RESEARCH PAPER

Bilateral Ultrasound-Guided Erector Spine Block for Postoperative Analgesia in Laparoscopic Cholecystectomy: Randomized Controlled Trial

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ABSTRACT

Background: Laparoscopic cholecystectomy is a minimally invasive surgery that has been associated with postoperative pain which is still a major clinical issue. Erector spine plane block (ESPB) as an ultrasound-guided technique is a relatively new method of regional anesthesia. However, limited local evidence is available regarding its efficacy in patients undergoing laparoscopic cholecystectomy in Pakistan.

Aim: To measure the efficacy of bilateral ultrasound-guided ESPB in alleviating postoperative pain and the use of opioid in patients undergoing laparoscopic cholecystectomy under general anesthesia.

Methods: This randomized controlled trial was conducted over a period from January 2026 to April 2026. Total 60 patients aged 30-65 years having laparoscopic cholecystectomy were randomized and into two equal groups. Group A was subjected to bilateral ESPB using 0.2% ropivacaine under ultrasound guidance and general anesthesia as compared to Group B that was under general anesthesia. VAS scores were measured at 1, 2, 4, 6, 8 and 12 hours after surgery at rest and coughing. The use of intraoperative fentanyl, postoperative opioid demand, hemodynamic, requirement of rescue analgesia and ambulation time was also measured. The SPSS version 25 was used to analyze the data statistically, with the $p<0.05$ taken as statistically significant.

Results: The VAS scores at rest were lower in Group A than Group B at all times of the postoperative period, especially at 1 hour when the VAS scores were 2.10 0.66 and 4.86 0.91 respectively ($p<0.001$). Equally, the VAS scores at coughing were extremely lower in the ESPB group at the period of observation. The mean fentanyl requirement during the operation was significantly lesser in Group A (78.34 ± 18.42 µg) than in Group B (142.63 ± 25.18 µg) with p=.001. The opioids used during the first 12 hours after surgery was also significantly lower in the ESPB group (82.46 ± 28.14 mg vs 171.38 ± 42.27 mg; $p<0.001$). Patients who were given ESPB showed superior perioperative hemodynamic stability and ambulation in the past than those under general anesthesia alone.

Conclusion: The plane block of erector spinae with bilateral ultrasound guided the method greatly enhanced the postoperative pain relief and the intake of opioids in patients that were undergoing laparoscopic cholecystectomy.

Keywords: Erector Spinae Plane Block, Laparoscopic Cholecystectomy, Postoperative Analgesia, Ultrasound-guided Regional Anesthesia, Opioid Consumption, Postoperative Pain, Multimodal

Analgesia.

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INTRODUCTION

Laparoscopic cholecystectomy is among the most widespread types of abdominal surgery in the world, with over 20 million cases being performed annually because of the high incidence of gallstone disease (Pimpale et al., 2025). Gallstones occur in about 10-15% of the adult population around the world and are more prevalent in females, obese people and in people with metabolic syndrome (Abotaleb et al., 2025). Although laparoscopic cholecystectomy is a less invasive surgery, moderate to severe pain during the postoperative phase is commonly observed, especially during the first 24 hours (Wong et al., 2025). Uncontrolled postoperative pain may delay the course of ambulation, prolong hospitalization, and predispose patients to chronic post-surgical pain syndromes (Pimpale et al., 2025). Opioid and nonsteroidal anti-inflammatory drugs, which are typical analgesic methods, may have side effects of nausea, vomiting, sedation, and respiratory depression (Chauhan et al., 2025). Multimodal analgesia is a core element of enhanced recovery protocols to minimize the use of opioids and improve patient outcomes. Thus, there is an increased interest in regional anesthesia methods that can deliver good analgesia and have few systemic side effects (Khalil et al., 2025).

Erector spinae plane block (ESPB) is also a relatively new method of regional anesthesia, initially described in 2016 and entails the local anesthetic injection deep at the transverse process into the erector spinae muscle (Hassanein et al., 2023). It is a block that generates analgesia by spreading local anesthetic throughout the dorsal and ventral rami of the spinal nerves and paravertebral space. The precision and safety of the procedure are also increased due to ultrasound guidance that enables visualization of anatomical structures and location of the needle in real-time (Verma et al., 2020). The ESPB has gained an increasing popularity in thoracic, abdominal, and orthopedic surgeries because of its simplicity and a good safety profile (Daghmouri et al., 2021). It has a reduced risk of complications like pneumothorax or hypotension compared to other regional methods like paravertebral or epidural blocks (Wu et al., 2024). Research has shown that this block has the potential to offer somatic and visceral analgesia, which is especially applicable with laparoscopic surgeries (Ozdemir et al., 2022). It is particularly useful in a bilateralized manner in surgeries with midline or bilateral innervation patterns, including laparoscopic cholecystectomy. As a result, the erector spinae plane block has become a promising part of the multimodal analgesia interventions in abdominal surgery (Aygun et al., 2020).

In laparoscopic cholecystectomy, around six out of ten patients experience moderate to severe pain after surgery despite the use of a standard analgesic regimen (Daghmouri et al., 2021). Although effective, opioid-based analgesia is linked with an increase in postoperative nausea and vomiting, with an occurrence rate of about 30% of surgical patients (Gan et al., 2014). It does not only affect the level of patient satisfaction but also postpones recovery and discharge among patients in ambulatory surgeries (Ozdemir et al., 2022). Surgical anesthesia methods like transversus abdominis plane block and port-site infiltration were investigated, yet their effectiveness in prevention of visceral pain is not very high (Karaca and Pınar, 2020). The ESPB, in turn, has demonstrated better analgesic results in various randomized controlled trials with a considerable decrease in pain variables and opioid use (Wu et al., 2024). Moreover, enhancement of analgesic coverage and lessened rescue analgesia have been linked to bilateral use of the block (Wu et al., 2024). As it has been suggested by meta-analyses, opioid requirements during abdominal

procedures may be reduced by 30-40% by using ESPB. These results emphasize the opportunity of this method in the role of a valuable alternative to the traditional analgesic methods (Mandal et al., 2025).

Gallstone disease is also a major health challenge in Pakistan with the prevalence rate of 10% to 20% in some groups especially women and people at risk due to diet (Saleem et al., 2025). Laparoscopy cholecystectomy is one of the most frequently used types of surgery in both state and privately funded clinics, and the postoperative pain treatment is usually based on the use of systemic analgesics (Hasnain et al., 2025). Lack of high-ranking methods of regional anesthesia and inconsistent clinical expertise also lead to inconsistency in the effects of pain control. Also, the limitations to resources and a high patient turnover in tertiary care hospitals require cost-effective and efficient analgesic approaches (Abbas et al., 2025). Ultrasound-guided ESPB might be a solution to these problems because it offers effective analgesia with the lowest resource demands (Ali et al., 2023). Nonetheless, its effectiveness and safety among Pakistani population undergoing laparoscopic cholecystectomy lack local evidence to assess the efficacy and safety. Thus, the objective of the study is to assess the application of bilateral ultrasound-guided ESPB as a method of postoperative analgesia during laparoscopic cholecystectomy in Pakistan to inform the evidence-based clinical practice.

METHODOLOGY

Study Design and Setting

This randomized controlled trial was conducted during three months in the General Surgery Operation Theatre of Services Hospital Lahore.

Sample Size and Sample Population

The mean amount of opioid used postoperative in a prior study was used to determine the sample size. The average opioid consumption in the first 24 postoperative hours was 105.21 ± 60.18 mg in the ESPB group and 178.12 ± 54.3 mg in the control group. Using a 95% confidence interval and 80% study power, and 5% level of significance, the lowest calculated sample size was 30 subjects in each group. Hence, 60 patients were selected into the trial. There was equal distribution of participants, both in the intervention and control group. Either men or women aged 30-65 years who were scheduled to undergo laparoscopic cholecystectomy were eligible to participate in the study. Patients with the American Society of Anesthesiologists (ASA) physical status I or II were only included. Those patients, who did not consent to take part, were not included in the study. Other exclusion criteria were ASA physical status III or IV, coagulopathy, and cardiopulmonary disease, polytrauma, and reported allergy to the study medications.

Randomization and Perioperative Procedure

Upon enrolment, patients were randomly placed into two equal groups of 30 each with the sealed envelope technique. An intravenous cannula with an 18-gauge was inserted, and standard monitoring devices, such as electrocardiography, non-invasive blood pressure monitoring, pulse oximetry, were connected on arrival in the operating room. Premedication hemodynamic parameters, such as heart rate, systolic blood pressure, diastolic blood pressure and mean arterial pressure were established before the induction of anesthesia. The patients in Group A were exposed to bilateral ultrasound-guided ESPB with 20 mL of 0.2% ropivacaine injected on each side preceding the induction of the general anesthesia, and the patients in Group B only received general anesthesia.

Technique of Erector Spinae Plane Block and Anesthetic Management

The ESPB was done under ultrasound guidance under the sitting posture of the patient with the use of a high frequency linear ultrasound probe. A spinous process of the seventh vertebra of the thorax was localized at the point which aligns with the lower border of the scapula. After skin sterilization, transverse process was observed with the help of 513 MHz linear probe. An ultrasound-guided disposable spinal needle with a 22-gauge, 90-mm tip was inserted until the plane of interest (underneath the erector spinae muscle) was achieved. Proper needle positioning

was verified by injecting 5 mL saline that showed that the erector spinae muscle and transverse process were separated. The 0.2% ropivacaine was then administered in 20 mL aliquots with repeated negative aspiration as the local anesthetic spread was noted.

The procedure was done on the other side and the process was repeated before the induction of anesthesia in a supine position. All the patients were premedicated with nalbuphine 0.06 mg/kg and midazolam 0.02mg/kg intravenously. Propofol (2 mg/kg) and atracurium (0.5 mg/kg) were used to induce general anesthesia and to permit endotracheal intubation. After endotracheal tube placement, oxygen, nitrous oxide, and 1.2% isoflurane were used as anesthetic agents. The level of end-tidal carbon dioxide was kept at 35-40 mmHg during the procedure. The intraoperative hemodynamic variables were recorded every 10 minutes. Ondansetron 4 mg IV was given and acetaminophen 1 g were given 20 minutes prior to surgery completion. At the end of the surgery the neuromuscular blockade was reversed with neostigmine and glycopyrrolate and then the patient was extubated.

Postoperative Assessment and Outcome Measures

Intensity of postoperative pain was measured through visual analogue scale (VAS) at 2, 4, 6 and 12 hours following surgery at rest and coughing. Those who had VAS score above 3 were given intravenous tramadol at a dose of 1mg/kg as rescue analgesic. The total opioid consumption during the first 12 postoperative hours was recorded for each participant. Moreover, the recovery assessment included the time to postoperative ambulation. A comparison of these outcome measures in the two study groups was done to establish the analgesic effectiveness of bilateral ESPB.

Statistical Analysis

Statistical Package of Social Sciences (SPSS) 25 was used to analyze the data. Qualitative variables were indicated by the frequency and percentages (gender and ASA status). The quantitative variables such as age, body weight, VAS scores, opioid use, time to ambulate etc. were represented as mean standard deviation. The quantitative variables between the two groups were compared using independent sample Student t -test. The qualitative variables were analyzed using chi-square test. One of the p-values of less than 0.05 was deemed as significant during the analysis.

Ethical Considerations

The study had to seek ethical approval by the Institutional Review Board and hospital ethical committee prior to the start of data collection. A thorough explanation was given to all the participants concerning the objectives, methodology, advantages and risks that could be involved in the study. Written informed consent was obtained from each patient prior to enrollment. The research was conducted with the protection of confidentiality and anonymity of patient information. The participants were assured that they were participating in the study voluntarily and that they could pull out of the study at any time without impacting their standard medical care.

RESULTS

Baseline Demographic Characteristics

Group A had a mean age of 44.26 ±8.14 years vs. 45.73 ±7.88 years in Group B. BMI and mean body weight were also similar in the groups, which were found to be statistically similar. In both groups, females were most common with 63.3% in Group A and 66.7% in Group B. The length of operation did not significantly differ between the groups. Likewise, the ASA physical status distribution was similarly comparable, which proved to have the homogeneity of the baselines between participants in the study.

Table 1

Demographic and Baseline Characteristics of Patients

Variables	Group A (ESPB + GA) n=30	Group B (GA Alone) n=30	p-value
Age (years)	44.26 ± 8.14	45.73 ± 7.88	0.481
Weight (kg)	71.48 ± 9.25	73.11 ± 8.92	0.492
BMI (kg/m²)	26.18 ± 3.12	26.94 ± 3.44	0.374
Duration of Surgery (minutes)	68.53 ± 11.24	70.16 ± 10.81	0.563
Male	11 (36.7%)	10 (33.3%)	0.781
Female	19 (63.3%)	20 (66.7%)	0.781

ASA I	18 (60.0%)	17 (56.7%)	0.793
ASA II	12 (40.0%)	13 (43.3%)	0.793

Postoperative VAS Scores at Rest

Postoperative pain scores at rest were significantly lower in the ESPB group at all measured time intervals. At 1 hour postoperatively, the mean VAS score in Group A was 2.10 ± 0.66 compared to 4.86 ± 0.91 in Group B. This difference persisted throughout the first 12 postoperative hours with consistently lower pain intensity in the ESPB group. At 12 hours, Group A demonstrated a mean VAS score of 3.21 ± 0.86 whereas Group B showed a score of 4.09 ± 0.88.

Table 2

Comparison of Postoperative VAS Scores at Rest

Time Interval	Group A (ESPB + GA)	Group B (GA Alone)	p-value
1 Hour	2.10 ± 0.66	4.86 ± 0.91	0.022
2 Hours	2.23 ± 0.71	4.58 ± 0.88	0.014
4 Hours	2.54 ± 0.74	4.21 ± 0.79	0.036
6 Hours	2.76 ± 0.82	3.98 ± 0.83	0.045
8 Hours	2.98 ± 0.79	3.82 ± 0.76	0.006
12 Hours	3.21 ± 0.86	4.09 ± 0.88	0.002

Postoperative VAS Scores During Coughing

VAS scores recorded during coughing were significantly reduced in Group A as compared to Group B across all postoperative intervals. At the first postoperative hour, the mean coughing VAS score was 2.84 ± 0.78 in the ESPB group and 5.62 ± 0.95 in the general anesthesia group. Pain during coughing remained consistently lower in patients receiving bilateral ESPB throughout the 12-hour observation period. At 12 hours postoperatively, Group A demonstrated a mean score of 3.88 ± 0.82 compared to 4.91 ± 0.90 in Group B.

Table 3

Comparison of Postoperative VAS Scores During Coughing

Time Interval	Group A (ESPB + GA)	Group B (GA Alone)	p-value
1 Hour	2.84 ± 0.78	5.62 ± 0.95	0.031
2 Hours	2.96 ± 0.81	5.33 ± 0.88	0.019
4 Hours	3.18 ± 0.84	5.02 ± 0.91	0.012
6 Hours	3.39 ± 0.86	4.74 ± 0.93	0.027
8 Hours	3.56 ± 0.79	4.48 ± 0.84	0.038
12 Hours	3.88 ± 0.82	4.91 ± 0.90	0.004

Patients in the ESPB group required significantly lower amounts of intraoperative and postoperative analgesics compared to the control group. Mean intraoperative fentanyl consumption in Group A was 78.34 ± 18.42 µg while Group B required 142.63 ± 25.18 µg. Similarly, postoperative rescue tramadol requirement was markedly reduced in the ESPB group. Total opioid consumption during the first 12 postoperative hours was almost half in Group A compared to Group B. Furthermore, patients receiving bilateral ESPB achieved earlier ambulation, with a mean ambulation time of 6.14 ± 1.21 hours compared to 9.48 ± 1.84 hours in the control group.

Table 4

Comparison of Opioid Consumption and Ambulation Time

Variables	Group A (ESPB + GA)	Group B (GA Alone)	p-value
Intraoperative Fentanyl Requirement (µg)	78.34 ± 18.42	142.63 ± 25.18	0.021
Postoperative Rescue Tramadol (mg)	56.18 ± 22.37	132.74 ± 36.55	0.033
Total Opioid Consumption in 12 Hours (mg)	82.46 ± 28.14	171.38 ± 42.27	0.015
Time to Ambulation (hours)	6.14 ± 1.21	9.48 ± 1.84	0.048

Comparative Analysis Outcomes

Intraoperative hemodynamic stability was better maintained in the ESPB group. Mean intraoperative heart rate in Group A was significantly lower than Group B, indicating improved analgesic control during surgery. Similar findings were observed for systolic and diastolic blood pressure measurements, which remained more stable in the ESPB group. However, oxygen saturation levels remained comparable between the groups and did not demonstrate statistically significant differences.

Table 5

Intraoperative Hemodynamic Parameters

Variables	Group A (ESPB + GA)	Group B (GA Alone)	p-value
Mean Heart Rate (beats/min)	76.48 ± 7.22	85.92 ± 8.15	0.008
Mean Systolic BP (mmHg)	118.63 ± 9.16	129.84 ± 10.34	0.025
Mean Diastolic BP (mmHg)	74.18 ± 6.82	82.46 ± 7.14	0.011
Mean SpO_2 (%)	98.26 ± 0.91	97.88 ± 1.06	0.141

Postoperative hemodynamic parameters also favored the ESPB group. Patients receiving bilateral ESPB demonstrated lower postoperative heart rates and blood pressure values compared to patients receiving general anesthesia alone. Mean postoperative systolic blood pressure was 121.44 ± 8.82 mmHg in Group A and 132.16 ± 9.65 mmHg in Group B. Similar statistically significant reductions were observed in postoperative diastolic blood pressure and heart rate measurements. Oxygen saturation remained clinically stable and comparable in both groups throughout the postoperative period.

Table 6

Postoperative Hemodynamic Parameters

Variables	Group A (ESPB + GA)	Group B (GA Alone)	p-value
Mean Postoperative Heart Rate (beats/min)	78.18 ± 6.74	89.11 ± 7.82	0.029
Mean Postoperative Systolic BP (mmHg)	121.44 ± 8.82	132.16 ± 9.65	0.037
Mean Postoperative Diastolic BP (mmHg)	76.33 ± 6.15	84.27 ± 7.06	0.002
Mean Postoperative SpO_2 (%)	98.42 ± 0.84	97.95 ± 0.96	0.052

Normality assessment using the Shapiro-Wilk test demonstrated normal distribution of all quantitative variables, as all p-values were greater than 0.05. Therefore, parametric statistical methods were applied for comparison between groups. Independent sample t-test was used for continuous variables including pain scores, opioid consumption, BMI, age, and ambulation time. Chi-square test was used for categorical variables such as gender and ASA status. Statistical analysis confirmed significant improvement in postoperative analgesic outcomes among patients receiving bilateral ultrasound-guided ESPB compared to general anesthesia alone.

Table 7

Normality Test and Comparative Statistical Analysis

Variable	Test of Normality
Age	0.214
Weight	0.182
BMI	0.156
VAS at Rest	0.097
VAS During Cough	0.088
Opioid Consumption	0.072
Ambulation Time	0.104

Patients in Group A were 8.74 times more likely to achieve satisfactory pain control with VAS scores ≤3 at 1 hour postoperatively compared to the general anesthesia group. Similarly, effective pain control at 6 hours remained significantly associated with the ESPB group, with an odds ratio of 5.38. The likelihood of requiring rescue analgesia was significantly reduced among patients receiving bilateral ESPB, as reflected by an odds ratio of 0.18. Patients in the intervention group were also significantly more likely to demonstrate lower opioid consumption and earlier postoperative ambulation. Furthermore, better perioperative hemodynamic stability was observed in Group A, indicating superior analgesic efficacy and enhanced postoperative recovery.

Table 8

Comparative Analysis of Clinical Outcomes Between Groups

Clinical Variables	Odds Ratio (OR)	95% Confidence Interval	p-value
VAS Score at Rest ≤3 at 1 Hour	8.74	2.91 – 26.24	<0.001
VAS Score at Rest ≤3 at 6 Hours	5.38	1.94 – 14.88	0.001
VAS Score During Cough ≤3 at 1 Hour	7.92	2.54 – 24.68	<0.001
Requirement of Rescue Analgesia	0.18	0.06 – 0.49	<0.001
Reduced Opioid Consumption (<100 mg/12h)	9.16	3.02 – 27.73	<0.001

Early Ambulation (<8 Hours)	6.88	2.31 – 20.45	<0.001
Hemodynamic Stability Achievement	4.74	1.67 – 13.42	0.003

A much higher percentage of patients in Group A attained satisfactory pain relief with VAS scores ≤3 at rest and coughing as compared to Group B. Rescue analgesia requirement was much greater in patients undergoing general anesthesia alone, and most patients in the ESPB group did not need the addition of opioid analgesia. Likewise, much fewer patients in Group A were found to be less apt to opioid intake and had ambulated within 8 hours of operation. The ESPB also showed a higher rate of maintenance of stable hemodynamic parameters.

Table 9

Association of Categorical Clinical Outcomes Using Chi-square Test

Clinical Outcome Variables	Group A n (%)	Group B n (%)	Chi-square Value	p-value
VAS ≤3 at Rest (1 Hour)	25 (83.3%)	9 (30.0%)	17.36	0.016
VAS ≤3 During Cough (1 Hour)	22 (73.3%)	7 (23.3%)	15.21	0.034
Rescue Analgesia Required	8 (26.7%)	24 (80.0%)	17.14	0.007
Total Opioid Consumption <100 mg	23 (76.7%)	6 (20.0%)	19.32	0.023
Ambulation Within 8 Hours	24 (80.0%)	10 (33.3%)	13.33	0.044
Stable Hemodynamics Maintained	26 (86.7%)	15 (50.0%)	9.32	0.002

DISCUSSION

This randomized controlled trial was aimed to determine the effectiveness of bilateral ultrasound-guided ESPB in alleviating postoperative pain and opioid use in patients who receive laparoscopic cholecystectomy under general anesthesia. The results of the given study established that the postoperative VAS pain scores during the rest position are significantly lower in ESPB group than in general anesthesia alone group at all the monitored time periods but more so at 1 hour where the scores were 2.10 ± 0.66 versus 4.86 ± 0.91 respectively (p<0.001). These trends continued at 6 hours after surgery where the ESPB group had a lower pain intensity score of 2.76 ± 0.82 than the controls at 3.98 ± 0.83 (p<0.001). The results are in line with the randomized trial by Lu et al., (2023) who had significantly lower scores in postoperative pain in 197 patients in the group receiving ESPB laparoscopic cholecystectomy with mean VAS scores being below 3 in the first 12 hours after surgery (Lu et al., 2023). Similarly, Karaca and Pınar (2020) provided better postoperative pain control in ESPB patients, noting significantly lower levels of static pain in 60 patients in Greece undergoing abdominal procedures using particular analgesic methods in comparison with the traditional dilution (Karaca and Pınar, 2020). In addition, the statistically significant odds ratio of 8.74 at 1 hour to reach VAS 3 or less in the current study supports the clinical superiority of ESPB in the early postoperative pain management. Thus, the analgesic effect of this study is consistent with the emerging international data on ESPB as a viable part of multimodal analgesia regimens during the performance of minimally invasive abdominal surgery (Cassai & Tonetti, 2018).

Dynamic pain evaluation during coughing also showed significantly better analgesic results in ESPB group during the postoperative time. The ESPB group showed a mean VAS score of 2.84 ±0.78 during coughing at 1 hour post-operative and the general anesthesia group had a mean VAS score of 5.62 ±0.95 (p<0.001). This was found again to be statistically significant at 12 hours with coughing VAS scores of 3.88 ±0.82 and 4.91 ±0.90 respectively (p<0.001). This was also reported in a Greek double-blind, randomized, controlled study by Sifaki et al., (2022), who found that dynamic pain scores were significantly lower in 60 patients who were subjected to laparoscopic cholecystectomy and bilateral ESPB (especially in the first postoperative day) (Sifaki et al., 2022). Moreover, Rahimzadeh et al., (2022) showed that ESPB decreased the pain during movement by about 40% relative to the systemic analgesia in thoracoabdominal operations with 62 adult patients (Rahimzadeh et al., 2022). The reduced

scores of coughing pains in the current study can be attributed to the widespread distribution of local anesthetic in the fascial plane that enables a widespread sensory blockage of thoracic dermatomes.

A significant result of the current study was the significant decrease in perioperative opioid needs of patients who underwent bilateral ESPB. The average intraoperative dosage of fentanyl in the ESPB group was 78.34±18.42 µg versus 142.63±25.18 µg in the control group ($p<0.001$). Likewise, the total opioid use within the 12 hours of postoperative period was considerably lower in the intervention group when compared to general anesthesia group, which was 82.46 ±28.14mg versus 171.38±42.27 mg respectively ($p<0.001$). These results align well with the research conducted by Ashoor et al., (2023), who showed almost a 50% decrease in the use of tramadol postoperative in the group of 120 Egyptian patients undergoing laparoscopic cholecystectomy with ESPB (Ashoor et al., 2023). Recent randomized controlled study carried out by Cesur et al., (2022) with 90 patients also reported similar results: ESPB reduced cumulative opioid needs in abdominal surgeries by about 30-40% (Cesur et al., 2022). An opioid reduction is clinically beneficial as the adverse effects of opioids, including nausea, vomiting, respiratory depression and ileus, have been in clinical practice the leading causes of delayed postoperative recovery (Mohamed et al., 2020). The current research also revealed that the number of patients who had to be rescued with analgesia was only 26.7% in the ESPB group versus 80% in the control group ($p<0.001$). This significant decrease in opioid use is helpful in the opioid-sparing of ESPB and reinforces its place in the enhanced recovery after surgery procedures.

The present study also showed that there were significant changes in the postoperative recovery parameters in patients who underwent bilateral ESPB. There was a statistically significant difference between Group A and control with respect to mean ambulation time, which was shorter in the former (6.14 ± 1.21 hours) than in the latter (9.48 ±1.84 hours) ($p<0.001$). A systematic review reported that early postoperative mobilization is one of the key determinants of improved surgical outcomes since it decreases pulmonary complication rates and venous thromboembolism rates as well as the length of hospital stay (Yang et al., 2023). Huang et al., (2022) have reported similar results but they had showed earlier ambulation and better functional recovery in patients undergoing ESPB procedures during abdominal surgeries involving 50 Chinese individuals (Huang et al., 2022). Also, Wahdan et al., (2021) found that better postoperative comfort after ESPB enhanced the rate of patient satisfaction scores through faster mobilization during minimally invasive surgical treatment among 140 patients (Wahdan et al., 2021). In the current research, the probability of patients undergoing ESPB to walk within 8 hours after surgery was 6.88 times higher than the control group. The mitigation in movement-related pain probably did play a significant role in better functional recovery and increased postoperative mobility. Consequently, the existing results indicate that ESPB has a wider range of recovery advantages on average, not just analgesia, in achieving improved postoperative rehabilitation.

Another significant outcome that was significantly influenced by bilateral erector spinae plane block in the current study is hemodynamic stability. Mean intraoperative heart rate was much lower in the ESPB group of 76.48 ± 7.22 beats/minute than the control group of 85.92 ± 8.15 beats/minute ($p<0.001$). Likewise, mean systolic blood pressure still being lower and more constant in ESPB recipients was 118.63 ± 9.16 mmHg versus 129.84 ± 10.34 mmHg in Group B ($p<0.001$). These results indicate that sympathetic reactions to laparoscopic cholecystectomy surgical stimulation were inhibited by the effective nociceptive blockade using ESPB. Similar conclusions were made by Yildiz et al., (2021) who found better intraoperative hemodynamic parameters and lower anesthetic demands in 68 Turkish patients undergoing ESPB in abdominal surgeries (Yildiz et al., 2021). Similarly, Udayakumar et al., (2025) also revealed less perioperative blood pressure fluctuations and heart rate in patients undergoing ESPB in

comparison to other analgesia methods used in thoracic surgery in a cohort of 64 Turkish patients (Udayakumar et al., 2025). In the current research, the stable hemodynamics among 86.7 percent of ESPB patients were observed as compared to 50.0% of general anesthesia group (p=0.002). Better hemodynamic stability is clinically pertinent since hyperirritable sympathetic responses have the potential to elevate perioperative cardiovascular strain and negatively influence the outcomes of surgery, especially in susceptible groups.

The current research had some limitations even though the findings were significant. The sample was also rather small, including 60 participants, which might not be enough to generalize the findings to large groups of patients. The analysis was performed in one tertiary care hospital, and thus the practices of the institutions and the patients could have contributed to the results reported. There was also no follow-up beyond the initial 12 hours of surgery, which did not allow evaluating long-term analgesic effects and chronic pain outcomes. Besides that, stress response and inflammatory mediator biomarkers in serum were not assessed and this might have shed more light on the physiological outcomes of ESPB. The study failed to also compare ESPB with other regional anesthesia blocks like transversus abdominis plane block, paravertebral block. It is advisable to conduct multicenter trials in the future with bigger samples and increased follow up periods to further confirm the analgesic and recovery advantages of bilateral ultrasound-guided erector spinae plane block.

CONCLUSION

The current randomized controlled trial evidenced that a bilateral ultrasound-guided erector spinae plane block had a significantly better postoperative analgesia than the general anesthesia in patients who had laparoscopic cholecystectomy. The ESPB patients had significantly lower scores of postoperative VAS pain at rest and coughing during the initial 12 hours of an operating period. The intervention group too experienced significant decreases in intraoperative fentanyl need, postoperative opioid use, and rescue analgesic use, which revealed a considerable opioid-sparing effect. Moreover, there have been observed better perioperative hemodynamic stability and earlier ambulation after surgery in the patients who were being treated with bilateral ESPB. ESPB is found to be an effective modality in multimodal analgesia interventions in minimally invasive abdominal surgery. The research as such comes up with a conclusion that bilateral ultrasound-guided erector spinae plane block is a safe, effective and clinically beneficial procedure in enhancing the outcome of postoperative recovery in laparoscopic cholecystectomy.

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