, -1.26, P<0.00001; I2=61%) and 1.1 cm (95% CI: -1.65, 0.55, P<0.0001; I2=20%), respectively. The laparoscopic subgroup (I2=64%), cesarean section subgroup (I2=20%) and posterior QLB subgroup (I2=61%) all showed statistical differences compared with control group.

At 24 h postoperatively, QLB can reduce rest VAS score and NRS score 2.05 cm (95% CI: -3.39, -0.7, P=0.003; I2=97%) and 2.34 cm (95% CI: -3.22, -1.45, P<0.00001; I2=94%), respectively. Compared with control group, QLB subgroup can reduce NRS score 1.07 cm (95% CI: -1.51, -0.62, P<0.00001; I2=0%) in patients underwent cesarean section (Additional file 2 and Additional Figure 4).

At 48 h after operation, QLB can only reduce rest VAS score 0.81 cm (95% CI: -1.56, -0.03, P=0.04; I2=0%) but cannot statistically reduce NRS score.

Dynamic pain

Six trials [10,14,16,29-31] evaluated postoperative dynamic pain scores, 3 trials [10,30,31] used VAS, and 3 trials [14,16,29] used NRS

Table 1: Outcomes of the included articles.

Author/year	Surgery	Sample size	Groups (n)	Anesthesia	Primary outcome	Rest pain scores	Dynamic pain scores	Opioid consumption	Number of additional analgesics	Adverse effects	Quality of recovery
Blanco, 2015 [10]	caesarean section	50	QLB (23) sham block (25)	spinal anesthesia	morphine demands and the actual doses	√	√	√		√	
Dam, 2019 [31]	percutaneous nephrolithotomy	60	QLB (25) sham block (26)	general anesthesia	OME consumption	√	√	√		√	
Fujimoto, 2019 [30]	gynaecological laparoscopic surgery	60	QLB (27) no block (29)	general anesthesia	quality of recovery	√		√	√	√	√
Hansen, 2019 [28]	caesarean section	72	QLB (34) sham block (34)	spinal anesthesia	OME consumption	√	√	√		√	
Irwin, 2019 [32]	caesarean section	90	QLB (44) sham block (42)	spinal anesthesia	morphine consumption	√	√	√		√	√
Ishio, 2017 [14]	laparoscopic gynecologic surgery	74	QLB (35) no block (35)	general anesthesia	NRS score	√	√		√	√	
Kilic, 2018 [35]	percutaneous nephrolithotomy	44	QLB (22) sham block (22)	spinal anesthesia	VAS scores and morphine consumption	√		√			
Krohg, 2017 [16]	caesarean section	40	QLB (20) sham block (20)	spinal anesthesia	ketobemidone consumption	√	√	√		√	
Mieszkowski, 2018 [18]	caesarean section	60	QLB (28) no block (30)	spinal anesthesia	morphine consumption	√		√		√	
Okmen, 2019 [34]	percutaneous nephrolithotomy	60	QLB (30) no block (30)	general anesthesia	morphine consumption and VAS scores	√		√	√	√	
Tamurua, 2019 [29]	caesarean section	176	QLB+spinal morphine (34) sham block+spinal morphine (38) QLB+spinal saline (36) sham block and spinal saline (38) *	spinal anesthesia	VAS score	√	√	√	√	√	
Yayik, 2019 [33]	extracorporeal shock wave lithotripsy	44	QLB (20) no block (20)	intravenous anesthesia	VAS score, opioid consumption, patient satisfaction, ESWL and stone details	√		√	√		√
Zhu, 2019 [36]	laparoscopic nephrectomy	60	QLB (29) sham block (29)	general anesthesia	Sufentanil consumption	n	n	y	y	y	y

Abbreviations: OME: Oral Morphine Equivalent; VAS: Visual Analogue Scale; NRS: Numerical Rating Scale
*Only QLB+spinal saline group and sham block + spinal saline group were included in the analysis

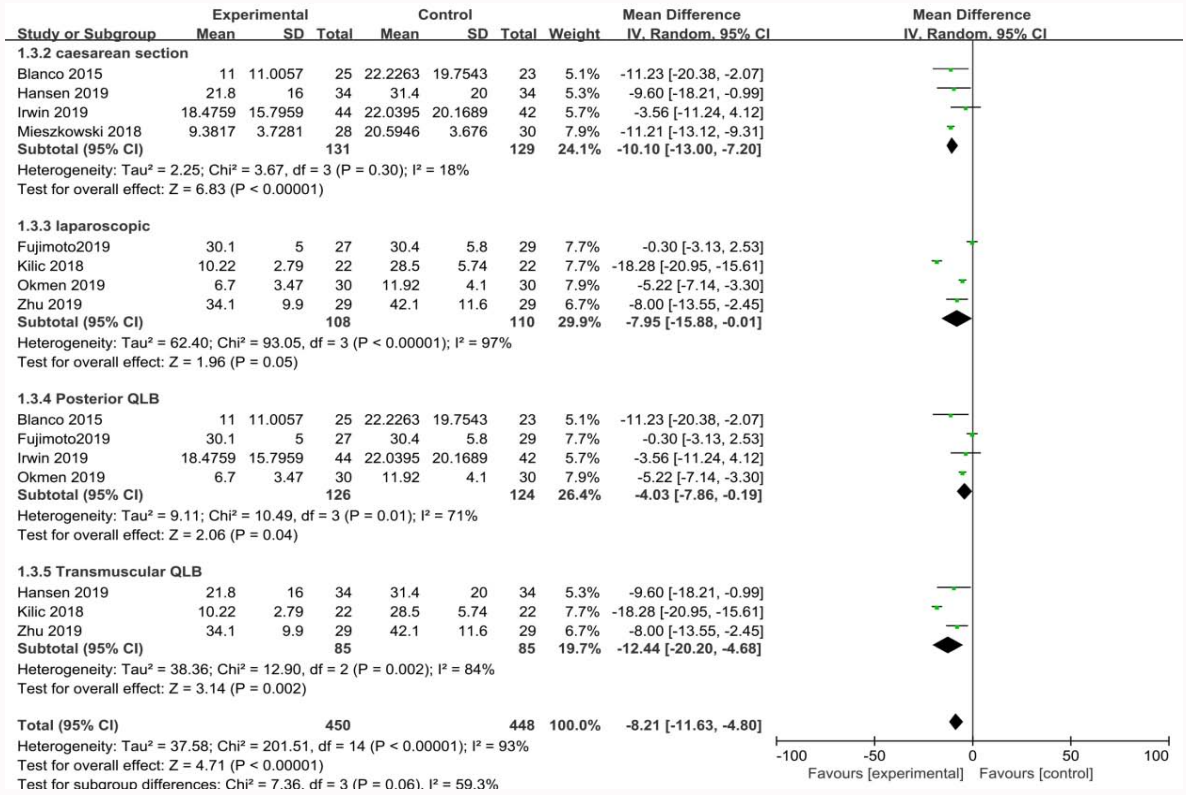

Figure 3: Cumulative opioid consumption 24 hours after surgery.

Table 2: Results of meta-analysis.

Outcome	Subgroup	Studies included	OR or mean difference [95% CI]	P-value for statistical significance	P-value for heterogeneity	I2 test for heterogeneity
Cumulative morphine consumption at 6 h (mg)	Total*	23,24,26,29,31	-3.49 [-5.4, -1.51]	0.0006	<0.00001	92%
	Caesarean section	29,31	-3.48 [-8.81,1.85]	0.2	0.02	83%
	Laparoscopic*	23,24,26	-4.91 [-9.68, -0.14]	0.04	<0.00001	96
	Posterior	23,26,31	-0.51 [-2.36,1.33]	0.59	0.003	82%
	Transmuscular	24,29	-16.75 [-37.61,4.11]	0.12	<0.0001	94%
Cumulative morphine consumption at 12 h (mg)	Total*	10,18,26,27,31	-4.68 [-7.73, -1.62]	0.003	<0.0001	93%
	Caesarean section	10,18,31	-6.47[-13.27,0.33]	0.06	<0.0001	92%
	Laparoscopic**	26,27	-3.19[-6.23, -0.16]	0.04	0.19	41%
	Posterior*	10,26,31	-3.11 [-7.73, -1.62]	0.003	<0.00001	93%
Cumulative morphine consumption at 24 h (mg)	Total*	10,18,23,26-29,31	-8.21 [-11.63, -4.8]	<0.00001	<0.00001	93%
	Caesarean section**	10,18,29,31	-10.1 [-13, -7.2]	<0.00001	0.3	18%
	Laparoscopic*	23,26-28	-7.95 [-15.88, -0.01]	0.05	<0.00001	97%
	Posterior *	10,23,26,31	-4.03 [-7.86, -0.19]	0.04	0.01	71%
	Transmuscular*	27-29b	-12.44 [-20.2, -4.68]	0.002	0.002	84%
Cumulative morphine consumption at 48 h (mg)	Total	10,18,27	-10.66 [-23.27,1.95]	0.1	<0.0001	98%
	Caesarean section**	10,18	-16.22 [-19.39,13.03]	<0.00001	0.98	0%
Rest VAS at 6 h (cm)	Total/Posterior	10,23,26,30,31	-1.16 [-2.42,0.11]	0.07	<0.00001	92%
	Caesarean section	10,30,31	-1.27 [-3.12,0.57]	0.18	<0.00001	92%
	Laparoscopic	23,26	-0.96 [-3.62,1.7]	0.48	<0.00001	95%
Rest VAS at 12 h (cm)	Total*	10,26,27	-1.66 [-2.07, -1.26]	<0.00001	0.08	61%
	Laparoscopic*	16,26	-1.5 [-1.96, -1.05]	<0.00001	0.1	64%
	Posterior*	10,26	-1.64 [-2.04, -.1.23]	<0.00001	0.11	61%
Rest NRS at 12 h (cm)	Total/Caesarean section**	16,18,29	-1.1 [-1.65, -0.55]	<0.0001	0.29	20%
Rest VAS at 24 h (cm)	Total*	10,23,26,27,30	-2.05 [-3.39, -0.7]	0.003	<0.00001	97%
	Caesarean section	10,30	0.1 [-0.45,0.66]	0.71	0.36	0%
	Laparoscopic*	23,26,27	-6.53 [-11.56, -1.51]	0.01	<0.00001	99%
	Posterior	10,23,26,30	-0.62[-1.97,0.72]	0.37	<0.00001	93%
Rest NRS at 24 h (cm)	Total*	14,16,18,29	-2.34 [-3.22, -1.45]	<0.00001	<0.00001	94%
	Cesarean section**	16,18,29	-1.07 [-1.51, -0.62]	<0.00001	0.4	0%
	Posterior	14,16	-1.91 [-3.97,0.14]	0.07	0.01	84%
Rest VAS at 48 h (cm)	Total**	10,27	-0.81[-1.59, -0.03]	0.04	0.77	0%
Rest NRS at 48 h (cm)	Total/Cesarean section	16,18	-0.55 [-1.56,0.45]	0.29	0.02	82
Dynamic VAS at 6 h (cm)	Total/Cesarean section/	10,30,31	-0.62 [-2.36,1.13]	0.49	0.02	81%
	Posterior					
Dynamic NRS at 12 h (cm)	Total/Cesarean section	16,29	-0.53 [-1.39,0.32]	0.22	0.95	0%
Dynamic NRS at 24 h (cm)	Total*	14,16,29	-1.76 [-2.29, -1.22]	<0.00001	0.0005	83%
	Cesarean section**	16,29	-0.89 [-1.67, -0.12]	0.02	0.66	0%
	Posterior*	14,16	-2.54 [-3.28, -1.8]	<0.00001	0.003	88%
Time to the first additional	Total	18,29,31	2.16 [-2.6,6.92]	0.37	<0.00001	98%
analgesic (h)						
Numbers of patients who used additional analgesic (n/N)	Total	14,18,23,26,28	0.41 [0.12,1.42]	0.16	0.11	50%
Incidence of PONV at 24 h (n/N)	Total	10,16,18,26,28,29,31	0.57 [0.31,1.05]	0.07	0.14	36%
	Caesarean section	10,16,18,29,31	0.63 [0.14,2.9]	0.55	0.08	66%
	Laparoscopic	26,28	0.58 [0.08,4.41]	0.6	0.18	43%
	Posterior	10,16,26,31	1.41 [0.5,3.96]	0.52	0.61	0%
	Transmuscular**	28,29	0.29 [0.12,0.7]	0.005	0.88	0%
Incidence of teaching at 24 h (n/N)	Total	10,18,26,31	0.7 [0.37,1.32]	0.27	0.96	0%
	Caesarean section	10,18,31	0.68 [0.27,1.73]	0.42	0.6	0%
	Posterior	10,26,31	0.71 [0.29,1.71]	0.44	0.84	0%

Abbreviations: OR: Odds Ratio; CI: Confidence Interval; VAS: Visual Analogue Scale; NRS: Numerical Rating Scale

*The difference between the intervention group and the control group was statistically significant

**The difference between the intervention group and the control group was statistically significant, and the I2 value was less than 50%

Table 3: Characteristics of the included articles.

Author/year	Surgery	Block timing	Block solution	Surgical analgesia	Supplemental postoperative analgesia	Reason for being excluded
Blanco, 2015 [10]	caesarean section	postoperation	Posterior QLB with 0.125% bupivacaine 0.2 ml/kg	Hyperbaric bupivacaine 15 mg and fentanyl 20 mg (spinal)	Bupivacaine and fentanyl 20mg (spinal)	Two were excluded because they delivered their baby on the night before the planned caesarean section.
Dam, 2019 [31]	percutaneous nephrolithotomy	preoperation	Transmuscular QLB with 0.75% ropivacaine 30 mL	Sufentanil 0.5 μg/kg remifentanil 0.1~0.3 μg/(kg·min) (IV)	Paracetamol (oral); dexamethasone, remifentanil and sufentanil (i.v.).	None
Fujimoto, 2019 [30]	gynaecological laparoscopic surgery	preoperation	Posterior QLB with 0.25% levobupivacaine 30 mL or 0.25% levobupivacaine 25 mL (patients who weighed less than 50 kg)	Remifentanil 0.3–0.5 μg/kg/min or fentanyl 100 μg (IV), sevoflurane 3–5% (inhalation).	Desflurane (inhalation); fentanyl, remifentanil. And flurbiprofen (i.v.).	Two patients in the QLB group and 2 patients in the Control group were transferred to open surgery and lost to follow-up.
Hansen, 2019 [28]	caesarean section	postoperation	Bilateral transmuscular QLB with either 30 mL ropivacaine 0.375%	Fentanyl 6 μg/kg, remifentanil 0.20~0.40 μg/(kg·min) (IV)	Bupivacaine and sufentanil (spinal)	None
Irwin, 2019 [32]	caesarean section	postoperation	Posterior QLB with 20 ml levobupivacaine 0.25% injected on each side	Isobaric bupivacaine 10 mg and sufentanil 4 μg (spinal)	Bupivacaine, morphine and fentanyl (spinal), diclofenac (rectal) and paracetamol (i.v.)	
Ishio, 2017 [14]	laparoscopic gynecologic surgery	postoperation	Posterior QLB with 20 mL of 0.375% ropivacaine on each side	0.5% hyperbaric bupivacaine 1.5 ml (spinal)	Remifentanil or fentanyl (i.v.), sevoflurane (inhalation)	None
Kilic, 2018 [35]	percutaneous nephrolithotomy	preoperation	Transmuscular QLB with 0.2 mL/kg 0.0125 isobaric bupivacain	0.5% hyperbaric bupivacaine 12.5 mg and fentanyl 20 ug (spinal) metoclopramide 10 mg and paracetamol 1 g (IV)	Bupivacaine and fentanyl (spinal)	Two patients from the QLB I group were excluded because of postoperative analgesic protocol violations
Krohg, 2017 [16]	caesarean section	postoperation	Posterior QLB with 0.2 mL/kg 0.125% bupivacaine	Fentanyl 1 μg/kg (IV)	Bupivacaine and sufentanil (spinal)	One patient in the placebo group was switched to open surgery
Mieszkowski, 2018 [18]	caesarean section	postoperation	Bilateral lateral QLB with 24 mL 0.375% ropivacaine per side (in total 180mg)	0.5% bupivacaine 12 mg (spinal)	Bupivacaine and fentanyl (spinal); metoclopramide and paracetamol (i.v.)	None
Okmen, 2019 [34]	percutaneous nephrolithotomy	postoperation	Posterior QLB with 20 ml of 0.25 % bupivacaine		Sevoflurane (inhalation) and fentanyl (i.v.).	
Tamurua, 2019 [29]	caesarean section	postoperation	Bilateral posterior QLB with 0.45 mL/kg 0.3% ropivacaine per side		Lidocaine (infiltrated); bupivacaine and fentanyl (spinal) droperidol, fentanyl and acetaminophen (i.v.)	
Yayik, 2019 [33]	extracorporeal shock wave lithotripsy	preoperation	Transmuscular QLB with 10 ml of 0.5% bupivacaine and 10ml of 2% lidocaine		Fentanyl (i.v.)	
Zhu, 2019 [36]	laparoscopic nephrectomy				Sufentanil and remifentanil (i.v.)	

Abbreviations: QLB: Quadratus Lumborum Block; i.v.: Intravenous Infusion; PCA: Patient-Controlled Analgesia

[10,30,31]. Because few trials could be included, we analyzed pain scores at 6, 12 and 24 h after operation.

Only at 24 h postoperatively, QLB can effectively reduce dynamic NRS scores 1.76 cm (95% CI: -2.29, -1.22, P<0.00001; I2=83%), the dynamic NRS of patients after cesarean section was reduced by 0.89 cm (95% CI: -1.67, -0.12, P=0.02; I2=0%) (Table 2).

Opioid-related adverse effects

Seven articles [10,15-19,22] reported the incidence of nausea and vomiting 24 h after surgery, and only three of these articles reported nausea and vomiting [15,17,19]. Two articles [14,16] used NRS scores to measure the degree of nausea and vomiting. We synthesized the incidence of nausea and vomiting 24 h after surgery. There was no significant difference in the incidence of nausea and vomiting between the QLB group and the control group.

Few observations were reported about the incidence of itching and sedation [10,18,22], therefore statistical synthesis was not performed. Only one article [10] observed the incidence of itching and sedation (one case of itching and one case of sedation), and it was not possible to determine whether a significant difference exists between the QLB group and the control group.

Additional analgesic

Three articles [14,18,29] reported the time interval to the first additional analgesic, and 5 articles [14,18,23,26,28] reported the numbers of patients who used additional analgesic. No statistical differences were found after subgroup analysis (Table 2).

Opioid-related adverse effects

Eight articles [10,14,16,18,26,28,29,31] reported the incidence of Postoperative Nausea and Vomiting (PONV) within 24 h. We found that statistical differences only exist in the transmuscular QLB subgroup with an odds ratio of 0.29 (95% CI: 0.12, 0.70, P=0.005, I2=0%) (Table 2).

Four articles [10,18,26,31] reported the incidence of pruritus within 24 h after surgery, and no statistical differences were found after analysis (Table 2 and Figure 5).

Patient satisfaction

Three trials [23,28,29] performed patient satisfaction surveys, but different scales were used (Bruggemann Comfort Scale (BCS) scores, Quality of Recovery 40 (QoR-40) questionnaire score and Obstetric Quality-of-recovery scoring tool (ObsQoR -11)), We did not perform data synthesis.

Zhu et al. [28] reported that the recovery quality of patients in the QLB group was significantly higher than that of the control group. No statistical difference was found in the other two articles [23,31].

Discussion

Postoperative analgesia

The results of the statistical synthesis show that the QLB can effectively reduce the cumulative opioid consumption within 24 h after surgery, even the pain score of 48 h after surgery. The blocking range of the QLB may explain this result; a cadaver study showed that the QLB can stably block the T12-L3 nerve roots, and another cadaver study claimed that the coloring agent of the QLB can reach the thoracic sympathetic trunk, which can effectively reduce visceral pain [37,38].

Interestingly, for patients underwent laparoscopic surgery,

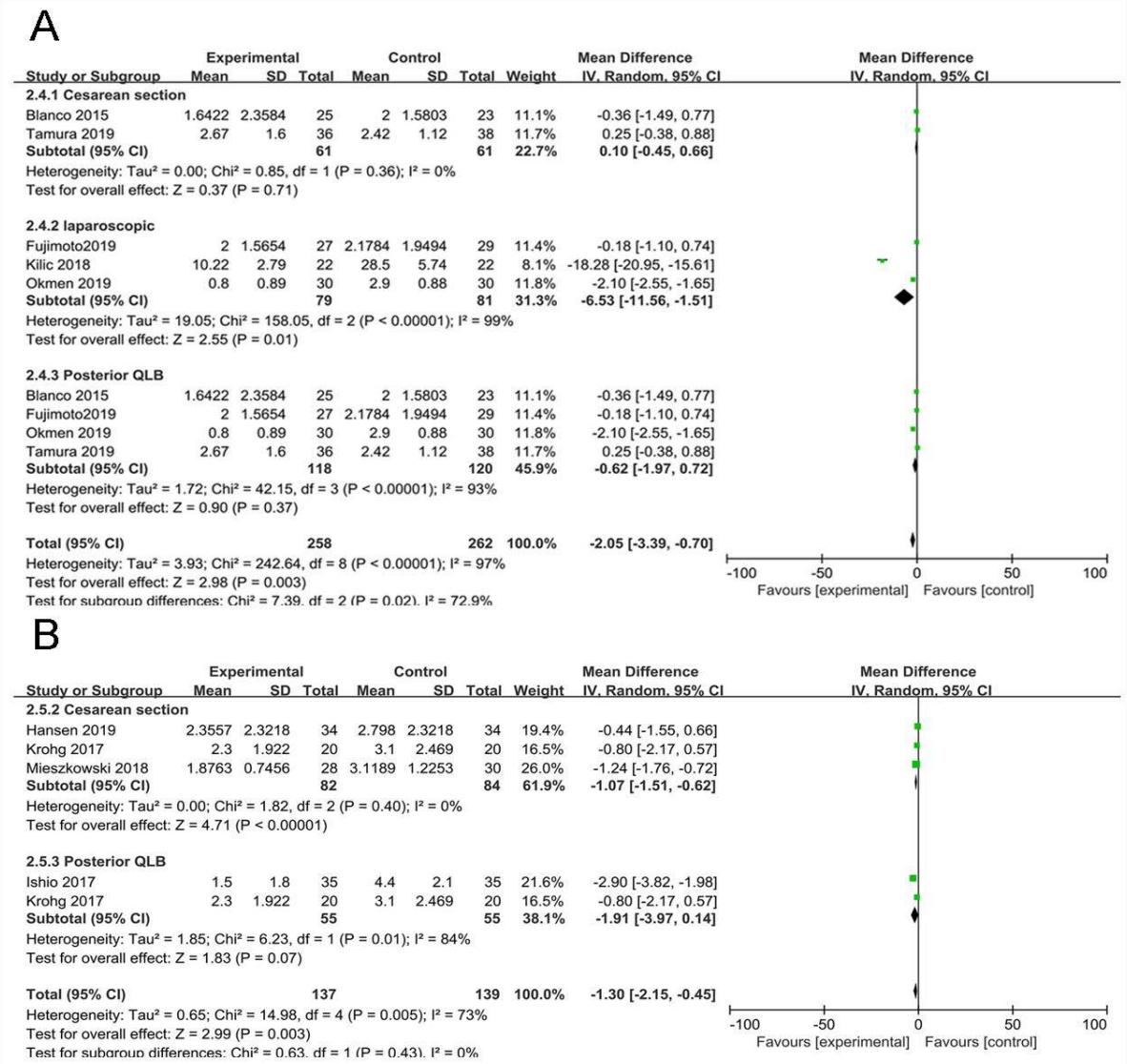

Figure 4: Rest pain score at 24 hours after surgery.

statistically significant analgesic effect began to appear from 6 h after operation; for patients with cesarean section, the analgesic effect often showed statistical difference from 24 h after operation. Compared with the control group, the QLB group had a lower reduction in dynamic pain score than the rest pain score. There is no statistical difference in time to the first additional analgesic and numbers of patients who used additional analgesic. These seem to indicate that the postoperative analgesic effect of QLB is more pronounced when the pain is relatively mild.

QLB showed limited analgesic efficacy in patients undergoing cesarean section within 12 h of surgery. However, it's undeniable that QLB reduced the cumulative consumption of opioids, rest pain scores and dynamic pain scores in patients underwent cesarean section at 24 h postoperatively, and the heterogeneity of these data was low, indicating that QLB can provide good analgesia for parturients. All QLB were performed at the end of cesarean section, which would not affect the operation. Blanco et al. [8] have shown that QLB has a better postoperative analgesia after cesarean section than TAPB. QLB may be a good choice for parturients who are prone to postoperative pain.

Without direct comparison, we only found differences in 24 h postoperatively cumulative opioid consumption between posterior QLB and transmuscular QLB (4.03 g (95% CI: -7.86, -0.19), I2=71% *vs.* 12.44 g (95% CI: -20.2, -4.68), I2=84%), limited by heterogeneity, no certain assertion can be made. One trial directly compared posterior QLB and transmuscular QLB, and found that the mixed effect of the two approaches was better, but the analgesic effect of the two approaches was not statistically different [39].

PONV

The occurrence of nausea and vomiting after lower abdominal surgery is one of the most common side effects, mainly related to the traction of the intestine and the application of postoperative opioids. As a part of postoperative analgesia, QLB may have the potential to reduce the use of opioids. Although the cumulative opioid consumption in each subgroup decreased significantly within 24 h after surgery, only the transmuscular QLB group had statistically preventive effects on PONV and showed low heterogeneity. This may be related to the more reduction on postoperative opioid consumption of transmuscular QLB compared to posterior QLB

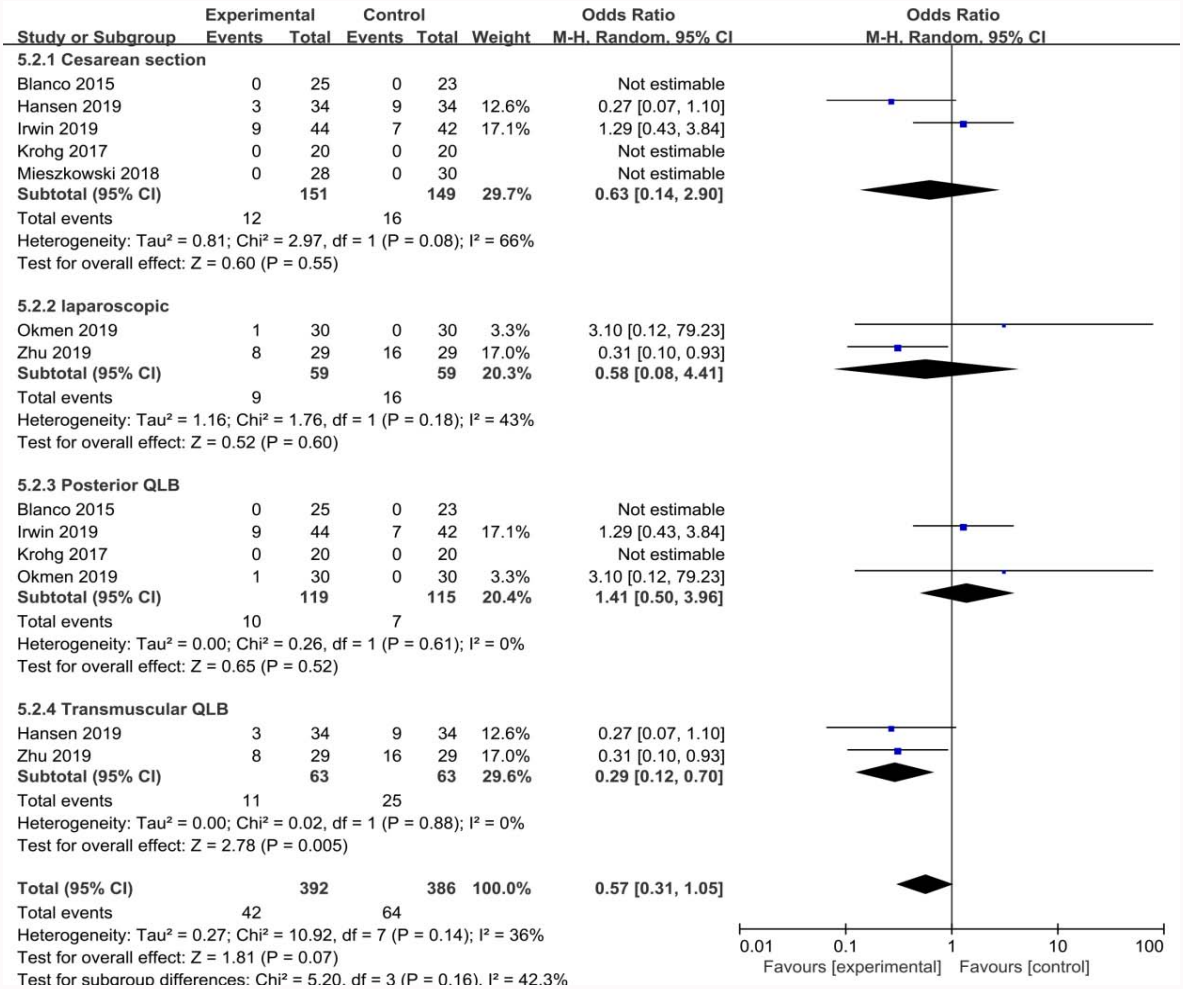

Figure 5: The incidence of Postoperative Nausea and Vomiting (PONV) within 24 hours after surgery.

(Table 2 and Figure 3) [28,29]. Because few articles were included, this conclusion is restrictive. In the future, more research is needed to study the effect of transmuscular on the incidence of postoperative nausea and vomiting.

Performance of QLB

Seven of included RCTs performed posterior QLB, 5 RCTs performed transmuscular QLB, and 1 RCT performed lateral QLB. Although QLB is an invasive procedure, local anesthetics and ultrasound can be used to minimize damage to the patient [10,14,16,18,23-31]. Because the structure of the abdominal wall muscles involved in the QLB is difficult to locate, the QLB procedures in all of the included articles were performed under ultrasound guidance. Under ultrasound guidance, transversus abdominis, the external oblique and the internal oblique can be clearly identified, which reduces the difficulty of executing QLB [10].

Complications of QLB

Because there is no great vessel and loose connective tissue around the optimal point of injection, this reduces the possibility of tissue damage, and complications of local hematoma and abdominal organ damage have not been reported. However, because local anesthetics can spread to the lumbar plexus, there is a potential risk of quadriceps weakness and accidental falls [40,41].

SaM et al. [42] reported that after 30 min to 40 min of QLB in two patients, severe hypotension and tachycardia occurred, possibly due to the spread of local anesthetic to the paravertebral space and epidural space, leading to sympathetic blockade.

Limitations

Our meta-analysis had some limitations. First, the number of articles included was small, and the amount of data that could be synthesized was limited. Because the articles obtained during the search were limited, only the amount of literature for the lower abdominal surgery was met and no analysis of upper abdomen, hip and lower limb surgery was performed [10,14,16,18,19,23-31,44,47]. Some outcomes could not be analyzed because of insufficient documentation. The incidence of postoperative opioid-related complications was too small, which may mask the significant difference between the QLB group and the control group. Furthermore, prospective studies of patients with long-term follow-up were not retrieved, making it impossible to judge the impact of the QLB on long-term prognosis in patients. Finally, the heterogeneity within the literature is large and cannot be eliminated by subgroup analysis and sensitivity analysis, which affects the reliability of the results.

Conclusion

QLB showed effective postoperative analgesia at 6 h to 24 h

after laparoscopic surgery and 24 h to 48 h after cesarean section. Transmuscular QLB appears to have more reduction on postoperative opioid consumption compared to posterior QLB. Transmuscular QLB had statistically preventive effects on PONV. In future, more RCTs are needed to support our conclusions.

Authors' Contributions

L , X, Z and Q made substantial contributions to conception and design of the study; GL, GX and S searched literature, extracted data from the collected literature and analyzed the data; L wrote the manuscript; X and Z revised the manuscript; All authors approved the final version of the manuscript.

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