Comparison of quadratus lumborum versus continuous epidural block for laparoscopic donor nephrectomy: analysis of postoperative analgesia and motoric ability

Dita Aditianingsih1,2, Pryambodo1,2, Naufal Anasy1,2, Rahendra1,2, Aida Rosita Tantri1,2

1 Department of Anesthesiology and Intensive Care, Faculty of Medicine, Universitas Indonesia
2 Cipto Mangunkusumo National General Hospital, Jakarta, Indonesia

E-mail: ditaaditiaa@gmail.com

Abstract. Pain management in post transperitoneal laparoscopic nephrectomy is a key to early recovery. Different types of regional anesthesia techniques have been applied for managing post-operative pain. However, the results are still not satisfactory. This study aims to compare effectiveness of ultrasound-guided bilateral Quadratus Lumborum (QL) block with continuous epidural analgesia in improving post transperitoneal laparoscopic nephrectomy analgesia and motoric mobility. This is a randomized controlled trial that included 26 healthy living kidney donor patients. All subjects were randomized to receive preoperatively bilateral QL block (n=13) or continuous epidural analgesia (n=13). Subjects in QL group received 20 mL of bupivacaine 0.25% bilaterally and subjects in epidural group received continuous bupivacaine 0.125% infusion 6 mL/hour. Numerical rating scale (NRS), Bromage score, and duration of urinary catheterization were recorded. The results presented no significant differences in NRS scores at rest and movement, and Bromage score between QL block group and epidural block group in at 2, 6, 12, 24 hours after surgery. The QL block group received significantly lower total dose of bupivacaine (p<0.001) and duration of urinary catheterization was significantly shorter (p=0.001) compared to epidural group. This study found that QL block produced similar postoperative NRS and Bromage score with fewer dose of bupivacaine and shorter duration of urinary catheterization compared with continuous epidural analgesia within 24 hours.

1. Introduction
Laparoscopic donor nephrectomy is currently the better technique compared to open nephrectomy due to its role in decreasing the incidence of postoperative pain, however, some patients still experience severe pain after surgery. Pain management plays an important role in patient recovery after donor nephrectomy [1,2]. In Cipto Mangunkusumo National Hospital, continuous epidural analgesia is the current treatment of choice for pain management after donor nephrectomy, of which average pain intensity measured using numerical rating scale (NRS) was 2. However, epidural technique has a limitation in patient with coagulopathy disorder, often causes numbness or tingling complaints and sometimes needs longer urinary catheterization that can delay the early mobilization of donor patients postoperatively [1,2].
Ultrasound-guided Quadratus Lumborum (QL) block is a new technique of regional anesthesia and its effectiveness for lower abdominal surgery has been proven in several studies [3]. The aim of this study is to compare the effectiveness of bilateral QL block and continuous epidural analgesia as postoperative pain management following transperitoneal laparoscopic donor nephrectomy.

2. Methods
This study was approved by the Ethics and Research Committee of Universitas Indonesia (0211/UN2.F1/ETIK/2018) and also has been registered in ClinicalTrials.gov (ID:NCT03520205). This randomized controlled trial included all the donors with age 18-60 years old, American Society Anesthesiologist (ASA) physical status I-II, and body mass index below 30 kg/m², who fulfilled the criteria of kidney donor determined by the hospital transplant team and underwent transperitoneal laparoscopic nephrectomy in Cipto Mangunkusumo National General Hospital from May 1st until July 1st, 2018. Exclusion criteria were as follows: occurrence of systemic allergy, anaphylactic reaction and cardiac arrest, failure of epidural anesthesia, failure of QL block, migration of epidural catheter to subarachnoid space, or intraoperative complication such as massive bleeding or hypotension during operation. We obtained written consent from all the patients included in the study.

We used a computerized generating table of random numbers (www.randomizer.org) to determine the list of sample numbers, and randomized all the patients into the QL block group as the intervention group or the epidural block group as the control group. A total sample size of 26 patients was calculated to detect 20% difference in the postoperative pain assessed by NRS between the two groups, with a power of 80% at detecting the difference at 5 % level.

We performed an analysis after first 26 patients and the results are discussed. The primary outcome was a comparison of the postoperative pain intensity using NRS at 2, 6, 12, and 24 hours after surgery. The NRS ranges from 0 to 10, with 0 indicating no pain and 10 indicating the worst pain imaginable. Patients were educated about the QL block, epidural block, how to reflect the degree of pain using NRS, and the usage of patient-controlled analgesia (PCA) contained intravenous morphine and PCA button could be pressed when the NRS was 4 or above. Secondary outcomes were comparisons of Bromage score at 2, 6, 12, and 24 hours, total dose of bupivacaine usage from intraoperative up to 24 hours after surgery, and duration of urinary catheterization between those two groups.

Sealed envelopes numbered for each subject were used and opened by the time patient at the operating room. The same anesthetic and surgical team performed both anesthesia and surgery in this study. All patients received general anesthesia using fentanyl 2 mcg/kg IV and midazolam 0.05 mg/kg IV as co-induction and continued with propofol 1-2 mg/kg IV. Intubation with an endotracheal tube (ETT) was facilitated by atracurium 0.5 mg/kg IV as the muscle relaxant. Maintenance of anesthesia was done with sevoflurane 1.2-2.0%, 50% oxygen and compressed air. The ventilation mode was set with tidal volume of 8 ml/kg, PEEP of 5 cmH₂O, and the respiratory rate was adjusted with the target of end tidal CO₂ (ETCO₂) of 35-45 mmHg.

Epidual block for the control group was done before the induction of general anesthesia. Patients were positioned in the sitting position, an 18-gauge Tuohy needle inserted into epidural space of Th11-12 intervertebral space under lidocaine 2% local infiltration and aseptic condition. The length of catheter insertion was 6 cm inside the epidural space and the correct location in the epidural space was confirmed by vacuum aspiration and injecting bupivacaine 0.25% 3 mL and adrenaline 1:200,000 to get the test dose results of no change in motoric sensation on extremities, heart rate and blood pressure. Before the first surgical incision, bupivacaine 0.25% 3 mL was administered and followed by continuous bupivacaine 0.25% 6 mL/hour.

Bilateral QL block type 3 (anterior) for the intervention group was performed on both sides of patient after the induction of general anesthesia. Patient was positioned in semi-lateral decubitus and using low-frequency ultrasonography (USG) guidance attached to inferior lumbar region (Petit’s triangle) that was consisted of inferior iliac crest and bordered by two muscles such as latissimus dorsi muscle in the posterior, abdominal external oblique muscle in the anterior. The USG displayed the Shamrock sign, where the transverse process of vertebrae L4 role as the trunk, erector spinae muscle on the posterior side, psoas major (PM) on the anterior side, and QL muscle on the lateral side. After the visualization of QL and PM muscles, the Contiplex® needle was directed parallel to the posterior
side of the ultrasound probe until the tip of needle was confirmed in the border of QL and PM muscle. The aspiration test should be revealed a negative result, and then 1 mL of NaCl 0.9% was injected to get the sign of hydrodissection. Local anesthetic agent 20 mL of bupivacaine 0.25% was injected into the fascia between PM and QL muscles. The catheter was then inserted with maintenance of the needle position and USG guided. The QL block on the contralateral side was performed in the same approach (Figure 1).

![Figure 1. Ultrasound-guided Quadratus Lumborum procedures.](image)

After the completion of surgery, QL block group received 20 mL of bupivacaine 0.25% in both sides, then all catheters were removed. Epidural block group were treated with continuous bupivacaine 0.125% with rate 6 mL/hour for 24 hours, and the catheter was removed afterward. Neuromuscular blockade was antagonized with neostigmine and atropine sulphate, then the patient was extubated. PCA pump contained intravenous morphine was applied in the recovery room. Morphine PCA with setting of bolus dose 1 mg, lockout time 10 minutes, and limit dose 6 mg/hour was started, and subjects were instructed to press the button when the NRS was above or equal to 4. Time to arrival at the recovery room became time 0. The degree of pain at rest and movement were assessed using NRS at 2, 6, 12, and 24 hours. Motoric ability was assessed using Bromage score at 2, 6, 12, and 24 hours of postoperative period. Total bupivacaine dose within 24 hours and length of urinary catheterization were recorded.

Statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS) 22.0. Parametric data was compared using independent T-test and was presented in mean with standard deviation. Non-parametric data was compared using Mann-Whitney U test and was presented in median with range.

3. Results
Between May to July 2018 we randomly allocated the first 26 patients, 13 to the epidural block group and 13 to the QL block group. None of patient was excluded from this study. Figure 2. shows the CONSORT flowchart of patient recruitment.

Table 1. shows comparable demographics and perioperative characteristics between the two groups. There were more ASA I patients in epidural groups, and more ASA II patients in QL block group. The epidural group received more ephedrine to maintain mean arterial pressure 70 to 80 mmHg, compared to QL block group.

Table 2. shows there were no significant differences in the NRS scores at rest and movement between QL block group and epidural block group in all measurements. The median of NRS scores at rest in the QL block group was lower compared to the epidural block group from 6 to 24 hours after surgery. The mean of NRS score at movement in QL block group was lower compared to the epidural block group from 2 to 24 hours after surgery. There was no significant difference of median Bromage scores between the QL block group and the epidural block group in all measurements. Patients in QL block groups received the significantly lower total dose of bupivacaine in this study compared to epidural group (p<0.001). The duration of urinary catheterization was significantly shorter in QL block group compared to epidural group (p=0.001).
4. Discussions
Laparoscopic surgery is associated with reduced surgical trauma response and shortened recovery when compared with open procedures. However, early postoperative pain is a frequent complaint among patients. Accordingly, peripheral regional techniques for postoperative pain relief are an attractive approach which may improve early pain control and minimize the need for opioids. Although the use of incisional and intraperitoneal local anesthetics is a common practice, QL block has recently become popular owing to the ultrasound guidance practice [4,5].

**Figure 2. CONSORT diagram.**

Several reports have shown that local anesthetic injection of QL block is effective in providing pain relief following various abdominal operations and in patients with chronic pain. Moreover, QL block has the potential to provide some visceral analgesia considering its spread to paravertebral and epidural spaces [3]. Kadam (2016) reported that ultrasound-guided QL block using catheter infusion had low pain scores with minimal use of opioid analgesia without any complication after abdominal surgery [6]. Visoiu (2013) found that continuous postoperative analgesia via QL block was an alternative to transversus abdominis plane block with low pain scores and minimal use of rescue analgesic medication [7].

Epidural analgesia has been considered as the gold standard as it provides excellent analgesia. However, there are well-known side effects and potentially catastrophic risks to this technique as well as a reported failure rate ranging from 17% to 37% [8]. Our study using QL block suggested that this was an effective technique for providing analgesia in patients undergoing major abdominal surgery including laparoscopic procedure. Therefore, we selected the boluses technique through the QL catheters to allow greater patient mobility because no pump attachments required perioratively [2,3]. Our data proved that the QL block using 20 ml of 0.25% bupivacaine for each bolus regimen produced an effective concentration and volume that resulted in similar pain relief compared to continuous epidural block with higher doses of bupivacaine.
Table 1. Baseline patient characteristics.

| Variable               | Epidural group (n=13) | QL block group (n=13) |
|------------------------|-----------------------|-----------------------|
| Male (%)               | 7 (53.8)              | 8 (61.5)              |
| Female (%)             | 6 (46.2)              | 5 (38.5)              |
| Age (years)            | 38.54±10.66           | 43.3±15.91            |
| Weight (kg)            | 61.55±10.28           | 62.74±10.25           |
| Height (cm)            | 160.54±7.71           | 163.08±7.99           |
| BMI (kg/m²)            | 23.90±3.95            | 23.61±3.58            |
| ASA I (%)              | 10 (76.9)             | 5 (38.5)              |
| ASA II (%)             | 3 (23.1)              | 8 (61.5)              |
| Fentanyl Intra-op (µg) | 200 (200-300)         | 200 (150-300)         |
| Ephedrine Intra-op (mg)| 5 (0-30)              | 0 (0-5)               |
| Duration of surgery (hours) | 5 (4.5-6)   | 5 (4.5-6)             |
| Duration of anesthesia (hours) | 5.5 (5.6-5) | 5.5 (5.6-5)          |

QL, quadratus lumborum; BMI, body mass index; ASA, American Society of Anesthesiologist
Categorical data are presented as percentage, numerical data are presented as mean ± SD.

According to the literature, functional recovery after laparoscopic nephrectomies has been evaluated in comparison to open procedures. Acar et al. (2013) evaluated functional recovery using pethidine patient-controlled analgesia. They showed that mean time to oral intake in the laparoscopic group was 19 hours and ambulation started 14 hours after surgery [9]. In our study the majority of patients started oral intake in less than 6 hours, however, the ambulation time was not superior. For the motoric ability, there was no significant difference of them between the QL block group and the epidural block group. However, the shorter duration of urinary catheterization and a little motor blockade in the QL block group could promote early ambulation contributing to decreased days of hospital stay. The use of urinary catheter might cause some side effects to the patients, like discomfort and limited mobility. Moreover, the use of continuous epidural increases the risk of urinary retention and infection due to the blockage in autonomous nerves and inhibition of impulse transmission in afferent and efferent nerves involving the urinary bladder [10].

There were several limitations associated with our study. Firstly, although the QL blocks were performed under ultrasound guidance by an experienced anesthetist, pinprick sensation was not used to assess the level sensory blockage of QL blocks. Additionally, this is an open-label randomized controlled trial because the patients, anesthetist, surgeon in the operating room, and pain service team who collected the data could not be blinded to the studied group. Moreover, we did not collect educational background of the participants that might influence pain scale scoring.

To our knowledge, this is the first controlled randomized trial that compares the application of bilateral QL block with continuous epidural analgesia in transperitoneal laparoscopic nephrectomy. The study results confirmed the comparable effectiveness of the bilateral QL block with continuous epidural analgesia as the postoperative pain control. It appears that bilateral QL block is a promising method of analgesia for transperitoneal laparoscopic procedure in healthy patients. Future studies to evaluate the effectiveness of QL block as postoperative analgesia on other population such as obese patients or patient with cardiac dysfunction are needed.

5. Conclusions
In this study, bilateral ultrasound-guided QL block was an effective technique for postoperative analgesia following laparoscopic nephrectomy. It produced similar postoperative NRS and Bromage
score with fewer doses of bupivacaine and shorter urinary catheter use compared to the continuous epidural within 24 hours after surgery.

Table 2. Evaluation of Numerical Rating Scale (NRS) pain intensity, Bromage score, bupivacaine dosage and duration of urinary catheterization.

| Outcome                              | Quadratus Lumborum group (n=13) | Epidural group (n=13) | p-value |
|--------------------------------------|---------------------------------|-----------------------|---------|
| 1. NRS pain at rest                  |                                 |                       |         |
| a. 2 hours                           | 2.00 (0.00 – 4.00)              | 2.00 (1.00 – 6.00)    | 0.191   |
| b. 6 hours                           | 1.00 (1.00 – 4.00)              | 2.00 (1.00 – 4.00)    | 0.545   |
| c. 12 hours                          | 1.00 (1.00 – 4.00)              | 2.00 (1.00 – 4.00)    | 0.479   |
| d. 24 hours                          | 1.00 (1.00 – 3.00)              | 2.00 (1.00 – 3.00)    | 0.180   |
| 2. NRS pain during movement          |                                 |                       |         |
| a. 2 hours                           | 3.08 ± 1.12                    | 3.85 ± 1.68           | 0.181   |
| b. 6 hours                           | 3.15 ± 1.28                    | 3.38 ± 1.45           | 0.670   |
| c. 12 hours                          | 3.15 ± 1.14                    | 3.31 ± 1.18           | 0.739   |
| d. 24 hours                          | 2.62 ± 0.77                    | 3.00 ± 1.00           | 0.282   |
| 3. Bromage score                     |                                 |                       |         |
| a. 2 hours                           | 1.00 (1.00 – 2.00)              | 1.00 (1.00 – 2.00)    | 1.000   |
| b. 6 hours                           | 1.00 (1.00 – 2.00)              | 1.00 (1.00 – 1.00)    | 0.317   |
| c. 12 hours                          | 1.00 (1.00 – 1.00)              | 1.00 (1.00 – 1.00)    | 1.000   |
| d. 24 hours                          | 1.00 (1.00 – 1.00)              | 1.00 (1.00 – 1.00)    | 1.000   |
| 4. Total Bupivacaine dose intraoperative and 24-hours postoperative (mg) | 200.00 (200.00 – 200.00) | 255.00 (247.50 – 270.00) | <0.001* |
| 5. Duration of urinary catheterization (hours) | 30.00 (6.00 – 42.00) | 42.00 (20.00 – 60.00) | 0.001* |

NRS, numerical rating scale
Data are presented as mean ± SD or median (minimum – maximum). *p<0.05 is significant.

6. References
[1] Wisbono E, Wahyudi I, Mochtar CA, Hamid ARA and Sukmono RB 2016 Laparoscopic living donor nephrectomy in Cipto Mangunkusumo Hospital: postoperative pain and recovery analysis Fac. Med. Univ. Indones. Cipto Mangunkusumo Hosp. 1–10
[2] Martinez BS, Gasanova I and Adesanya AO 2013 Anesthesia for kidney transplantation - a review J. Anesth. Clin. Res. 4 270–6
[3] Ueshima H, Otake H and Lin J 2017 Ultrasound-guided quadratus lumborum block: an updated review of anatomy and techniques BioMed. Res. Int. 2017 1–7
[4] Greco F, Hoda MR and Alcaraz A 2010 Laparoscopic living-donor nephrectomy: analysis of the existing literature Eur. Urol. 58 498–509
[5] Moiniche S, Jorgensen H and Wetterslev J 2000 Local anesthetic infiltration for postoperative pain relief after laparoscopy: a qualitative and quantitative systematic review of intraperitoneal, port-site infiltration and mesosalpinx block Anesth. Analg. 90 899–912
[6] Rao Kadam V, Van Wijk RM, Moran JJ and Miller D 2013 Epidural versus continuous transversus abdominis plane catheter technique for postoperative analgesia after abdominal surgery Anaesth. Intensive Care 41 476–81
[7] Visoiu M and Yakovleva N 2013 Continuous postoperative analgesia via quadratus lumborum block - An alternative to transversus abdominis plane block Paediatr. Anaesth. 23 959–61
[8] Rigg JR, Jamrozik K, Myles PS, Silbert BS, Peyton PJ, Parsons RW and Collins KS 2002 Epidural anaesthesia and analgesia and outcome of major surgery: a randomised trial The Lancet 359 1276–82
[9] Acar C, Bilen C and Bayazit Y 2014 Quality of life survey following laparoscopic and open radical nephrectomy *Urol. J.* **11** 1944–50

[10] Baldini G, Bagry H, Aprikian A and Carli F 2009 Postoperative urinary retention: anesthetic and perioperative considerations *Anesthesiology* **5** 1139-57

**Acknowledgements**

Universitas Indonesia is greatly acknowledged for the financial supports under PITTA (Publikasi Terindeks Internasional Untuk Tugas Akhir Mahasiswa UI) grant (2043/UN2.R3.1/HKP.05.00/2018). The authors also wish to thank the Department of Anesthesiology and Intensive Care Cipto Mangunkusumo Hospital and Faculty of Medicine, Universitas Indonesia for supporting this study.