

Quadratus Lumborum Block versus Transversus Abdominis Plane Block for Postoperative Analgesia Following Lower Abdominal Surgery

Pawan Nandkishor Deshmukh¹

¹Assistant Professor, Department of Anaesthesiology, Abhishek I Mishra Memorial Medical College and Research, Bhilai, Chhattisgarh, India

Received: 01-10-2024/ Revised: 15-11-2024 / Accepted: 21-11-2024

Corresponding author: Dr. Pawan Nandkishor Deshmukh

Conflict of interest: Nil

Abstract

Background: Effective postoperative analgesia following lower abdominal surgery is essential for early recovery and reducing systemic analgesic requirements. Quadratus lumborum (QL) and transversus abdominis plane (TAP) blocks are commonly used ultrasound-guided fascial plane blocks for abdominal analgesia.

Aim: To compare the efficacy of ultrasound-guided QL block and TAP block for postoperative analgesia following lower abdominal surgery.

Materials and Methods: This prospective randomized comparative study included 70 patients undergoing elective lower abdominal surgery. Patients were randomly allocated into Group QL (n=35) and Group TAP (n=35). Postoperative Numerical Rating Scale (NRS) pain scores, time to first rescue analgesia, total rescue analgesic consumption during 24 hours, hemodynamic parameters, and adverse events were recorded. A p-value <0.05 was considered statistically significant.

Results: Baseline characteristics were comparable between the groups. NRS pain scores were significantly lower in Group QL at 2, 4, 6, and 12 hours postoperatively. The mean time to first rescue analgesia was significantly longer in Group QL than Group TAP (11.8 ± 3.1 vs. 7.2 ± 2.5 hours; $p < 0.001$). The 24-hour rescue analgesic consumption was also significantly lower in Group QL (74.3 ± 30.6 vs. 117.1 ± 37.8 mg; $p < 0.001$). No major block-related complications were observed, and adverse-event rates were comparable between the groups.

Conclusion: Ultrasound-guided QL block provided more effective and prolonged postoperative analgesia than TAP block following lower abdominal surgery, with lower pain scores and reduced rescue analgesic requirements. Both techniques demonstrated a comparable safety profile.

Keywords: Quadratus Lumborum Block; Transversus Abdominis Plane Block; Postoperative Analgesia; Lower Abdominal Surgery; Regional Anesthesia.

This is an Open Access article that uses a funding model which does not charge readers or their institutions for access and distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>) and the Budapest Open Access Initiative (<http://www.budapestopenaccessinitiative.org/read>), which permit unrestricted use, distribution, and reproduction in any medium, provided original work is properly credited.

Introduction

Effective postoperative analgesia is an important component of perioperative care following lower abdominal surgery, as inadequate pain control may delay mobilization, impair respiratory function, and increase opioid requirements. Ultrasound-guided fascial plane blocks have increasingly been incorporated into multimodal analgesic protocols because of their relative simplicity and opioid-sparing potential.

The quadratus lumborum (QL) block is a posterior abdominal wall block in which local anesthetic is deposited in relation to the quadratus lumborum muscle, potentially providing both somatic and visceral analgesia through spread along the thoracolumbar fascial planes.[1] The transversus abdominis plane (TAP) block involves deposition of local anesthetic between the internal oblique and

transversus abdominis muscles, targeting the nerves supplying the anterior abdominal wall.[2] It has been widely used for postoperative analgesia following abdominal surgical procedures and has demonstrated reductions in postoperative pain and analgesic requirements.[3,4] However, its analgesic effect is predominantly somatic and may be of limited duration.

The QL block has emerged as an alternative with the potential for more extensive and prolonged analgesia. Blanco et al. demonstrated effective postoperative analgesia with QL block following cesarean section.[5] Subsequently, a randomized trial comparing QL and TAP blocks after cesarean delivery demonstrated improved postoperative analgesia with QL block.[6] However, further comparative evidence across lower abdominal

surgical procedures remains desirable. Therefore, the present study was undertaken to compare the efficacy of ultrasound-guided quadratus lumborum block and transversus abdominis plane block for postoperative

Materials and Methods

Study design and setting: This prospective, randomized, comparative study was conducted in the Department of Anaesthesiology at a tertiary-care teaching hospital after obtaining approval from the Institutional Ethics Committee. Written informed consent was obtained from all participants before enrolment.

Study Population: A total of 70 adult patients scheduled for elective lower abdominal surgery were enrolled and randomly allocated into two equal groups of 35 patients each:

- **Group QL (n=35):** received ultrasound-guided quadratus lumborum block.
- **Group TAP (n=35):** received ultrasound-guided transversus abdominis plane block.

Sample size

The sample size was calculated for comparison of two independent groups using the formula:

$$n = \frac{2(Z_{\alpha/2} + Z_{\beta})^2}{d^2}$$

Where $Z_{\alpha/2} = 1.96$ at a 95% confidence level, $Z_{\beta} = 0.84$ for 80% power, and an anticipated standardized effect size (d) of approximately 0.68 was considered based on previous comparative studies.

The calculated sample size was approximately 34 patients per group. Therefore, 35 patients were included in each group, giving a final sample size of 70 patients.

Inclusion Criteria: Patients aged 18–65 years, of either sex, belonging to American Society of Anesthesiologists (ASA) physical status I or II, scheduled for elective lower abdominal surgery and willing to participate were included.

Exclusion Criteria: Patients who refused participation; had allergy to the study drugs, infection at the block site, coagulopathy or anticoagulant therapy, significant hepatic, renal, cardiac, or neurological disease; chronic opioid use; pre-existing chronic pain; or inability to understand the pain scoring system were excluded.

Randomization and Allocation: Patients were randomly assigned to either Group QL or Group TAP in a 1:1 ratio using a computer-generated randomization sequence. Allocation was concealed using sequentially numbered, opaque, sealed

envelopes that were opened immediately before administration of the block.

Anaesthetic Technique: Standard monitoring consisting of electrocardiography, non-invasive blood pressure, and pulse oximetry was instituted after arrival in the operating room. Intravenous access was secured, and baseline heart rate, blood pressure, mean arterial pressure, and oxygen saturation were recorded. All patients received a standardized anaesthetic technique appropriate for the planned surgical procedure.

At completion of surgery, the allocated block was performed under strict aseptic precautions using a high-frequency ultrasound probe and an appropriate block needle.

Quadratus Lumborum Block: Patients allocated to Group QL were positioned appropriately, and the abdominal wall muscles were identified ultrasonographically. The probe was moved posteriorly until the quadratus lumborum muscle was visualized. Using an in-plane technique, the needle was advanced under continuous ultrasound visualization, and after negative aspiration, 20 mL of 0.25% bupivacaine was deposited on each side in the fascial plane adjacent to the quadratus lumborum muscle.

Transversus Abdominis Plane Block: In Group TAP, the ultrasound probe was positioned between the iliac crest and costal margin in the mid-axillary line. The external oblique, internal oblique, and transversus abdominis muscles were identified. The needle was advanced using an in-plane technique until its tip was positioned between the internal oblique and transversus abdominis muscles. Following negative aspiration, 20 mL of 0.25% bupivacaine was administered on each side.

The total dose of bupivacaine was kept within the recommended maximum safe dose for each patient.

Postoperative Assessment: Postoperative pain was evaluated using an 11-point Numerical Rating Scale (NRS), where 0 represented no pain and 10 represented the worst imaginable pain. Pain scores were recorded at 0, 2, 4, 6, 12, and 24 hours postoperatively, both at rest and, where feasible, during movement.

Rescue analgesia was administered when the NRS score was ≥ 4 . The time from completion of the block to the first request for rescue analgesia was recorded as the duration of analgesia. The total rescue analgesic consumption during the first 24 postoperative hours was also documented. Heart rate, blood pressure, mean arterial pressure, and oxygen saturation were monitored during the postoperative period. Adverse effects including nausea, vomiting, hypotension, bradycardia, local

anesthetic systemic toxicity, hematoma, and other block-related complications were recorded.

Outcome Measures: The primary outcome was the time to first rescue analgesic requirement. Secondary outcomes included NRS pain scores at predefined postoperative intervals, cumulative rescue analgesic consumption during 24 hours, hemodynamic parameters, and incidence of adverse events.

Statistical Analysis: Data were entered into Microsoft Excel and analyzed using SPSS software. Continuous variables were expressed as mean $\pm$ standard deviation or median with interquartile range, as appropriate, while categorical variables were presented as frequencies and percentages. Continuous variables between the

two groups were compared using the independent-samples t-test or Mann-Whitney U test, depending on data distribution. Repeated pain scores were analyzed using an appropriate repeated-measures analysis. Categorical variables were compared using the Chi-square test or Fisher's exact test. A p-value <0.05 was considered statistically significant.

Results

A total of 70 patients undergoing lower abdominal surgery were included and randomized equally into Group QL (n=35) and Group TAP (n=35). All patients completed the study and were included in the final analysis. Baseline demographic and perioperative characteristics were comparable between the two groups ($p>0.05$).

Table 1: Demographic and perioperative characteristics

Parameter	Group QL (n=35)	Group TAP (n=35)	p-value
Age (years), mean $\pm$ SD	41.8 $\pm$ 11.2	42.6 $\pm$ 10.7	0.761
Male/Female, n	17/18	16/19	0.811
BMI (kg/m ²), mean $\pm$ SD	24.7 $\pm$ 3.1	25.1 $\pm$ 3.3	0.603
ASA I/II, n	21/14	20/15	0.808
Duration of surgery (min), mean $\pm$ SD	91.6 $\pm$ 20.8	94.2 $\pm$ 22.1	0.614
Baseline heart rate (beats/min), mean $\pm$ SD	78.9 $\pm$ 8.6	80.1 $\pm$ 9.1	0.573
Baseline MAP (mmHg), mean $\pm$ SD	92.4 $\pm$ 7.8	91.7 $\pm$ 8.2	0.716

There were no statistically significant differences in age, sex distribution, BMI, ASA physical status, duration of surgery, or baseline hemodynamic parameters between the groups, indicating adequate comparability at baseline.

Table 2: Comparison of postoperative NRS pain scores

Postoperative time	Group QL (n=35), mean $\pm$ SD	Group TAP (n=35), mean $\pm$ SD	p-value
0 hour	1.11 $\pm$ 0.68	1.26 $\pm$ 0.70	0.367
2 hours	1.37 $\pm$ 0.69	1.74 $\pm$ 0.78	0.039
4 hours	1.66 $\pm$ 0.76	2.29 $\pm$ 0.86	0.002
6 hours	1.94 $\pm$ 0.80	2.77 $\pm$ 0.91	<0.001
12 hours	2.43 $\pm$ 0.85	3.09 $\pm$ 0.92	0.003
24 hours	2.20 $\pm$ 0.80	2.46 $\pm$ 0.85	0.192

Postoperative pain scores were significantly lower in Group QL at 2, 4, 6, and 12 hours compared with Group TAP. The greatest difference was observed at 6 hours (1.94 $\pm$ 0.80 vs. 2.77 $\pm$ 0.91; $p<0.001$). By 24 hours, pain scores were comparable between the groups ($p=0.192$).

Table 3: Postoperative analgesic outcomes

Outcome	Group QL (n=35)	Group TAP (n=35)	p-value
Time to first rescue analgesia (hours), mean $\pm$ SD	11.8 $\pm$ 3.1	7.2 $\pm$ 2.5	<0.001
24-hour rescue analgesic consumption (mg)*, mean $\pm$ SD	74.3 $\pm$ 30.6	117.1 $\pm$ 37.8	<0.001
Patients requiring rescue analgesia within 6 h, n (%)	4 (11.4)	13 (37.1)	0.012
Patients requiring ≥ 2 rescue doses, n (%)	7 (20.0)	17 (48.6)	0.012
Patients requiring no rescue analgesia during 24 h, n (%)	8 (22.9)	2 (5.7)	0.040

*Expressed as the standardized rescue analgesic dose used in the study protocol.

The duration of analgesia was significantly longer following QL block. The mean time to first rescue analgesia was 11.8 $\pm$ 3.1 hours in Group QL compared with 7.2 $\pm$ 2.5 hours in Group TAP

($p<0.001$). Total 24-hour rescue analgesic consumption was also significantly lower in the QL group. Fewer patients receiving QL block required early or multiple rescue analgesic doses.

Table 4: Postoperative adverse effects and block-related complications

Adverse event	Group QL (n=35), n (%)	Group TAP (n=35), n (%)	p-value
Nausea	3 (8.6)	7 (20.0)	0.171
Vomiting	1 (2.9)	4 (11.4)	0.356
Hypotension	2 (5.7)	1 (2.9)	1.000
Bradycardia	1 (2.9)	1 (2.9)	1.000
Hematoma at block site	0	0	—
Local anesthetic toxicity	0	0	—
Any adverse event	6 (17.1)	11 (31.4)	0.164

The incidence of postoperative adverse effects was low in both groups. Nausea and vomiting were numerically less frequent in Group QL, although the differences were not statistically significant. No patient developed hematoma or features of local anesthetic systemic toxicity. Postoperative hemodynamic parameters remained clinically stable and comparable between the groups.

Discussion

The present study compared ultrasound-guided quadratus lumborum (QL) block with transversus abdominis plane (TAP) block for postoperative analgesia following lower abdominal surgery. The principal findings were that QL block resulted in lower postoperative pain scores, a longer duration of analgesia, and reduced rescue analgesic consumption compared with TAP block, while both techniques had a comparable safety profile.

Our findings are consistent with Öksüz et al., who compared QL and TAP blocks in children undergoing lower abdominal surgery and demonstrated superior and more prolonged analgesia with the QL block.[7] Similarly, Yousef reported that QL block provided better postoperative analgesia than TAP block in patients undergoing total abdominal hysterectomy, with lower pain scores and reduced analgesic requirements.[8]

In the present study, NRS scores were significantly lower in the QL group at 2, 4, 6, and 12 hours, although the difference was no longer significant at 24 hours. Verma et al. also demonstrated lower postoperative pain scores and prolonged analgesia with QL block compared with TAP block following cesarean section.[9] Comparable findings in pediatric lower abdominal surgery were reported by İpek et al., supporting the effectiveness of QL block as part of multimodal postoperative analgesia.[10]

A particularly important finding was the significantly longer time to first rescue analgesia with QL block (11.8 ± 3.1 hours) compared with TAP block (7.2 ± 2.5 hours). Deng et al. similarly demonstrated favorable postoperative analgesic outcomes with QL block compared with TAP block following laparoscopic colorectal surgery.[11] The prolonged effect of QL block may be related to the

more posterior deposition of local anesthetic and its spread along the thoracolumbar fascial planes, potentially producing a broader sensory blockade than TAP block.

The 24-hour rescue analgesic requirement was also significantly lower in the QL group. Evidence synthesized by Jin et al. supports the postoperative analgesic and opioid-sparing effects of single-injection QL block across different adult surgical procedures.[12] Likewise, the systematic review and meta-analysis by Uppal et al. demonstrated that QL block can improve postoperative analgesia and reduce opioid requirements following abdominal and other surgical procedures.[13]

Liu et al., in a meta-analysis directly comparing QL and TAP blocks for abdominal surgery, reported that QL block was associated with improved postoperative analgesic outcomes, although the magnitude of benefit varied among studies.[14] More recent comparative evidence from Roy et al. in adults undergoing laparoscopic inguinal hernia repair further supports the use of these fascial plane blocks for postoperative analgesia, while highlighting that their relative benefit can vary according to surgical procedure, block technique, and analgesic regimen.[15]

Both techniques were well tolerated in the present study. No major block-related complications or local anesthetic systemic toxicity occurred, and the incidence of adverse events was comparable between groups. The study was limited by its relatively small sample size, single-centre design, and follow-up restricted to the first 24 postoperative hours. Furthermore, inclusion of different types of lower abdominal surgery may have introduced some heterogeneity in postoperative pain intensity. Larger multicentre studies using standardized surgical procedures and block techniques would help clarify the magnitude and duration of benefit associated with QL block.

Conclusion

Ultrasound-guided quadratus lumborum block provided more effective and prolonged postoperative analgesia than transversus abdominis plane block following lower abdominal surgery. QL block was associated with lower early postoperative pain scores, longer time to first

rescue analgesia, and reduced 24-hour rescue analgesic consumption.

Both blocks demonstrated a comparable safety profile. QL block may therefore be a useful component of multimodal analgesia for lower abdominal surgical procedures.

References

1. Ueshima H, Otake H, Lin JA. Ultrasound-guided quadratus lumborum block: an updated review of anatomy and techniques. *Biomed Res Int.* 2017;2017:2752876. doi: 10.1155/2017/2752876.
2. Tsai HC, Yoshida T, Chuang TY, Yang SF, Chang CC, Yao HY, et al. Transversus abdominis plane block: an updated review of anatomy and techniques. *Biomed Res Int.* 2017; 2017:8284363. doi: 10.1155/2017/8284363.
3. Petersen PL, Mathiesen O, Torup H, Dahl JB. The transversus abdominis plane block: a valuable option for postoperative analgesia? A topical review. *Acta Anaesthesiol Scand.* 2010; 54(5):529-535. doi: 10.1111/j.1399-6576.2010.02215.x.
4. Abdallah FW, Chan VW, Brull R. Transversus abdominis plane block: a systematic review. *Reg Anesth Pain Med.* 2012;37(2):193-209. doi: 10.1097/AAP.0b013e3182429531.
5. Blanco R, Ansari T, Girgis E. Quadratus lumborum block for postoperative pain after caesarean section: a randomised controlled trial. *Eur J Anaesthesiol.* 2015;32(11):812-818. doi: 10.1097/EJA.0000000000000299.
6. 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):757-762. doi: 10.1097/AAP.0000000000000495.
7. Öksüz G, Bilal B, Gürkan Y, Urfalıoğlu A, Arslan M, Gişi G, et al. Quadratus lumborum block versus transversus abdominis plane block in children undergoing low abdominal surgery: a randomized controlled trial. *Reg Anesth Pain Med.* 2017;42(5):674-679. doi: 10.1097/AAP.0000000000000645.
8. Yousef NK. Quadratus lumborum block versus transversus abdominis plane block in patients undergoing total abdominal hysterectomy: a randomized prospective controlled trial. *Anesth Essays Res.* 2018;12(3):742-747. doi: 10.4103/aer.AER_108_18.
9. Verma K, Malawat A, Jethava D, Jethava DD. Comparison of transversus abdominis plane block and quadratus lumborum block for post-caesarean section analgesia: a randomised clinical trial. *Indian J Anaesth.* 2019;63(10): 820-826. doi: 10.4103/ija.IJA_61_19.
10. İpek CB, Kara D, Yılmaz S, Yeşiltaş S, Esen A, Dooply SSSL, et al. Comparison of ultrasound-guided transversus abdominis plane block, quadratus lumborum block, and caudal epidural block for perioperative analgesia in pediatric lower abdominal surgery. *Turk J Med Sci.* 2019;49(5):1395-1402. doi: 10.3906/sag-1812-59.
11. Deng W, Long X, Li M, Li C, Guo L, Xu G, et al. Quadratus lumborum block versus transversus abdominis plane block for postoperative pain management after laparoscopic colorectal surgery: a randomized controlled trial. *Medicine (Baltimore).* 2019; 98(52):e18448. doi: 10.1097/MD.00000000000018448.
12. Jin Z, Liu J, Li R, Gan TJ, He Y, Lin J. Single injection quadratus lumborum block for postoperative analgesia in adult surgical population: a systematic review and meta-analysis. *J Clin Anesth.* 2020;62:109715. doi: 10.1016/j.jclinane.2020.109715.
13. Uppal V, Retter S, Kehoe E, McKeen DM. Quadratus lumborum block for postoperative analgesia: a systematic review and meta-analysis. *Can J Anaesth.* 2020;67(11):1557-1575. doi: 10.1007/s12630-020-01793-3.
14. Liu X, Song T, Chen X, Zhang J, Shan C, Chang L, et al. Quadratus lumborum block versus transversus abdominis plane block for postoperative analgesia in patients undergoing abdominal surgeries: a systematic review and meta-analysis of randomized controlled trials. *BMC Anesthesiol.* 2020;20:53. doi: 10.1186/s12871-020-00967-2.
15. Roy A, Bhoi D, Chhabra A, Mohan VK, Darlong V, Prasad G. Quadratus lumborum block vs. transversus abdominis plane block in laparoscopic trans-abdominal pre-peritoneal repair of inguinal hernia in adults: a randomised controlled trial. *Indian J Anaesth.* 2023; 67(2):207-215. doi: 10.4103/ija.ija_304_22.