# Efficacy of Quadratus Lumborum Block Compared to Paravertebral Block on Pediatric Patients Undergoing Abdominal Surgery

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## ABSTRACT

**Background:** Abdominal surgery is a major procedure associated with severe postoperative pain in pediatric patients. Quadratus lumborum block (QLB) is considered an effective pain control in such cases. Paraverterbral block (PVB) is another option for postoperative pain management. The aim of this study was to compare the effectiveness of quadratus lumborum block with paravertebral block.
**Methods:** This single-blind randomized controlled trial included 22 pediatric patients who underwent abdominal surgery at Sanglah Hospital, Denpasar between August – October 2022. Research subjects were divided into 2 treatment groups; group A consisted of general anesthesia combined with quadratus lumborum block and group B consisted of general anesthesia combined with paravertebral block. Duration of analgesia was recorded based on the time to analgesic recue, FLACC pain scale at 0, 2, 4, 6, 12 and 24 hours and total opioid consumption 24 hours after surgery. Statistical analyses were performed using SPSS.
**Results:** Eleven patients received QLB and PVB respectively. There was a significant difference in mean analgesia duration of 1287 ± 129.69 minutes compared to 750 ± 122.22 minutes ($p < 0.001$) (CI 95%: 425.18 – 649.36), median FLACC pain scale at 12 (1 (IQR 2) vs 4 (IQR 1)) and 24 hours postoperative (1 (IQR 2) vs 3 (IQR 1)) between QLB and PVB ($p < 0.001$ and $p < 0.007$). Mean 24-hour postoperative opioid consumption was significantly lower in the QLB compared to the PVB.
**Conclusion:** QLB has better effectiveness than PVB in pediatrics undergoing abdominal surgery.

**Keywords:** anesthesia adjuvant; local anesthesia; pain management; pediatric anesthesia; postoperative pain

# Efektivitas Blok Kuadratus Lumborum Dibandingkan Blok Paravertebral pada Pasien Anak yang Menjalani Operasi Perut

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**ABSTRAK**

***Latar Belakang:*** *Pembedahan abdomen merupakan tindakan mayor yang sering disertai nyeri berat pada pasien pediatri. Blok quadratus lumborum (QLB) dianggap efektif dalam mengontrol nyeri, sementara blok paravertebral (PVB) menjadi alternatif lain untuk manajemen nyeri pascaoperasi. Studi ini bertujuan membandingkan efektivitas QLB dengan PVB terhadap waktu pertama mendapatkan analgesia, skala nyeri (FLACC), dan konsumsi opioid selama 24 jam pascaoperasi pada pasien pediatri.*

***Metode:*** *Sebanyak 22 pasien pediatri yang menjalani operasi abdomen di RSUP Prof. dr. I.G.N.G. Ngoerah Denpasar, antara Agustus–Oktober 2022, ikut serta dalam studi single blind randomized controlled trial ini. Subjek dibagi menjadi dua kelompok: kelompok A menerima QLB dengan bupivakain 0,25% sebanyak 0,5 ml/kgbb, dan kelompok B menerima PVB dengan dosis yang sama. Durasi analgesia, skala nyeri FLACC pada jam ke 0, 2, 4, 6, 12, dan 24, serta total konsumsi opioid selama 24 jam dicatat.*

***Hasil:*** *Kedua kelompok terdiri dari 11 pasien. Durasi analgesia pada QLB secara signifikan lebih lama dibandingkan PVB, dengan rerata 1287 ± 129,69 menit vs 750 ± 122,22 menit ($p < 0,001$, IK 95%: 425,18–649,36 menit). Skala nyeri FLACC pada jam ke-12 dan ke-24 juga menunjukkan hasil yang lebih baik pada QLB ($p < 0,001$ dan $p < 0,007$). Konsumsi opioid pada kelompok QLB lebih rendah secara signifikan, yaitu 0,59 ± 0,43 mcg/kg dibandingkan 1,04 ± 0,47 mcg/kg pada kelompok PVB ($p = 0,030$, IK 95%: 0,05–0,85).*

***Simpulan:*** *QLB memiliki efektivitas yang lebih baik dibandingkan PVB pascaoperasi pada pediatri yang menjalani operasi abdomen.*

***Kata kunci:*** *adjuvan anestesi; anestesi pediatric; lokal anestesi; manajemen nyeri; nyeri pascaoperasi*

## INTRODUCTION

Abdominal area surgery is a major procedure commonly performed in pediatric patients. Adequate pain management and early mobilization are important components of perioperative management on pediatric patients. Research conducted in the United States reported that 44% of children undergoing surgery experienced moderate to severe pain.[1] European Society for Paediatric Anaesthesiology (ESPA) stated that perioperative pain management in pediatric patients is combination of NSAIDs and nerve blocks. Caudal and epidural blocks are the most common techniques used in pediatric patients undergoing lower abdominal surgery because they are convenient with good effectiveness.[1,6]

The quadratus lumborum block (QLB) is a type of interfascial plane block introduced by Blanco in 2007. This method was done by administering local anesthetic drugs around quadratus lumborum muscle with the aim of blocking nerves in the thoracolumbar fascia.[2,8] A study comparing quadratus lumborum blocks with caudal blocks in pediatric patients undergoing hernia surgery and orchiopexy reported a lower need for analgesic consumption 24 hours postoperatively and significantly lower face, legs, activity, cry and consolability (FLACC) pain scores at 4, 6 and 12 hours postoperatively.[3,7] Paravertebral block (PVB) was first done in 1905 by Arthur Lawen. PVB are superior in stable hemodynamics outcome and complete somatosensory blocks than epidural blocks without the risk of spinal cord injury.[4,9] A study inguinal hernia surgery on pediatric patients reported that only 11.4% of PVB group required opioid rescue compared to 34.3% of caudal block group.[10]

Regional block combination is expected to be able to bring better pain management, improve perfusion to the intestinal organs, and support early postoperative mobilization. QLB and PVB are commonly used as adjuvant analgesics in pediatric patients, but studies comparing the effectiveness of QLB and PVB in pediatric patients are lacking. In this study, we compare the effectiveness of QLB with PVB in pediatric patients undergoing abdominal surgery.

## METHOD

This single-blind, randomized controlled trial was conducted in tertiary medical center Sanglah Hospital in Denpasar from August to October 2022. Ethical approval was obtained from medical committee of Prof. dr. I.G.N.G. Ngoerah Hospital (No: 2362/UN14.2.2.VII.14/LT/2022). Study subjects were collected using consecutive admission random sampling method. Subjects included in this study were aged 6 months-7 years old, underwent abdominal surgery performed under general anesthesia, ASA status I-II, and parents of the subjects consented to participate in the study. Patients were excluded if there were perioperative wound infection, coagulopathy, anesthetic or opioid allergy, history of liver, kidney, or heart disease, and patient did not consent to participate in the study. Included subjects with duration of surgery > 4 hours, class III hemorrhage, and intubated postoperatively were dropped out from the study.

Premedication was done to patients in both groups using midazolam 0.05 mg/kg IV as general anesthesia, induced by sevofluran 2% dan 50% air in oxygen or propofol 2 mg/kg or fentanyl 1 mcg/kg IV. After patients was unconscious, atracurium 0.5 mg/kg was injected for endotracheal intubation. In group A, QLB was done while patients in lateral decubitus. Low-frequency ultrasound transducer curve (5-10 Hz) was used between iliac crest and costal margin on the midaxillary line. Stimuplex© 22G 50 mm needle was inserted from medial using to transversal fascia (anterior from quadratus lumborum). After the needle was in front of quadratus lumborum muscle, 0.9% normal saline 1 mL was injected, followed by local anesthetic bupivacaine 0.25% 0.5 ml/kg for each side (maximal dose 2.5 mg/kg). For group B, paravertebral block was also done in lateral decubitus position after general anesthesia. For this technique, L4 spice processes was identified and palpated to L2-T10. Stimuplex© 22G 50 mm needle was inserted caudally from cranial using ultrasound as its guidance until “pop” sound was heard. Local anesthetic used in PVB was bupivacaine 0.25% 0.5 ml/kg for each side (maximal dose 2.5 mg/kg).

Patients in recovery room was assessed for pain scale using FLACC. FLACC score > 3 would be given rescue analgesia in fentanyl 0.5µg/

kg bolus IV, while patients with FLACC score < 3 can be moved from recovery room. FLACC score was assessed 0 ,2, 4, 6, 12 and 24 hours postoperatively by acute pain service teams who were blinded to group assignments. Both groups received paracetamol 15 mg/kg every 6 hours. Total opioid dose was accounted for 24 hours postoperatively in patients who received rescue analgesia.

This study analyzed the effectiveness of general anesthesia combined with QLB or PVB in pediatric patients undergoing lower abdominal surgery. Analgesia duration, pain score, and 24-hour opioid dose were recorded. Confounding identified in this study were age, surgery duration, and bleeding. Baseline characteristics including age, weight, height, surgery duration, and bleeding were presented in numeric data (mean ± SD), as well as rescue analgesia duration and opioid total dose. Pain scale assessed using FLACC was presented in median and interquartile range (IQR). Comparative test using independent T test was done on age, weight, height, surgery duration, bleeding, rescue analgesia duration, and total opioid dose. Categorical data was analyzed using Fisher's exact test, while Mann-Whitney Test was used as comparative study test for FLACC pain scale.

## RESULT

A total of 22 pediatric patients were divided into 2 groups. The first group consisted of 11 patients with general anesthesia and QLB, while the second group consisted of 11 patients with general anesthesia and PVB. No samples were dropped out from this study. Patient baseline characteristics was similar in both groups as shown in Table 1.

**Tabel 1.** Baseline characteristics of subjects

| Variables | QLB (n=11) | PVB (n=11) | p value |
|---|---|---|---|
| Age (years), Mean±SD | 1.99 ± 1.55 | 2.18 ± 1.52 | 0.769* |
| Sex, n (%) | | | 1.00† |
| Male | 7 (63.63%) | 7 (63.63%) | |
| Female | 4 (36.36%) | 4 (36.36%) | |
| ASA physical status, n (%) | | | 0.635† |
| 1 | 2 (18.8%) | 4 (36.36%) | |
| 2 | 9 (81.82%) | 7 (63.64%) | |
| Height (cm), Mean±SD | 84.81 ± 11.77 | 83.09 ± 15.44 | 0.771* |
| Weight (kg), Mean±SD | 10.91 ± 3.39 | 9.93 ± 2.43 | 0.444* |
| Duration of surgery (minutes), Mean±SD | 172.27 ± 28.31 | 161.81 ± 29.93 | 0.410* |
| Bleeding (ml), Mean±SD | 25.45 ± 18.36 | 20.91 ± 14.80 | 0.530* |
| Types of surgery, n | | | |
| Laparotomy colostomy | 4 | 4 | |
| Laparotomy colostomy closure | 4 | 1 | |
| Laparotomy colostomy repair | 2 | 2 | |
| Laparotomy nephrectomy | 1 | 1 | |
| Laparotomy hernia repair | 0 | 2 | |
| Laparotomy redo Swenson | 0 | 1 | |

*T-test †Fisher Exact

Table 2 shows comparison of time to rescue analgesia in both groups. Patient who received QLB had significantly longer time to rescue analgesia compared to PVB (1287 ± 129.69 minutes vs 750 ±122.22 minutes, 95% CI 425.18 – 649.36, p<0.001). Shortest time to rescue analgesia in QLB group was 1080 minutes whereas the longest was 1440 minutes. In PVB group, shortest time was 600 minutes, while the longest was 1020 minutes. Highest demand for rescue analgesia was found after 1320 minutes in three patients of QLB group and 720 minutes in four patients of PVB group (Figure 1).

**Table 2.** Comparison of time to rescue analgesia duration based on study groups

| Variables | QLB (n=11) | PVB (n=11) | p value | Mean diff (95%CI) |
|---|---|---|---|---|
| Time to rescue analgesia (minutes), Mean±SD | 1287 ± 129.69 | 750 ± 122.22 | < 0.001* | 537,27 (425.18 – 649.36) |

*Independent T test

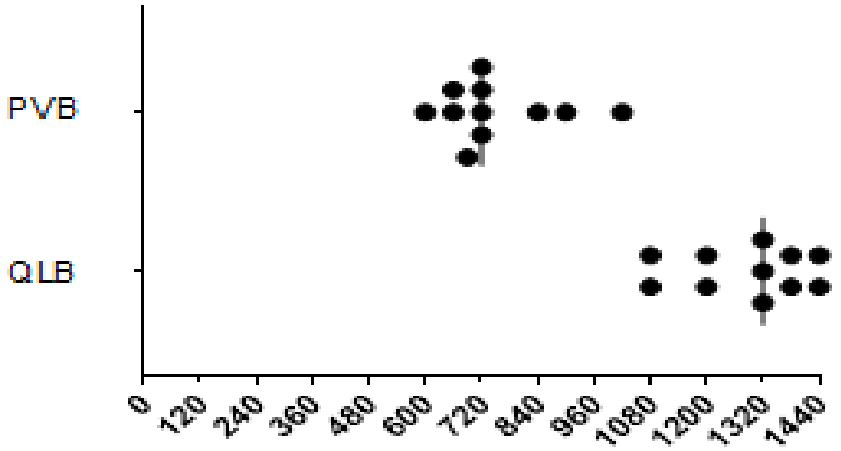


**Figure 1.** Curve for total time to first rescue analgesic based on study groups

There was statistically significant lower FLACC pain scale 12- and 24-hour postoperative in QLB group compared to PVB group (1, IQR 2 vs 4 IQR 1, p=0.001; 1, IQR 2 vs 3 IQR 1, p=0.007). Change in FLACC pain scale after 0-, 2-, 4- dan 6-hours postoperatively was not significant. Patients in QLB and PVB groups experienced drastic increase of FLACC scale 12 hours after surgery (Figure 2). Nine patients in both groups was given rescue analgesia.

Opioid dose was significantly lower in patients who received QLB compared to PVB (0.59 ± 0.43 mcg/kg vs 1.04 ± 0.47 mcg/kg, 95%CI 0.05-0.85, p=0.030). None of the patients in this study showed complications related to anesthesia such as local anaesthetic systemic toxicity (LAST), arrhythmia, motoric block, hematoma, or allergic reactions during perioperative period.

**Tabel 3.** Comparison of postoperative FLACC pain scale based on study groups

| Variables | | QLB (n=11) | PVB (n=11) | p value |
|---|---|---|---|---|
| FLACC scale, median (IQR) | | | | |
| Hour | 0 | 0 (2) | 1 (2) | 0.779* |
| | 2 | 0 (1) | 1 (1) | 0.333* |
| | 4 | 0 (0) | 0 (0) | 0.147* |
| | 6 | 0 (0) | 0 (0) | 0.148* |
| | 12 | 1 (2) | 4 (1) | 0.001* |
| | 24 | 1 (2) | 3 (1) | 0.007* |

*Mann Whitney

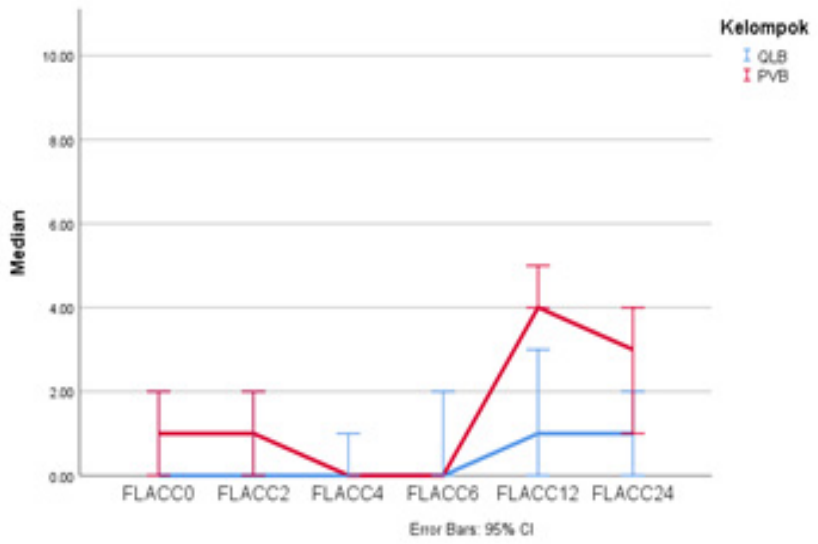


**Figure 2.** Periodic FLACC pain scale graph until 24 hours after surgery

**Table 4.** Comparison of opioid dose in 24 hours after surgery based on study groups

| Variables | QLB (n=11) | PVB (n=11) | p value | Mean diff (95%CI) |
|---|---|---|---|---|
| Opiod dose in 24 hours (mcg/kg), Mean ± SD | 0.59 ± 0.43 | 1.04 ± 0.47 | 0.030* | 0.45 (0.05-0.85) |

*Mann Whitney

## DISCUSSION

This study aims to determine the effectiveness of QLB compared to PVB for postoperative pain in pediatrics undergoing abdominal surgery at Prof. Hospital. dr. I.G.N.G. Ngoerah. In this study, a significant difference was found in time to rescue analgesia where patients received QLB had longer time to rescue analgesia compared to PVB. This may be due to QLB injected into thoracolumbar fascia which has little vascularization, therefore it can reduce the absorption of local anesthetic drugs and lessen the pain until 24 - 48 hours after surgery.[5,8] The results of this study were also supported by a study which compared the effectiveness of QLB compared to the erector spinae block in pediatric patients who underwent low abdominal surgery. The average time to rescue analgesic in QLB group was ±27 hours (SD 16.5–31 hours).[11] The results obtained in the PVB group were similar to a study conducted by Chalam et al. showing that time to rescue analgesics after ultrasound-guided PVB is 8-10 hours in 80% of children who underwent thoracotomy with bupivacaine 0.25%.[12]

There was no significant difference in the FLACC pain scale at 0, 2, 4, and 6 hours postoperatively in both groups. This may be influenced by intraoperative analgesics and postoperative paracetamol given to each patient according to study protocol. The FLACC pain scale was found to be significantly lower in patients who received QLB compared to the PVB at 12 and 24 hours postoperatively. In line with this study, Oksuz et al. conducted a study comparing QLB with the transversus abdominis plane block in pediatrics undergoing lower abdominal surgery, where FLACC pain scale was consistently lower in QLB group 24-hours postoperatively.[2] Optimal analgesia can be achieved by QLB due to wide area of analgesia and the extent of dermatomes that can be covered by QLB. In some cases, analgesia can be achieved up to T7-L1 dermatomes. Several studies described cranial extension up to T4-T5 and caudal extension up to L2-L3.[13]

Opioid dose 24-hour postoperative was lower in the QLB group than in the PVB group. This number is higher than the study conducted by Narasimhan et al. which stated postoperative fentanyl dose in pediatric patients undergoing kidney surgery combined with general anesthesia and paravertebral anesthesia was 0.56 ± 0.82 mcg/kg.[14] This may be due to the use of adjuvant adrenaline in the PVB block technique used. PVB had a beneficial effect on pain scores at 4-6 hours after surgery, but the effect did not persist until 24 hours.[9]

No anesthesia related complications or side effects were observed postoperatively, which is caused of local anesthetic regimen was in accordance with the recommendations issued by ESPA. Using ultrasound in both groups also increased the safety and accuracy of the block so as to reduce side effects and complications in both treatments.[15]

The limitation of this study is that anxiety assessment was not accounted for. The FLACC pain scale assessment is very influential on anxiety in pediatric patients which can lead to bias during evaluation.

## CONCLUSION

QLB has better effectiveness than PVB in pediatrics undergoing abdominal surgery based on time to rescue analgesic, postoperative pain scale, and opioid dose 24 hours after surgery.

## CONFLICT OF INTEREST

The author declares that there is no conflict of interest in writing this article.

## REFERENCES

1. Ardon AE, Lee J, Franco CD, Riutort KT, Greengrass RA. Paravertebral block: anatomy and relevant safety issues. Korean J Anesthesiol. 2020;73(5):394-400. doi: 10.4097/kja.20065.
2. Bennett M. Assessing pain in children in the perioperative setting. J Perioper Pract. 2019;29(1-2):9-16. doi: 10.1177/1750458918780109.
3. Elsharkawy H, El-Boghdadly K, Barrington M. Quadratus Lumborum Block: Anatomical Concepts, Mechanisms, and Techniques. Anesthesiology. 2019;130(2):322-35. doi: 10.1097/ALN.0000000000002524.
4. Gupta A, Sondekoppam R, Kalagara H. Quadratus Lumborum Block: a Technical Review. Curr Anesthesiol Rep. 2019;9(3):257-

62. doi: 10.1007/s40140-019-00338-9.
5. Ma D, Li H, Shi R, Yang Y, Liu H, Ge X. Ultrasound-Guided Lumbar Paravertebral Block After Pre-Designed Route on X-Ray Film for Radicular Pain Following Failed Back Surgery Syndrome: A Case Report. J Pain Res. 2020;13:3331-6. doi: 10.2147/JPR.S280541.
6. Groenewald CB, Rabbitts JA, Schroeder DR, Harrison TE. Prevalence of moderate-severe pain in hospitalized children. Paediatr Anaesth. 2012;22(7):661-8. doi: 10.1111/j.1460-9592.2012.03807.x.
7. Öksüz G, Arslan M, Urfalıoğlu A, Güler AG, Tekşen Ş, Bilal B, et al. Comparison of quadratus lumborum block and caudal block for postoperative analgesia in pediatric patients undergoing inguinal hernia repair and orchiopexy surgeries: a randomized controlled trial. Reg Anesth Pain Med. 2020;45(3):187-91. doi: 10.1136/rapm-2019-101027.
8. Blanco R, Ansari T, Riad W, Shetty N. Quadratus Lumborum Block Versus Transversus Abdominis Plane Block for Postoperative Pain After Cesarean Delivery: A Randomized Controlled Trial. Reg Anesth Pain Med. 2016;41(6):757-62. doi: 10.1097/AAP.0000000000000495.
9. Page EA, Taylor KL. Paravertebral block in paediatric abdominal surgery-a systematic review and meta-analysis of randomized trials. Br J Anaesth. 2017;118(2):159-66. doi: 10.1093/bja/aew387.
10. Tug R, Ozcengiz D, Güneş Y. Single level paravertebral versus caudal block in paediatric inguinal surgery. Anaesth Intensive Care. 2011;39(5):909-13. doi: 10.1177/0310057X1103900517.
11. Aksu C, Şen MC, Akay MA, Baydemir C, Gürkan Y. Erector Spinae Plane Block vs Quadratus Lumborum Block for pediatric lower abdominal surgery: A double blinded, prospective, and randomized trial. J Clin Anesth. 2019;57:24-8. doi: 10.1016/j.jclinane.2019.03.006.
12. Chalam KS, Patnaik SS, Sunil C, Bansal T. Comparative study of ultrasound-guided paravertebral block with ropivacaine versus bupivacaine for post-operative pain relief in children undergoing thoracotomy for patent ductus arteriosus ligation surgery. Indian J Anaesth. 2015;59(8):493-8. doi: 10.4103/0019-5049.162988.
13. Chin KJ, McDonnell JG, Carvalho B, Sharkey A, Pawa A, Gadsden J. Essentials of Our Current Understanding: Abdominal Wall Blocks. Reg Anesth Pain Med. 2017;42(2):133-83. doi: 10.1097/AAP.0000000000000545.
14. Narasimhan P, Kashyap L, Mohan VK, Arora MK, Shende D, Srinivas M, et al. Comparison of caudal epidural block with paravertebral block for renal surgeries in pediatric patients: A prospective randomised, blinded clinical trial. J Clin Anesth. 2019;52:105-10. doi: 10.1016/j.jclinane.2018.09.007.
15. Vittinghoff M, Lönnqvist PA, Mossetti V, Heschl S, Simic D, Colovic V, et al. Postoperative pain management in children: Guidance from the pain committee of the European Society for Paediatric Anaesthesiology (ESPA Pain Management Ladder Initiative). Paediatr Anaesth. 2018;28(6):493-506. doi: 10.1111/pan.13373.