Original Article

Comparison of transversus abdominis plane block and quadratus lumborum block for post-caesarean section analgesia: A randomised clinical trial

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ABSTRACT

Background and Aims: Effective post-operative analgesia after caesarean section (CS) is important because it facilitates early amelioration, ambulation and expedites breastfeeding. Quadratus lumborum (QL) block is an interfascial block providing effective visceral and somatic analgesia. We conducted this study to compare the analgesic efficacy of QL block and transversus abdominis plane (TAP) block after CS. **Methods:** In this single hospital-based, prospective double-blind study, 60 patients scheduled for an elective CS between December 2018 and January 2019 were randomised to receive ultrasound-guided TAP block (n = 30) or QL block (n = 30) bilaterally with 0.2% ropivacaine postoperatively. The primary objective was to measure the time for rescue analgesic requirement and secondary objectives included the total number of analgesic dose required over a period of 72 hours and severity of post-operative pain assessment via visual analogue scale (VAS) score at rest and with movement. Statistical analysis was done using SPSS version 21. Data were compared using the Chi-square test and students' t-test. **Results:** Time for rescue analgesic requirement was higher in the QL group than the TAP group (mean ± SD: 68.77 ± 1.74 h vs. 13.3 ± 1.21 h) ($P < 0.001$). The QL group had significantly less analgesic demand ($P < 0.001$) at 2, 4, 6, 12, 24, 36, 48 and 72 h post-CS. The VAS at rest and movement was significantly reduced in the QL group at all times. **Conclusion:** The QL block provided prolonged and effective analgesia in comparison to TAP block up to 72 hours post-CS.

Key words: Caesarean section, quadratus lumborum block, transversus abdominis plane block

INTRODUCTION

Post-operative analgesia is of vital importance to prevent various undesirable side effects such as respiratory complications, venous thromboembolism, and increased hospital stay.[1] Consequential pain and discomfort are expected after caesarean section (CS); hence, the analgesic regimen should assure efficient and safe anodynia.[2] Commonly, opioids are used for post-caesarean pain relief. While dose-dependent respiratory depression is the most discomforting side effect, other insignificant side effects such as pruritus, itching, gastrointestinal upset and urinary retention can be vexing during the initial puerperium.

The transversus abdominis plane (TAP) block has been used for post-operative pain relief in various abdominal surgeries as part of the multimodal analgesic approach.[3,4] It creates satisfactory somatic analgesia with insignificant or no visceral blockade.[5]

Quadratus lumborum (QL) block, first reported in 2007 by Blanco, is a posterior abdominal wall block which permits spread of local anaesthetic agent behind the quadratus lumborum muscle into a triangular space known as a lumbar interfascial triangle which lies

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beside the middle layer of the thoracolumbar fascia.[6,7] This interfascial plane is in adjoining proximity with numerous sympathetic fibres and conjoin with the thoracic paravertebral space, thus preceding to a long-standing block with the capability to provide visceral analgesia.[8] Various case reports are there showing effective post-operative analgesic profile of QL block.[4,9-12]

Therefore, we conducted a randomised, prospective study to compare the post-operative analgesic efficacy of QL block and TAP block in patients undergoing elective CS under spinal anaesthesia with primary aim to compare the time for rescue analgesic requirement and secondary aim to compare the total number of analgesic dose required and visual analogue scale (VAS) score for up to 72 hours post-CS.

METHODS

Ethical approval for this study was provided by the Institutional Ethics Committee at Mahatma Gandhi Medical College and Hospital (Jaipur, Rajasthan; reference number MGMCH/IEC/JPR/2018/11). The study was registered with the Clinical Trials Registry- India (Registration No.: CTRI/2018/11/016420).

This prospective randomised study was carried out in the obstetrics and gynaecology operation theatre of our hospital for 2 months (from December 2018 to January 2019) on all the parturients with American Society of Anesthesiologists (ASA) Physical Status Class I and II, and a normal singleton pregnancy with a gestation of a minimum of 37 weeks; scheduled for elective CS under spinal anaesthesia. Exclusion criteria were the inability to comprehend or participate in pain scoring system, systemic coagulopathy, anatomic abnormalities, allergy to study medication and localised infection. Written and informed consent was obtained from each patient. The protocol adhered to 2013 Declaration of Helsinki. Thereafter, random allocation of patients were done into two equal groups - Group QL: Each patient received bilateral posterior approach QL block and Group TAP: Each patient received bilateral TAP block.

For randomisation, a list of number using computer system was created where each number referred to one of the two groups. To ensure equality of the groups, block randomisation was used. Each number was enclosed in an opaque envelope. Each patient was then asked to select one of the opaque envelopes and give it to an anaesthesiologist, who compared it with the computer-generated list and thereby assigned the patient to one of the two groups.

Both block procedures were performed under the supervision of an experienced anaesthesiologist after completion of surgery and before transfer to the post-anaesthesia care unit.

As per perioperative anaesthesia management all patients received 40-mg pantoprazole by mouth in the morning, 2 hours before surgery. In the operating room, an intravenous cannula of 18-gauge was secured in the non-dominant hand or arm. Spinal anaesthesia and surgical treatment were executed in the usual manner.

At the completion of the surgery, with the patient still in the supine position and fully monitored, the abdomen was cleaned with the surgical solution, thereafter the QL block or TAP block was performed. A linear array (6-13 MHz) transducer (FUJIFILM Sonosite, Inc. Bothell, Washington) was used.

For the QL block, the posterior approach was used. A wedge was placed beneath the buttocks to facilitate probe movement, thereafter the transducer was placed at the level of the anterosuperior iliac spine and moved cranially until clear visualisation and identification of the 3 abdominal wall muscles. Then, the transducer probe was moved posteriorly until appreciation of the lumbar interfascial triangle covering the paraspinal muscle between the latissimus dorsi and QL muscles [Figure 1a]. A 21 gauge spinal needle was inserted in the plane anterolaterally to posteromedially. The needle tip was further progressed until it was inside the thoracolumbar fascia's middle layer. A total of 0.2% ropivacaine 0.2 ml/kg was then injected. The spread of injectate was observed ultrasonographically [Figure 1b]. The same procedure was repeated on the other side also.

For the TAP block, the transducer probe was initially placed at anterosuperior iliac spine's level, the probe then moved cranially as in QL block until identification of the 3 abdominal wall muscles thereafter moved posteriorly between the internal oblique and transversus abdominis muscles to the most posterior end of the TAP, where transversus abdominis tails off and turns into the aponeurosis [Figure 2a]. The target was the most posterior end of the TAP. The same type of needle was introduced in the midaxillary line and

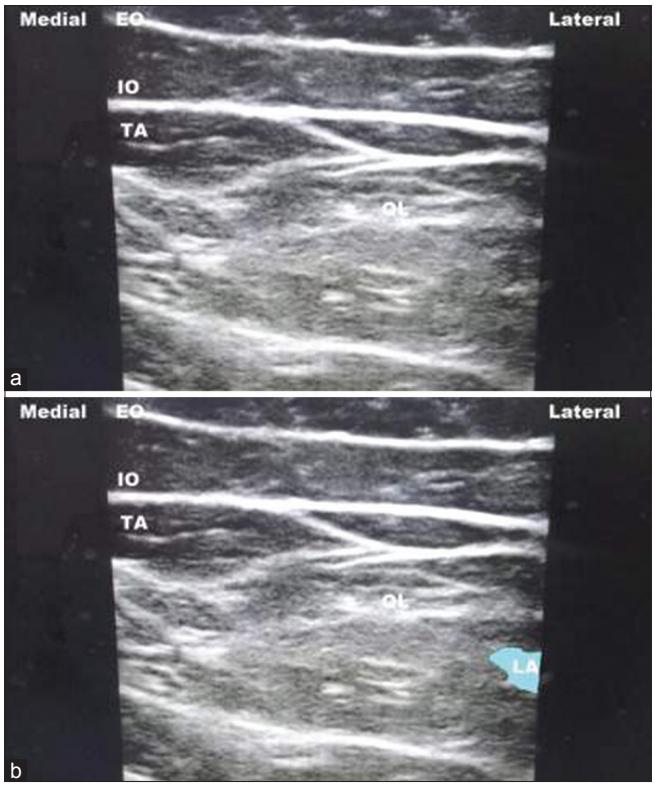

Figure 1: (a) Ultrasound preinjection image of posterior approach of QL block. EO: External oblique muscle, IO: Internal oblique muscle, TA: Transverses abdominis, QL: Quadratus lumborum. (b) Ultrasound post-injection image of posterior approach of QL block. EO: External oblique muscle, IO: Internal oblique muscle, TA: Transverses abdominis, QL: Quadratus lumborum, LA: Local anaesthetic drug, and blue colored area: Deposition site of local anaesthetic

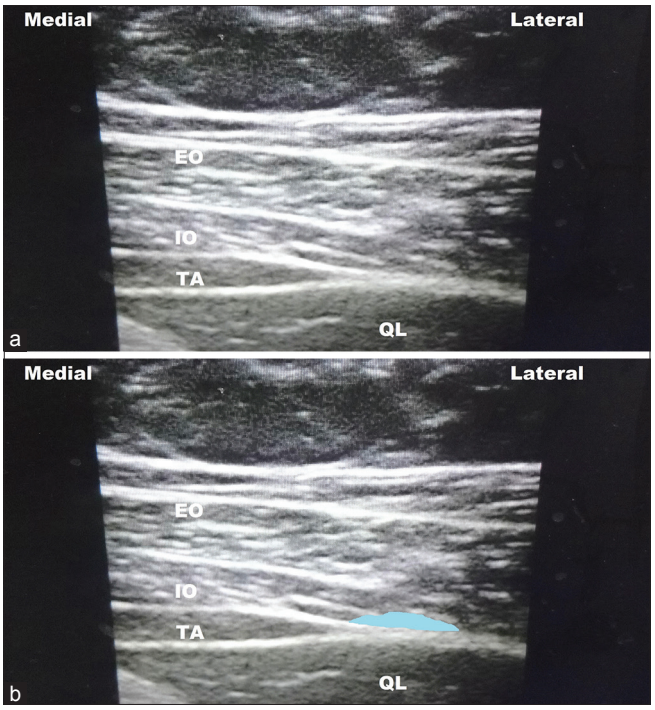

Figure 2: (a) Ultrasound preinjection image of posterior approach of TAP block. EO: External oblique muscle, IO: Internal oblique muscle, TA: Transverses abdominis, QL: Quadratus lumborum. (b) Ultrasound post-injection image of posterior approach of TAP block. EO: External oblique muscle, IO: Internal oblique muscle, TA: Transverses abdominis, QL: Quadratus lumborum, LA: Local anaesthetic drug, and blue colored area: Deposition site of local anaesthetic

progressed posteriorly until it reached the posterior end of the TAP. A total of 0.2% ropivacaine 0.2 ml/kg was injected after hydro dissection [Figure 2b]. The same procedure was repeated on the other side as well.

The intensity of post-operative pain was recorded for all the patients by an investigator blinded to the allotment using visual analogue scale (VAS) score (0 = no pain and 100 = worst possible pain) at various predetermined time intervals (2, 4, 6, 12, 24, 36, 48 and 72 h). The 'time for first analgesic requirement' was noted, considering the completion of block procedure as 'Time 0'. Rescue analgesia was considered in when VAS ≥40. Intravenously Tramadol in the bolus of 100 mg was administered for the same. The total consumption of analgesic (tramadol) in terms of the number of doses in 72 hours was calculated for each patient. The primary outcome was the time for rescue analgesic requirement, and the secondary outcomes were the total number of analgesic dose required in 72 h, post-operative VAS pain score at rest and with movement.

A sample size calculation (Power of study = 80.00% and Sample Size Calculation by MEDCALC 16.4 version software) showed that 53 patients were required in each group, based on 5.43 mean time difference for rescue analgesic requirement between the two groups.

However, this study was time-bound and had to be completed in a period of 2 months, from December 2018 to January 2019. Hence, all the patients fulfilling the inclusion criteria and scheduled for elective CS during the period of December 2018 to January 2019 were enrolled in this study, which were a total of 60 patients. Thus, a sample size of 60 patients (30 in each group) was obtained for this study.

Statistical analysis with the SPSS, version 21 for Windows statistical software package (SPSS inc., Chicago, IL, USA) was performed. The Categorical data were given as numbers (percent) and were compared using the Chi-square test among groups. The quantitative data were presented as mean and standard deviation and were compared by students' *t*-test. Probability if less than 0.05 was considered to be significant.

RESULTS

Our study group comprised of 60 patients, with 30 patients randomly allocated to each group. The flow of patients in the trial is shown in the Consort flow diagram [Figure 3]. There was no change from the protocol. Patient's demographics [Table 1] were similar with no significant differences among both groups in terms of operative time, right or left procedure and presence or absence of related viscera visibility (uterus, urinary bladder).

As per the primary outcome, time for rescue analgesic requirement (Injection tramadol 100 mg intravenously) was significantly prolonged in Group QL (mean ± SD = 68.77 ± 1.74 h) as compared to Group TAP (mean ± SD – 13.3 ± 1.21 h), $P < 0.001$ [Figure 4a].

Table 1: Demographic and other data

Demographic data	Group: QL		Group: TAP	
	Mean	SD	Mean	SD
Age (years)	30	3	28	3
Weight (kg)	70	5	71	4
Height (cm)	153	4	152	5
Previous caesarean				
0	27		28	
1	3		2	
Surgical duration (min)	43	9	44	10

Values are mean±SD. QL – Quadratus lumborum, TAP – Transversus abdominis plane

In Group QL, the requirement for analgesic over 72 hours reduced significantly as compared to Group TAP. In QL group, only 13 patients required a single dose of analgesic and 17 patients required no analgesic, while 6, 7 and 8 doses of analgesic were required by 1, 19 and 10 patients, respectively, in TAP group, which was statistically significant ($P = 0.000$) [Figure 4b].

The VAS was significantly reduced in the QL group than in the TAP group, taking into account VAS at rest [Figure 5a] and with movement (dynamic) [Figure 5b] at all times post-CS. At the same time, there were no statistically significant disparity in oxygen saturation level, heart rate and mean blood pressure.

DISCUSSION

There are various modalities to control post-operative pain after a CS.[1] Most commonly used modality

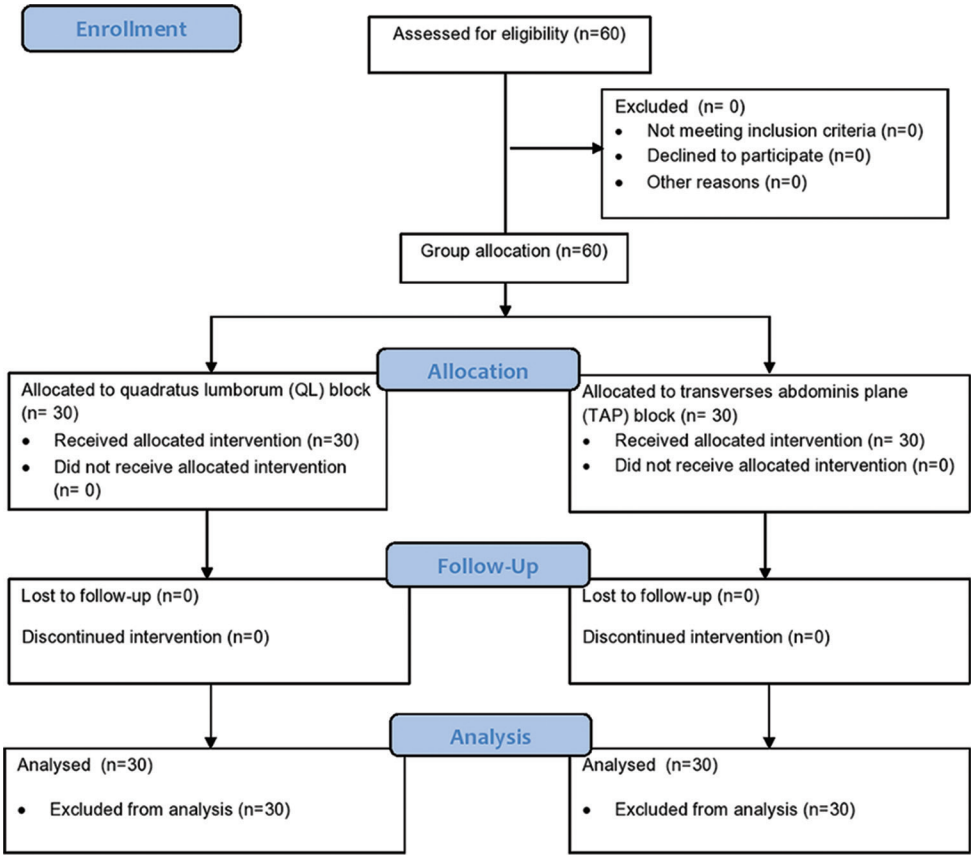

Figure 3: Consort flow diagram. QL: Quadratus lumborum, TAP: Transversus abdominis plane

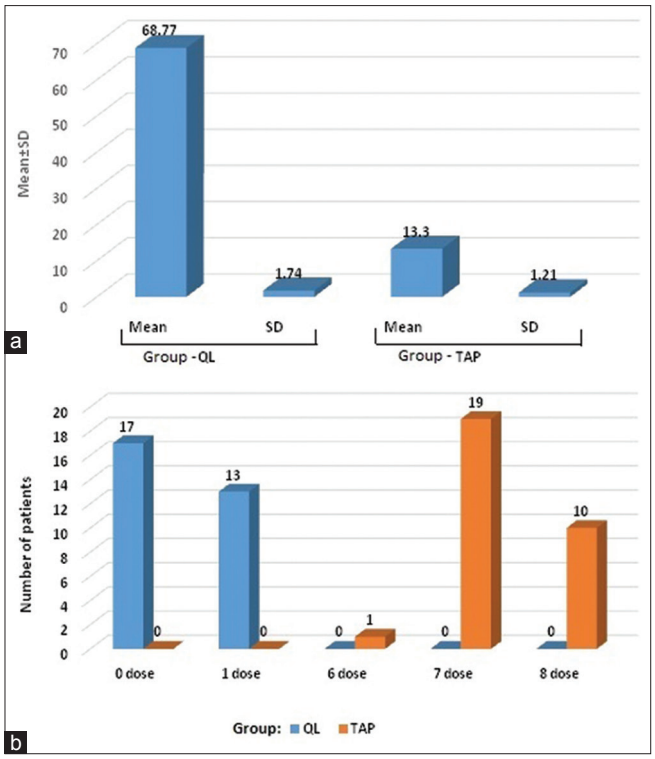

Figure 4: (a) Time for rescue analgesic requirement in hours. Group QL: Quadratus lumborum group, Group TAP: Transversus abdominis plane group, SD: Standard deviation. (b) Total number of analgesic dose in 72 hours. Group QL: Quadratus lumborum group, Group TAP: transversus abdominis plane group

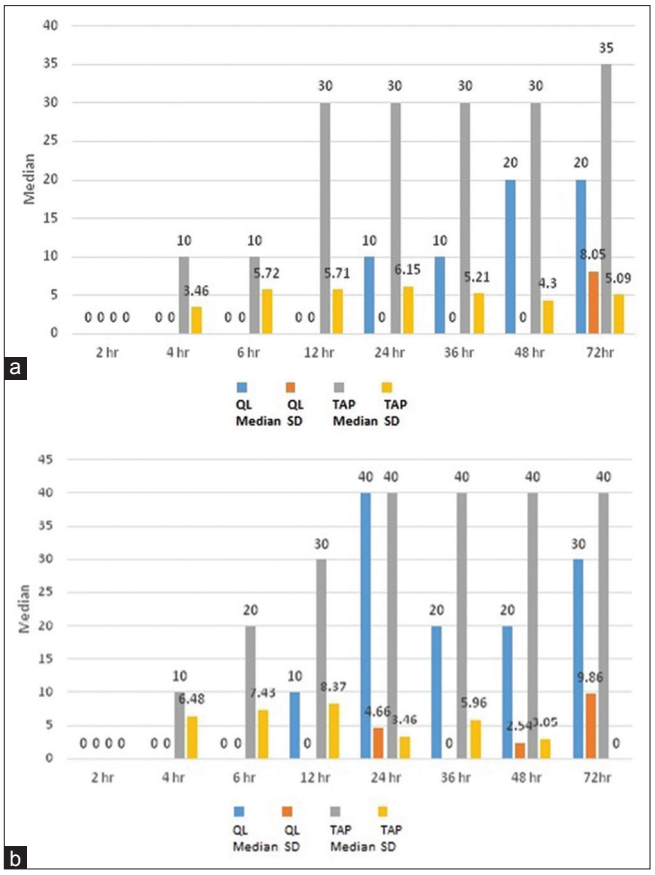

Figure 5: (a) VAS at rest. QL: Quadratus lumborum, TAP: Transversus abdominis plane, SD: Standard deviation. (b) VAS at movement. QL: Quadratus lumborum, TAP: Transversus abdominis plane, SD: Standard deviation

includes intravenous,[13] intrathecal and epidural[14] administration of opioids and NSAIDs which are associated with alteration of the normal gastrointestinal, hepatic and renal system.[13-15] Another popular technique of pain relief includes epidural analgesia but increased chances of the dural and vascular puncture in presence of gravid uterus[16] along with difficult space identification and non-feasibility in emergency scenario limit its application.

Therefore, none of these techniques used in the past can be considered ideal either due to systemic side effects or due to lack of technical feasibility associated with them. Hence, in order to search for a near ideal option of post-caesarean pain relief in terms of simplicity, safety, efficacy, and feasibility, regional anaesthesia techniques come into consideration.[17,18]

One such regional anaesthesia technique is TAP block which has been used successfully in CSs as a component of the multimodal analgesic approach. It blocks the thoracolumbar nerves T10 to L1[19] and provides adequate somatic analgesia with little or no visceral blockade.[5]

Another regional technique is QL block which claims to provide extensive analgesia of T7 to L1 dermatomes due to the spread of local anaesthetic into the paravertebral space or in the thoracolumbar plane that contains mechanoreceptors and multiple sympathetic fibres, thus contributing to extensive somatic and visceral analgesia.[20]

Naglaa Khalil Yousef conducted a study in 2018 comparing ultrasound-guided bilateral TAP block versus bilateral QL block in patients undergoing total abdominal hysterectomy and observed that duration of postoperative analgesia was higher in QL group than in TAP group (15.1 ± 2.12 h vs. 8.33 ± 4 h, $P = 0.001$) with significantly reduced opioid requirement in QL group.[21]

Blanco *et al*.[20] in their study observed that QL block was better than TAP block in post-caesarean pain relief with longer effective analgesia exceeding 24 hours and less supplementary opioid consumption.

Oksuz *et al*.,[22] conducted a study to compare QL block and TAP block in 53 pediatric patients after lower

abdominal surgery and observed a significant analgesia of up to 24 hours with QL block ($P < 0.05$), and higher FLACC (Face, Legs, Activity, Cry, Consolability) scores postoperatively in TAP block group when compared to QL group ($P < 0.05$) with significantly reduced number of patients receiving rescue analgesia in QL group ($P < 0.05$).

Furthermore, Baidya *et al*.[23] and Murouchi[24] in their study on children undergoing pyeloplasty and laparoscopic appendectomy respectively reported that QL block was associated with significantly good and long-lasting postoperative analgesia.

Our study results were in line with all these previously conducted studies which showed that the QL block is a capital analgesic technique in comparison to TAP block. The primary outcome of the study reflected that duration of analgesia was significantly longer in the patients receiving QL block as compared to TAP block in terms of prolonged time for rescue analgesic requirement (mean ± SD: 68.77 ± 1.74 h vs. 13.3 ± 1.21 h). Also, the secondary outcomes showed that there was reduced number of analgesic dose consumption in comparison to patients receiving TAP block over 72 hours with significantly lower VAS scores at each observation time.

The reason for extensive analgesia of up to mean 68.77 hours as seen with our study can possibly due to spread of drug along the thoracolumbar fascia and the endothoracic fascia into the paravertebral space,[20] which is filled with adipose tissue[25] and since local tissue perfusion is low in adipose tissue, it results in low absorption speed of local anaesthetic agent into the blood.[26]

The suggestion that a posterior approach would be better than the TAP block for abdominal pain relief is not new and our data validate it. In addition to profound analgesia, other advantages of QL block includes comparatively safer injection with the needle tip distant from the peritoneum by the quadratus lumborum muscle hence, avoiding the chances of intraperitoneal injection and bowel injury; the technical ease of QL block to carry out due to its superficial location between the posterior abdominal wall muscles, and ease of block technique performance with the patient in a supine position, which is valuable to patients who had surgery under spinal anaesthesia. Until now, we have not encountered any single case of hypotension due to the performance of the block. Other complications have also not been observed. Accepting the QL block as the default analgesic technique would surely provide a clinical advantage in patients with substantial pain.

In the current study, we did not evaluate the potential effect of local anaesthetic diffusion through the paravertebral space and the motor component of the QL block; which should be further investigated.

CONCLUSION

The current results showed that QL block produces long-lasting analgesia than the TAP block.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient(s) has/have given her/their consent for her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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