

Retrospective study of quadratus lumborum block for postoperative analgesia in patients undergoing percutaneous nephrolithotomy

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Abstract

Background:

The postoperative analgesic effect of transmuscular quadratus lumborum block (QLB-TM) in patients following lower abdominal surgeries has been identified, however, the efficacy of QLB using the lateral approach (QLB-L) is still in debate. Therefore, this retrospective study was conducted to investigate the effect of a single-shot block with QLB-L on postoperative analgesia for patients undergoing percutaneous nephrolithotomy (PCNL).

Methods:

The medical information of the patients undergoing PCNL was retrieved from the electronic charter system (Medisystem, Suzhou, China) in our Nanjing Drum Tower Hospital during the period of Jan/2019 to Jun/2019. Among the total of 57 patients, there are 17, 18, and 22 patients subjected to QLB-L, QLB-TM, or routine treatment respectively. The primary observational parameter was to assess postoperative pain with visual analog scales (VAS) at rest 30 min after extubation, 24 h, and 48 h after surgery respectively. The secondary observatory endpoints including the consumption of intraoperative opioids, the cumulative dose of non-steroid anti-inflammatory drugs (NSAIDs) and the incidence of adverse events related to postoperative analgesia were evaluated as well.

Results:

The static VAS score at 24 h after surgery and the intraoperative consumption of sufentanil were significantly lower in patients receiving either intervention of QLB-L or QLB-TM as compared with those receiving routine treatment. However, one shot of QLB had no impact on VAS scores at 30 min post-extubation, 48 h after PCNL procedure compared with the patients receiving routine treatment. The percentage of non-ambulatory patients within 24 h post-PCNL was significantly higher in the QLB-TM group compared with the routine treatment group ($P = 0.04$). There were no significant differences in the incidence of postoperative nausea and vomit (PONV), respiratory depression, the time for the first defecation and the length of hospital stay (LOS) among the three groups.

Conclusions:

QLB-L procedure exerts as equivalent as QLB-TM in terms of abrogating postoperative pain within 24 h post-surgery and decreasing intraoperative sufentanil consumption in patients undergoing PCNL procedure as well. The caution should be taken to avoid lower extremities weakness in the patients after QLB-TM within the first 24 h post-PCNL.

1. Background

Percutaneous nephrolithotomy (PCNL) is currently prevailing surgical procedure in the treatment for patients with multiple or complex kidney or upper urinary tract stones due to its minimally invasive procedure. Notwithstanding, previous studies suggested that the majority of patients following PCNL suffered from mild to moderate pain due to renal capsule dilation or nephrostomy-tube-related stress during the first postoperative 24 hours, which necessitated the meticulous multi-modality analgesia management for those patients.[1] Hence, alternative options of infiltrative local analgesia at the wound or truncal nerve block technique are recommended as an appropriate adjunctive to systemic analgesia in these procedures[2–4].

In addition to transverse abdominis plane block (TAP), ultrasound-guided quadratus lumborum block has been introduced in controlling postoperative pain after thoracic or abdominal surgeries in recent years[5–7]. In 2015, Børglum *et al.* defined transmuscular quadratus lumborum block (QLB-TM) using the Shamrock sign[8]. The injectate trajectory is aiming at the interfascial plane between the anterior border of quadratus lumborum (QL) muscle and psoas major muscle. Relative to the lateral approach of QLB which was initially introduced by Blanco in 2007 and is only applied in limited clinical practices nowadays[9], the transmuscular approach has gained wider acceptance in a variety of abdominal surgeries comprising of cesarean section, renal, hernioplasty as well as laparoscopic procedures for its reliable narcotic sparing effect[7, 10, 11]. The cephalad spread of local anesthetics to the thoracic paravertebral region is considered one of the underlying analgesic mechanisms for the QLB-TM technique[12], while QLB-L may in effect be a variant of TAP block with suboptimal analgesic efficacy[13]. The efficacy of QLB-L in postoperative pain control after PCNL was questioned for its incapability of providing the adequate analgesic plane from T9-12[14]. The studies from Blanco and Kadam *et al.*, however, suggested that QLB-L provided effective postoperative analgesia in lower abdominal surgeries as well, given the local anesthetics were administered beneath the medial layer of the thoracolumbar fascia lateral to the QL muscle to acquire adequate cephalad-distribution with the blockade of T9-12 spinal nerves[5, 15].

In this study, we investigated the effect of ultrasound-guided QLB, targeting anterior-laterally or transmuscularly to the QL muscle, on pain relief after PCNL. Our objective in this study is that the patients who receive QLB-L procedure record as low VAS values at rest as QLB-TM.

2. Methods

Ethical approval

This study was approved by the ethics committee of Drum Tower Hospital Affiliated with the Nanjing University Medical School

Methods

The medical information of the patients undergoing PCNL was retrieved from the electronic charter system (Medisystem, Suzhou, China) in our Nanjing Drum Tower Hospital from Jan/2019 to Jun/2019. Query used the following criteria:(a) anesthesia start time within the specified date/time parameters;(b) surgical procedure equal to PCNL;(C) patient has a completed pain assessment procedure form indicating the performance of QLB-L or QLB-TM. This is a retrospectively comparative study comparing the analgesic effect of ultrasound-guided QLB with two different approaches (QLB-L group, QLB-TM group) versus routine practice (control group) on postoperative pain following PCNL.

Data collection

Preoperative and intraoperative demographic variables included the following: age (years); gender; BMI(kg/m²); American Society of Anesthesiologists(ASA); underlying diseases (Diabetes, Coronary artery disease, Hypertension); duration of operation (minutes); anesthesia time (defined as the time spent in the operating room in minutes); categories of drugs used for general anesthesia; Intraoperative mean arterial pressure (MAP) and heart rate (HR) dosage of intraoperatively administered narcotics. Postoperative variables included the following: additional analgesic requirement (NSAIDS, Dizocine); pain intensity assessed on visual analog scales (VAS); the incidence of postoperative nausea and vomiting (PONV), itching, respiratory depression, the time for the first defecation, and the length of hospital stay (LOS).

Outcome measurements

The primary outcome was VAS scores of patients at rest at 30 min post-extubation, 24 and 48 h after surgery respectively. Secondary outcomes comprised of blood pressure and HR of patients recorded at the following time-points: arrival at the operating room (T0), beginning of surgery (T1), the end of surgery (T2), immediate post-extubation (T3), and leaving PACU (T4); the duration of operation, intraoperative opioid (sufentanil) consumption; LOS; postoperative additional analgesic requirement within 48 h after PCNL as well as the adverse effects (such as PONV, itching, respiratory depression the time for the first defecation) were recorded for further analysis.

Induction and maintenance of anesthesia

All patients received standard general anesthesia monitoring and intravenous infusion commenced with Lactic Ringer's solution at the rate of 400 ml/h to replace the fluid loss owing to 8 h fasting and no drinking. General anesthesia was obtained by total intravenous anesthesia with continuous infusion of propofol (4-6 mg/kg/min), cisatracurium (2 µg/kg/min) to ensure appropriate sedation (BIS at the range of 40-60), substantial analgesia and muscle relaxation respectively. The invasive arterial pressure monitor was established via left radial artery cannulation with a transducer connected to Philips (IntelliVue MP60, Bothell, Washington, United States) prior to surgery. Intermittent sufentanil (0.1 ug/kg) was given if the HR, blood pressure or both increased more than 20% of the baseline. At 10 minutes before the beginning of the surgical procedure, 50 mg of flurbiprofen dissolved in 100ml saline were intravenously administered. The hemodynamic parameters and oropharyngeal temperature were recorded automatically by Medisystem electronic charter database (Suzhou, China) in our department.

Postoperative care and pain management

At the end of the operation, the patient was transferred to the post-anesthesia care unit (PACU) and the tracheal tube was removed after full emergence from anesthesia. The patient was discharged from the PACU to the ward once Steward Scale score was higher than 5 assessed by an experienced physician in PACU. The VAS scores were assessed by a well-trained doctor at 30 min immediately after extubation, every other 4 hours thereafter till 48 h post-surgery in the ward. When the VAS score of patients was over 3, 50 mg flurbiprofen was titrated to free of pain. If VAS score over 5, dizocine (0.1 mg/kg) was administrated for pain control as a rescue dose. The maximal dose of flurbiprofen or dizocine is 200 mg, 0.2mg/kg daily respectively.

QLB-L technique

QLB-L technique (schematic illustration in Fig-1a, b): The patient was placed securely in the lateral decubitus position. A low-frequency curvilinear probe (SonoSite Edge, transducer C60x/5 2MHz, Fujifilm Sonosite Inc, US) was attached above the iliac crest. Under the guidance of ultrasound, the 18 gauge 10-cm needle (Stimuplex[®] D, B. Braun Medical Inc., Germany) was applied to puncture from dorsal to ventral direction aiming at the anterolateral margin of the junction of QL and transversalis fascia, and 5 ml saline solution was injected to confirm the correct position by hydro-dissection phenomenon. [16] The block was completed with the 0.375% ropivacaine at a volume of 0.5 ml/kg thereafter. The range of block was tested 30 min after the procedure. Patients whose block plane of abdominal wall between T10-L1 level 30 min after the block were considered to have achieved effective blockade.

QLB-TM technique

QLB-TM technique (Fig-1c and d): The patient was placed on the same position as the QLB-L technique. The ultrasound probe was vertically attached above the iliac crest. The transverse process of second lumbar vertebra (L2) and typical shamrock image were identified, and the needle was inserted from the edge of the probe and proceeded further into the fascia between the QLM and psoas major muscle. The local anesthetics were injected into the accurate interfascial plane between these two muscles.

Statistical analysis:

A Shapiro-Wilk test was used to evaluate whether or not the data are normally distributed; The distribution of each continuous variable was summarized by its mean±standard deviation and/or median with range (R)/ interquartile range (IQR). The distribution of each categorical variable was summarized in terms of its frequency and percentage. One-way analysis of variance using LSD correction for multiple comparisons of parametric variables and the Mann-Whitney U test is used for the non-parametric variables followed by Dunn's test for multiple comparisons. Repeated measurement analysis of variance was used to analyze repeated measurements. The test of chi-square or Fisher's exact test is applied for the categorized data. A P value of <0.05 is accepted as statistically significant. The analysis of the data was carried out using the IBM SPSS 21.0 statistical package software.

3. Results

3.1 Patients characteristics

As is shown in Table.1, the demographic characteristics including gender, age, body mass index (BMI), American Society of Anesthesiologist physical status, comorbidities and duration of surgical procedure of patients were recorded among three groups. There were no differences observed in preoperative or perioperative features among the three groups ($P > 0.05$).

3.2 Effect of two different types of QLB on postoperative pain of PCNL patients at rest

The postoperative pain scores assessed using the visual analog scale (VAS) were collected at 30 min after removal of the endotracheal tube in a post-anesthesia care unit (PACU), 24, 48 h after surgery in the ward (0/10: pain-free, 10/10: severe pain couldn't tolerate) respectively. The patients receiving either type of QLB had lower VAS values at rest 24 h after surgery compared with the patients under routine analgesic treatment (QLB-TM vs Con: 1.26 ± 0.25 vs 2.62 ± 0.29 , $P < 0.01$; QLB-L vs Con: 1.27 ± 0.26 vs 2.62 ± 0.29 , $P < 0.01$). As shown in Figure 2, however, at the time-point of 30 min post-extubation or 48 h after surgery, there is no significant difference in VAS values among three groups ($P > 0.05$).

3.3 Effect of two different types of QLB on intraoperative consumption of sufentanil, the changes of hemodynamic parameters, and the rescuing dose of NSAIDs after PCNL

As shown in Figure 3, the intraoperative cumulative consumption or the consumption dosage /per hour of sufentanil was $38.8 \pm 1.92 \mu\text{g}$, $22.1 \pm 1.52 \mu\text{g/h}$ in control group respectively, which was higher compared with either of QLB group respectively ($P < 0.05$).

In contrast with the previous study, the decreased consumption of NSAIDs during the first or second 24 h after surgery in QLB groups wasn't observed in the present study. As shown in Table 2, the median value of cumulative dose of NSAIDs during the first 24 h after surgery was (75 (0-150) mg) in QLB-TM group and (50 (0-100) mg) in QLB-L respectively, which was equivalent to that consumed in the control group ($P > 0.05$). Furthermore, there is also no significant difference in the rescue dose of dizocine among three groups within 48 h after PCNL.

As shown in table 3, the application of either type of QLB had a negligible impact on the perioperative mean blood pressure and HR ($P > 0.05$).

3.4 Comparison of postoperative anesthesia-related complications among three groups

As shown in Table 4, the first time of flatus, the postoperative complications including PONV, itching, respiratory depression were not significantly different among the three groups. Inconsistent with the previous results, LOS was not shortened in patients receiving either QLB treatment ($P > 0.05$).

In this study, we found that there were 8 out of 18 patients in the QLB-TM group who couldn't get out of bed and ambulated voluntarily without the assistance of an instrument during the first 24 h after surgery,

the percentage of which was statistically higher compared with the Con group ($P=0.04$, Fig 4A). The lower extremity muscle strength score in the ipsilateral side of the block was lower in the QLB-TM group compared with the Con group on POD 1 ($P=0.003$, Fig 4C). However, the ratio of the ambulatory patients to all subjects and muscle strength scores in the ipsilateral side of the block in QLB-L group 24 h post-PCNL was not significantly different from Con group ($P =0.677$, Fig 4A and C). The lower extremity score in contralateral side of the block wasn't significantly different among the three groups on POD 1 (Fig 4 D). Furthermore, the percentage of ambulatory patients on POD2 was not significantly different among the three groups ($P>0.05$, Fig 4B).

4. Discussion

To our knowledge, this is the first retrospective cohort study by comparison of the analgesic effect of two distinct approaches of QLB in patients following PCNL procedure with the systemic analgesia strategy. Our results in the present study suggest that QLB-L is as effective as QLB-TM in attenuating postoperative pain within 24 h after PCNL. Additionally, either type of QLB procedure similarly decreases the intraoperative consumption of sufentanil without causing hemodynamic instability albeit it couldn't lead to further decrease in the incidence of adverse events associated with narcotics use and shortening of LOS.

There are at least 4 types of QLB approaches performed in the clinic at present. Except for the intramuscular technique reported by Murouchi[17], the other 3 QLB techniques are used by the majority of physicians for pain control following diverse types of surgeries[18, 19]. Actually, QLB-TM has been accepted as one of the most popular approaches in abdominal surgeries as an adjunctive to systemic analgesia, bearing better and reliable pain control advantage[20]. Albeit these distinct approaches of QLB (posterior, lateral, and transmuscular) may have different analgesic efficacy, the quantitative analysis of the analgesic potency of these approaches is yet lacking due to the heterogeneity in surgical types [19]. The first prospective study was conducted by Ahmed *et. al* in the year of 2019 to compare the analgesic efficacy in patients receiving either posterior or transmuscular approach of QLB in unilateral inguinal hernia repair[21]. Their results implicated that QLB-TM is superior to the posterior approach in decreasing the postoperative pain intensity. In the recent two prospective clinical studies conducted by Dam and KılıçE *et. al* respectively,[14, 22] the potency of transmuscular approach of QLB in postoperative pain relief after PCNL procedure was assessed. As a result, QLB-TM rendered the beneficial effect in alleviating the pain of patients during activity after surgery, shortened the time to ambulation, LOS, and promoting the recovery of patients. In line with the previous studies, QLB-TM elicited significant pain relief at rest 24 h-post PCNL in the present study. Furthermore, all patients had an analgesic plane from T9 - L1 30 min after QLB-TM prior to general anesthesia induction and played a role in decreasing the intraoperative sufentanil consumption owing to the blockade of noxious afferent signal from the surgical site.

Nevertheless, there is still no comparison between transmuscular and lateral approach of QLB after PCNL surgery in a randomized prospective study till now. Our results in this retrospective study showed that the

loss of pinprick dermatome plane 30 min after QLB-L was not distinct from the QLB-TM group at the extent from T9 to L1, which provided satisfactory intraoperative analgesia and was facilitated to decreasing the sufentanil consumption. In addition, the analgesic effect of QLB-L was equivalent to that of QLB-TM within 24 h post- PCNL surgery in the present study. In the study by Dam *et.al*, they reiterated the importance of the accurate position of needle at the plane between the anterior border of quadratus lumborum muscle and psoas muscle to ensure the cranial spread of local anesthetics beyond arcuate ligament into the thoracic paravertebral region[14]. The trajectory in the lateral approach of QLB, they thought, was directed the fascial plane between the pararenal fat layer and middle thoracolumbar fascia, which prevented local anesthetics entering thoracic paravertebral spaces and barely had the value of clinical significance in pain control for PCNL patients. However, consistent with several other studies[23], our results demonstrate that the lateral type of QLB exerts a favorable effect in controlling postoperative pain after PCNL with the duration of analgesia lasting as long as 24 h. The mechanism underlying the analgesic effect of QLB-L for PCNL patients in the present study is still elusive. The plausible explanations can be attributed as follows: first, the lateral QLB is inclined to spread cephalad beneath the middle layer of thoracolumbar fascia and transversalis fascia in anatomy to interfere the pain signal conduction of T9-12 spinal nerves, which had been identified by several clinical or cadaver studies[18]. Additionally, the injection of 0.5 ml/kg (0.375% ropivacaine) was a relatively larger volume than that used in the previous studies and might be facilitated in the cranial spread of the drug.

We observed that the number of non-ambulatory patients in the QLB-TM group on POD 1 approximated 2-fold of that in the conventional treatment group. The weakness of lower extremities was identified in patients receiving QLB-TM. Previous studies indicated that the QLB-TM reduced postoperative 24 h pain scores and opiates consumption in patients after total hip arthroplasty[24]. The lower extremities weakness was accidentally reported in patients receiving QLB-TM [25]. Recent a cadaver study conducted by Carline to assess the dimension of stained nerves using the following 3 different QLB groups[18]. They observed that a higher rate of lumbar plexus stain (L1-3) occurred in the QLB-TM group. The injection site in the vicinity of lumbar plexus and local anesthetics infiltration accounts for the faintness in lower extremities and better pain control after hip arthroplasty. We couldn't explain the reason why LOS is not significantly shortened in QLB groups in the present trial. We postulate that the PCNL is a relatively minimally-invasive procedure causing moderate postoperative pain which can be controlled with NSAIDs drugs. In addition, one shot of injection has only 24 h duration of pain relief after PCNL, therefore the advantage of QLB on controlling pain is not evident contrary to the continuous QLB strategy in pain control after liver surgery[26].

There are still several limitations in this study: this is a preliminary retrospective cohort study, hence a prospective randomized study is warranted to assess the beneficial pain control effect of QLB-L with ropivacaine compared with placebo in PCNL patients. The larger sample size is needed to detect the difference in lower extremity weakness 24 h after PCNL among QLB groups. Lastly, the optimal concentration and volume for ropivacaine for unilateral QLB are still unknown, and our study cannot give information regarding the adequate dose or volume of QLB in postoperative analgesia.

5. Conclusions

Collectively, ultrasound-guided QLB-L technique provides as similar satisfactory pain-control as QLB-TM after PCNL and deserves clinically wide application. Cautions should be taken in patients for the latent risk of the weakness of low extremities during the first 24 h after QLB with the transmuscular approach, which can be avoided by being substituted with the lateral approach.

6. Abbreviations

ASA

American Society of Anesthesiologists

BMI

Body-mass index

HR

Heart rate

LOS

Length of hospital stay

MAP

Mean arterial pressure

NSAIDs

Non-steroid anti-inflammatory drugs

PACU

Post-anesthesia care unit

PCNL

Percutaneous nephrolithotomy

POD

Postoperative day

PONV

Postoperative nausea and vomit

QL

Transmuscular quadratus lumborum block

QLB

Quadratus lumborum block

QLB-L

Lateral approach quadratus lumborum block

QLB-TM

Transmuscular quadratus lumborum block

TAP

Transverse abdominis plane block

VAS

Visual analog scales

7. Declarations

Ethics approval and consent to participate: This study was approved by the ethics committee of Drum Tower Hospital Affiliated with the Nanjing University Medical School

Consent for publication: Not applicable

Availability of data and material: All data generated or analyzed during this study are included in this published article and its supplementary information files.

Competing interests: The authors declare that they have no competing interests

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Tables

Table 1. Demographic characteristics, surgical data of the patients undergoing PCNL

Variables	Con (n=22)	QLB-TM (n=18)	QLB-L (n=17)	F,Z or χ^2	P
Age (years)	48.7±10.0	55.1±8.1	51.1±11.2	2.16	0.12
Gender (M/F)	16/6	9/9	13/4	3.35	0.19
BMI(kg/m ²)	26.9±3.3	25.2±3.3	25.6±3.9	1.25	0.30
ASA (II/III)	15/7	12/6	11/6	0.05	0.97
Hypertension n(%)	5(23%)	5(28%)	5(29%)	0.25	0.89
Diabetes n(%)	3(14%)	3(17%)	1(6%)	1.00	0.60
Coronary disease n(%)	0(0%)	0(0%)	1(6%)	2.40	0.30
Duration of Operation (min)	117.6±40.2	114.4±40.4	116.6±44.8	0.03	0.96

Data are presented as mean±standard deviation, case (%)

BMI: body mass index; M: male, F: female; ASA: American Society of Anesthesiologists

Con: control; QLB-L: QLB-Lateral; QLB-TM:QLB-transmuscular

Table 2. Postoperative Consumption of flurbiprofen(mg)

Variables	Con (n=22)	QLB-TM (n=18)	QLB-L (n=17)	F,Z or χ^2	P
24 h NSAIDS	50(0-150)	75(0-150)	50(0-100)	0.75	0.69
48 h NSAIDS	0(0-100)	0(0-100)	0(0-100)	0.04	0.98
Dizocine rescue n(%)	1(5%)	1(6%)	1(6%)	0.04	0.98

Data are presented as median (interquartile range)

Table3. Comparison of mean arterial pressure(MAP) and heart rate(HR)

Time	Variables	Con (n=22)	QLB-TM (n=18)	QLB-L (n=17)	F,Z or χ^2	P
T0	MAP	106.1±10.7	102.0±11.9	103.3±11.6	MAP:1.697	0.113
	HR	77.0±11.8	71.4±10.4	76.2±12.7		
T1	MAP	94.9±10.9	95.2±16.7	93.0±13.5		
	HR	61.8±9.1	65.7±6.2	65.8±12.8		
T2	MAP	88.1±9.5	91.3±8.9	92.5±8.0		
	HR	60.8±10.0	56.9±9.1	59.9±8.7		
T3	MAP	94.4±11.7	93.1±11.7	96.8±13.9	HR:1.611	0.131
	HR	67.2±10.6	63.4±13.1	64.2±12.7		
T4	MAP	95.7±10.7	96.6±9.2	100.2±11.8		
	HR	68.0±10.5	64.8±10.7	61.6±17.0		

Data are presented as mean±standard deviation

PACU: Postanesthesia care unit

T0: Arrival at the operating room;T1: The beginning of operation;T2: The end of operation

T3: Extubation;T4: Transfer from PACU

Table 4. Recovery of patients following PCNL and adverse events

Variables	Con (n=22)	QLB-TM (n=18)	QLB-L (n=17)	F,Z or χ^2	p
LOS(days)	7(6-10)	8(7-9)	7(5-8)	4.0	0.14
First time to Defecation(hours)	48(48-60)	48(36-60)	48(36-48)	3.9	0.14
PONV n(%)	1(5%)	1(6%)	1(6%)	0.4	0.98
Itches n(%)	0(0%)	0(0%)	0(0%)		1
Respiratory depression n(%)	0(0%)	0(0%)	0(0%)		1

Data are presented as median (interquartile range), case (%)

LOS: length of hospital stay(days) POD: postoperative day

PONV: postoperative nausea and vomiting

Figures

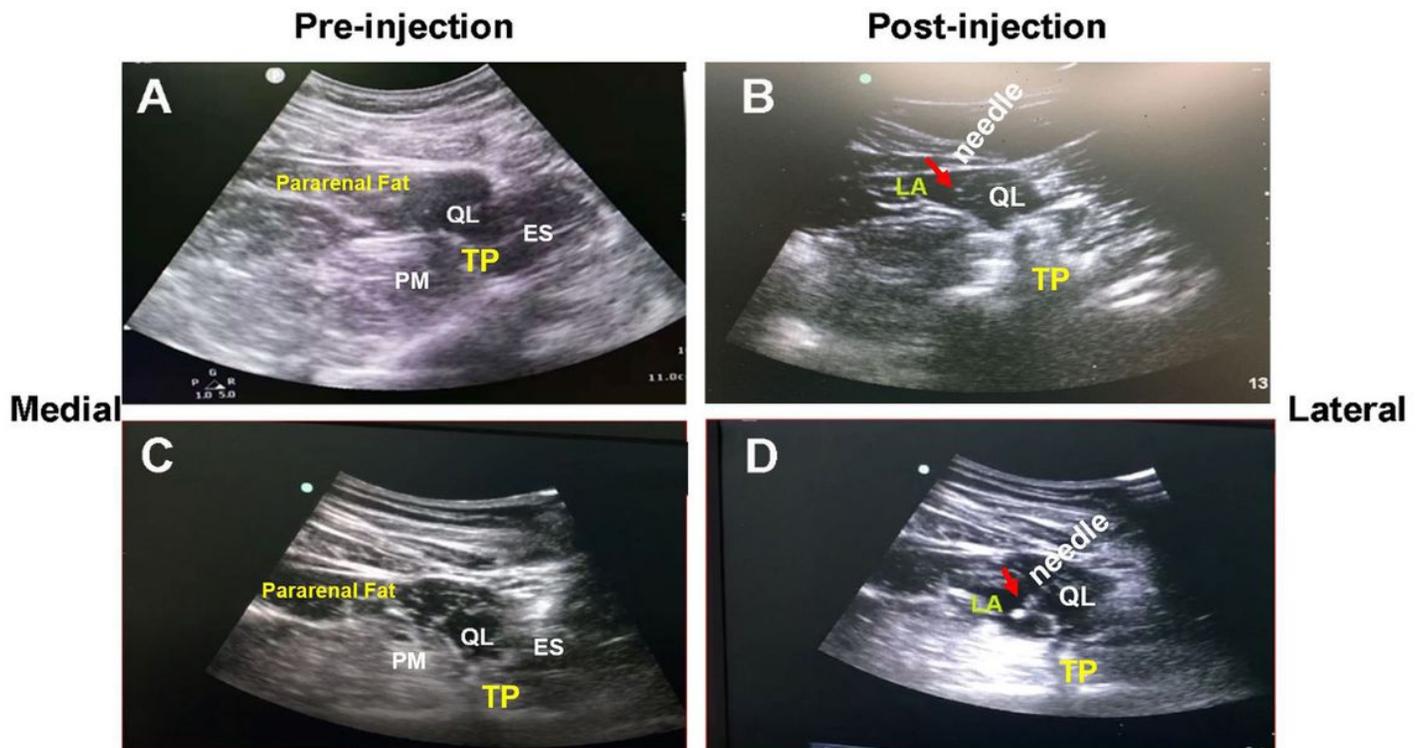


Figure 1

Schematic illustration of the procedure of QLB-L (A: Pre-injection; B: Post-injection of local anesthetics) and QLB-TM (C: Pre-injection; D: Post-injection of local anesthetics). QL: Quadratus lumborus; PM: Psoas major muscle; ES :Erector spinae muscle TP: Transverse process; LA: local anesthetics; Red arrow: tip of the stimplex needle®.

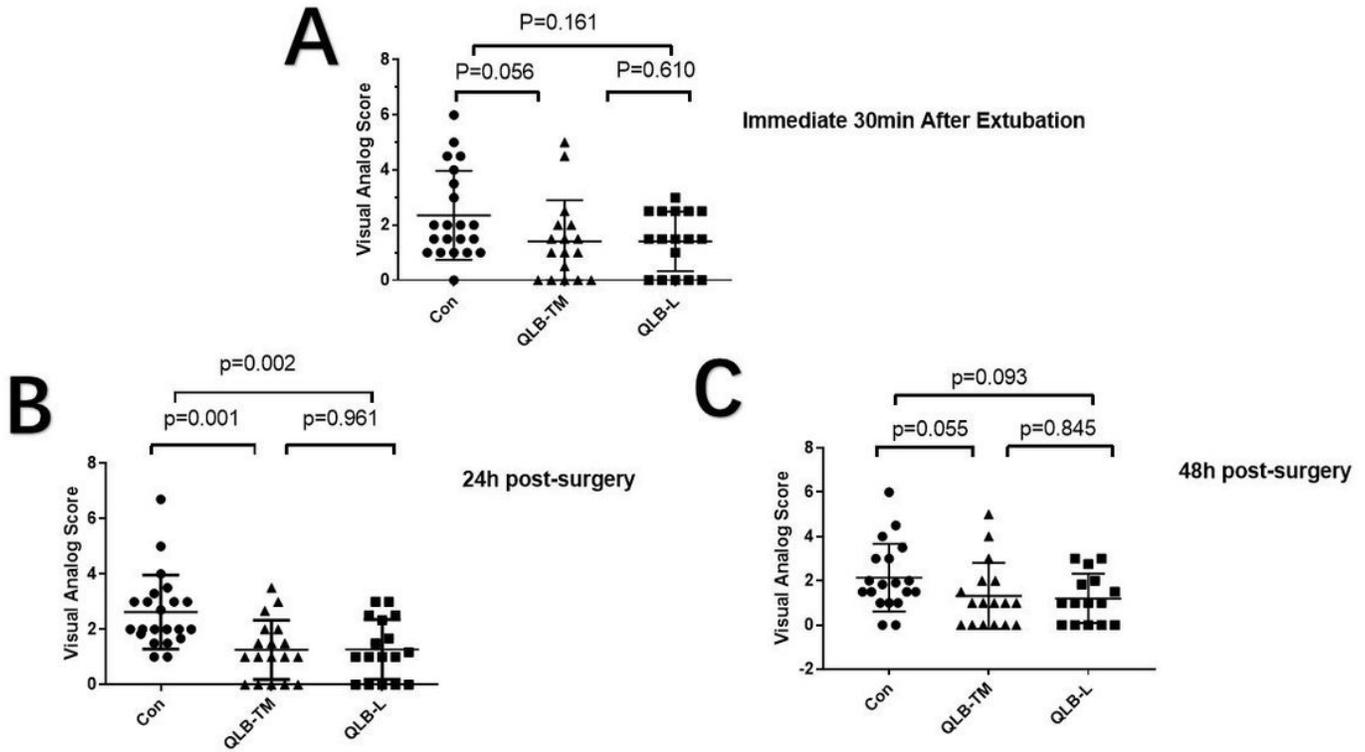
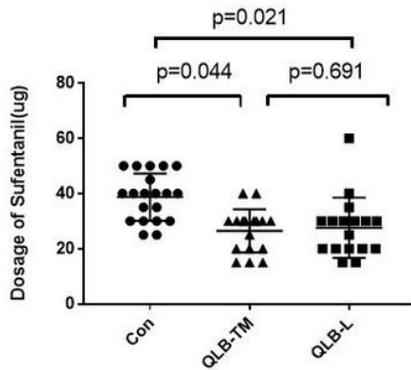
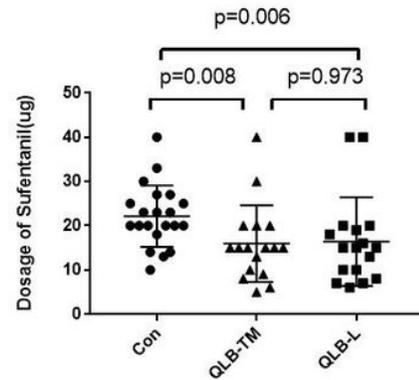


Figure 2

Effect of either type of QLB on the VAS scores in patients undergoing PCNL. The VAS scores were assessed at 30 min immediately after extubation (A), 24 h (B), and 48 h after surgery (C). The data was presented mean \pm standard deviation if it conformed to normal distribution or median with the range/ interquartile of range if not normally distributed. Con: control; QLB-L: quadratus lumborum –lateral; QLB-TM: quadratus lumborum- transmuscular.

A**Intraoperative Cumulative Consumption of sufentanil****B****Intraoperative Hourly Consumption of sufentanil****Figure 3**

Effect of either type of QLB on the intraoperative sufentanil consumption (A: cumulative dosage; B: the dosage of sufentanil consumed per hour in patients undergoing PCNL). The data was presented mean \pm standard deviation conformed to normal distribution or median with the range/ interquartile of range if not normally distributed. Con: control; QLB-L: quadratus lumborum –lateral; QLB-TM: quadratus lumborum- transmuscular.

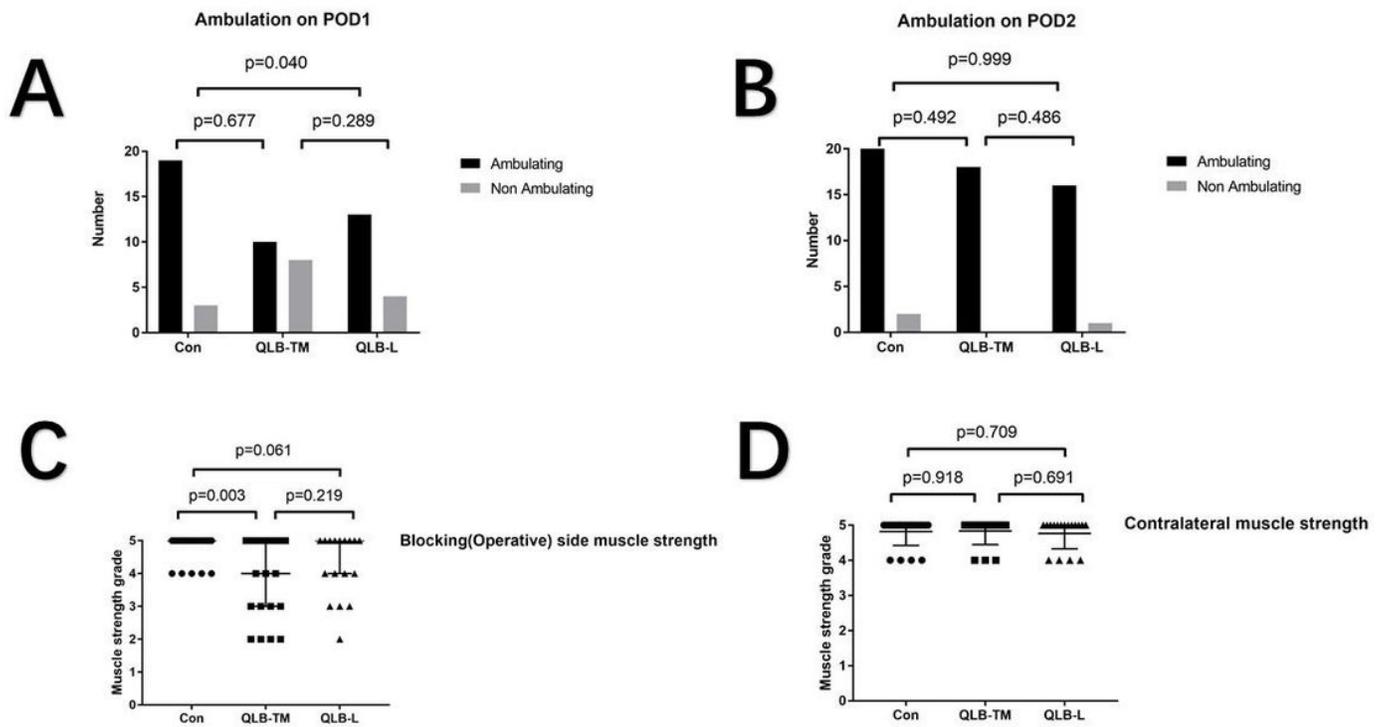


Figure 4

Effect of either type of QLB on the postoperative motor function of lower extremities and ambulation. The number of the ambulatory and non- ambulatory patient on the POD 1 (A), POD 2(B). Muscle strength score in blocking (Operative) side (C)or the contralateral side of the block (D). The ordinal data was presented median with the range/ interquartile of range. The test of chi-square or Fisher’s test is applied for the categorized data. Con: control; QLB-L: quadratus lumborum –lateral; QLB-TM: quadratus lumborum- transmuscular; POD: postoperative day.