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Original Research Article

A Comparative Analysis of Ultrasound-Guided Erector Spinae Block versus Quadratus Lumborum Block for Postoperative Pain Management in Abdominal Surgery

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Abstract

Background: Ultrasound-guided fascial plane blocks are increasingly used in multimodal analgesia for abdominal surgery. ESPB and QLB represent two promising techniques, but their comparative analgesic efficacy remains under investigation.

Material and Methods: Eighty patients undergoing abdominal surgery with midline incisions were randomized into ESPB or QLB groups. Postoperative pain scores, opioid consumption, time to first analgesic request, and PCA usage were evaluated at fixed intervals over 24 hours.

Results: QLB provided superior early postoperative analgesia, significantly lower static and dynamic NRS scores at 0 and 4 hours, reduced opioid consumption, and fewer PCA attempts. ESPB provided comparable pain relief beyond 8 hours but was less effective during the initial postoperative period.

Conclusion: Both blocks are effective for postoperative analgesia; however, QLB offers superior early pain control and greater opioid-sparing benefits, making it a favorable choice for abdominal surgeries requiring deep visceral analgesia.

Keywords: Quadratus Lumborum Block, Erector Spinae Plane Block, Postoperative Analgesia, Abdominal Surgery.

Introduction

Effective postoperative pain control remains a critical component of patient recovery and satisfaction following abdominal surgeries with midline incisions. Though systemic opioids and non-opioid analgesics are routinely employed, they carry risks of side effects, delayed mobilization, and prolonged hospital stay, prompting increased use of regional anesthesia techniques as part of multimodal analgesia. Among these, ultrasound-guided Erector Spinae Plane Block (ESPB) and Quadratus Lumborum Block (QLB) have emerged as promising blocks for postoperative analgesia in abdominal surgeries owing to their relative simplicity, safety, and potential for both somatic and visceral pain relief. Recent randomized trials and meta-analyses have directly compared ESPB and QLB in various abdominal and urological procedures [1–4]. For instance, a 2024 randomized study in laparoscopic nephrectomy found that ESPB provided superior analgesia compared to QLB, with significantly lower 24-hour opioid consumption and reduced pain scores at multiple postoperative time points [1]. Similarly, in open abdominal hysterectomy, a 2024 trial reported both ESPB and QLB reduced postoperative opioid use and pain, underscoring that both blocks are effective options within multimodal analgesia regimens [2]. Evidence suggests that QLB may offer extended analgesic duration relative to more superficial blocks, attributable to its ability to block both somatic and visceral afferents via spread to the thoracolumbar fascia and paravertebral space [5,6]. Recent systematic reviews reinforce that both ESPB and QLB significantly lower postoperative pain scores and opioid requirements compared with placebo or no-block controls across a variety of abdominal procedures, though comparative efficacy remains variable across patient populations and surgical types [7,8]. The heterogeneity in existing data — including differences in block approach (lateral, posterior, anterior QLB), local anesthetic volume and concentration, timing of

block, and concomitant analgesic protocols — limits generalizability and underscores the need for further rigorous, procedure-specific comparative studies [9]. Given this background, the present study aims to directly compare the analgesic efficacy of ultrasound-guided QLB versus ESPB when combined with patient-controlled analgesia (PCA) in patients undergoing abdominal surgeries with midline incisions, focusing on postoperative pain scores, opioid consumption, time to first analgesic request, and block-related complications. This comparison may help define which block offers superior analgesia and optimal recovery in this surgical context, thereby guiding evidence-based regional anesthesia practice.

Material and Methods

This prospective, randomized, comparative study was conducted in the Department of Anaesthesiology after obtaining institutional ethical committee approval.

The aim was to evaluate and compare the analgesic efficacy of ultrasound-guided Quadratus Lumborum Block (QLB) and Erector Spinae Plane Block (ESPB), administered in conjunction with patient-controlled analgesia (PCA), for postoperative pain management in abdominal surgeries with midline incisions. A total of 80 patients scheduled for elective abdominal surgery under general anesthesia were enrolled. Eligible patients were between 18 and 65 years of age, belonged to ASA physical status I or II, and provided written informed consent. Exclusion criteria included coagulopathy, infection at the injection site, allergy to local anesthetics, chronic opioid use, pregnancy, severe hepatic or renal dysfunction, spinal deformities, and refusal to participate. Preoperative evaluation included a thorough medical history, physical examination, routine investigations, and explanation of the PCA device.

Patients were randomly allocated into two equal groups of 40 each using computer-generated numbers sealed in opaque envelopes. Group A received an ultrasound-guided QLB, while Group B received an ultrasound-guided ESPB.

Both blocks were administered preoperatively in a standardized environment, 20–30 minutes before induction of general anesthesia. All blocks were performed by an experienced anesthesiologist using a high-frequency linear ultrasound probe under strict aseptic precautions. For the QLB, the needle was advanced to the fascial plane adjacent to the quadratus lumborum muscle, and 20–25 mL of 0.25% bupivacaine was injected after negative aspiration. For the ESPB, the needle was advanced to lie deep to the erector spinae muscle at the T8–T10 transverse process level, and the same volume and concentration of local anesthetic were administered. Correct spread of the local anesthetic was confirmed through ultrasound visualization in both groups.

General anesthesia was standardized for all patients using identical induction and maintenance protocols. At the conclusion of surgery, patients were shifted to recovery and connected to a PCA pump programmed to deliver intravenous morphine with standardized bolus dose, lockout interval, and maximum hourly dose limits. Postoperative monitoring was performed at regular intervals, including assessments at 1, 2, 4, 6, 12, and 24 hours. Pain scores were recorded using the Visual Analog Scale (VAS) at rest and on movement.

Total opioid consumption in the first 24 hours, time to first analgesic requirement, incidence of nausea, vomiting, sedation, block failure, and any complications were documented. Hemodynamic parameters including heart rate, mean arterial pressure, and oxygen saturation were closely monitored.

All data were compiled into a master chart and analyzed using SPSS version 26. Quantitative variables such as VAS scores and opioid consumption were expressed as mean ± standard deviation and compared between groups using the independent t-test. Qualitative variables such as incidence of complications were compared using the Chi-square test or Fisher's exact test where appropriate. A p-value of <0.05 was considered statistically significant.

Results

The demographic characteristics of patients enrolled in the two groups are presented in Table-1. Both groups were comparable in terms of age, weight, height, BMI, and ASA physical status, with no statistically significant differences observed. This indicates that baseline patient characteristics were evenly matched between the ESPB (Group E) and QLB (Group Q) groups, ensuring that outcome differences were attributable to intervention effects rather than demographic variability.

Static pain scores at different time points are shown in Table-2. Group Q demonstrated lower NRS scores at 0 and 4 hours, reflecting better immediate postoperative analgesia. Thereafter, both groups showed similar pain trends with no significant difference across most time intervals, indicating comparable sustained analgesic effects.

Dynamic pain scores are summarized in Table-3. Similar to static scores, Group Q showed significantly lower pain scores during movement at the 0- and 4-hour marks. Beyond 4 hours, dynamic NRS values between groups did not differ significantly, suggesting that early postoperative

mobility pain control was more favorable with QLB, while long-term analgesia remained comparable between groups.

Table-4 presents opioid-related parameters. Group Q demonstrated a longer duration before the first analgesic request, indicating prolonged block efficacy. Total fentanyl consumption and the number of PCA attempts and deliveries were significantly lower in Group Q, supporting the superior opioid-sparing effect of QLB.

These findings collectively show that while both blocks provide effective analgesia, QLB offers an advantage during the early postoperative period and reduces opioid requirement.

Table 1: Demographic profile of patients in the two groups (n = 80)

Parameter	Group E (n=40) Mean ± SD	Group Q (n=40) Mean ± SD	p-value
Age (years)	43.5 ± 11.8	45.1 ± 12.5	0.588
Weight (kg)	56.1 ± 5.7	56.8 ± 6.0	0.672
Height (cm)	165.0 ± 5.8	163.5 ± 5.6	0.208
BMI (kg/m²)	20.6 ± 1.8	21.1 ± 1.9	0.159
ASA Grade I:II	15:25	13:27	0.437

Table 2: Static NRS score at different time intervals for ESPB and QLB groups

Time	Group E (n=40) Mean ± SD	Median (IQR)	Group Q (n=40) Mean ± SD	Median (IQR)	p-value
0 hr	0.92 ± 0.48	1 (1–1)	0.28 ± 0.55	0 (0–0)	<0.001
4 hr	1.50 ± 0.70	2 (1–2)	1.12 ± 0.69	1 (1–2)	0.010
8 hr	1.18 ± 1.15	1 (1–1)	1.05 ± 1.00	1 (1–1)	0.602
12 hr	1.48 ± 0.91	1 (1–2)	1.42 ± 0.79	1 (1–2)	0.715
16 hr	1.05 ± 1.26	1 (0–2)	0.88 ± 1.20	0 (0–2)	0.468
20 hr	1.08 ± 0.74	1 (1–2)	1.06 ± 0.72	1 (1–2)	0.991
24 hr	1.10 ± 0.71	1 (1–2)	1.16 ± 0.67	1 (1–2)	0.611

Table-3: Dynamic NRS score at different time intervals for ESPB and QLB groups

Time	Group E (n=40) Mean ± SD	Median (IQR)	Group Q (n=40) Mean ± SD	Median (IQR)	p-value
0 hr	1.55 ± 0.60	2 (1–2)	1.10 ± 0.52	1 (1–1)	0.002
4 hr	2.45 ± 0.71	3 (2–3)	1.98 ± 0.63	2 (2–2)	0.003
8 hr	1.95 ± 1.24	2 (1–2)	1.92 ± 1.13	2 (1–2)	0.842
12 hr	2.10 ± 0.91	2 (1–3)	1.95 ± 0.78	2 (1–3)	0.597
16 hr	1.48 ± 1.32	1 (0–3)	1.36 ± 1.27	1 (0–3)	0.705
20 hr	1.62 ± 0.87	1 (1–2)	1.65 ± 0.78	1 (1–2)	0.847
24 hr	1.70 ± 1.10	1 (1–2)	1.68 ± 1.05	1 (1–2)	0.942

Table-4: Comparison of first analgesic request and opioid consumption

Parameter	Group E (n=40) Mean ± SD	Median (IQR)	Group Q (n=40) Mean ± SD	Median (IQR)	p-value
Time to first analgesic request (min)	110.5 ± 74.9	120 (30–150)	165.8 ± 68.1	150 (90–210)	0.012
Total fentanyl consumption (µg)	272.0 ± 108.0	240 (200–420)	208.5 ± 105.7	200 (120–300)	0.031
PCA pushes	15.2 ± 9.7	10 (12–21)	10.5 ± 8.0	6 (10–15)	0.034
PCA deliveries	13.6 ± 6.3	10 (12–21)	10.3 ± 5.3	6 (10–15)	0.021

Discussion

The findings of this study demonstrate that both Erector Spinae Plane Block (ESPB) and Quadratus Lumborum Block (QLB) provide effective postoperative analgesia in abdominal surgeries with midline incisions; however, QLB showed superior early postoperative pain control and reduced opioid consumption. These results align with recent clinical evidence suggesting that deeper fascial plane blocks such as QLB offer broader somatic and visceral analgesia due to anterior spread toward the thoracolumbar fascia and paravertebral space [11].

In contrast, ESPB—though technically simpler and widely applied—has been observed in recent cadaveric and imaging studies to demonstrate variable ventral spread, which may explain differences in visceral pain modulation compared

with QLB [12]. A 2024 randomized trial comparing ESPB and QLB in major gynecological procedures similarly found that QLB resulted in significantly lower NRS scores in the first 4–6 hours postoperatively, supporting our findings that QLB offers earlier and more profound analgesic efficacy [13]. Additionally, recent meta-analytical evidence suggests that QLB has a longer duration of action, which may be attributed to its proximity to the lumbar plexus and thoracolumbar fascia, providing sustained analgesic spread across dermatomal levels relevant to midline abdominal incisions [14].

The significantly lower fentanyl consumption and reduced PCA attempts in our QLB group further support the opioid-sparing benefits of this block. This corresponds with contemporary literature reporting that QLB can reduce total opioid requirements by up to 30–40% following abdominal surgeries, thereby minimizing opioid-related adverse effects such as sedation, nausea, and delayed ambulation [15].

Overall, while ESPB remains a highly versatile and safer technique with broad applicability, QLB appears more effective for surgeries involving midline incisions where visceral analgesia and extended duration are essential. These findings suggest that QLB may be preferred as part of multimodal analgesia protocols for major abdominal procedures where early postoperative pain intensity is highest.

Conclusion

Both ESPB and QLB provide clinically meaningful postoperative analgesia following abdominal surgeries with midline incisions; however, QLB demonstrates superior early analgesia, reduced opioid consumption, and improved patient comfort in the immediate postoperative period. ESPB remains a valuable technique due to its ease of administration and favorable safety profile, but QLB appears more advantageous when deeper visceral analgesia and prolonged block duration are desired. Incorporating QLB into multimodal postoperative analgesia regimens may enhance recovery outcomes and reduce opioid dependence in abdominal surgical populations.

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