

Ultrasound-Guided Erector Spinae Plane Block versus Quadratus Lumborum Block for Postoperative Analgesia in Adults Undergoing Laparoscopic Cholecystectomy

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ABSTRACT

Background: While laparoscopic cholecystectomy (LC) is associated with less postoperative pain relative to open surgery, adequate analgesia remains vital for optimal recovery. The erector spinae plane block (ESPB) and quadratus lumborum block (QLB) are ultrasound (US)-guided regional anesthetic (RA) approaches increasingly utilized to enhance postoperative pain management.

Aim of the study: This study was designed to examine the analgesic efficacy of US-guided QLB and ESPB in individuals subjected to LC.

Methods: This prospective randomized double-blinded trial was executed on 80 participants with ASA physical status I-II and listed for elective LC. Participants were placed into two groups: Group A (ESPB) (n=40) had bilateral ESPB, and Group B (QLB) (n=40) had bilateral QLB. The study was double-blinded, where outcome assessors and participants were blinded to the study.

Results: Preoperative, intraoperative, or postoperative mean arterial pressure and heart rate at all measured time points were similar among the two groups. Intraoperative fentanyl intake, time to first (1st) rescue analgesia, and cumulative nalbuphine intake were also comparable among groups. Additionally, visual analog scale scores and time to extubation showed no significant differences at any measurement interval. Patient satisfaction scores were similar among the two groups.

Conclusions: US-guided bilateral ESPB and QLB provided comparable and effective perioperative analgesia in LC, with similar opioid intake, pain control, safety profile, and patient satisfaction. Both approaches can be used as safe and efficacious components of multimodal analgesia.

Keywords: Ultrasound-Guided Erector Spinae, Postoperative Analgesia, Quadratus Lumborum Block, Laparoscopic Cholecystectomy

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INTRODUCTION

Laparoscopic cholecystectomy (LC) is associated with reduced postoperative pain and a shorter recovery period compared with open surgery. Currently, due to its shorter hospitalization, it can be performed on a day-case basis (Bandey and Singh, 2016, Michaloliakou et al., 1996).

Postoperative pain following laparoscopy differs from that after laparotomy; although it is predominantly parietal in origin (arising from the abdominal wall), patients may also experience visceral pain related to pneumoperitoneum (Wills and Hunt, 2000).

Various analgesic strategies, including non-steroidal anti-inflammatory drugs, opioids, and regional anesthetic (RA) approaches, are employed as components of integrated analgesia for postoperative pain management (Wills and Hunt, 2000, Niraj et al., 2011).

Among RA approaches employed in abdominal surgery are thoracic epidural analgesia, paravertebral block, erector

spinae plane block (ESPB), transversus abdominis plane block (TAPB), and quadratus lumborum block (QLB) (Niraj et al., 2011).

The ESPB is a paraspinal RA method in which local anesthetic (LA) is delivered into the fascial plane between the transverse process (TP) and the erector spinae muscle (ESM). This allows spread into the paravertebral space, achieving cranio-caudal distribution across approximately three to four vertebral levels (Chin et al., 2017.), thereby covering ventral and dorsal rami and providing blockade of somatic as well as visceral pain (Chin et al., 2017, Aksu and Gurkan, 2019).

Another truncal block increasingly utilized recently is the QLB. It involves the ultrasound (US)-guided delivery of LA into the fascial plane between the QL muscle and the medial layer of the thoracolumbar fascia. It has been documented that QLB can provide a broader sensory blockade from a

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single injection compared with that achieved with the TAPB (Blanco, 2007, Blanco et al., 2016).

The purpose of this work was to contrast the analgesic effects of US-guided QLB versus ESPB for LC.

MATERIALS AND METHODS:

This prospective randomized, parallel-group clinical trial involved 80 participants aged 18–60 years, both genders, with ASA physical status I–II, who underwent elective LC. The study was conducted from 2023 to 2025 after approval by the Ethical Committee of Port Said University Hospitals, Port Said, Egypt (approval code: MED (1/1/2024), S. No. 124, ANE 921 003). Each participant provided written informed consent.

Individuals were excluded if they had a body mass index > 35 kg/m², an acute attack of cholecystitis, an allergy to LA, known hypersensitivity to any study medication, coagulopathy or were receiving anticoagulant therapy, an infection at the injection site, or required conversion of LC to open surgery.

Randomization and blindness:

An online randomization program was utilized to generate the randomization sequence, and each participant's allocation code was placed in an opaque, sealed envelope. Participants were randomly assigned in a 1:1 ratio to two parallel groups: Group A (ESPB) received bilateral ESPB, and Group B (QLB) received bilateral QLB. Blinding was maintained for both participants and outcome assessors regarding group allocation. The anesthesiologist administering the block was aware of the block technique assigned because the ESPB and QLB procedures were technically different. The block-performing anesthesiologist did not participate in postoperative outcome assessment.

All participants were subjected to history taking, clinical investigation, and routine laboratory estimations, e.g., prothrombin time, complete blood count, international normalized ratio, and activated partial thromboplastin time. Pain intensity was estimated on a visual analog scale (VAS), where 0: the absence of pain and 10: the worst pain imaginable. VAS was recorded before induction of general anesthesia (GA), on admission to the post-anesthetic care unit (PACU), and at 1, 2, 6, 12, 18, and 24 h after surgery. Pain was measured at rest / during movement or coughing. Patient satisfaction was evaluated using a 4-point Likert scale (excellent, good, fair, or poor) (Astiena et al., 2026). All participants had a standardized preoperative medication regimen to optimize perioperative care and minimize complications. This includes Omeprazole 40 mg administered intravenously (IV) in the evening before surgery and repeated on the morning of the procedure to reduce gastric acidity and the risk of aspiration. Additionally, Ondansetron 4 mg IV was given immediately before surgery to prevent nausea and vomiting, thereby enhancing patient comfort and improving postoperative recovery.

Monitoring:

A multi-parameter monitor was applied to continuously record electrocardiography for heart rate (HR) (beats/min) and rhythm, non-invasive arterial blood pressure (BP),

peripheral oxygen (O₂) saturation, and end-tidal carbon dioxide (EtCO₂) levels.

Anesthetic method:

All participants had GA. After preoxygenation, induction was performed with IV administration of 1.5 µg/kg fentanyl and propofol 1.5– 2.5mg/kg IV, titrated until onset of induction. 0.5 mg/kg atracurium was administered to facilitate tracheal intubation. Thereafter, participants were mechanically ventilated in volume-controlled mode using a tidal volume of 6–8 mL/kg and a respiratory rate adjusted to keep EtCO₂ within the range of 35–45 mmHg. Positive end-expiratory pressure was preserved at 5 cm water, and the fraction of inspired O₂ was set at 50%.

The anesthesia was maintained using isoflurane with 1–1.2 minimum alveolar concentration, fresh gas flow 3 L/minute and an incremental dose of muscle relaxant every half hour. Fentanyl increments (1 µg/kg) were delivered as required to manage the HR and BP to ± 20% of the initial values. The total amount of fentanyl administered was recorded. For a decrease in mean arterial pressure (MAP) that could not be controlled by adjusting the anesthetic depth, ephedrine (6 mg) was given and repeated every five minutes if needed. For a decrease in HR, atropine (0.01 mg/kg) was given. The total amount of their administration was recorded. IV fluid requirements (fasting and maintenance needs) were calculated and given to the participants throughout the procedure. CO₂ gas flow rate was 8–10 L/Min, and insufflation pressure was over-versus needle 12–14 mmHg.

Group A (Thoracic ESPB):

For block performance, the block was done after GA and before surgical incision; participants were located in the lateral decubitus posture, and the skin was disinfected via an antiseptic solution. The T9 spinous process was detected and marked. A linear transducer (GE LOGIQ e US system) was introduced 3cm lateral to the midline and moved laterally to detect the T9 TP and the ESM.

A 22-gauge needle was advanced in-plane in a cranial-to-caudal direction until the tip reached the fascial plane between the ESM and the TP. Correct needle insertion was verified by hydro dissection via 2mL of normal saline. Subsequently, 20mL of 0.375% bupivacaine was administered. The local anesthetic solution was prepared by diluting 15mL of 0.5% bupivacaine with 5mL of normal saline. The same concentration and volume of bupivacaine were used for both ESPB and QLB to ensure consistency of local anesthetic exposure in this direct comparison. US was used to visualize and confirm the dispersion of the injectate. The identical process was then executed on the contralateral side (Aygun et al., 2020).

Group B (Transversalis Fascia Plane QLB):

For block performance, the block was performed following induction of GA and before surgical incision. Participants were positioned in the supine position, and the skin was disinfected with an antiseptic solution. A linear transducer (GE LOGIQ US system) was positioned in the axial plane along the midaxillary line between the subcostal margin and the iliac crest and then moved posteriorly to identify the posterior aponeurosis of the transversus abdominis (TA) muscle. The target plane was immediately deep to this aponeurosis and superficial to the thoracolumbar fascia at

the lateral border of the QL muscle, adjacent to the pararenal fat compartment.

The needle was introduced from the anterior aspect of the US transducer and advanced until its tip reached the posterior aponeurosis of the TA muscle. A total of 20 mL of 0.375% bupivacaine, prepared by diluting 15mL of 0.5% bupivacaine with 5mL of normal saline, was administered in 5-mL increments with repeated aspiration into the fascial plane between the aponeurosis and the thoracolumbar fascia at the lateral border of the QL muscle. The same procedure was conducted on the contralateral side (Blanco et al., 2015).

At the conclusion of surgery, isoflurane administration was removed, and participants were ventilated with 100% oxygen. Neuromuscular blockade was antagonized via 0.04 mg/kg IV neostigmine along with an appropriate dose of atropine. Extubation was performed once patients demonstrated spontaneous eye opening, an effective cough reflex, and adequate tidal volume. The time from discontinuation of isoflurane to extubation was documented.

HR and MAP were documented before initiation of anesthesia, at the time of skin incision and subsequently at 15-min intervals intraoperatively until the conclusion of surgery, on admission to PACU, every hour for 4 hours postoperatively, 8, 12 and 24 h after surgery.

After operation, analgesia was maintained using nalbuphine analgesia on demand (2 mg IV to be repeated after 20 minutes if VAS ≥ 4 till a maximum of 4 mg/h) and IV paracetamol 1 gm/8 h.

The primary objective was postoperative pain intensity assessed by the VAS score at 8 hours after surgery. The VAS was assessed on a 0–10 scale, with higher scores representing greater pain intensity. Secondary objectives involved VAS scores at the other predefined postoperative time points (PACU, 1, 2, 6, 12, 18, and 24 h), time to first (1st) rescue analgesia, intraoperative fentanyl consumption, cumulative postoperative nalbuphine consumption, time to extubation, intra- and postoperative hemodynamic

parameters, sedation, patient satisfaction, and postoperative nausea and vomiting (PONV).

Sample Size Calculation:

PASS software (version 11.0; NCSS PASS, UT, USA) was utilized for sample size estimation. The primary objective was the VAS score at 8 h. The calculation was based on a 95% confidence level, 80% study power, and a 1:1 group allocation ratio. A common standard deviation of 1.21 for the VAS score was adopted from a previous study (Mohamed et al., 2024a, Mohamed et al., 2024b). The non-inferiority margin was set at 0.7. To account for potential dropout, three additional patients were included in each group. Accordingly, a total of 40 cases were recruited per group.

Statistical analysis:

Statistical analysis was done utilizing SPSS V26 (IBM Inc., Chicago, IL, USA). The Shapiro–Wilk test and histograms were utilized to assess the normality of data distribution. Normally distributed quantitative variables were displayed as mean $\pm$ (SD) and compared between the two groups via the independent-samples Student's t-test. Non-normally distributed quantitative variables were displayed as median (IQR) and compared via the Mann–Whitney U test. Qualitative variables were displayed as frequencies (%) and compared via chi-square test or Fisher's exact test. Statistical significance was determined using a two-tailed P value threshold of <0.05 .

RESULTS:

Ninety-six participants were evaluated for eligibility; 11 participants did not fulfil the criteria, and 5 participants declined to be enrolled in the study. The other 80 individuals were placed into two equal groups (40 participants in each). All participants were followed up and analyzed statistically. Figure 1.

Demographic data and period of surgery didn't differ significantly between the two groups ($P > 0.05$). Table 1

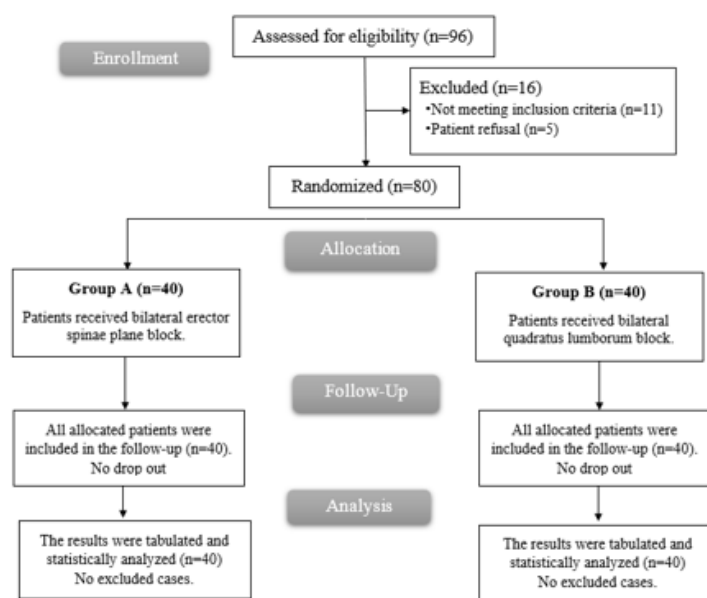


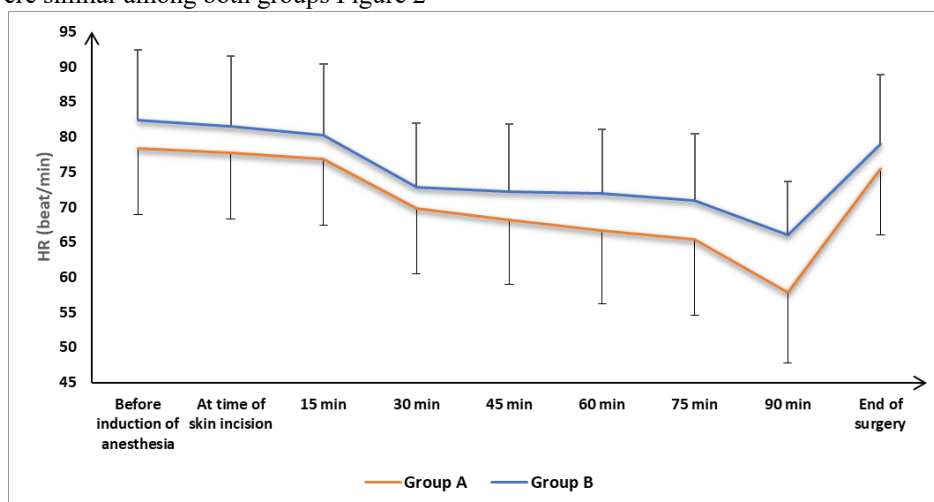
Figure 1: CONSORT flowchart of participants

Table 1: Patients characteristics of the investigated groups

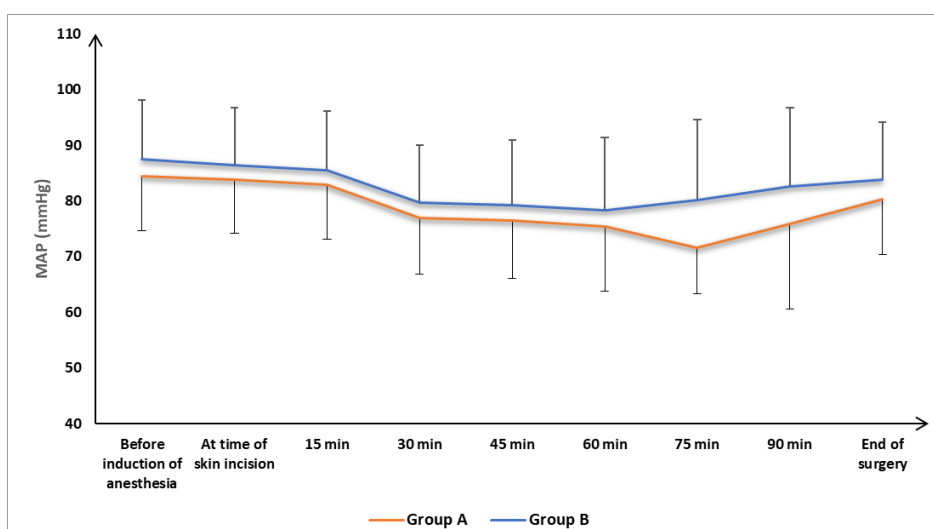
		Group A (n=40)	Group B (n=40)	P	MD/RR (95%CI)
Age (years)		39.78±13.79	40.88±9.98	0.684	-1.1(-6.46: 4.26)
Sex	Male	17(42.5%)	19(47.5%)	0.653	0.89(0.55:1.45)
	Female	23(57.5%)	21(52.5%)		
Weight (kg)		77.33±14.36	83.15±14.18	0.072	-5.83(-12.18: 0.53)
Height (cm)		167.15±7.92	169.05±10.55	0.365	-1.9(-6.05: 2.25)
BMI (kg/m²)		27.76±5.25	29.13±4.48	0.212	-1.37(-3.54: 0.8)
ASA physical status	I	23(57.5%)	26(65%)	0.491	0.88(0.62:1.26)
	II	17(42.5%)	14(35%)		
Duration of surgery (min)		68.13±21.83	71.5±18.72	0.460	-3.38(-12.43: 5.68)

Data shown as mean ± SD or frequency (%).

Preoperative and intraoperative HR and MAP at all measurements were similar among both groups Figure 2



(A)



(B)

Figure 2: Preoperative and intraoperative (A) HR , (B) MAP of the investigated Gs

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Intraoperative use of fentanyl, time of 1st rescue analgesia and nalbuphine intake didn't differ significantly between the two groups ($P > 0.05$). Table 2.

VAS at rest and time to extubation were comparable between both groups at all measurements ($P > 0.05$). Table 3.

Table 2: Intraoperative use of fentanyl, time of first rescue analgesia and interval of analgesia of the investigated groups

	Group A (n=40)	Group B (n=40)	P	MD/RR (95% CI)
Intraoperative use of fentanyl (µg)	114.5±13.82	137.4±19.49	0.089	-22.9(-30.42: -15.38)
Intraoperative use of fentanyl	4(10%)	5(12.5%)	1	0.8(0.23:2.76)
Ephedrine (mg)	6±0	6±0	---	---
Atropine (mg)	0.83±0	---	---	---
Nalbuphine intake (mg)	4.25±0.67	4.35±0.77	0.537	-0.1(-0.42: 0.22)
Time of first rescue analgesia (h)	7.63±1.71	7.25±1.37	0.282	0.38(-0.31: 1.06)

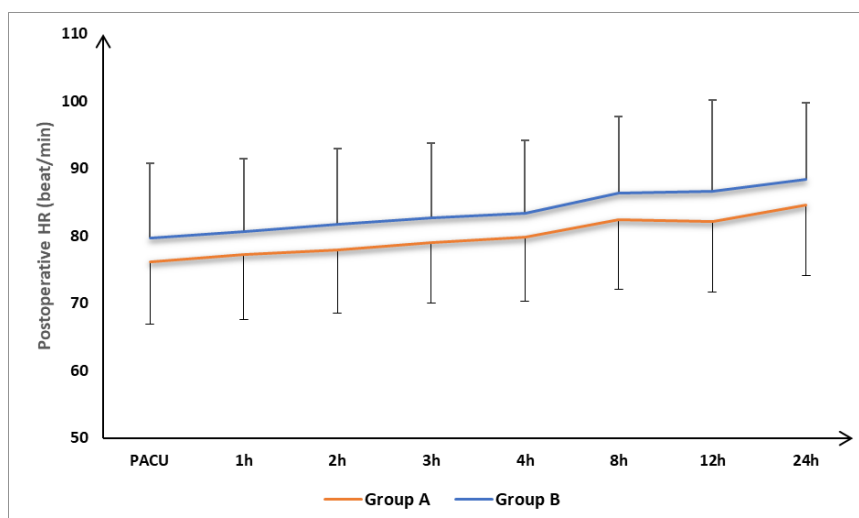
Data shown as mean ± SD. RR: Relative risk, MD: Mean difference.

Table 3: VAS at rest and time to extubation of the investigated groups

	Group A (n=40)	Group B (n=40)	P	MD (95% CI)
PACU	1 (0 – 1)	0 (0 – 1)	0.266	0 (0:0)
1 h	1 (0 – 1)	2 (1 – 2)	0.053	0 (-1:0)
2 h	2 (1 – 2)	2 (1 – 3)	0.585	0 (0:0)
6 h	2 (1 – 3)	2 (1 – 3)	0.893	0 (0:1)
12h	2 (1 – 3)	2 (2 – 4)	0.59	0 (-1:0)
18 h	3 (2 – 4)	3 (2 – 5)	0.903	0 (-1:1)
24 h	3 (1 – 5)	3 (2 – 5)	0.811	0 (-1:1)
Time to extubating (min)	9.03 ± 2.26	9.78 ± 1.12	0.064	-0.75 (-1.54: 0.04)

VAS presented as median (IQR), Time to extubating presented as mean ± SD.

Postoperative MAP and HR at all measurements were comparable between both groups. Figure 3



(A)

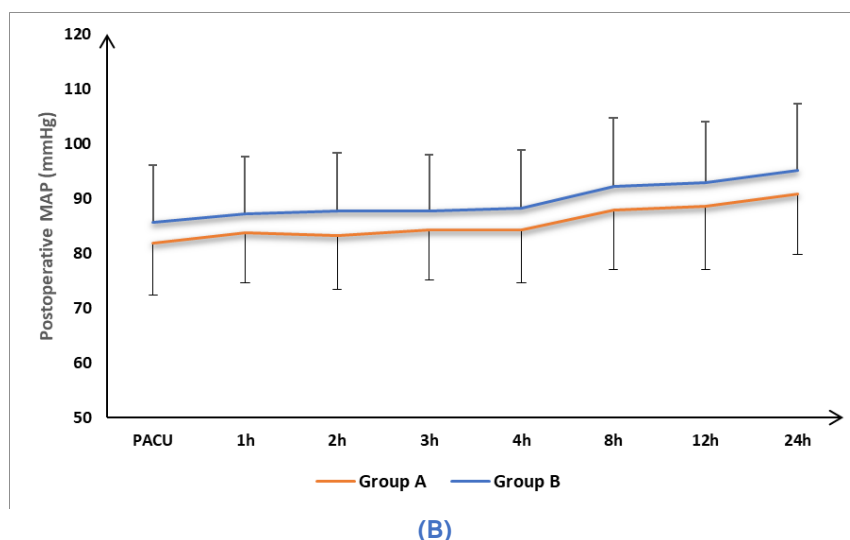


Figure 3: Postoperative (A) HR and (B) MAP of the investigated Gs

Patient satisfaction didn't differ significantly between both groups ($P=0.792$). Table 4

Table 4: Patient satisfaction of the investigated groups

	Group A (N=40)	Group B (N=40)	P
Excellent	32(80%)	30(75%)	0.792
Good	7(17.5%)	8(20%)	
Fair	1(2.5%)	2(5%)	
Poor	0(0%)	0(0%)	

Data are shown as frequency (%).

DISCUSSION:

LC is among the most frequently performed abdominal operations worldwide due to its benefits over open surgery, including decreased tissue trauma, shorter hospitalization, and rapid recovery (Mannam et al., 2023).

Our findings demonstrated no significant differences between the ESPB and QLB groups concerning perioperative hemodynamic parameters, as both preoperative and postoperative HR and MAP measurements were comparable. In addition, intraoperative fentanyl intake, time to 1st rescue analgesia, total nalbuphine intake, interval of analgesia, postoperative pain scores assessed by VAS, and time to extubation proved no significant differences among both groups. Furthermore, the rate of complications and patient satisfaction were similar among the groups, demonstrating comparable effectiveness and tolerability profiles of ESPB and QLB in participants planned for LC.

Although previous studies have compared ESPB and QLB, the present randomized trial adds procedure-specific evidence by directly comparing the two techniques in patients undergoing LC under a standardized perioperative analgesic protocol. Importantly, the same volume and concentration of bupivacaine were used in both groups, reducing variability related to local anesthetic exposure and allowing a more direct assessment of the relative performance of the two blocks. The comparable findings across outcomes strengthen the available evidence that both ESPB and QLB can provide effective perioperative

analgesia for LC and support their use as alternative components of multimodal analgesic strategies according to clinical expertise and feasibility.

Similar to our findings, (Zhu et al., 2026), documented that the adverse events after operation were similar among the two groups.

Aligning with our findings, (Wu et al., 2025) showed that time to the 1st analgesic request or after-operation pain scores at rest at 6, 12 and 24 h was similar between ESPB and QLB groups. Also, (Mohamed et al., 2024a) reported that US-guided ESPB and QLB3 demonstrated comparable efficacy in analgesia and tolerability, without causing significant hemodynamic changes. No serious adverse events were reported in either G.

In line with our data, (Hamada et al., 2023) concluded that the ESPB was equally effective as the posterior QLB to offer adequate analgesia in cases undergoing elective LC. Likewise, (Ashoor et al., 2023) concluded that both bilateral US-guided ESPB and bilateral SU-guided QLB offered adequate after operation pain control and decreased after operation analgesic needs.

In addition, (Hassanein et al., 2023) showed that both ESPB and QLB effectively declined VAS scores at both cough and rest in patients scheduled for LC.

Our data were confirmed by (Elkotory et al., 2022), who documented no marked divergence in intraoperative and after operation MAP or HR among QLB and ESPB groups. They also reported insignificant differences regarding pain

score, total analgesic intake, time of analgesia and patient satisfaction between QLB and ESPB.

Our data were in line with (Abd Ellatif and Abdelnaby, 2021), who documented that no marked divergence was documented among ESPB and QLB concerning MAP or HR at different time points. No significant difference was documented among ESPB and QLB cases when it came to intraoperative fentanyl doses, 1st time to rescue analgesic, cumulative morphine intake and pain score. No block or LA-toxicity-related adverse events were documented among the groups (QLB and ESPB).

Also, our data were confirmed by (Kang et al., 2021) recorded that intraoperative fentanyl dosage, pain scores at rest at 24, 48 and 72 h and cumulative 24-h opioid intake were comparable among ESPB and QLB. (Aksu et al., 2019) documented that pain scores and times to 1st analgesia were similar among QLB and ESPB groups.

Different to our findings, (Fakhry et al., 2024) reported that ESPB cases demonstrated a significant extended time to 1st request for rescue analgesia (280 ± 15.5 min) relative to QLB cases (260 ± 13.8 min). Similarly, cumulative nalbuphine intake within the 1st 24 after surgery hours was significantly decreased in ESPB cases (24 ± 2.5 mg) than in QLB cases (30.5 ± 1.55 mg). This discrepancy may be related to differences in the surgical population, block technique, and local anesthetic concentration, as they used 20 mL of 0.25% bupivacaine compared with 20 mL of 0.375% bupivacaine in the present study. Such methodological differences may influence the extent and duration of local anesthetic spread.

Contrary to our findings, (Aygun et al., 2020) documented significantly reduced pain scores at rest and within movement/coughing in ESPB cases relative with QLB cases within the 1st after operation hour ($P < 0.001$). The difference may reflect variations in local anesthetic dose and volume, block approach, and anatomical spread, as Aygun et al. used 30 mL of 0.5% bupivacaine. Differences in patient characteristics and perioperative analgesic protocols may also have contributed to the divergent findings.

As regards ESPB and in consistence with previous case series conducted by (Niraj and Tariq, 2018) demonstrating that persistent ESPB achieved satisfactory visceral and somatic analgesia after major abdominal surgical procedures, resulting in a significant decrease in after operation pain scores and morphine intake during the 1st 48 after operation hours. Also, (Yang et al., 2023) documented that US-guided ESPB offers effective after operation analgesia in adult participants subjected to LC. Conversely, (Tulgar et al., 2019) also reported that ESPB provided effective analgesia in most patients, although block failure occurred in 12 of 182 cases (6.5%) across different surgical procedures. However, their study did not provide a direct comparison between ESPB and QLB; therefore, its findings primarily support the overall analgesic effectiveness and potential variability of ESPB rather than its comparative efficacy against QLB.

Regarding QLB, and consistent with the data of our study, several investigations have highlighted the effectiveness of QLB in providing after operation analgesia for adult

individuals subjected to LC (Ökmen et al., 2018, Chooklin and Chuklin, 2025).

Several limitations should be acknowledged, including the single-center design, which may limit the generalizability of the findings. Postoperative outcomes were assessed only during the first 24 hours, preventing evaluation of longer-term analgesic effects. ESPB and QLB were not compared with other regional analgesic techniques, such as TAPB or epidural analgesia. Additionally, the block-performing anesthesiologist could not be blinded because of procedural differences but was not involved in postoperative outcome assessment. Finally, although the blocks were performed according to standardized techniques, some operator-dependent variability in block performance and local anesthetic spread cannot be excluded.

CONCLUSIONS:

US-guided bilateral ESPB and QLB provided comparable perioperative analgesic efficacy in patients undergoing LC. Both approaches demonstrated similar effects on intraoperative hemodynamics, opioid intake, postoperative pain scores, time to 1st rescue analgesia, total nalbuphine needs, interval of analgesia, time to extubation, complication rates, and patient satisfaction, with no substantial variances among the groups. These results suggest that both ESPB and QLB were equally effective and safe RA options for multimodal analgesia in LC, and either method may be used based on clinician preference, expertise, and availability.

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REFERENCES

1. Abd Ellatif, S. & Abdelnaby, S. 2021. Ultrasound guided erector spinae plane block versus quadratus lumborum block for postoperative analgesia in patient undergoing open nephrectomy: a randomized controlled study. *Egypt J Anaesth*, 37, 123-34.
2. Aksu, C. & Gurkan, Y. 2019. Ultrasound-guided bilateral erector spinae block could provide effective postoperative analgesia in laparoscopic cholecystectomy in paediatric patients. *Anaesth Crit Care Pain Med*, 38, 87-8.
3. Aksu, C., Şen, M., Akay, M., Baydemir, C. & Gürkan, Y. 2019. Erector spinae plane block vs quadratus lumborum block for pediatric lower abdominal surgery: a double blinded, prospective, and randomized trial. *J Clin Anesth*, 57, 24-8.
4. Ashoor, T., Jalal, A., Said, A., Ali, M. & Esmat, I. 2023. Ultrasound-guided techniques for postoperative analgesia in patients undergoing laparoscopic sleeve gastrectomy: erector spinae plane block vs. quadratus lumborum block. *Pain Physician*, 26, 245-56.
5. Astiena, A. K., Asdi, Y. & Hadiguna, R. A. 2026. Beyond the standard: Rethinking Likert scale use in measuring patient satisfaction at public health center in Indonesia. *J Public Health Res*, 15, 22-5.

6. Aygun, H., Ozturk, N., Pamukcu, A., Inal, A., Kiziloglu, I., Thomas, D., et al. 2020. Comparison of ultrasound guided Erector Spinae Plane Block and quadratus lumborum block for postoperative analgesia in laparoscopic cholecystectomy patients; a prospective randomized study. *J Clin Anesth*, 62, 109-16.
7. Bandey, S. & Singh, V. 2016. Comparison between IV paracetamol and tramadol for postoperative analgesia in patients undergoing laparoscopic cholecystectomy. *J Clin Diagn Res*, 10, 5-9.
8. Blanco, R. 2007. Tap block under ultrasound guidance: the description of a "no pops" technique: 271. *Reg Anesth Pain Med*, 32, 130-1.
9. Blanco, R., Ansari, T. & Girgis, E. 2015. Quadratus lumborum block for postoperative pain after caesarean section: a randomised controlled trial. *Eur J Anaesthesiol* 32, 812-8.
10. Blanco, R., Ansari, T. & Riad, W. 2016. Quadratus lumborum block versus transversus abdominis plane block for postoperative pain after cesarean delivery. *Reg Anesth Pain Med*, 41, 757-62.
11. Chin, K., Adhikary, S., Sarwani, N. & Forero, M. 2017. The analgesic efficacy of pre-operative bilateral erector spinae plane (ESP) blocks in patients having ventral hernia repair. *Anaesthesia*, 72, 452-60.
12. Chin, K., Malhas, L. & Perlas, A. .2017. The erector spinae plane block provides visceral abdominal analgesia in bariatric surgery: A report of 3 cases. *Reg Anesth Pain Med*, 42, 372-6.
13. Chooklin, S. & Chuklin, S. 2025. A hidden ally in laparoscopic cholecystectomy: quadratus lumborum block and the quest for pain-free recovery. *Front Surg*, 12, 1-15.
14. Elkotory, M., Amer, G. & El Badawy, M. 2022. Comparative study between ultrasound guided quadratus lumborum plane block versus ultrasound guided erector spinae plane block for postoperative pain relief in patients undergoing elective caesarean section. *Al-Azhar Intern Med J*, 3, 55-9.
15. Fakhry, D., Mahmoud, H., Kassim, D. & AbdElAzeem, H. 2024. Erector spinae plane block versus quadratus lumborum block for postoperative analgesia after laparoscopic resection of colorectal cancer: A prospective randomized study. *Anesthesiol Res Pract*, 10, 1-10.
16. Hamada, M., Elahwal, L., Eid, G. & El-Gendy, H. 2023. Ultrasound guided erector spinae plane block versus quadratus lumborum block for post-operation analgesia in laparoscopic cholecystectomy surgeries: A randomized controlled trial. *IJMA*, 6, 118-25.
17. Hassanein, A., Abdel-Haleem, M. & Mohamed, S. 2023. Regional analgesia for laparoscopic cholecystectomy using ultrasound-guided quadratus lumborum block or erector spinae block: a randomized controlled trial. *Pain Physician*, 26, 133-41.
18. Kang, R., Lee, S., Kim, G., Jeong, J., Gwak, M., Kim, J., et al. 2021. Comparison of analgesic efficacy of erector spinae plane block and posterior quadratus lumborum block in laparoscopic liver resection: a randomized controlled trial. *J Pain Res*, 14, 3791-800.
19. Mannam, R., Narayanan, R., Bansal, A., Yanamaladoddi, V., Sarvepalli, S., Vemula, S., et al. 2023. Laparoscopic cholecystectomy versus open cholecystectomy in acute cholecystitis: A literature review. *Cureus*, 15, 1-11.
20. Michaloliakou, C., Chung, F. & Sharma, S. 1996. Preoperative multimodal analgesia facilitates recovery after ambulatory laparoscopic cholecystectomy. *Anesth Analg*, 82, 44-51.
21. Mohamed, A., Elnaggar, A. & Hashish, M. 2024a. Comparative study between ultrasound-guided erector spinae plane block versus transmuscular quadratus lumborum block for postoperative analgesia in laparoscopic cholecystectomy. *Al-Azhar Intern Med J*, 5, 1-5.
22. Mohamed, A. A. A., Elnaggar, A. M. A. & Hashish, M. I. M. 2024b. Comparative Study Between Ultrasound-Guided Erector Spinae Plane Block Versus Transmuscular Quadratus Lumborum Block for Postoperative Analgesia in Laparoscopic Cholecystectomy. *Al-Azhar International Medical Journal*, 5, 17.
23. Niraj, G., Kelkar, A. & Jeyapalan, I. 2011. Comparison of analgesic efficacy of subcostal transversus abdominis plane blocks with epidural analgesia following upper abdominal surgery. *Anaesthesia*, 66, 465-71.
24. Niraj, G. & Tariq, Z. 2018. Continuous erector spinae plane (ESP) analgesia in different open abdominal surgical procedures: A case series. *J Anesth Surg*, 5, 57-60.
25. Ökmen, K., Ökmen, B. & Topal, S. 2018. Ultrasound-guided posterior quadratus lumborum block for postoperative pain after laparoscopic cholecystectomy: a randomized controlled double blind study. *J Clin Anesth*, 49, 112-7.
26. Tulgar, S., Ahiskalioglu, A., De Cassai, A. & Gurkan, Y. 2019. Efficacy of bilateral erector spinae plane block in the management of pain: current insights. *J Pain Res*, 12, 2597-613.
27. Wills, V. & Hunt, D. 2000. Pain after Laparoscopic Cholecystectomy. *Br J Surg*, 87, 273-84.

28. Wu, L., Zhang, W., Wei, Y. & Zhang, D. 2025. Comparison of the analgesic effects of ultrasound-guided erector spinae plane block and quadratus lumborum block: a systematic review and meta-analysis. *Front Pharmacol*, 16, 1-14.
29. Yang, X., Zhang, Y., Chen, Y., Xu, M., Lei, X. & Fu, Q. 2023. Analgesic effect of erector spinae plane block in adults undergoing laparoscopic cholecystectomy: a systematic review and meta-analysis of randomized controlled trials. *BMC Anesthesiol*, 23, 1-7.
30. Zhu, K., Qian, K., Zhang, H., Zhai, W., Zhang, Y. & Yang, J. 2026. Comparison of the analgesic effect and recovery quality between erector spinae plane block and quadratus lumborum plane block in laparoscopic cholecystectomy: A retrospective study. *J Pain Res*, 19, 1-10.