e-ISSN: 0976-822X, p-ISSN:2961-6042

Available online on http://www.ijcpr.com/

International Journal of Current Pharmaceutical Review and Research 2026; 18(5); 1755-1762

Original Research Article

Comparison of Transversus Abdominis Plane Block versus Quadratus Lumborum Block after laparoscopic surgery

J. Vennela[1], Jyothi Sheelavantar[2], Veereshkumar Gobburkar[3]

[1]Senior Resident, Department of Anaesthesiology, ESIC Medical College, Gulbarga, Karnataka, India
[2]Senior Resident, Department of Anaesthesiology, Mahadevappa Rampure Medical College, Gulbarga, Karnataka, India
[3]Senior Resident, Department of Anaesthesiology, ESIC Medical College, Gulbarga, Karnataka, India

Received: 01-02-2026 / Revised: 15-03-2026 / Accepted: 21-04-2026
Corresponding author: Dr. J. Vennela
Conflict of interest: Nil

Abstract

Background: Effective postoperative pain management following laparoscopic surgery is essential for facilitating early recovery and minimizing opioid-related adverse effects. Ultrasound-guided Transversus Abdominis Plane Block (TAPB) and Quadratus Lumborum Block (QLB) are commonly employed regional analgesic techniques; however, their comparative efficacy remains under investigation.

Methods: This prospective, randomized comparative study included 80 adult patients undergoing elective laparoscopic abdominal surgery under general anesthesia. Patients were randomly allocated to receive either ultrasound-guided TAPB (Group T, n=40) or ultrasound-guided QLB (Group Q, n=40). The primary outcome was postoperative pain intensity assessed using the Numeric Rating Scale (NRS). Secondary outcomes included time to first rescue analgesia, 24-hour opioid consumption, recovery characteristics, patient satisfaction, and postoperative adverse effects.

Results: Baseline demographic and perioperative characteristics were comparable between the groups. Patients receiving QLB demonstrated significantly lower postoperative pain scores at all assessment intervals ($p<0.001$). The time to first rescue analgesia was significantly longer in Group Q than Group T (12.3 ± 2.8 vs. 7.4 ± 2.1 hours; $p<0.001$), while 24-hour tramadol consumption was significantly lower (82.8 ± 24.3 mg vs. 138.5 ± 31.6 mg; $p<0.001$). QLB was also associated with earlier ambulation (12.6 ± 2.9 vs. 15.8 ± 3.5 hours; $p<0.001$), earlier oral intake (18.3 ± 3.9 vs. 21.6 ± 4.8 hours; $p=0.001$), shorter hospital stay (3.9 ± 0.9 vs. 4.8 ± 1.1 days; $p<0.001$), and higher patient satisfaction scores (9.3 ± 0.7 vs. 8.2 ± 0.9; $p<0.001$). Although postoperative nausea, vomiting, sedation, pruritus, and urinary retention were less frequent in the QLB group, these differences were not statistically significant. No block-related complications occurred in either group.

Conclusion: Ultrasound-guided quadratus lumborum block provided superior postoperative analgesia, prolonged opioid-free analgesia, reduced postoperative opioid consumption, and enhanced recovery compared with the transversus abdominis plane block after laparoscopic surgery. QLB may therefore be considered the preferred regional analgesic technique within multimodal analgesia and ERAS pathways for laparoscopic abdominal surgery.

Keywords: Laparoscopic Surgery; Quadratus Lumborum Block; Transversus Abdominis Plane Block; Regional Anesthesia; Postoperative Analgesia; Multimodal Analgesia; ERAS.

DOI: 10.25258/ijcpr.18.5.280

Introduction

Laparoscopic surgery has become the standard approach for a wide range of abdominal procedures owing to its association with smaller incisions, reduced surgical trauma, lower postoperative morbidity, shorter hospital stay, and faster recovery compared with conventional open surgery [1,2]. Despite these advantages, postoperative pain remains a significant clinical challenge following laparoscopic procedures. Pain after laparoscopic surgery is multifactorial, comprising somatic pain originating from trocar insertion sites and abdominal wall incisions, visceral pain resulting from peritoneal stretching and manipulation of intra-abdominal organs, and referred shoulder pain secondary to diaphragmatic irritation caused by residual carbon dioxide pneumoperitoneum [3,4]. Inadequately controlled postoperative pain impairs respiratory function, delays ambulation, prolongs postoperative ileus, increases opioid consumption, extends hospital stay, and adversely affects patient satisfaction and overall recovery [5,6]. Therefore, effective postoperative analgesia remains a fundamental component of perioperative management. Enhanced Recovery After Surgery (ERAS) protocols advocate multimodal analgesia as a cornerstone of perioperative care to optimize postoperative recovery while minimizing opioid-related adverse effects [7,8]. Multimodal analgesia combines different analgesic agents and regional anesthesia techniques that target multiple pain pathways, thereby improving analgesic efficacy and reducing opioid requirements. This opioid-sparing strategy decreases the incidence of postoperative nausea and vomiting, sedation, respiratory depression, urinary retention, postoperative ileus, and delayed mobilization, ultimately facilitating earlier functional recovery and discharge [9–11]. Consequently, ultrasound-guided regional anesthesia techniques have assumed an increasingly important role in contemporary perioperative pain management.

Among ultrasound-guided fascial plane blocks, the transversus abdominis plane block (TAPB) is one of the most commonly employed techniques for postoperative analgesia following laparoscopic abdominal surgery. First described by Rafi in 2001, TAPB involves deposition of local anesthetic between the internal oblique and transversus abdominis muscles, producing blockade of the anterior rami of the thoracolumbar nerves supplying the anterolateral abdominal wall [12,13]. Numerous randomized controlled trials and systematic reviews have demonstrated that TAPB effectively reduces postoperative pain scores, opioid consumption, and opioid-related adverse effects after laparoscopic surgery [14,15]. Nevertheless, because TAPB predominantly blocks somatic afferent nerves, its analgesic efficacy is largely confined to the abdominal wall and provides limited relief of visceral pain, which constitutes a major component of postoperative discomfort following laparoscopic procedures [16].The quadratus lumborum block (QLB) has emerged as an attractive alternative regional analgesic technique with the potential to provide both somatic and visceral analgesia.

The block involves injection of local anesthetic adjacent to the quadratus lumborum muscle, allowing spread through the thoracolumbar fascia and, in some cases, into the thoracic paravertebral space [17,18]. This wider distribution of local anesthetic may produce sensory blockade extending approximately from T7 to L1 while also influencing sympathetic fibers responsible for visceral pain transmission [19]. Consequently, QLB has been associated with prolonged duration of analgesia, lower postoperative pain scores, reduced opioid consumption, earlier mobilization, and improved patient satisfaction in patients undergoing various laparoscopic abdominal procedures [20,21]. Several randomized controlled trials and meta-analyses have compared TAPB and QLB following laparoscopic cholecystectomy, colorectal surgery, gynecological surgery, bariatric surgery, nephrectomy, and other minimally invasive abdominal procedures [22–24]. Although many studies have demonstrated superior postoperative analgesia, prolonged opioid-free intervals, and reduced analgesic requirements with QLB, other investigations have reported comparable outcomes between the two techniques.

Variations in surgical procedures, block approaches, local anesthetic regimens, timing of block administration, and perioperative analgesic protocols have contributed to these inconsistent findings [25,26]. Therefore, further comparative studies are warranted to establish the relative effectiveness of these two commonly used fascial plane blocks in patients undergoing laparoscopic surgery.

The present study was undertaken to compare ultrasound-guided transversus abdominis plane block and quadratus lumborum block for postoperative analgesia in patients undergoing laparoscopic surgery.

Materials and Methods

This prospective, randomized, comparative study was conducted in the Department of Anaesthesiology at a tertiary care teaching hospital. The study was carried out over a period of 12 months. Written informed consent was obtained from all participants before enrolment in the study.

Study Population: Adult patients aged 18–70 years of either sex, belonging to the American Society of Anesthesiologists (ASA) physical status I–III, who were scheduled to undergo elective laparoscopic abdominal surgery under general anesthesia were screened for eligibility.

Inclusion Criteria

Patients fulfilling the following criteria were included:

- Age between 18 and 70 years.
- ASA physical status I–III.
- Scheduled for elective laparoscopic abdominal surgery under general anesthesia.
- Ability to understand the pain scoring system and provide informed consent.

Exclusion Criteria

Patients were excluded if they had:

- Refusal to participate in the study.
- Allergy or contraindication to local anesthetic agents.

- Coagulopathy or ongoing anticoagulant therapy.
- Infection at the proposed block site.
- Chronic opioid use or chronic pain syndrome.
- Severe hepatic, renal, or cardiac dysfunction.
- Pregnancy or lactation.
- Body mass index (BMI) >35 kg/m².
- Conversion from laparoscopic to open surgery.
- Incomplete data or block failure.

Randomization and Allocation: Eligible patients were randomly allocated in a 1:1 ratio into two groups using a computer-generated randomization sequence. Group allocation was concealed using sequentially numbered, opaque, sealed envelopes that were opened immediately before administration of the regional block.

- **Group T (n = 40):** Patients received ultrasound-guided Transversus Abdominis Plane (TAP) block.
- **Group Q (n = 40):** Patients received ultrasound-guided Quadratus Lumborum (QL) block.

Preoperative Assessment: All patients underwent detailed pre-anesthetic evaluation, including medical history, physical examination, airway assessment, routine laboratory investigations, electrocardiography, and additional investigations whenever indicated. Patients were instructed regarding the Numeric Rating Scale (NRS) for postoperative pain assessment, where 0 represented no pain and 10 represented the worst imaginable pain.

Anesthetic Technique: All patients followed standard fasting guidelines before surgery. In the operating room, routine monitoring comprising electrocardiography, non-invasive blood pressure, pulse oximetry, and capnography was instituted. Baseline heart rate, mean arterial pressure, and oxygen saturation were recorded. General anesthesia was induced using intravenous fentanyl (2 µg/kg), propofol (2–2.5 mg/kg), and atracurium (0.5 mg/kg) to facilitate endotracheal intubation. Anesthesia was maintained with oxygen-air mixture and sevoflurane, while additional doses of atracurium were administered as required. Intraoperative analgesia and fluid therapy were standardized for all patients.

Ultrasound-Guided Regional Block: Following completion of surgery and before extubation, ultrasound-guided regional block was performed under strict aseptic precautions using a high-frequency linear ultrasound transducer.

Group T: Transversus Abdominis Plane Block: The ultrasound probe was positioned transversely along the mid-axillary line between the iliac crest and the costal margin. The fascial plane between the internal oblique and transversus abdominis muscles was identified. Using an in-plane technique, 20 mL of 0.25% bupivacaine was deposited on each side after negative aspiration, resulting in a total volume of 40 mL.

Group Q: Quadratus Lumborum Block: The ultrasound probe was positioned over the flank to identify the quadratus lumborum muscle and surrounding fascial planes. Using an in-plane approach, the needle was advanced under ultrasound guidance until the desired fascial plane adjacent to the quadratus lumborum muscle was reached. After careful negative aspiration, 20 mL of 0.25% bupivacaine was injected on each side, for a total volume of 40 mL.

Postoperative Analgesic Protocol: All patients received standardized multimodal analgesia consisting of intravenous paracetamol 1 g every 8 hours. Rescue analgesia was administered with intravenous tramadol 50 mg whenever the Numeric Rating Scale (NRS) score was ≥4 or when requested by the patient. The time to first rescue analgesia and total tramadol consumption during the first 24 postoperative hours were recorded.

Outcome Measures

Primary Outcome: The primary outcome measure was postoperative pain intensity assessed using the Numeric Rating Scale (NRS) at rest at recovery room admission and at 2, 6, 12, and 24 hours after surgery.

Secondary Outcomes

Secondary outcome measures included:

- Time to first rescue analgesic requirement.
- Total opioid consumption during the first 24 postoperative hours.
- Number of rescue analgesic doses.
- Time to first ambulation.
- Time to first oral intake.
- Length of postoperative hospital stay.
- Patient satisfaction score (0–10).
- Incidence of postoperative nausea and vomiting, sedation, respiratory depression, urinary retention, pruritus, and other block-related complications.

Data Collection: Demographic characteristics including age, sex, body mass index, ASA physical status, duration of surgery, and type of laparoscopic procedure were recorded. Hemodynamic parameters including heart rate, mean arterial pressure, and oxygen saturation were documented intraoperatively and postoperatively. Pain scores, rescue analgesic consumption, recovery parameters, adverse events, and patient satisfaction were recorded by an investigator who was unaware of group allocation.

Statistical Analysis: Data were entered into Microsoft Excel and analyzed using Statistical Package for the Social Sciences (SPSS) software version 26.0 (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean ± standard deviation (SD), while categorical variables were presented as frequencies and percentages. The independent Student's t-test was used for comparison of normally distributed continuous variables, whereas the Mann–Whitney U test was applied for non-normally distributed data. Categorical variables were compared using the Chi-square test or Fisher's exact test, as appropriate. A p-value of <0.05 was considered statistically significant.

Results

A total of 80 patients undergoing elective laparoscopic abdominal surgery were enrolled in the study. Patients were randomly allocated into two groups: Group T (n=40) received ultrasound-guided Transversus Abdominis Plane (TAP) block, while Group Q (n=40) received ultrasound-guided Quadratus Lumborum (QL) block. All patients completed the study protocol and were included in the final analysis. Baseline demographic characteristics, ASA physical status, BMI, and operative duration were comparable between the two groups, with no statistically significant differences observed (Table 1). The postoperative pain scores assessed using the Numeric Rating Scale (NRS) were significantly lower in patients receiving QL block compared with TAP block at all evaluated time points. Patients in Group Q demonstrated reduced pain scores in the recovery room, at 2 hours, 6 hours, 12 hours, and 24 hours postoperatively compared with Group T (Table 2).

The trend of superior pain control with QL block throughout the postoperative period is illustrated in Figure 1.Analgesic requirements were significantly reduced in the QL block group. The time to first rescue analgesia was significantly prolonged in Group Q compared with Group T (12.3 ± 2.8 hours vs 7.4 ± 2.1 hours, p<0.001). Furthermore, total tramadol consumption over 24 hours was significantly lower among patients receiving QL block (82.8 ± 24.3 mg vs 138.5 ± 31.6 mg, p<0.001). The proportion of patients requiring rescue analgesia and the number of rescue analgesic doses were also significantly reduced in Group Q compared with Group T (Table 3).Recovery parameters showed significant improvement with QL block. Patients in Group Q achieved earlier ambulation (12.6 ± 2.9 hours vs 15.8 ± 3.5 hours, p<0.001), earlier oral intake (18.3 ± 3.9 hours vs 21.6 ± 4.8 hours, p=0.001), and shorter hospital stay (3.9 ± 0.9 days vs 4.8 ± 1.1 days, p<0.001) compared with Group T. Patient satisfaction scores were also significantly higher in the QL block group (9.3 ± 0.7 vs 8.2 ± 0.9, p<0.001) (Table 4). Comparative recovery outcomes between both groups are presented graphically in Figure 2.Intraoperative and postoperative haemodynamic parameters remained comparable between the two groups. Mean heart rate, mean arterial pressure, and oxygen saturation showed no statistically significant differences between Group T and Group Q, indicating similar haemodynamic stability with both techniques (Table 5). The comparison of haemodynamic variables is demonstrated in Figure 3.The incidence of postoperative adverse effects was lower in the QL block group; however, none of the differences reached statistical significance. Postoperative nausea and vomiting occurred in 10 patients (25.0%) in Group T compared with 4 patients (10.0%) in Group Q (p=0.078). Sedation, pruritus, urinary retention, and respiratory depression were numerically less frequent in Group Q. No block-related complications were observed in either group (Table 6).

Table 1: Baseline Demographic and Perioperative Characteristics

Variable	Group T (n=40)	Group Q (n=40)	p-value
Age (years), Mean ± SD	46.9 ± 12.3	45.7 ± 11.6	0.661
Male, n (%)	22 (55.0)	23 (57.5)	0.821
Female, n (%)	18 (45.0)	17 (42.5)	
BMI (kg/m²), Mean ± SD	24.8 ± 3.1	24.5 ± 3.4	0.682
ASA I, n (%)	14 (35.0)	15 (37.5)	0.913
ASA II, n (%)	20 (50.0)	19 (47.5)	
ASA III, n (%)	6 (15.0)	6 (15.0)	
Duration of surgery (minutes), Mean ± SD	118.5 ± 24.6	116.9 ± 23.2	0.768

Table 2: Comparison of Postoperative Pain Scores (Numeric Rating Scale)

Time	Group T	Group Q	p-value
Recovery room	3.8 ± 0.8	2.9 ± 0.7	<0.001
2 hours	3.5 ± 0.9	2.5 ± 0.7	<0.001
6 hours	3.9 ± 0.8	2.8 ± 0.8	<0.001
12 hours	4.4 ± 0.9	3.2 ± 0.8	<0.001
24 hours	3.7 ± 0.8	2.9 ± 0.7	<0.001

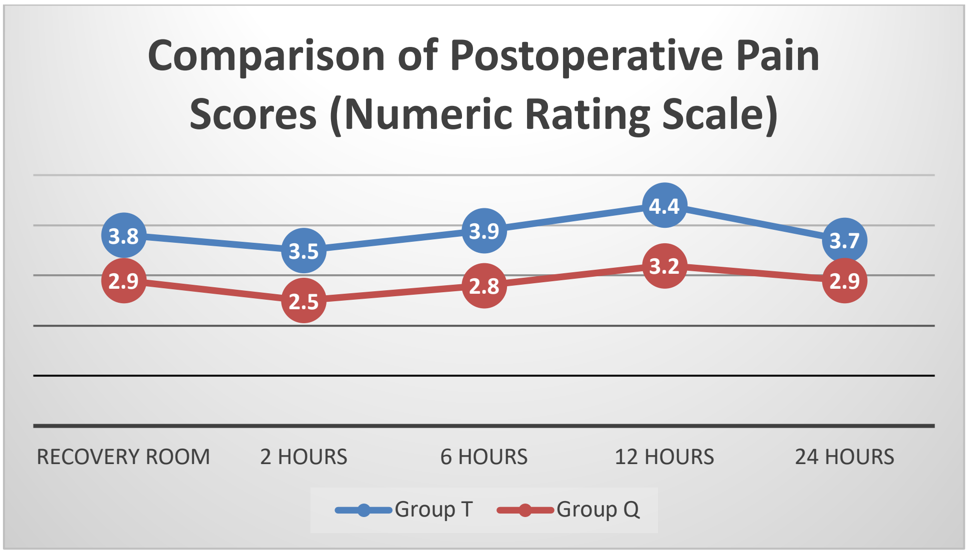

Figure 1: Comparison of Postoperative Pain Scores (Numeric Rating Scale)

Table 3: Comparison of Analgesic Outcomes

Parameter	Group T	Group Q	p-value
Time to first rescue analgesia (hours)	7.4 ± 2.1	12.3 ± 2.8	<0.001
Total tramadol consumption (mg/24 h)	138.5 ± 31.6	82.8 ± 24.3	<0.001
Patients requiring rescue analgesia, n (%)	36 (90.0)	24 (60.0)	0.002
Number of rescue analgesic doses	2.4 ± 0.8	1.3 ± 0.6	<0.001

Table 4: Comparison of Recovery Outcomes

Parameter	Group T	Group Q	p-value
Time to first ambulation (hours)	15.8 ± 3.5	12.6 ± 2.9	<0.001
Time to first oral intake (hours)	21.6 ± 4.8	18.3 ± 3.9	0.001
Length of hospital stay (days)	4.8 ± 1.1	3.9 ± 0.9	<0.001
Patient satisfaction score (0–10)	8.2 ± 0.9	9.3 ± 0.7	<0.001

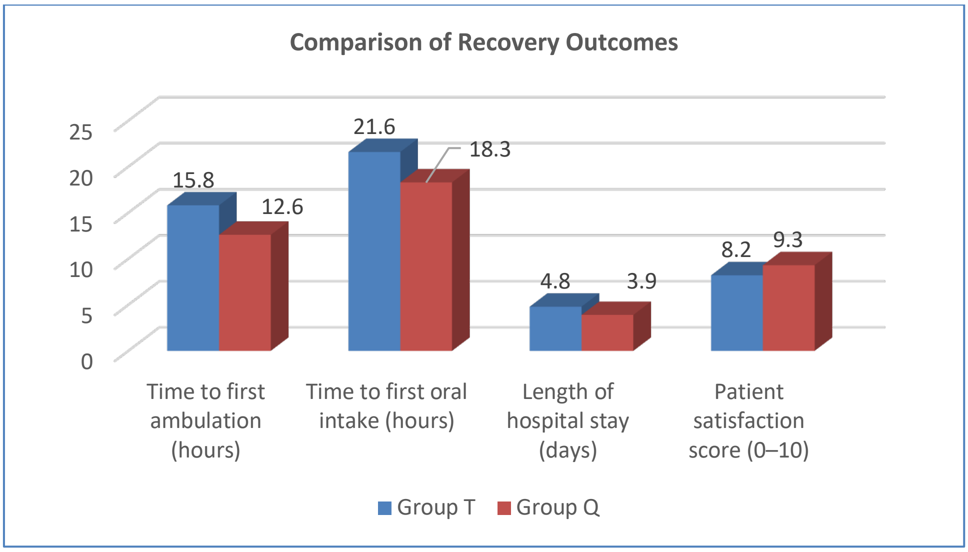

Figure 2: Comparison of Recovery Outcomes

Table 5: Hemodynamic Parameters

Parameter	Group T	Group Q	p-value
Mean heart rate (beats/min)	74.8 ± 6.5	72.3 ± 5.8	0.071
Mean arterial pressure (mmHg)	85.6 ± 6.7	83.4 ± 6.2	0.134
Oxygen saturation (%)	98.6 ± 0.8	98.8 ± 0.7	0.241

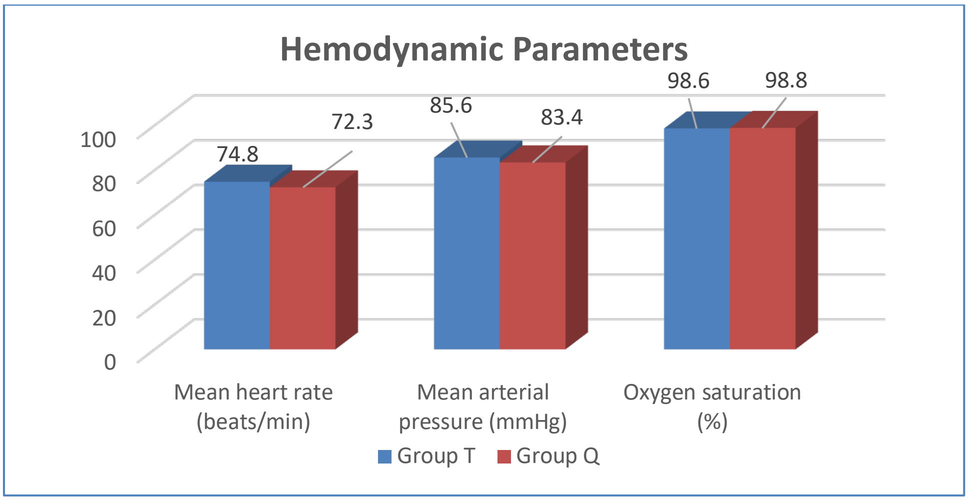

Figure 3: Hemodynamic Parameters

Table 6: Postoperative Adverse Effects

Adverse Effect	Group T n (%)	Group Q n (%)	p-value
Postoperative nausea and vomiting	10 (25.0)	4 (10.0)	0.078
Sedation	7 (17.5)	2 (5.0)	0.081
Pruritus	5 (12.5)	1 (2.5)	0.090
Urinary retention	4 (10.0)	2 (5.0)	0.396
Respiratory depression	2 (5.0)	0 (0.0)	0.152
Block-related complications	0 (0.0)	0 (0.0)	—

Discussion:

Our study demonstrated significantly lower postoperative pain scores at all postoperative time points in patients receiving quadratus lumborum block compared with transversus abdominis plane block (all p<0.001). These findings suggest that QLB provides more effective postoperative analgesia than TAPB in patients undergoing laparoscopic surgery. Similar findings were reported by Deng et al. [27] and Li et al. [28], who observed significantly lower postoperative pain scores following posterior QLB than TAPB after laparoscopic colorectal surgery. Likewise, Huang et al. [29] demonstrated that QLB produced superior analgesia during the first postoperative 24 hours, resulting in improved patient comfort and reduced opioid requirements.

The superior analgesic efficacy observed in our study is biologically plausible because TAPB primarily provides somatic analgesia by blocking the thoracolumbar nerves supplying the anterior abdominal wall, whereas QLB allows spread of local anesthetic through the thoracolumbar fascia into the thoracic paravertebral region, thereby providing both somatic and visceral analgesia [30,31]. This anatomical difference is particularly important in laparoscopic surgery, where visceral pain from pneumoperitoneum and bowel manipulation contributes substantially to postoperative discomfort [4,30]. In our study, the time to first rescue analgesia was significantly prolonged in the QLB group (12.3 ± 2.8 hours) compared with the TAPB group (7.4 ± 2.1 hours), while 24-hour tramadol consumption was significantly lower (82.8 ± 24.3 mg vs. 138.5 ± 31.6 mg; p<0.001). Comparable results were reported by Deng et al. [27], who demonstrated prolonged analgesia and reduced opioid consumption with posterior QLB. Similarly, Li et al. [28] found significantly lower morphine consumption during the first postoperative 24 hours in patients receiving QLB than TAPB. Our findings are also supported by the recent systematic review and meta-analysis by Abd-Elsalam et al. [32], which compared TAPB and QLB after laparoscopic colorectal surgery. The authors reported that posterior and posteromedial QLB techniques consistently provided superior analgesia, whereas studies using the lateral QLB approach showed results comparable to TAPB. They concluded that the considerable heterogeneity among studies primarily resulted from pooling anatomically distinct QLB techniques with different mechanisms of action [32].The meta-analysis further demonstrated that sensitivity analysis excluding studies by George et al. [33] and Bai et al. [34] significantly strengthened the opioid-sparing effect of QLB. Both studies employed the lateral QLB approach, which behaves predominantly as a somatic block similar to TAPB and therefore may underestimate the true analgesic benefit of posterior QLB [32–34]. This explanation is consistent with the superior postoperative analgesia observed in our study. Patients receiving QLB in the present study achieved earlier ambulation, earlier oral intake, shorter hospital stay, and higher patient satisfaction than those receiving TAPB.

Similar observations were reported by Huang et al. [29] and Li et al. [28], who demonstrated that improved early postoperative analgesia following QLB facilitated enhanced recovery and earlier mobilization. ERAS guidelines recommend opioid-sparing multimodal analgesia and emphasize the importance of optimal pain control during the first postoperative 24 hours to facilitate early mobilization and gastrointestinal recovery [8,35].

The improved recovery parameters observed in our study are therefore consistent with current ERAS recommendations and support the incorporation of QLB into multimodal analgesic protocols for laparoscopic abdominal surgery [35,36].

Conclusion

The present study demonstrated that ultrasound-guided quadratus lumborum block provided superior postoperative analgesia compared with the transversus abdominis plane block in patients undergoing laparoscopic surgery. Patients receiving QLB experienced significantly lower postoperative pain scores, prolonged duration of analgesia, reduced opioid consumption, earlier ambulation, shorter hospital stay, and higher patient satisfaction. Both regional analgesic techniques were safe, with no block-related complications observed. These findings support the incorporation of QLB as an effective opioid-sparing component of multimodal analgesia and Enhanced Recovery after Surgery (ERAS) protocols for laparoscopic abdominal procedures.

Limitations

The present study was conducted at a single tertiary care center with a relatively small sample size, which may limit the generalizability of the findings. Only short-term postoperative outcomes up to 24 hours were evaluated, while long-term pain control, functional recovery, and chronic postoperative pain were not assessed. Furthermore, different types of laparoscopic surgeries were included, which may have introduced variability in postoperative pain intensity.

References

1. Siegel RL, Wagle NS, Cercek A, Smith RA, Jemal A. Colorectal cancer statistics, 2023. CA Cancer J Clin. 2023;73:233-254.
2. Shida D, Tagawa K, Inada K, Nasu K, Seyama Y, Miyamoto S, et al. Enhanced recovery after surgery (ERAS) protocols for colorectal cancer in Japan. BMC Surg. 2015;15:90.
3. Joshi GP, Bonnet F, Kehlet H, Camu F, Fischer HBJ, Neugebauer EAM, et al. Evidence-based postoperative pain management after laparoscopic colorectal surgery. Colorectal Dis. 2013;15:146-155.
4. Simpson JC, Bao X, Agarwala A. Pain management in Enhanced Recovery After Surgery (ERAS) protocols. Clin Colon Rectal Surg. 2019;32:121-128.
5. Gedda C, Nygren J, Garpenbeck A, Hoffström L, Thorell A, Soop M, et al. Multimodal analgesia bundle and postoperative opioid use among patients undergoing colorectal surgery. JAMA Netw Open. 2023;6:e2332408.
6. Portilho AS, Olivé MLV, Almeida Leite RM, Tustumi F, Seid VE, Gerbasi LS, et al. The impact of Enhanced Recovery After Surgery compliance in colorectal surgery for cancer. J Laparoendosc Adv Surg Tech A. 2025;35:185-197.
7. Lohsiriwat V, Jitmungngan R. Enhanced recovery after surgery in emergency colorectal surgery: Review of literature and current practices. World J Gastrointest Surg. 2019;11:41-52.
8. Kannan V, Ullah N, Geddada S, Ibrahim A, Al-Qassab ZMS, Ahmed O, et al. Impact of Enhanced Recovery After Surgery (ERAS) protocols versus traditional perioperative care on patient outcomes after colorectal surgery: A systematic review. Patient Saf Surg. 2025;19:4.
9. May PL, Wojcikiewicz T. Regional anaesthesia and fascial plane blocks for abdominal surgery: A narrative review. Dig Med Res. 2022;5:42.
10. Khersonsky J, Alavi M, Yap EN, Campbell CI. Impact of fascial plane block on postoperative length of stay and opioid use among colectomy patients within an established Enhanced Recovery After Surgery program. J Pain Res. 2025;18:689-699.
11. Pilia E, Marrone F, Fusco P. Efficacy of fascial plane blocks in enhanced recovery after surgery protocols for abdominal surgery: A brief meta-analysis. Eur J Anaesthesiol Intensive Care. 2025;4:e0085.
12. Chin KJ, McDonnell JG, Carvalho B, Sharkey A, Pawa A, Gadsden J, et al. Essentials of our current understanding: Abdominal wall blocks. Reg Anesth Pain Med. 2017;42:133-183.
13. 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.
14. Brogi E, Kazan R, Cyr S, Giunta F, Hemmerling TM. Transversus abdominal plane block for postoperative analgesia: A systematic review and meta-analysis of randomized controlled trials. Can J Anaesth. 2016;63:1184-1196.

15. El-Boghdadly K, Elsharkawy HA. Transversus abdominis plane versus quadratus lumborum blocks for abdominal surgery: Where are we now? ASRA Pain Med Update. 2019.
16. Murouchi T, Iwasaki S, Yamakage M. Quadratus lumborum block: Analgesic effects and chronological ropivacaine concentrations after laparoscopic surgery. Reg Anesth Pain Med. 2016;41:146-150.
17. Akerman M, Pejčić N, Veličković I. A review of the quadratus lumborum block and ERAS. Front Med. 2018;5:44.
18. Elsharwaky H. How I Do It: Ultrasound-guided quadratus lumborum block. ASRA Pain Med Update. 2022;15:34-40.
19. Bai H, Zhong S, Yang X, Hou L, Liu Q, Wang Y, et al. Lateral quadratus lumborum block versus transversus abdominis plane block for perioperative analgesia in patients undergoing laparoscopic colorectal cancer surgery. BMC Anesthesiol. 2025;25:365.
20. Deng W, Long X, Li M, Li C, Guo L, Xu G. Quadratus lumborum block versus transversus abdominis plane block for postoperative pain management after laparoscopic colorectal surgery. Medicine (Baltimore). 2019;98:e18448.
21. George RM, McSwain JR, Gukasov M, Wilson DA, Nitchie H, Wilson SH, et al. Dermatomal spread in lateral quadratus lumborum blocks versus transversus abdominis plane blocks after laparoscopic colorectal surgery. Reg Anesth Pain Med. 2024.
22. Huang D, Song L, Li Y, Xu Z, Li X, Li C, et al. Posteromedial quadratus lumborum block versus transversus abdominis plane block for postoperative analgesia following laparoscopic colorectal surgery. J Clin Anesth. 2020;62:109716.
23. Li L, Xu Y, Jiang F, Zhang X. Quadratus lumborum block versus transversus abdominis plane block for laparoscopic radical resection for rectal cancer. Iran Red Crescent Med J. 2022;24.
24. El-Boghdadly K, Elsharkawy H, Short A, Chin KJ. Quadratus lumborum block nomenclature and anatomical considerations. Reg Anesth Pain Med. 2016;41:548-549.
25. 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.
26. Lee KY, Lee SY, Choi M, Kim M, Kim JH, Song JM, et al. The 2024 Korean Enhanced Recovery After Surgery (ERAS) guidelines for colorectal cancer: A secondary publication. Ann Coloproctol. 2025;41:3-26.
27. 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:e18448.
28. Li L, Xu Y, Jiang F, Zhang X. Quadratus lumborum block versus transversus abdominis plane block for laparoscopic radical resection for rectal cancer. Iran Red Crescent Med J. 2022;24.
29. Huang D, Song L, Li Y, Xu Z, Li X, Li C, et al. Posteromedial quadratus lumborum block versus transversus abdominis plane block for postoperative analgesia following laparoscopic colorectal surgery: A randomized controlled trial. J Clin Anesth. 2020;62:109716.
30. El-Boghdadly K, Elsharkawy H, Short A, Chin KJ. Quadratus lumborum block nomenclature and anatomical considerations. Reg Anesth Pain Med. 2016;41:548-549.
31. Akerman M, Pejčić N, Veličković I. A review of the quadratus lumborum block and ERAS. Front Med. 2018;5:44.
32. 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.
33. George RM, McSwain JR, Gukasov M, Wilson DA, Nitchie H, Wilson SH, et al. Dermatomal spread in lateral quadratus lumborum blocks versus transversus abdominis plane blocks after laparoscopic colorectal surgery: A randomized clinical trial. Reg Anesth Pain Med. 2024.
34. Bai H, Zhong S, Yang X, Hou L, Liu Q, Wang Y, et al. Lateral quadratus lumborum block versus transversus abdominis plane block for perioperative analgesia in patients undergoing laparoscopic colorectal cancer surgery: A randomized controlled clinical trial. BMC Anesthesiol. 2025;25:365.
35. Lee KY, Lee SY, Choi M, Kim M, Kim JH, Song JM, et al. The 2024 Korean Enhanced Recovery After Surgery (ERAS) guidelines for colorectal cancer: A secondary publication. Ann Coloproctol. 2025;41:3-26.
36. Kehlet H, Wilmore DW. Evidence-based surgical care and the evolution of fast-track surgery. Ann Surg. 2008;248:189-198.