The analgesic efficacy of ultrasound-guided transversus abdominis plane block for retroperitoneoscopic renal surgery: A randomized controlled study

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Abstract

Background Ultrasound-guided lateral transversus abdominis plane (TAP) block can provide definite analgesia to the anterior abdominal wall. However, whether it is useful in renal surgery involving access through the lateral abdominal wall remains unknown. Therefore, the study was aimed at evaluating the analgesic efficacy of lateral TAP block for retroperitoneoscopic partial or radical nephrectomy. Method In this prospective, randomized, double-blind, placebo-controlled trial, eligible patients were randomized into the intervention (T) and control (C) groups. After anesthesia induction, ultrasound-guided lateral TAP block was performed preoperatively with 30 mL of 0.4% ropivacaine and an equivalent amount of normal saline in groups T and C, respectively. The primary outcomes were opioid consumption during surgery and in the first 24 h after surgery. Secondary outcomes were postsurgical pain intensity at immediately awakening from anesthesia, and 0.5, 1, 2, 6, 12, 24 h after surgery, and recovery quality variables including the incidence of postoperative nausea and vomiting (PONV), sleep quality, time to first ambulation, drainage in the first 24 h after surgery, and length of hospital stay. Results 104 patients were enrolled and randomized: 53 and 51 in groups T and C, respectively. The median intraoperative sufentanil and remifentanil and postoperative sufentanil consumption per kilogram in the first 24 h after surgery was 0.33, 9.02, and 0.57 μg in Group T, respectively; the corresponding values in Group C were 0.30, 9.58, and 0.48 μg, all of which were not significant ($p = 0.528$, 0.903, and 0.244). Postsurgical pain intensity at all time points was comparable between the groups (all $p > 0.05$). Intergroup differences in recovery quality variables were not significant (all $p > 0.05$). Conclusion Our findings demonstrated that preoperative lateral TAP could not decrease intraoperative and postoperative opioid consumption and pain intensity in the first 24 h after surgery, nor could it promote postoperative recovery in patients undergoing laparoscopic renal surgery through retroperitoneal access.

Background

For laparoscopic renal surgery, retroperitoneal access is advantageous, in that it is associated with easier hilar control, lesser blood loss, and shorter total operative time than those associated with transperitoneal access [1]. Therefore, it is the most popular approach for radical or partial nephrectomy in Peking University First Hospital. Management of acute postsurgical pain is crucial for patient recovery after surgery. Systemic narcotics provide generalized analgesia but it may be accompanied by side effects such as respiratory depression, excessive sedation, pruritus, constipation, ileus, nausea, and vomiting. Multimodal analgesia aimed at decreasing the use of opioids and consequently their side-effects is advocated to improve early recovery after surgery [2]. The use of non-steroidal anti-inflammatory drugs (NSAIDS) is limited in renal surgery patients because of potential nephrotoxicity while epidural catheterization for analgesia carries a relatively high risk and requires the involvement of technically skilled anesthesiologists. A nerve block with local anesthetics is probably the most appropriate technique as an adjunct pain control measure after renal surgery [3].

Transversus abdominis plane (TAP) block is an effective local regional anesthetic technique that blocks neural afferents of the T6-L1 spinal nerve innervating the anterolateral abdominal wall [4]. Since the

original report by Rafi [5], there have been a plethora of studies on this block and variations of the original approach, among which lateral TAP is the most commonly used approach in abdominal surgery with its dermatomal blocking area covering from T10 to L1 [6]. Theoretically, the block can partially cover the incision area and trocar sites in retroperitoneal renal laparoscopy. Thus far, there is limited information about lateral TAP and its effect on the outcomes of retroperitoneal renal surgery. The primary objective of this study was to determine whether lateral TAP block could supply effective analgesia and improve recovery quality in patients undergoing laparoscopic radical or partial nephrectomy through retroperitoneal access.

Methods

Study design

This prospective, randomized, double-blinded study was approved by the Biomedical Research Ethics Committee of Peking University First Hospital (2017-1398). It was registered at http://www.chictr.org.cn with the identifier number: ChiCTR-INR-17013244. Written informed consent was obtained from each patient.

Participants

Potential participants were screened the day before surgery. Patients aged between 18 and 70 years and scheduled to undergo elective laparoscopic radical or partial nephrectomy were included. Patients who met any of the following criteria were excluded: (1) chronic opioid-addiction and/or use of other kinds of analgesic drugs for more than 3 months; (2) inability to communicate due to severe dementia, language barrier, or end-stage disease; (3) allergic to local anesthetics; (4) nerve block contraindication such as an infection in the puncture site or severe coagulation dysfunction; and (5) refusal to participate in the study. Patients who were eligible for this trial were taught how to evaluate pain intensity by using the numeric rating scale (NRS, an 11-point scale where 0 indicated no pain and 10 indicated the worst pain) and how to use a patient-controlled analgesia (PCA) device.

Anesthesia management and surgical technique

All patients were treated per a standardized anesthetic protocol. Besides basic standard monitoring (electrocardiography, noninvasive arterial blood pressure measurement, pulse oximetry, bispectral index (BIS), capnography), other interventions, such as central venous cannulation, invasive arterial cannulation, and/or monitoring using the Flotrac-Vigileo system were performed according to the patients' comorbidities. Anesthesia was induced with 0.15-0.3 μg/kg sufentanil, 1-3 mg/kg propofol, and 0.1-0.2 mg/kg etomidate. Endotracheal intubation was facilitated using 0.15 mg/kg cisatracurium or 0.6 mg/kg rocuronium bromide. Anesthesia was maintained with propofol infusion, remifentanil infusion with intermittent sufentanil or sufentanil infusion, with or without dexmedetomidine infusion, with an aim to maintain BIS values between 40 and 60 and mean arterial pressure and heart rate in a 10-20% interval in relation to the corresponding preoperative values. Thirty minutes before the end of surgery, intravenous

flurbiprofen axetil 50 mg and tropisetron 5 mg were administered to all patients. On emergence from anesthesia, patients were transferred to the post-anesthesia care unit (PACU) followed by transferred to the ward 1 h later.

All patients were managed according to a standard postoperative pain management protocol, i.e., a PCA pump with sufentanil 1.25 μg /ml at a basal rate of 0.5 mL/h and an on-demand bolus of 4 mL every 10 min with a rigorous rescue analgesia plan. The analgesic aim was to maintain the NRS pain score below 4. In the PACU, regular pain evaluation was performed every 30 min. If the NRS score was higher than 7, a first bolus 4 mL from the pump was administered by medical workers and pain was evaluated 5 min later. If the score continued to remain higher than 7, sufentanil 3-5 μg was administered according to the patient's weight. If however the score decreased to 4 or less, no more rescue analgesics were administered. In the ward, pain evaluation was performed at 2, 6, 12, and 24 h after the surgery. In addition to these follow-ups, patients were instructed to request additional medication in case of breakthrough pain. Breakthrough pain control measures were similar as those in the PACU, except morphine 3-5 mg was administered instead of sufentanil 3-5 μg. NSAIDS could be used as additional drugs according to the surgeons' preference.

The retroperitoneal laparoscopic procedure was usually performed through three ports. The primary port was invariably placed through the incision made for the creation of the working space. The location of this incision was just below the tip of the 12th rib on the posterior axillary line. The secondary port was placed 2 cm above the iliac crest on the midaxillary line while the third port was placed under the costal margin on the anterior axillary line. In radical nephrectomy, the initial incision was extended ventrally for kidney removal. Pneumoperitoneum was maintained around 12-14 mmHg throughout the procedure (Fig. 1).

Randomization and intervention

Stratified randomization with a block size of 4 was performed using the SAS statistical package version 9.3 (SAS Institute, Cary, NC, USA) by an independent biostatistician. The stratified factor was the type of surgery, i.e., radical or partial nephrectomy. The randomization results were then sealed in sequentially numbered envelopes and stored at the site of the investigation until the end of the study. The patients were randomly assigned to two groups: Group T and Group C. Perioperative management was identical in both groups except from the drug used in the TAP block. The drug used in Group T was 0.4% ropivacaine 30 ml while an equivalent amount of normal saline was used in Group C. Study drugs were provided as clear aqueous solutions in the same 20 ml syringes by an independent pharmacist who did not participate in the rest of the study.

Two anesthetists (Da Huang and Hao Kong) experienced in the technique, under ultrasound guidance, performed the block. They opened the randomized envelopes and did not participate in the rest of the study. Ultrasound-guided TAP block was performed immediately after the induction of anesthesia and about 15 min before skin incision. With the patient in the supine position, the US probe was placed at the midaxillary line between the lower costal margin and the iliac crest. At this point, the plane between the

internal oblique and transverse abdominal muscles was identified (Fig. 2A). A special needle used for nerve block (80 mm or 100 mm, Stimuplex D, Germany) was inserted using an in-plane technique in the anteroposterior direction. After aspiration, to avoid inadvertent intravascular injection and abdominal paracentesis, an injection with 2 mL of normal saline was used to ensure correct positioning of the needle. Then the prepared drug was injected into this plane. Successful study drug injection was defined as the appearance of a hypoechoic ellipsoid with well-defined margins on ultrasonic imaging (Fig. 2B). The anesthesiologist, surgeon, attending staff in charge of the patient, investigators, and the patients themselves were fully blinded to the group assignment.

Follow-up schedule and outcomes

An investigator (Xue Li) was in charge of the follow-up at several time points in the first 24 h after surgery. Besides, the electronic medical system was reviewed to obtain necessary data.

The primary outcomes were opioid consumption during surgery and in the first 24 h after surgery. The secondary outcomes were as follows: (1) NRS pain scores both at rest and with coughing at the following time points: immediately awakening from anesthesia, and 0.5, 1, 2, 6, 12 and 24 h after the operation; (2) time to the first bolus demand in the PCA system with its required and effective bolus numbers; (3) time to the first rescue analgesic as well as its frequency and percentage besides the use of the PCA system; (4) the incidence of postoperative nausea and vomiting (PONV) in 24 h after surgery and the percentage of antiemetic use; (5) patients' sleep quality evaluated by the NRS (an 11-point scale where 0 indicated the best sleep quality and 10 indicated the worst sleep experience) on the night of surgery day; (6) time to the first ambulation after surgery; (7) drainage in the first 24 h after surgery; and (8) the length of hospital stay after surgery.

For assessment of the safety of the technique, complications associated with the TAP block, anesthesia, and surgery were also recorded. These adverse events included but were not limited to the following conditions: numbness in the lower extremities, hematoma and bleeding in the needle trajectory, visceral organ injury, anaphylaxis, local anesthetic toxicity, airway spasm, hypoxemia, cardiac arrest, new-onset arrhythmia, persistent hypotension (systolic blood pressure reduction of more than 30% from baseline [average value in the ward] lasting for at least 15 minutes) and bradycardia (heart rate < 45 beats per minute or a decrease of more than 30% from baseline [average value in the ward] lasting for at least 5 minutes), major hemorrhage (loss of over one blood volume [70 mL/kg or >5 L in a 70-kg adult] in 24 h, loss of 50% of total blood volume in less than 3 h, or bleeding at a rate greater than 150 mL/min), conversion of laparoscopic surgery to open surgery, and re-operation after leaving the operation room.

Statistical analysis

Sample size estimation

According to previous studies [7, 8], the TAP block could decrease morphine consumption by more than 40% in comparison with the placebo within the first 24 h after surgery. We conservatively assumed that

opioid consumption would be reduced by 10% in the TAP block group. We based our sample size calculation on a previous data analysis from our clinical follow-up system, which showed that the total dosage of sufentanil in laparoscopic renal surgery with no TAP block intervention was 36.5 5.4 μg. With the significance and power set at 0.05 (two-sided) and 90% respectively, the sample size required to detect differences was 94 patients. Taking into account a drop-out rate of about 10%, we planned to enrol 104 patients. Sample size calculation was performed with the PASS 11.0 software (Stata Corp. LP, College Station, TX).

Outcome analyses

Normally distributed continuous variables were expressed as mean ± SD values and were compared using a two-tailed Student's t-test. Non-normally distributed continuous variables and ordinal data were expressed as median (interquartile range) and were analyzed using the Mann-Whitney U test. Categorical variables were expressed as number (percentage) and were compared with Chi-squared analysis or Fischer's exact test. Time-event data were analyzed by the Kaplan-Meier estimator, with the difference between groups compared by the log-rank test. Two-sided P values of less than 0.05 were regarded as statistically significant. All statistical analyses were performed with the SPSS statistical package version 22.0 (SPSS Inc, Chicago, IL, USA).

Results

From January 1, 2018 to March 20, 2018, 166 patients were screened for eligibility; 130 patients met the inclusion/exclusion criteria; 104 patients gave consent and were randomized into the study, with 53 patients in Group T and 51 in Group C. All subjects followed the study protocol, except one patient who showed major hemorrhage and had to undergo conversion to open surgery. The CONSORT diagram is shown in Figure 3. Each of these patients was included in the final intention-to-treat analysis.

There were no significant intergroup differences in the demographic and baseline characteristics (Table 1). As for intraoperative parameters, both groups were comparable in terms of the anesthesia and surgical duration, the kind of opioids as well as their consumption, the percentage of dexmedetomidine usage and its dosage, and the blood loss (Table 2).

In the first 24 h after surgery, data from the PCA system showed that the total dose of sufentanil consumption per kilogram was 0.57 (0.37-1.17) μg in Group T and 0.48 (0.35-0.94) μg in Group C, which was not statistically significant (p = 0.244). The required and effective bolus numbers were similar in the two groups (p = 0.287 and 0.299). Time to the first bolus demand tended to be longer in Group T (6.0 (3.2-8.8) h vs. 1.7 (0.4-3.0) h, p = 0.074), although the difference was not statistically significant.

There was no statistically significant intergroup difference in the percentage and frequency of rescue analgesic administration besides the use of the PCA system (p = 0.117 and 0.387). In patients who received rescue analgesia, the time for administration of the first dose of rescue analgesia was comparable in the two groups (p = 0.927). Post-surgical pain scores at these above-mentioned time

points were comparable at rest and with coughing in the two groups (all p > 0.05) (Table 3, in the end of this text).

Regarding the recovery quality, in the first 24 h after surgery, the incidence of PONV, percentage of antiemetic usage for therapy, subject sleep quality, time for the first ambulation, drainage, and length of postsurgical stay in the hospital were similar between the two groups (all p > 0.05) (Table 4).

No complications related to the TAP block technique were observed in both groups, and none of the other adverse events listed above were noted in this trial, except for a major hemorrhage (blood loss, 6500 ml) and persistent hypotension that required conversion to open surgery in one patient from Group T and emergence delirium that occurred in one patient from Group C.

Discussion

Our results showed that for patients undergoing laparoscopic renal surgery through retroperitoneal access, preoperative lateral TAP could not decrease intraoperative and postoperative opioid consumption as well as pain intensity in the first 24 h after surgery, although it seemed to prolong the time for the first bolus required in the PCA system. In comparison with the sham control, TAP block showed no advantage in promoting postoperative recovery in those patients. Our study added new evidence to the current knowledge of analgesic measures for retroperitoneal urological laparoscopy.

To our knowledge, this is the first study that aimed to investigate lateral TAP efficiency in retroperitoneal renal laparoscopy. We emphasized that it was crucial to assess the surgical technique and incisions, TAP approaches, as well as the control measures when comparing the TAP efficiency among different trials.

Hosgood, S. A et al [9] found that in comparison to the sham control, bilateral TAP block could reduce early morphine requirement (6 h after surgery) and postoperative pain intensity in patients undergoing laparoscopic donor nephrectomy (LDN) while there was no difference in the total amount of morphine required (24 h after surgery). The authors ascribed this to the short duration of bupivacaine anesthesia in the single-shot TAP block and suggested that a continuous block should be used in LDN. Similarly, Aniskevich, S et al [8] demonstrated that a TAP block reduced overall pain scores at 24 h, with a trend toward decreased total morphine consumption in patients who underwent laparoscopic hand-assisted nephrectomy.

In comparison with these trials, our results appeared to be rather disappointing. Notably, the surgical incision and trocar sites in these trials were completely different from those in our study. In the studies of Hosgood and Aniskevich, the main incision for kidney retrieval was a supraumbilical or infraumbilical midline incision, while it was a flank incision under the costal margin between the anterior and posterior axillary lines in our study. We thought that this distinction was the primary reason for the widely different results between our study and others. Further clarification of these findings will require detailed interpretation of the innervation of the abdominal wall.

The anterolateral abdominal wall is mainly innervated by the anterior rami of thoracolumbar spinal nerves (T6-L1), which follow a curvilinear course from the back toward the midline of the body [4]. Generally, as they proceed, after giving off lateral cutaneous branches (LCB) near the costal angle innervating the lateral areas of the abdominal wall [10], they enter into the TAP with a varied course and finally perforate the rectus abdominis and end as the anterior cutaneous branches innervating the anterior abdomen (area from the midline to the midclavicular line) [11]. Most of the LCB arise before the main nerves enter the TAP, and only those of T11 and T12 have a short course within or through the TAP [11]. After refining the anatomy of the thoracolumbar nerves, it is not surprising that the lateral TAP approach performed at the midaxillary line between the costal margin and iliac crest can consistently provide the anterior abdomen (mainly periumbilical and infra-umbilical area) analgesia while the lateral abdomen wall analgesia is not reliable. The reason is that only the LCB of T11 -12 may be blocked depending on their course in TAP while most LCB of segmental nerves cannot be blocked. Therefore, studies with the main incision in the midline always showed positive results for the efficiency of the TAP block while our trial with the flank incision yielded negative findings.

If lateral abdominal wall analgesia is required, the posterior TAP approach (US-guided or through the Perit triangle) should be performed posterior to the midaxillary line with the aim of blocking the LCB. Coincidentally, Qu G. et al [12] demonstrated that US-guided posterior TAP substantially decreased the intraoperative fentanyl consumption, the postoperative pain scores, and the incidence of postoperative rescue analgesic use and could accelerate postoperative recovery in patients who received retroperitoneoscopic urological surgeries.

One important finding in our study was that the time to first analgesic demand seemed to be longer in Group T. This result was comparable with that obtained by Parikh et al [13], who showed that the time to first dose of rescue analgesia was significantly prolonged in the TAP block group for patients undergoing LDN. This finding suggested that the single-shot lateral TAP block might be useful in the early postsurgical period.

Regarding the quality of recovery, we observed no advantages in Group T in terms of the incidence of PONV, the length of hospital stay, time for ambulation, and the subject sleep quality. This was consistent with the findings of many studies that focus on the recovery enhanced effect of TAP in nephrectomy [8, 9, 14]. Probably because of the relatively higher recovery quality in laparoscopic surgery even in the control group (low pain scores, less drainage, early ambulation), TAP block as a multimodal analgesia measure could not promote recovery any further.

In a comparison of the effects of TAP block to wound infiltration, Araújo, A. M. et al [15] demonstrated that the intraoperative remifentanil consumption, morphine administration in the recovery room, and postsurgical pain scores as well as the functional recovery variables were all comparable in laparoscopic nephrectomy. In addition, Azawi, N. H. et al [16] found that the pain score and sufentanil and morphine consumption in the first postoperative hour were even higher in the TAP block group for nephrectomy.

However, these results should be interpreted carefully because of the retrospective nature of their study and the lack of description of the surgical technique.

Our study had some limitations. First, we did not assess sensory dermatome blockage to confirm a successful TAP block because the block was performed after anesthesia induction for blinding. Second, we did not collect data for sufentanil consumption at every time point in the follow-up periods. Our results showed that the TAP block tended to prolong the time for the first bolus dose requirement, which reminded us that the early sufentanil consumption might be less in the true TAP block group. If the continuous block was used with frequent data collection for opioid consumption, we might have obtained a different result.

Conclusion

This prospective, randomized, blind trial demonstrated that preoperative single-shot lateral TAP could not decrease intraoperative and postoperative opioid consumption as well as pain intensity in the first 24 h after surgery, although it tended to prolong the time for the first bolus requirement in the PCA system, neither could it promote postoperative recovery in the patients undergoing laparoscopic renal surgery through retroperitoneal access. Other approaches for TAP block or other kinds of nerve block (quadratus lumborum block or intercostal nerve block) aiming to reliably block lateral abdomen should be used and investigated in future studies.

List Of Abbreviations

ASA: America Society of Anesthesiologist; BMI: Body Mass Index; BIS: Bi-spectral index; COPD: chronic obstructive pulmonary disease; LDN: laparoscopic donor nephrectomy; LCB: lateral cutaneous branches; NYHA: New York Heart Association; NSAIDS: non-steroidal anti-inflammatory drugs; NRS: numeric rating scale; PONV: postoperative nausea and vomiting; PCA: Patient-controlled analgesia; PACU: Post-anesthesia care unit; TAP: Transversus abdominis plane.

Declarations

Ethics approval and consent to participate

The research protocol was approved by the Biomedical Research Ethics Committee of Peking University First Hospital (Number: 2017-1398), and all the patients signed the written informed consent voluntarily.

Consent for publication

Not applicable.

Availability of data and materials

The datasets are not publicly available, but available from the corresponding

author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

XL: Study design, data collection and analysis, manuscript drafting.

ZML: Study design, data analysis, manuscript revision.

All authors have agreed both to be personally accountable for their own contributions and approved the final version of the manuscript.

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Tables

Table 1 Patients' demographic and baseline characteristics

	Group C (n=51)	Group T (n=53)	P value
Age, year	51.1±11.1	51.7±10.3	0.768
BMI, kg/ m2	24.8±3.3	24.9±3.9	0.935
Male	31 (60.8%)	33 (62.3%)	0.877
Type of surgery			0.991
Radical nephrectomy	24 (47.1%)	25 (47.2%)	
Partial nephrectomy	27 (52.9%)	28 (52.8%)	
ASA class			
□	27 (52.9%)	24 (45.3%)	0.400
□	24 (47.1%)	28 (52.8%)	
□	0 (0%)	1 (1.9%)	
NYHA class			0.495
□	51 (100%)	51 (96.2%)	
□	0 (0%)	2 (3.8%)	
Comorbidities			
Stoke	2 (3.9%)	4 (7.5%)	0.710
Hypertension	19 (37.3%)	17 (32.1%)	0.579
Coronary artery disease	1 (2.0%)	3 (5.7%)	0.638
Diabetes Mellitus	3 (5.9%)	10 (18.9%)	0.045
Asthema and/ or COPD	2 (3.9%)	0 (0%)	0.238
History of abdomen and back surgery	14 (27.5%)	10 (18.9%)	0.299

Results are presented as mean ± standard deviation, number (%) or median (interquartile range);

COPD: chronic obstructive pulmonary disease.

Table 2 Intraoperative data

	Group C (n=51)	Group T (n=53)	P value
Duration of anesthesia, min	144.0 (122.0-168.0)	140.0 (127.0-165.5)	0.938
Duration of surgery, min	78.0 (59.0-112.0)	79.0 (64.0-103.5)	0.933
Dose of Suf., g	20.0 (15.0-38.2)	25.0 (20.0-32.2)	0.604
Dose of Suf., g/kg	0.30 (0.23-0.57)	0.33 (0.27-0.48)	0.528
Percentage of using Ref.	33 (64.7%)	40 (75.5%)	0.230
Dose of Ref., μg	600.0 (501.5-793.5)	613.5 (431.3-842.8)	0.877
Dose of Ref., μg/kg	9.58 (7.32-11.39)	9.02 (6.48-12.33)	0.903
Percentage of using Dex.	20 (39.2%)	13 (24.5%)	0.108
Dose of Dex., μg	30.0 (22.5-39.0)	30.0 (22.2-50.0)	0.785
Blood loss, ml	50.0 (50.0-50.0)	50.0 (50.0-50.0)	0.524
Convert to open surgery	0 (0%)	1 (1.9%)	>0.999
Hypotension*	0 (0%)	1 (1.9%)	>0.999

Results are presented as number (%) or median (interquartile range);

Suf.: Sufentanil; Ref.: Remifentanil; Dex.: Dexmedetomidine;

*a decrease of systolic blood pressure of more than 30% from baseline (average value in the ward) and lasting for at least 15 minutes.

Table 3 Effectiveness outcomes

	Group C (n=51)	Group T (n=53)	P value
Data in PCA system in the first 24h after surgery			
Total dose of sufentanil, g	32.5 (23.3-65.0)	42.5 (24.2-79.6)	0.289
Total dose of sufentanil, g/kg	0.48 (0.35-0.94)	0.57 (0.37-1.17)	0.244
Required bolus numbers	4 (1-10)	7 (1-15)	0.287
Effective bolus numbers	3 (1-10)	5 (1-12)	0.299
Time to first bolus demand, houra	1.7 (0.4-3.0)	6.0 (3.2-8.8)	0.074
Data besides PCA system in the first 24h after surgery			
Percentage of needing rescue analgesics	12 (23.5%)	20 (37.7%)	0.117
Time to first rescue analgesics required, houra	21.0 (14.4-27.6)	25.0 (21.7-28.3)	0.927
Frequency of rescue analgesics required	2 (1-3)	1 (1-4)	0.387
NRS pain score after surgery, at restb			
Immediately after anesthesia recovery	0 (0-2) (n=49)	0 (0-1) (n=52)	0.725
Postsurgical 0.5 hour	1 (0-3) (n=50)	1 (0-2) (n=52)	0.818
Postsurgical 1 hour	2 (0-3) (n=50)	1 (0-3) (n=52)	0.703
Postsurgical 2 hour	2 (1-3) (n=50)	2 (1-3) (n=52)	0.310
Postsurgical 6 hour	3 (1-3) (n=51)	2 (1-3) (n=52)	0.361
Postsurgical 12 hour	3 (2-4)	3 (1-4)	0.651
Postsurgical 24 hour	2 (2-3)	2 (1-3)	0.575
NRS pain score after surgery, with coughingb			
Immediately after anesthesia recovery	0 (0-3)	1 (0-2)	0.812

	(n=49)	(n=52)	
Postsurgical 0.5 hour	2 (0-4) (n=50)	2 (0-3) (n=52)	0.859
Postsurgical 1 hour	2 (1-4) (n=50)	2 (1-4) (n=52)	0.589
Postsurgical 2 hour	3 (2-5) (n=50)	3 (2-4) (n=52)	0.210
Postsurgical 6 hour	4 (2-5) (n=51)	3 (2-5) (n=52)	0.444
Postsurgical 12 hour	4 (2-6)	4 (2-6)	0.582
Postsurgical 24 hour	4 (3-5)	3 (2-5)	0.486

Results are presented as number (%) or median (interquartile range), unless otherwise indicated.

PCA: patient control analgesia; NRS: numeric rating scale.

aData were analyzed by Kaplan-Meier analysis and compared by log-rank test; results were presented as median (95% confidence interval).

bIn Group T, NRS score couldn't be evaluated because of sedation during the first 6 hours after surgery in one patient who suffered major hemorrhage intraoperatively and was transferred to ICU ; In Group C, NRS score couldn't be evaluated during the first 2 hours after surgery in one patient who was transferred to ICU unexpected resulting from the request of the surgeon with unknown reasons meanwhile NRS score couldn't be evaluated immediately after surgery in one patient because of emergence delirium.

Table 4 Comparisons of recovery variables

	Group C (n=51)	Group T (n=53)	P value
Incidence of PONV	15 (29.4%)	18 (34%)	0.618
Percentage of using antiemetics	10 (19.6%)	9 (17%)	0.729
Subject sleep quality, NRS score	5 (2-7)	4 (2-7)	0.834
Time to first ambulation, houra	19.5 (17.8-21.2)	20.0 (18.2-21.8)	0.314
Drainage ,ml	30.0 (0.0-55.0)	40.0 (0.0-90.0)	0.221
Length of hospital stay after surgery, daya	4.0 (3.7-4.3)	4.0 (3.6-4.4)	0.704

Results are presented as number (%) or median (interquartile range), unless otherwise indicated.

PONV: postoperative nausea and vomiting; NRS: numeric rating scale.

Except the length of hospital stay, all items listed in this table referred to data in the first 24 hours after surgery.

aData were analyzed by Kaplan-Meier analysis and compared by log-rank test; results were presented as median (95% confidence interval)

Figures

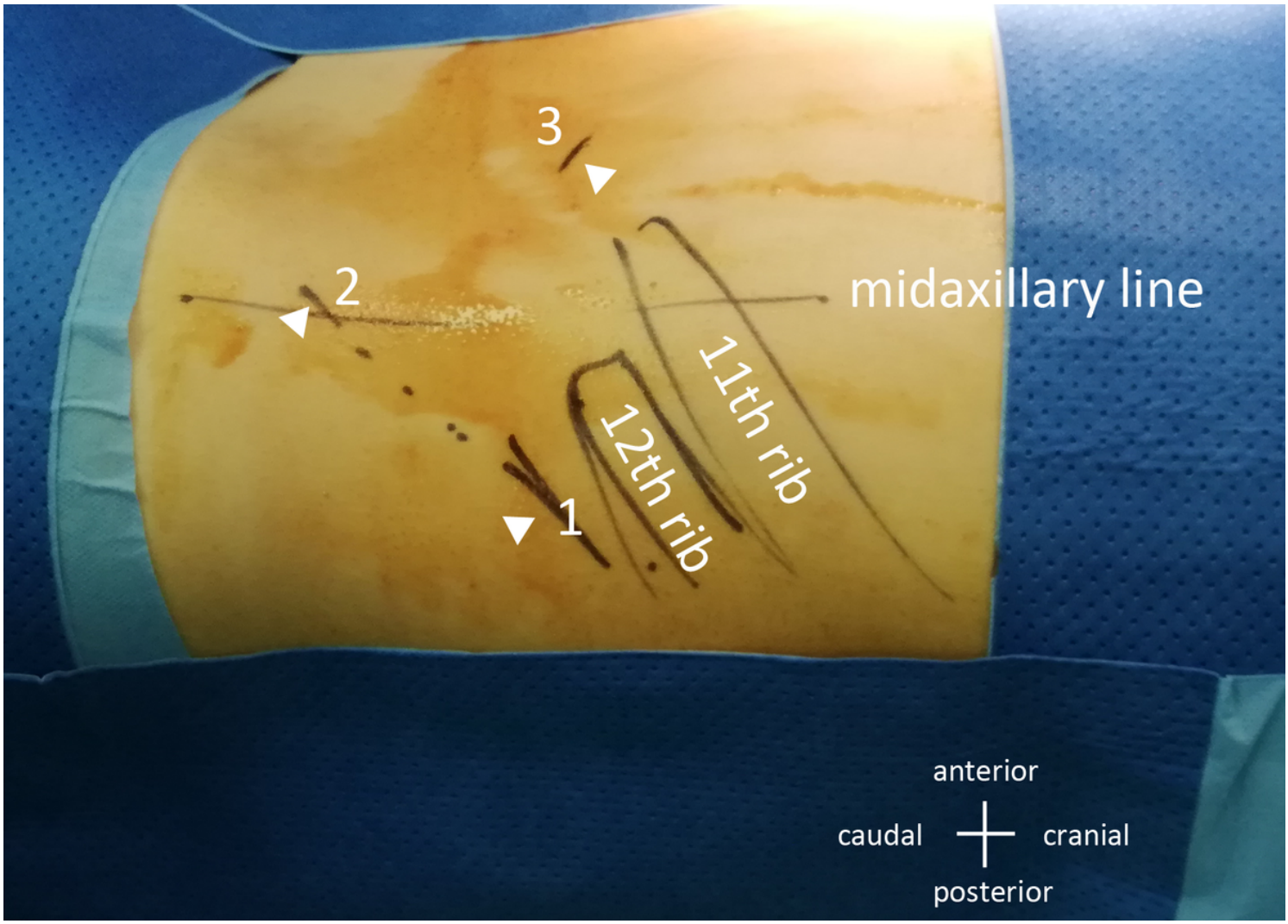

Figure 1

The three trocar sites in retroperitoneoscopic renal surgery

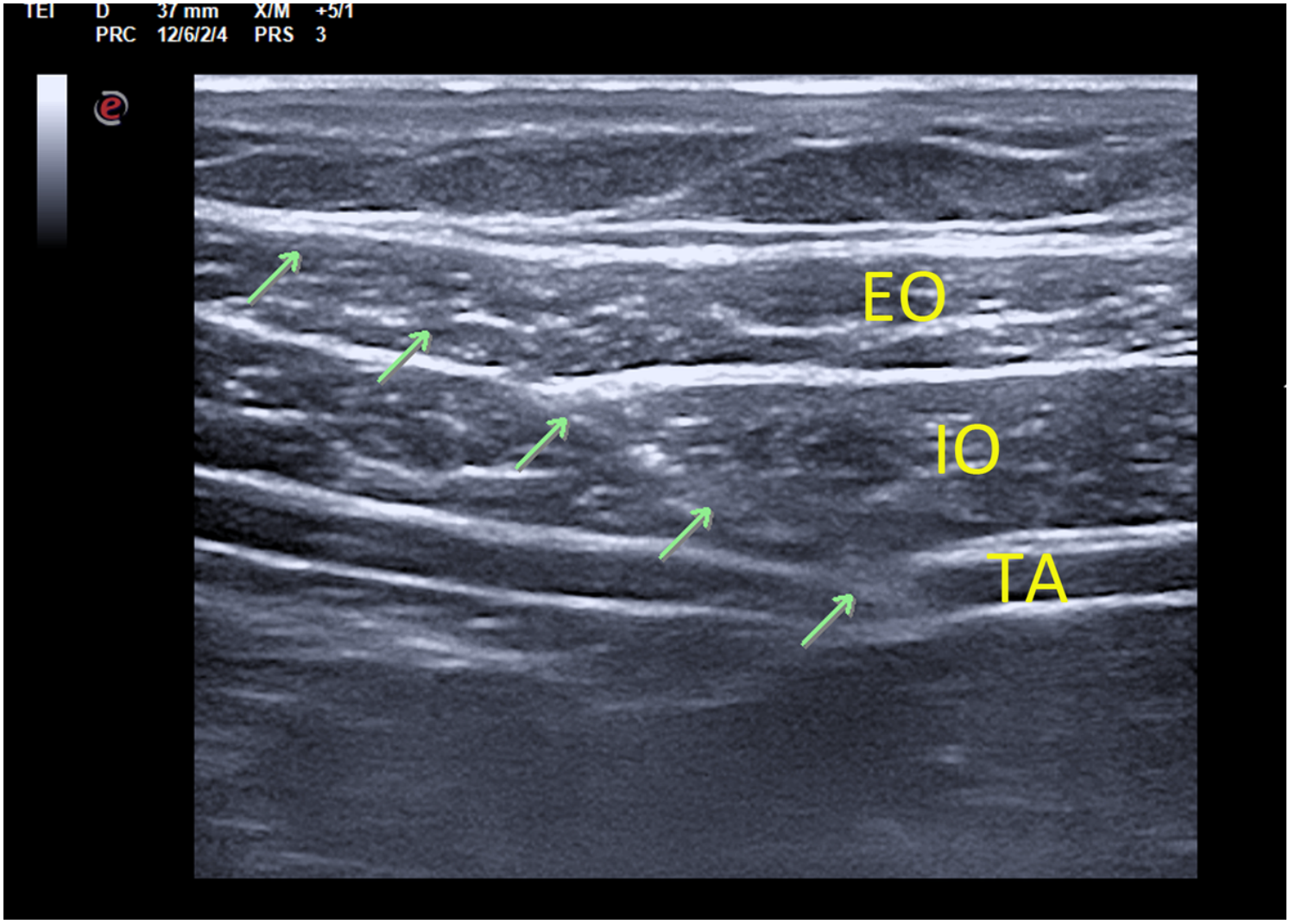

Figure 2

Sonography of the lateral TAP block. A: ultrasound anatomical structure. The green arrow indicates the needle trajectory; EO, external oblique; IO, internal oblique; TA, transversus abdominis; LA, local anesthetic.

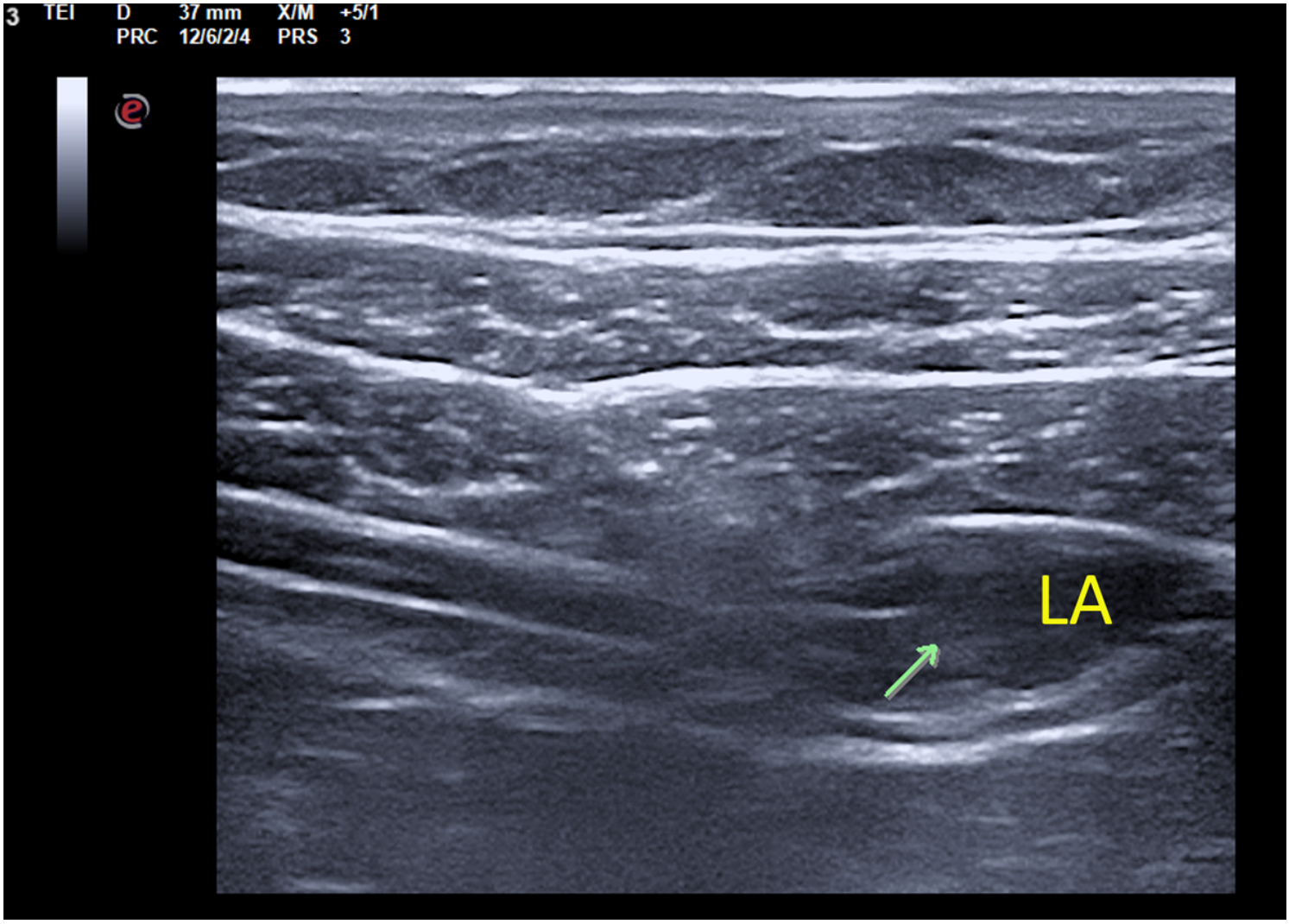

Figure 3

Sonography of the lateral TAP block. B: spread of local anesthetic. The green arrow indicates the needle trajectory; EO, external oblique; IO, internal oblique; TA, transversus abdominis; LA, local anesthetic.

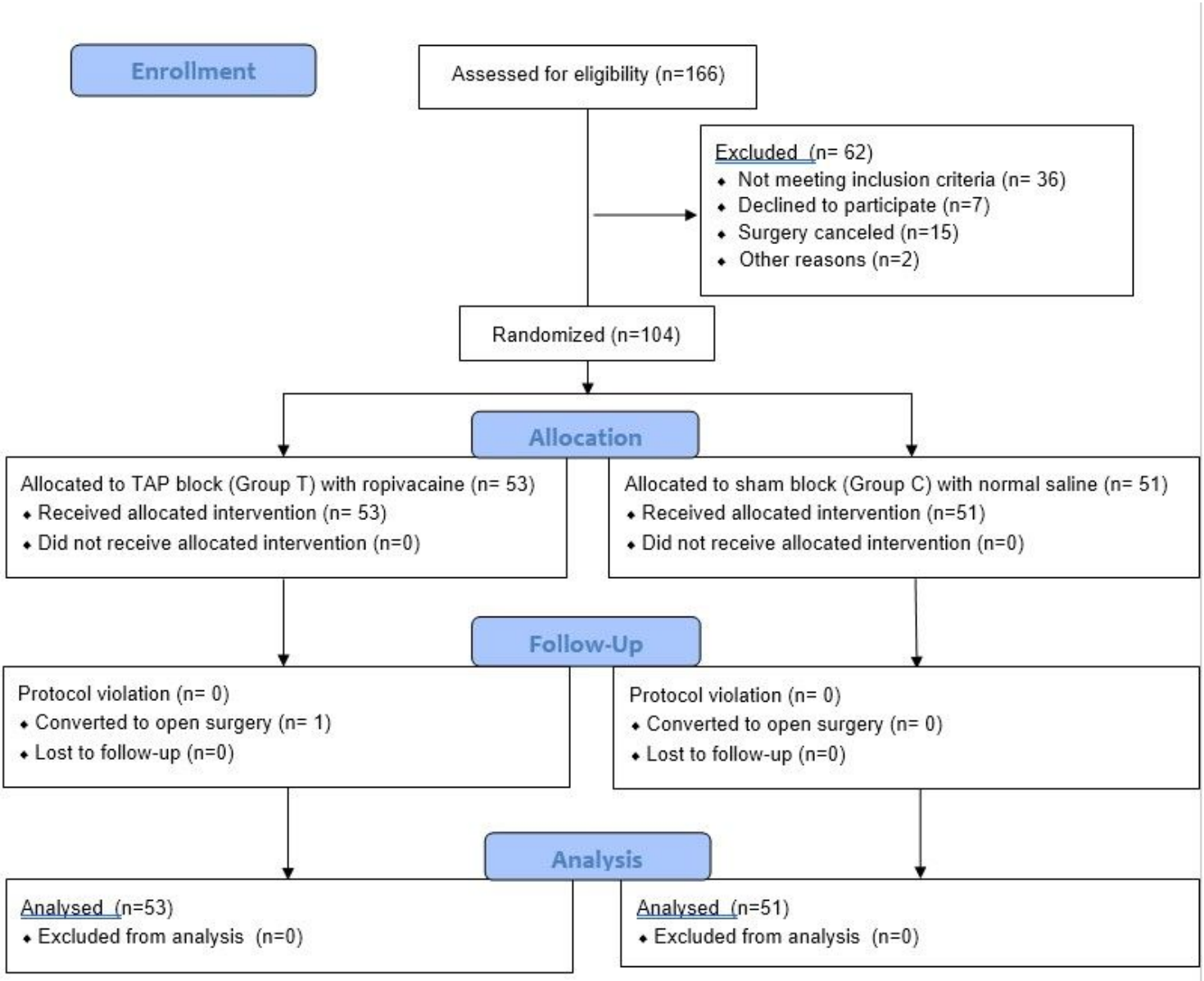

Figure 4

Flow Diagram of the study

Supplementary Files

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

- supplement1.xlsx