Ultrasound-guided Quadratus Lumborum Block for Perioperative Analgesia in Robot-assisted Partial Nephrectomy: A Randomized Controlled Trial

Jielan Lai
Sun Yat-sen University Cancer Center
Quehua Luo
Southern Medical University
Yanling Liu
Sun Yat-sen University Cancer Center
Ruifeng Xue
Sun Yat-sen University Cancer Center
Yang Huang
Sun Yat-sen University Cancer Center
Yongchun Li
Sun Yat-sen University Cancer Center
Renchun Lai (lairch@sysucc.org.cn)
Sun Yat-sen University Cancer Center https://orcid.org/0000-0002-8504-5157

Research article

Keywords: Quadratus lumborum block; Ultrasound; Robot-assisted partial nephrectomy; Analgesia; Opioids-sparing

Posted Date: April 2nd, 2020

DOI: https://doi.org/10.21203/rs.3.rs-19158/v1

Version of Record: A version of this preprint was published at Trials on November 24th, 2021. See the published version at https://doi.org/10.1186/s13063-021-05815-3.

Abstract

Background

Recently, several case reports and limited randomized studies have shown that the quadratus lumborum block (QLB) is effective in providing pain relief after intra-abdominal and retroperitoneal operations. Robot-assisted partial nephrectomy (RAPN) has also been proposed as a promising operative treatment for renal carcinoma because it enables early recovery and ambulation. Therefore, we aimed to evaluate the analgesic and opioid-sparing effects of a single-injection QLB, which may paly an important role on early recovery program in RAPN.

Methods

Fifty-six patients undergoing elective RAPN under general anesthesia were randomised to two equally sized groups. Patients were randomly allocated to receive unilateral QLB (n=28) with 0.375% bupivacaine 0.5 mL/kg (QLB group) or a conventional scheme (n=28) group (Control group). The QLB technique was performed as first described by Blanco, termed QLB2. The primary outcome was the visual analogue scale (VAS) scores with movement at 6 hours postoperatively. The secondary endpoints were the morphine consumption at different time-period after surgery, morphine-related side effects and assessment of postoperative rehabilitation.

Results

Both VAS pain score and cumulative opioid consumption were significantly lower in the QLB group at 6 hours after surgery as compared with the control group (all $P<0.05$). There was significant difference in pain scores at any other time-point except at 4 hours on movement and 48 hours at rest. However, no significant difference was observed in 12-48 hours cumulative opioid consumption, and in the duration of PACU and hospital stay between the two groups. The patient recovery scores was significantly higher in the QLB group.

Conclusions

Single-injection pre-emptive QLB applied to RAPN was effective and provided satisfactory analgesia and opioids-sparing in combination with a typical patient-controlled analgesia. In addition, it may provide an effective technique for early recovery in perioperative period.

Background

The quadratus lumborum block (QLB) was first described by Blanco in 2007, which later can be subdivided into three basic approaches, known as QLB1, 2, 3 and a modified approach, called intramuscular QLB, based on needle tip position and the spread of local anesthetic (LA)[1]. Recently, an increasing case reports and randomized trials have show that QLB may be effective in postoperative pain relief and opioids-sparing effect after various surgery operations [2–10].

Although analgesic effect is theoretically thought to be comparable among these four types of QLB, in fact that each approach resulted in different range of sensory blockade, due to the spread of LA vary for each method. QLB2 has been reported to be effective for both somatic and visceral pain due to the spread of LA tend to the paravertebral space, and is believed to achieve sensory blockade of ipsilateral abdominal wall (lateral and lower)[11, 12]. Furthermore, QLB2 technique, also termed the posterior approach, aims to inject LA into a fascial plane that is between the quadratus lumborum and the latissimus dorsi muscles. The superficial point of LA injection permits to be safer and user-friendly with real-time ultrasound guidance. Thus it is of paramount importance to analyze its clinical efficacy under different clinical procedures.

The past decade has seen the rise of robot-assisted partial nephrectomy (RAPN) for treatment of renal carcinoma, that has the advantage of shorten warm ischemia time and providing better solution for difficult-to-access renal tumors [13–16]. It acts as a minimally invasive technique and now is an an important part of early recovery program. Several case reports have shown that QLB was effective in providing pain relief after unilateral abdominals surgeries (e.g. pyeloplasty, radical nephrectomy [17, 18]). However, a literature search throughout the whole study had not yet found any randomised controlled trials that evaluated the effect of QLB after RAPN. In this randomised, controlled, double-blinded study, we investigated our hypothesis using QLB2 technique in combination with a typical postoperative analgesic scheme to evaluate the clinical efficacy on perioperative analgesia in RAPN.

Methods

Design and Patients

Ethical approval for this study was provided by the Research Ethics Committee of Sun Yat-sen University Cancer Center (Chairperson Prof. Wangqing Peng) on 5th June 2018. The study was registered at a clinical trials registry (, registered number: ChiCTR1800016790), and was conducted at the Sun Yat-sen University Cancer Center from June 2018 to November 2018. This study was designed and conducted on the basis of the Consolidated Standards of Reporting Trials (CONSORT) guidelines. Patients of American Society of Anesthesiologists (ASA) physical status to , aged 18 to 75 years old, were scheduled for elective robot-assisted partial nephrectomy received general anesthesia were enrolled into the study (Fig. 1). Exclusion criteria included: patient's refusal, mental illness, history of alcohol or analgesics dependence, coagulopathy, severe hepatic dysfunction, chronic pain, infection at the needle insertion site, allergy to local anesthetics, and body mass index (BMI) more than 30 kg/m^2 or less than 15 kg/m^2. Written informed consent was obtained from all patients for this trial. These patients were allocated randomly by computer-generated randomization schedule into one of the two groups (QLB group and control group). The QLB group received a unilateral QLB after anesthesia induction, and no nerve block was performed the in the control group.

A sealed opaque envelope contained a card with the computer-generated allocation number (1 = QLB group, 2 = control group) was opened by an anesthesia assistant who was not involved in the study.

Ultrasound-guided QLB was carried out by attending anesthesiologists who had extensive experience with this technique (over 60 attempts). Another anesthesiologists who were blinded to the patient group assignment were responsible for anesthesia management and pain management in postoperative care based on the specified scheme of anesthesia and analgesia. The research assistants who were engaged in the study performed the 48-hours postoperative follow-up and recorded the clinical variables.

Anaesthesia and analgesia protocol

All patients were seen on two days before surgery and were instructed on the use of a 11 points visual analogue scale (VAS): 0 = no pain, 10 = worst imaginable pain, for assessment of postoperation pain and how to use a patient controlled analgesia (PCA) device. Prophylactic analgesia was performed at the night before the surgery for all patients with celecoxib 200 mg except for contraindications.

Upon arrival in the preparation room, peripheral venous access (20-gauge) was established and standard ASA monitors were applied. Additionally, each patient received routinely continuous monitoring of bispectral index (BIS) and train-of-four stimulation. General anesthesia was induced with target-controlled infusion (TCI) of propofol 3–6 μg/ml and intravenous sufentanil 0.3 μg/kg and tracheal intubation was facilitated with rocuronium 0.9 mg/kg. A total intravenous anaesthesia with TCI propofol and remifentanil was used for maintenance of anaesthesia in accordance with BIS 40–60. Neuromuscular blockade was ensured thoughout surgical procedure using rocuronium according to TOF(train-of-four)index for adequate muscle relaxation. After intubation, the lungs were ventilated at 8 mL/kg tidal volume with 0–5 mmHg positive end-expiratory pressure. The frequency was set to keep the end-tidal carbon dioxide within the range of 35 to 45 mmHg. An infusion of phenylephrine between 0.1–0.4 μg/kg/min will be initiated in order to maintain blood pressure values within 20% of the baseline value, and bradycardia (heart rate < 50 beats/min) was treated with atropine 0.5 mg. Dexamethasone 8 mg combined with tropisetron 5 mg were used to treat nausea and vomiting. A single bolus of sufentanil 0.1 μg/kg and flurbiprofen 50 mg were administered at the start of skin closure. All patients were extubated prior to transport to the post-anesthesia care unit (PACU).

At the PACU, A dose of intravenous morphine 2 mg was defined for rescue analgesia if VAS pain score was > 3, every 15 minutes until the pain VAS was ≤ 3. Patients were transfered to ward when they achieved a modified Aldrete score ≥ 9 and VAS scores ≤ 3. All the patients were routinely received a morphine PCA pump with no background infusion. The PCA pump was programmed to deliver 1-mL bolus doses of morphine (1 mg/mL) on demand with a minimum lock-out interval of 6 minutes, and a total morphine dose not to exceed 15 mg during any 4 h interval. All patients received regular flurbiprofen 50 mg at 8-hourly intervals and a dose of intravenous tramadol 50 mg was defined for breakthrough pain if VAS was ≥ 6, every 1 hour until the VAS was ≤ 3 at the surgical ward. Antiemetic treatment with intravenous tropisetron was available as needed.

Ultrasound-guided QLB2 technique

All blocks were performed with the patient in the lateral decubitus position after induction of general anesthesia. After local sterilization with povidone iodine, a high-frequency (6–13 MHz) linear array

ultrasound probe (Sonosite M-turbo, SonoSite, Inc., Bothell, WA) covered with a sterile sheath was placed above the iliac crest, and moved cranially until the three abdominal wall muscles were clearly identified. Then, it slided medially until latissimus dorsi and quadratus lumborum muscle was confirmed within identical short-axis view. A 22-gauge, short-beveled stimulating needle (B. Braun Melsungen AG, Melsungen, Germany) was used for the single-injection block. The needle tip was inserted in-plane with the ultrasound beam and targeted the posterior of quadratus lumborum muscle. Accurate needle tip position was initially readjusted by injecting 1–2 mL of normal saline with hydrodissection image, 0.5 mL/kg of 0.375% bupivacaine was injected into the lumbar interfascial triangle behind the quadratus lumborum muscle under real-time ultrasound guidance.

Measurements

Demographic, anaesthesia- and operation-related parameters were recorded, including sex, age, height, weight, BMI, performance time, surgical duration, and intraoperative propofol and remifentanil consumption. The primary outcome measure of this study was the VAS scores with movement (cough or turn around the body) at 6 hours postoperatively. After surgery, patients were evaluated at 4, 6, 12, 24, and 48 hours postoperatively. The measured variables were as follows: VAS scores during rest and with movement at the predetermined intervals; morphine titration consumption in PACU, and cumulative morphine PCA consumption; length of PACU stay; morphine-related side effects included nausea and vomiting, sedation (Ramsay scale > 2), dizziness, hyoxemia (pulse oxygen saturation < 95%), pruritus; hospital stay duration and quality of recovery (measured using a 15-item quality of recovery score, QoR-15) were also documented.

Sample size calculation and statistical analysis

The sample size was calculated based on data from our pilot study (n = 10). we observed that the VAS scores (at movement) at 6 hours postoperatively was 4 (± 2.0). We considered that a 50% reduction in the VAS scores to be statistically significant, and therefore 23 patients per group were required to establish variance test with $\alpha = 0.05$ and $\beta = 0.1$. A total of 56 patients were finally calculated to account for the anticipated 20% dropout rate.

SPSS software of Windows 19.0 (SPSS, Chicago, IL, USA) was used for statistical analysis. For continuous variables, normality of the data was assessed using the Kolmogorov-Smirnov test. Continuous variables were summarized as mean ± standard deviation, median and interquartile range, and analyzed using the Student's t test or a Mann-Whitney U test, as appropriate. For categorical variables, research data of the 2 study groups summarized as a frequency, n (%), and the Pearson c^2 test, or Fisher exact test was performed, as appropriate. A $P < 0.05$ was considered statistically significant for all results.

Results

The flow chart of this study is presented in Fig. 1. Sixty-five patients scheduled for RAPN were screened for eligibility, and 9 patients were excluded due to not meeting inclusion criteria or decline to participate. A

total of 56 patients were randomized into two equally sized groups (n = 28, for each group) and included in final analysis. The results showed significant reduction for remifentanil consumption (1129.3 ± 310.22 μg vs 1778.43 ± 668.74 μg, P < 0.001) in the QLB group than in the control group. The two groups were similar regarding other demographic, anaesthesia- and surgery-related characteristics (Table 1).

Table 1
Demographic, Anaesthesia- and Surgery-related Characteristics

	Control group (n = 28)	QLB group (n = 28)	P value
Age(years)	48.25 ± 11.30	47.07 ± 12.05	0.707
Sex (male/female)			0.284
Male	13 (46.43)	17 (60.71)	
Female	15 (53.57)	11 (39.29)	
BMI (kg/m^2) BMI	23.61 ± 2.51	23.27 ± 3.14	0.661
ASA (/ /)			0.540
	9 (32.14)	11 (39.29)	
	15 (53.57)	14 (50.00)	
	4 (14.29)	3 (10.71)	
Surgical site (left/right)			0.593
Left	13 (46.43)	15 (53.57)	
Right	15 (53.57)	13 (46.43)	
Surgical duration (min)	187.68 ± 49.08	187.75 ± 53.57	0.996
Propofol consumption (mg)	1412.68 ± 449.30	1366.25 ± 464.85	0.705
Remifentanil consumption (μg)	1778.43 ± 668.74	1129.39 ± 310.22	< 0.001
Length of PACU stay (min)	50.61 ± 16.26	47.75 ± 17.23	0.526
Hospital stay (days)	6.32 ± 2.06	5.82 ± 1.87	0.345
Data are presented as mean ± standard deviation or number (%).			
*Significant (P < 0.05) difference between groups.			
ASA: American Society of Anesthesiologists physical status; BMI: Body Mass Index; PACU: Post-anesthesia Care Unit			

All VAS assessments (pain scores at rest, and during movement) at all predetermined intervals are shown in Table 2. Pain scores during movement at 6 hours postoperatively (primary outcome) were statistically significant lower in the QLB group than in the control group (3.4 ± 1.1 vs 4.4 ± 1.1, P < 0.001). Meanwhile, VAS scores during movement at other times except 4 hours were statistically lower in the QLB group (all P < 0.05). VAS scores at rest for most of the predetermined intervals, included at PACU, 4 hours, 12 hours and 24 hours but not at 48 hours were statistically significant lower in the QLB group than in the control group (all P < 0.05). In addition, during the first 6 hours after surgery (morphine titration and PCA use), patients in the QLB group used significantly less morphine than in the control group (all P < 0.05) but not at 12 hours, 24 hours and 48 hours (Table 3).

Table 2
Visual analogue scale pain scores at rest and movement

Measurement time	Control group (n = 28)	QLB group (n = 28)	P value
Rest			
4 h	1.93 ± 0.86	1.43 ± 1.03	0.022
6 h	3.04 ± 0.88	1.82 ± 0.77	< 0.001
12 h	2.64 ± 1.06	1.50 ± 0.69	0.001
24 h	2.04 ± 0.74	1.32 ± 0.82	0.008
48 h	1.46 ± 0.64	0.96 ± 0.69	0.076
Movement			
4 h	2.61 ± 0.88	2.07 ± 0.72	0.075
6 h	4.4 ± 1.1	3.4 ± 1.1	< 0.001
12 h	3.46 ± 1.10	2.32 ± 0.67	0.001
24 h	3.29 ± 0.85	2.57 ± 0.88	0.002
48 h	2.61 ± 0.63	2.25 ± 0.65	0.013
Data are presented as mean ± standard deviation.			
*Significant (P < 0.05) difference between groups.			

Table 3
Cumulative morphine consumption

Measurement time	Control group (n = 28)	QLB group (n = 28)	P value
Morphine titration consumption (mg)	2.00 (1.00, 4.00)	2.00 (0.00, 2.00)	0.037
Morphine PCA use (mg)			
Titration-4 h	1.00 (0.50, 2.00)	0.00 (0.00, 1.00)	0.002
6 h	3.00 (2.50, 4.00)	2.00 (1.00, 2.50)	< 0.001
12 h	8.00 (6.00, 10.50)	7.00 (6.00, 8.00)	0.089
24 h	13.00 (10.50, 16.00)	13.00 (11.50, 14.00)	0.718
48 h	17.00 (14.00, 19.00)	16.50 (15.00, 19.50)	0.617
Data are presented as median (IQR). IQR: Inter Quartile Range.			
PCA:Patient Controlled Analgesia.			
*Significant (P < 0.05) difference between groups.			

There were significant difference in terms of nausea and vomiting (all P < 0.05), and the proportion of subjects calculated in other morphine-related side effects were similar between the groups (all P > 0.05) (Table 4). However, the mean (SD) QoR-15 quality of recovery score was 75.4 (4.6) and 83.5 (4.5) for patients receiving QLB or no block, respectively (P < 0.001) (Table 5). There were significant difference in the five sub-items of QoR-15, those were “Have had a good sleep”, “Able to look after personal hygiene, urination and defecation unaided”, “Moderate pain”, “Severe pain”, and “Nausea or vomiting”, respectively (all P < 0.05).

Table 4
Morphine-related side effects

	Control group (n = 28)	QLB group (n = 28)	P value
Hyoxemia n(%)	2 (7.1%)	0	0.245
Sedation n(%)	9 (32.1%)	4 (14.3%)	0.114
Dizziness n(%)	10 (35.7%)	6 (21.4%)	0.237
Nausea n(%)	12 (42.9%)	5 (17.9%)	0.042
Vomiting n(%)	8 (28.6%)	2 (7.1%)	0.036
Pruritus n(%)	6 (21.4%)	4 (14.3%)	0.485
Data are presented as number (%).			
*Significant (P < 0.05) difference between groups.			

Table 5
QoR-15 items at Day 1 postoperatively.

	Control group (n = 28)	QLB group (n = 28)	P value
Able to breathe easily	6.0 (1.4)	6.3 (1.3)	0.559
Able to enjoy food	5.4 (1.6)	5.5 (1.3)	0.788
Feeling energized	5.2 (1.4)	5.2 (1.5)	1.000
Have had a good sleep	3.4 (1.1)	5.1 (1.5)	< 0.001
Able to look after personal hygiene, urination and defecation unaided	2.2 (1.0)	3.0 (0.8)	0.002
Able to communicate with family and friends	7.0 (1.5)	7.0 (1.3)	1.000
Getting support from hospital, doctors and nurses	6.5 (1.0)	6.9 (1.1)	0.190
Able to return to work or usual home activities	1.4 (1.0)	1.7 (0.9)	0.275
Feeling comfortable and in control	7.1 (1.0)	7.0 (1.0)	0.697
Having a feeling of general well-being	6.9 (0.9)	7.0 (1.4)	0.815
Moderate pain	3.3 (1.3)	4.8 (1.0)	< 0.001
Severe pain	5.0 (1.0)	6.4 (1.2)	< 0.001
Nausea or vomiting	3.5 (1.8)	5.1 (1.9)	0.003
Feeling worried or anxious	6.0 (1.7)	6.2 (1.6)	0.744
Feeling sad or depressed	6.2 (1.3)	6.5 (1.4)	0.438
Total score	75.4 (4.6)	83.5 (4.5)	< 0.001
Data are presented as mean ± standard deviation.			
QoR-15: 15-item Quality of Recovery Score			
*Significant (P < 0.05) difference between groups.			

Discussion

This current study was designed to evaluate the analgesic efficacy of preoperatively ultrasound-guided single-injection QLB in patients undergoing RAPN under general anesthesia for perioperative analgesia. The main findings of this study are that the QLB provided superior analgesia at early postoperative stage

resulting in lower pain scores and less opioid consumption and adverse reactions. We found that the preventive implement of QLB did reduce pain scores at rest during any time-point up to 24 hours. VAS scores at movement were significantly lower in the QLB group at all observed intervals except at 4 hours postoperatively. Similarly, the consumption of intraoperative remifentanil or postoperative morphine during the first 6 hours but not thereafter was significantly lower in the QLB group than in the control group. Hence, the QLB seem to be a useful analgesic method with a typical patient-controlled analgesia for RAPN.

Ultrasound-guided QLB technique was first described by Blanco [11, 12], and the benefits of QLB for postoperative pain relief and opioids-sparing effect have been reported by several randomized controlled trials and case reports[2, 5, 6, 8–10, 19–30]. All approaches have been proved the synergistic efficacy for multimode analgesia, especially for QLB2 or QLB3 after laparoscopic surgery, cesarean section and total hip arthroplasty. This is the first randomized, double-blinded controlled trial study that has compared the the preventive implement of QLB2 block to a standard perioperative analgesic regimen when applied in RAPN. For most studies, the QLB2 (posterior approach) was chosen as its targeted injection was more superficial and be focused much more tightly and can be easily positioned. Our findings echo most of previous trials. Irwin et al. [10]investigated the posterior approach for postoperative pain relief after caesarean section, and showed a reduction in median (IQR [range]) visual analogue scale pain scores at 6 h postoperatively. However, opioid consumption was similar in both groups during the first 24 hours after surgery. Kukreja et al. [29]have also demonstrated the benefits of opioid-sparing analgesic effect of the anterior quadratus lumborum block in total hip arthroplasty. The true mechanism of action of the QLB is not completely known. One of the important diffusion mechanisms of either anterior or posterior approaches is that local anesthetic spread to the paravertebral space region to achieve effective analgesia in the desired dermatomes. However, the postulation of local anaesthetic consistently tracking into the anterolateral penetration of quadratus lumborum and anterior thoracolumbar fascia has been called into question [31, 32]. It remains to be seen whether a different approach, such as the intramuscular or lateral, would provide superior or longer lasting analgesia.

The multi-modal analgesia consists of preoperative prophylactic analgesia, combined different analgesic medication, local infiltration anesthesia, and patient-controlled intravenous analgesia has become a routine standard for the postoperative pain management in our surgical center. We did not directly compare the use of QLB with sham block group (same volume of saline) or other approaches or epidural analgesia. We felt that the aforementioned analgetic scheme has remarkable efficacy in pain relief, especially for patients who are involved in the enhanced recovery programs. Therefore, this study focused on whether the QLB may enable an increased analgesic effect and the role it plays in the combination of a typical multi-modal analgesia[33, 34]. A recent study by Aditianingsih et al. [2]compared the anterior approach with epidural analgesia in patients underwent laparoscopic donor nephrectomy. They demonstrated that the morphine consumption and pain scores at 24 hours after surgery were comparable. A propensity score matching analysis has reported that postoperative pain was not significantly different between the different operation mode (robot-assisted partial nephrectomy vs

laparoscopic partial nephrectomy)[35]. A third arm in our study may have been beneficial in discerning whether the QLB has assistant effects when compared to“no block” pattern.

Postoperative pain management has always been a core value to enhanced recovery after surgery. We took this opportunity to use the 15-item quality of recovery score (QoR-15) developed by Stark et al. [36]as a secondary outcome measure. As the pain scores were the highest within 24 hours after surgery in accordance with previous studies, severe pain is associated with a series of adverse reactions after surgery and anesthesia. The QoR-15 providing a quantitative measure of comfort, emotional wellbeing, and physical functioning has the ability to assess functional recovery rather than pain, which may become more relevant supplementary information. In this study, there were significant statistical differences in terms of five sub-items (Have had a good sleep, Able to look after personal hygiene, urination and defecation unaided, Moderate pain, Severe pain and Nausea or vomiting) and total scores between the groups at 24 hours after surgery. Therefore, it seems like that single-injection QLB is not merely used to relieve acute pain. Besides, it serves as a supportive role for improving the overall health status at the early stages after surgery.

Limitations

There are some of limitations to our study. Firstly, VAS scores with movement at 6 hours postoperatively was chosen as the primary outcome measure. VAS scores in a pilot study and this study were tested to conform to a normal distribution. Then we chosen a Student’s t test for pain scores at all the predetermined intervals. Secondly, we did not check sensory dermatomal levels, assess visceral pain, record lower extremity weakness and accurately calculate the duration of the QLB to explain the characteristic of sensory blockade. The main purposes of this study were to compare pain scores and opioid consumption between two groups. Thirdly, some studies have proposed the problem of “rebound pain” phenomenon after single-shot peripheral nerve block, which defined as very severe pain when peripheral nerve block wears off. It is not so rare problem in clinical practice and could reach 40% of patients undergoing orthopedic procedures [37], but pathophysiological mechanisms remain unknown. The QoR-15 collected all the related data at 24 hours postsurgery, such as Have had a good sleep and Severe pain, which might provide a bit of tracing data in regard to rebound pain. However, we have not observed that severe pain interferes with sleep and complain of severe discomfort when QLB wore off. In the future, randomized controlled trials may be needed to include all the aforementioned indicators, which might have impacted pain management program and patient satisfaction.

Conclusions

In conclusion, the posterior QLB enabled adequate postoperative analgesia for patients undergoing RAPN, which could reduce pain scores and had opioid-sparing effects postoperatively. The preoperative implementation of single-shot QLB is an important component of multi-modal analgesia and may helpful to enhanced functional recovery. Further studies are warranted to determine the best approach and the

optimal dose and volume of LA or adjuncts required for more effective and lasting QLB for patients received RAPN.

Abbreviations

QLB
Quadratus Lumborum Block
LA
Local anesthetic
RAPN
Robot-assisted partial nephrectomy
ASA
American Society of Anesthesiologist
BMI
Body Mass Index
VAS
Visual analogue scale
PCA
Patient controlled analgesia
BIS
bispectral index
TCI
target-controlled infusion
TOF
Train-of-four
PACU
Post-anesthesia care unit
QoR-15
15-item quality of recovery score
IQR
Inter Quartile Range.

Declarations

Availability of data and materials

The datasets used and/or analysed during the current study available from the corresponding author on reasonable request.

Acknowledgements

This research was supported by Department of Anesthesiology, Sun Yat-sen University Cancer Center. The authors thank Professor Fangjian,Zhou,and Professor Hui□Han for performing the operation and assisting in manuscript preparation.

Funding

This research was supported by Department of Anesthesiology, Sun Yat-sen University Cancer Center.

Author information

Affiliation

Department of Anesthesiology, Sun Yat-sen University Cancer Center, State Key Laboratory of Oncology in South China, Collaborative Innovation Center for Cancer Medicine, Guangzhou 510060, P. R. China

Jielan Lai, Yanling Liu, Ruifeng Xue,Yang Huang, Yongchun Li, Renchun Lai

The Second School of Clinical Medicine, Southern Medical University, Guangzhou,China

Quehua Luo

Department of Anesthesiology, Guangdong Second Provincial General Hospital, Guangzhou, China.

Quehua Luo

Contributions

JL;Contribution:cnotributed to data acquisition and analysis, and drafted manuscripts . QL;Contribution:contributed to interpretation of data and helped to revise the manuscripts. YL;Contribution:contributed to data acquisition and helped evaluate the patients' responses and was blinded to the patient group assignment. RX;Contribution:contributed to performing the operation and was blinded to the patient group assignment. YH;Contribution:contributed to performing the operation and was blinded to the patient group assignment, and statistical analysis. YL;Contribution:contributed to data acquisition and revised the manuscripts. RL;Contribution:contributed to the design of the research and agreed to be accountable for all aspects of the work.All authors read and approved the final manuscript version.

Corresponding authors

Correspondence to Renchun Lai or Yanling Liu.

Ethics declarations

Ethics approval and consent to participate

Ethical approval for this study was provided by the Research Ethics Committee of Sun Yat-sen University Cancer Center (Chairperson Prof. Wangqing Peng) on 5th June 2018. Written informed consent was obtained from all patients participating in the trial.The study was registered at a clinical trials registry (http://www.chictr.org.cn, registered number: ChiCTR1800016790), and was conducted at the Sun Yat-sen University Cancer Center from June 2018 to November 2018. Our methodology followed the international guidelines for observational studies.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

References

1. Elsharkawy H, El-Boghdadly K, Barrington M: **Quadratus Lumborum Block: Anatomical Concepts, Mechanisms, and Techniques**. *Anesthesiology* 2019, **130**(2):322-335.
2. Aditianingsih D, Pryambodho, Anasy N, Tantri AR, Mochtar CA: **A randomized controlled trial on analgesic effect of repeated Quadratus Lumborum block versus continuous epidural analgesia following laparoscopic nephrectomy**. *BMC Anesthesiol* 2019, **19**(1):221.
3. Aksu C, Gurkan Y: **Ultrasound guided quadratus lumborum block for postoperative analgesia in pediatric ambulatory inguinal hernia repair**. *J Clin Anesth* 2018, **46**:77-78.
4. Aygun H, Kavrut Ozturk N, Pamukcu AS, Inal A, Kiziloglu I, Thomas DT, Tulgar S, Nart A: **Comparison of ultrasound guided Erector Spinae Plane Block and quadratus lumborum block for postoperative analgesia in laparoscopic cholecystectomy patients; a prospective randomized study**. *J Clin Anesth* 2019:109696.
5. Deng W, Long X, Li M, Li C, Guo L, Xu G, Yu S: **Quadratus lumborum block versus transversus abdominis plane block for postoperative pain management after laparoscopic colorectal surgery: A randomized controlled trial**. *Medicine (Baltimore)* 2019, **98**(52):e18448.
6. Fujimoto H, Irie T, Mihara T, Mizuno Y, Nomura T, Goto T: **Effect of posterior quadratus lumborum blockade on the quality of recovery after major gynaecological laparoscopic surgery: A randomized controlled trial**. *Anaesth Intensive Care* 2019, **47**(2):146-151.
7. Giordano C, Bassoricci E, Fusco P, Scimia P: **Ultrasound-guided quadratus lumborum block type 2 associated to continuous intravenous infusion of dexmetomidine for anesthesiologic management in laparoscopic adrenalectomy for pheochromocytoma: could it be a safe strategy?** *Minerva Anestesiol* 2019, **85**(8):919-920.
8. Gurkan Y, Yorukoglu HU, Ulugol H, Kus A: **[Quadratus lumborum block for both cholecystectomy and right-sided nephrectomy]**. *Agri* 2019, **31**(3):153-154.

9. Ipek CB, Kara D, Yilmaz S, Yesiltas S, Esen A, Dooply S, Karaaslan K, Turkoz A: **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**(5):1395-1402.
10. Irwin R, Stanescu S, Buzaianu C, Rademan M, Roddy J, Gormley C, Tan T: **Quadratus lumborum block for analgesia after caesarean section: a randomised controlled trial**. *Anaesthesia* 2020, **75**(1):89-95.
11. Blanco R, Ansari T, Girgis E: **Quadratus lumborum block for postoperative pain after caesarean section: A randomised controlled trial**. *Eur J Anaesthesiol* 2015, **32**(11):812-818.
12. Blanco R, Ansari T, Riad W, Shetty N: **Quadratus Lumborum Block Versus Transversus Abdominis Plane Block for Postoperative Pain After Cesarean Delivery: A Randomized Controlled Trial**. *Reg Anesth Pain Med* 2016, **41**(6):757-762.
13. Grivas N, Kalampokis N, Larcher A, Tyritzis S, Rha KH, Ficarra V, Buffi N, Ploumidis A, Autorino R, Porpiglia F *et al*: **Robot-assisted versus open partial nephrectomy: comparison of outcomes. A systematic review**. *Minerva Urol Nefrol* 2019, **71**(2):113-120.
14. Larcher A, Capitanio U, De Naeyer G, Fossati N, D'Hondt F, Muttin F, De Groote R, Guazzoni G, Salonia A, Briganti A *et al*: **Is Robot-assisted Surgery Contraindicated in the Case of Partial Nephrectomy for Complex Tumours or Relevant Comorbidities? A Comparative Analysis of Morbidity, Renal Function, and Oncologic Outcomes**. *Eur Urol Oncol* 2018, **1**(1):61-68.
15. Peyronnet B, Khene ZE, Mathieu R, Bensalah K: **Robot-assisted Versus Open Partial Nephrectomy: Do We Really Need More Evidence To End the Debate?** *Eur Urol Oncol* 2018, **1**(1):69-70.
16. Sunaryo PL, Paulucci DJ, Okhawere K, Beksac AT, Sfakianos JP, Abaza R, Eun DD, Bhandari A, Hemal AK, Porter J *et al*: **A multi-institutional analysis of 263 hilar tumors during robot-assisted partial nephrectomy**. *J Robot Surg* 2019.
17. Baidya DK, Maitra S, Arora MK, Agarwal A: **Quadratus lumborum block: an effective method of perioperative analgesia in children undergoing pyeloplasty**. *J Clin Anesth* 2015, **27**(8):694-696.
18. Sindwani G, Sahu S, Suri A, Saeed Z: **Bilateral quadratus lumborum block for postoperative analgesia in a Von Hippel-Lindau syndrome patient undergoing laparoscopic radical nephrectomy**. *Saudi J Anaesth* 2017, **11**(4):513-514.
19. McCrum CL, Ben-David B, Shin JJ, Wright VJ: **Quadratus lumborum block provides improved immediate postoperative analgesia and decreased opioid use compared with a multimodal pain regimen following hip arthroscopy**. *J Hip Preserv Surg* 2018, **5**(3):233-239.
20. Okmen K, Metin Okmen B, Topal S: **Ultrasound-guided posterior quadratus lumborum block for postoperative pain after laparoscopic cholecystectomy: A randomized controlled double blind study**. *J Clin Anesth* 2018, **49**:112-117.
21. Putzu M, Gambaretti E, Rizzo F, Latronico N: **Postoperative analgesia for laparotomic surgery provided by bilateral single-shot quadratus lumborum block**. *Minerva Anestesiol* 2018, **84**(10):1231-1232.

22. Segura-Grau E, Magalhaes J, Cabral F, Costa C: **Continuous quadratus lumborum type 2 block: Good analgesia alternative for complex iliac and acetabulum fracture**. *J Clin Anesth* 2018, **46**:91.
23. Kumar GD, Gnanasekar N, Kurhekar P, Prasad TK: **A Comparative Study of Transversus Abdominis Plane Block versus Quadratus Lumborum Block for Postoperative Analgesia following Lower Abdominal Surgeries: A Prospective Double-blinded Study**. *Anesth Essays Res* 2018, **12**(4):919-923.
24. Tulgar S, Kose HC, Selvi O, Senturk O, Thomas DT, Ermis MN, Ozer Z: **Comparison of Ultrasound-Guided Lumbar Erector Spinae Plane Block and Transmuscular Quadratus Lumborum Block for Postoperative Analgesia in Hip and Proximal Femur Surgery: A Prospective Randomized Feasibility Study**. *Anesth Essays Res* 2018, **12**(4):825-831.
25. Aksu C, Sen MC, Akay MA, Baydemir C, Gurkan 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**:24-28.
26. Atkins R: **Quadratus lumborum block for elective cesarean section: simpler approach may gain more acceptance**. *Reg Anesth Pain Med* 2019.
27. Baytar C, Yilmaz C, Karasu D, Topal S: **Comparison of Ultrasound-Guided Subcostal Transversus Abdominis Plane Block and Quadratus Lumborum Block in Laparoscopic Cholecystectomy: A Prospective, Randomized, Controlled Clinical Study**. *Pain Res Manag* 2019, **2019**:2815301.
28. Kinjo S, Kolodzie K, Dong K, Zhang AL: **The effects of transmuscular quadratus lumborum blocks on postoperative pain in arthroscopic hip surgery: a cohort analysis**. *J Anesth* 2019, **33**(4):516-522.
29. Kukreja P, MacBeth L, Sturdivant A, Morgan CJ, Ghanem E, Kalagara H, Chan VWS: **Anterior quadratus lumborum block analgesia for total hip arthroplasty: a randomized, controlled study**. *Reg Anesth Pain Med* 2019.
30. Segura-Grau E, Afonso A: **Quadratus lumborum type 2 block as a complementary regional anesthesia for polytrauma intensive care patient**. *J Clin Anesth* 2019, **54**:141.
31. Kumar A, Sadeghi N, Wahal C, Gadsden J, Grant SA: **Quadratus Lumborum Spares Paravertebral Space in Fresh Cadaver Injection**. *Anesth Analg* 2017, **125**(2):708-709.
32. Elsharkawy H, El-Boghdadly K, Kolli S, Esa WAS, DeGrande S, Soliman LM, Drake RL: **Injectate spread following anterior sub-costal and posterior approaches to the quadratus lumborum block: A comparative cadaveric study**. *Eur J Anaesthesiol* 2017, **34**(9):587-595.
33. Vonu PM, Campbell P, Prince N, Mast BA: **Analgesic Efficacy of Nerve Blocks After Abdominoplasty: A Systematic Review**. *Aesthet Surg J* 2019.
34. Akerman M, Pejcic N, Velickovic I: **A Review of the Quadratus Lumborum Block and ERAS**. *Front Med (Lausanne)* 2018, **5**:44.
35. Jin SJ, Park JY, Kim DH, Yoon SH, Kim E, Hwang JH, Song C, Kim YK: **Comparison of postoperative pain between laparoscopic and robot-assisted partial nephrectomies for renal tumors: A propensity score matching analysis**. *Medicine (Baltimore)* 2017, **96**(29):e7581.
36. Stark PA, Myles PS, Burke JA: **Development and psychometric evaluation of a postoperative quality of recovery score: the QoR-15**. *Anesthesiology* 2013, **118**(6):1332-1340.

37. Henningsen MJ, Sort R, Moller AM, Herling SF: **Peripheral nerve block in ankle fracture surgery: a qualitative study of patients' experiences**. *Anaesthesia* 2018, **73**(1):49-58.

Figures

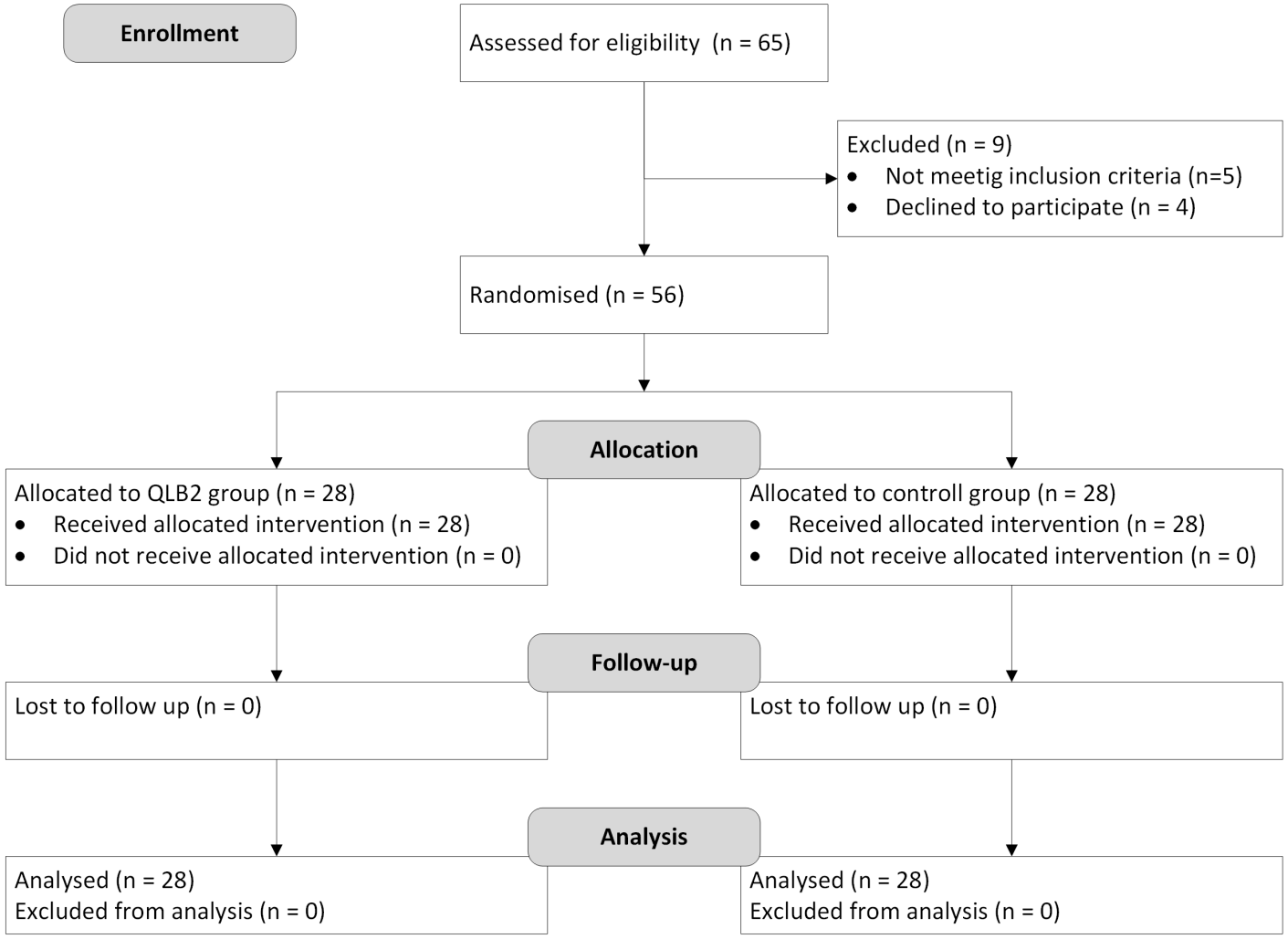

Figure 1

Flow diagram of this study. QLB: Quatratus Lumborum Block.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- CONSORT2010Checklist.doc