Ankyra Medical Journal
Original Article
DOI: 10.51271/ANKMJ-0057

Efficiency of erector spina plane block with ultrasonography in laparoscopic cholecystectomy operations

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Cite this article: Altıok Tandoğan D, Polat E, Aydın G, et al. Efficiency of erector spina plane block with ultrasonography in laparoscopic cholecystectomy operations. *Ank Med J.* 2026;5(1):1-9.

Received: 02/12/2025 ◆ **Accepted**: 06/01/2026 ◆ **Published**: 14/01/2026

ABSTRACT

Aims: The aim of our study is to evaluate the effects of ultrasound–guided erector spinae plane block (ESPB) on intraoperative opioid requirement, postoperative analgesic consumption and patient satisfaction in laparoscopic cholecystectomy (LC) procedures.

Methods: Ninety patients aged 18–65 years with American Society of Anesthesiologists (ASA) risk classification I–III who underwent elective LC between December 2018 and December 2020 were retrospectively analyzed. Patients were divided into three groups: control (no block), preoperative ultrasound-guided ESPB and postoperative ESPB performed just before extubation. Intraoperative opioid consumption, postoperative Visual Analog Scale (VAS) scores, additional analgesic requirements, and patient satisfaction were evaluated. Analysis of variance (ANOVA) and the Kruskal–Wallis test were used for statistical analysis.

Results: There were no significant differences among the groups regarding age, sex, height, or ASA physical status ($p>0.05$). However, significant differences were observed in mean body weight and body-mass index (BMI) values ($p=0.006$ and $p=0.007$, respectively). Pairwise comparisons revealed no significant differences in body weight or BMI between the preoperative and postoperative ESPB groups ($p=0.787$ and $p=0.882$); however, both block groups had significantly higher values compared with the control group ($p<0.05$). VAS scores, postoperative analgesic requirements, and patient satisfaction differed significantly among the groups at postoperative 0, 1, 2, 6, 12, and 24 hours, in favor of both ESPB groups ($p<0.001$). Postoperative VAS scores at 0, 1, 2, and 6 hours were significantly lower in the preoperative ESPB group compared with the postoperative ESPB group ($p<0.001$). Intraoperative opioid consumption and postoperative additional analgesic requirements were also significantly lower in the preoperative ESPB group than in the other two groups ($p<0.001$). However, VAS scores and patient satisfaction at 12 and 24 hours were comparable between the two ESPB groups. In the control group, VAS scores at postoperative 0, 1, 2, 6, 12, and 24 hours were significantly higher ($p<0.001$), resulting in a significantly greater need for additional analgesia.

Conclusion: Preemptive ESPB reduces the need for intraoperative opioids and maximizes patient satisfaction with postoperative low VAS scores.

Keywords: Pain management, postoperative analgesia, regional anesthesia

INTRODUCTION

Laparoscopic cholecystectomy (LC) is the most frequently performed laparoscopic surgical procedure.[1] Postoperative pain following LC is predominantly visceral in origin, while parietal pain occurs less commonly. Visceral pain results from tissue trauma, diaphragmatic and peritoneal irritation secondary to pneumoperitoneum, abdominal distension, and chemical irritation of the peritoneum. In contrast, parietal pain is primarily associated with surgical incisions and trocar insertion sites.

Multimodal analgesia in LC is achieved through the combined use of intravenous analgesics, opioids, local anesthetic infiltration at incision sites, preemptive analgesic

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strategies, and appropriate regional anesthesia techniques.[2] Currently, regional anesthesia methods such as epidural block, paravertebral block, transversus abdominis plane block, and erector spinae plane block (ESPB) are widely used and preferred approaches.[3]

The ESPB is a paravertebral-type regional anesthesia technique utilized for postoperative pain management. It was first described by Forero et al.[4] in 2016. Initially proposed for the management of chronic pain associated with rib fractures, ESPB has subsequently been applied for analgesic purposes in both pediatric and adult patients undergoing abdominal and thoracic surgeries during the preoperative and postoperative periods.[5,6]

ESPB is performed by the injection of a local anesthetic into the interfascial plane between the transverse process of the vertebra and the erector spinae muscles, allowing multidermatomal spread across several vertebral levels. The local anesthetic agent spreads in a craniocaudal direction along the fascial plane beneath the muscle, resulting in sensory blockade of the lateral and posterior thoracic regions, anterior thorax, and abdominal wall. It has been demonstrated that ESPB provides effective blockade of both visceral and somatic pain by affecting the dorsal and ventral rami of the spinal nerves.[7,8]

The aim of this study is to evaluate the effects of ultrasound-guided ESPB, routinely performed in our clinic during LC procedures, on intraoperative opioid consumption, postoperative analgesic efficacy, and patient satisfaction.

METHODS

The study was conducted at the Department of Anesthesiology and Reanimation, Kırıkkale University Faculty of Medicine, after obtaining approval from the Kırıkkale University Non-interventional Researches Ethics Committee (Date: 16.09.2021, Decision No: 2021.06.19). We obtained an informed consent form from all patients for procedure. All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki.

Medical records of patients who underwent LC between December 2018 and December 2020 were retrospectively reviewed.

A total of 90 patients were included in the study. The patients were equally divided into three groups:

- **Control group (n=30):** patients who did not receive any regional block,
- **Preoperative block group (n=30):** patients who received an ESPB during the preoperative period,
- **Postoperative block group (n=30):** patients who received ESPB during the postoperative period, immediately before extubation.

The following parameters were evaluated for all included patients:

- Demographic characteristics (age, sex, weight, and height),
- American Society of Anesthesiologists (ASA) physical status scores,
- Visual Analog Scale (VAS) pain scores at postoperative 0, 1, 2, 6, 12, and 24 hours,
- Patient satisfaction,
- Requirement for additional analgesia.

Patients with any of the following conditions were excluded from the study: known hypersensitivity to local anesthetic agents, bleeding diathesis, psychiatric disorders, a history of pneumothorax, phrenic nerve paralysis, severe aortic stenosis, obesity (body-mass index (BMI) >35 kg/m^2), or refusal of regional block.

In our clinic, ESPB is routinely offered to patients scheduled for elective LC procedures, provided that informed consent is obtained. According to patient preference, the block is performed either before transfer to the operating room or at the end of surgery immediately prior to emergence from anesthesia. Patients who consented to preoperative ESPB were transferred to the block room, where standard monitoring (electrocardiography, noninvasive blood pressure, and peripheral oxygen saturation) was applied. Sedation was achieved with intravenous midazolam at a dose of 0.03–0.05 mg/kg (Sedozolam®, Monemfarma, Ankara, Turkiye), and supplemental oxygen was administered via nasal cannula at 4 L/min. ESPB was performed under ultrasound guidance in the sitting position, after which patients were transferred to the operating room. Patients who consented to ESPB but declined preoperative block placement due to reasons such as needle phobia underwent ESPB at the end of surgery under general anesthesia, before extubation. In these patients, ESPB was performed in the left lateral decubitus position, followed by extubation and transfer to the post-anesthesia care unit.

Postoperative pain scores of all patients who routinely received peripheral nerve blocks in our clinic were assessed and recorded using the VAS at postoperative 0, 1, 2, 6, 12, and 24 hours. When the VAS score VAS>4, intravenous dexketoprofen trometamol 50 mg (Arveles®, Ufsa, İstanbul, Turkiye) was administered. If the VAS score was >6, intravenous tramadol at a dose of 1 mg/kg (Tramosel®, Haver, İstanbul, Turkiye) was administered. Additional analgesic requirements were documented in the block follow-up charts.

Ultrasound-Guided Erector Spinae Plane Block

After positioning the patient in the sitting and/or lateral decubitus position and ensuring sterile conditions, a linear 10–18 MHz ultrasound probe (Esaote MyLab 30, Genoa, Italy) was placed in the paramedian sagittal plane between two transverse processes. At the T7 vertebral level, the transverse processes and pleura were identified. An 18-gauge, 50-mm needle (Pajunk, Geisingen, Germany) was advanced using an in-plane technique until contact with the transverse process was achieved. After negative aspiration, with the needle tip positioned between the erector spinae muscle and the transverse process, 20 ml of 0.5% bupivacaine (Buvasin®, Vem, İstanbul, Turkiye) was injected. Craniocaudal spread of the local anesthetic was visualized under ultrasound guidance (**Figure 1, 2**).

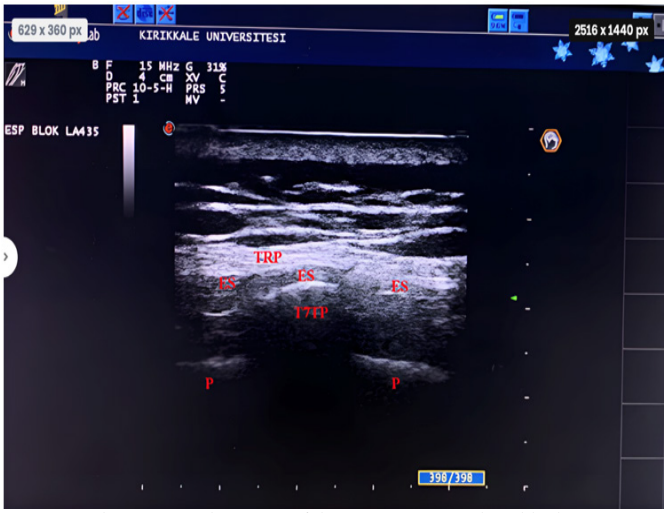

Figure 1. Ultrasonography image of the erector spinae plane block
TRP: Trapezius muscle, ES: Erector spinae muscle, P: Pleura, TP: Transverse process

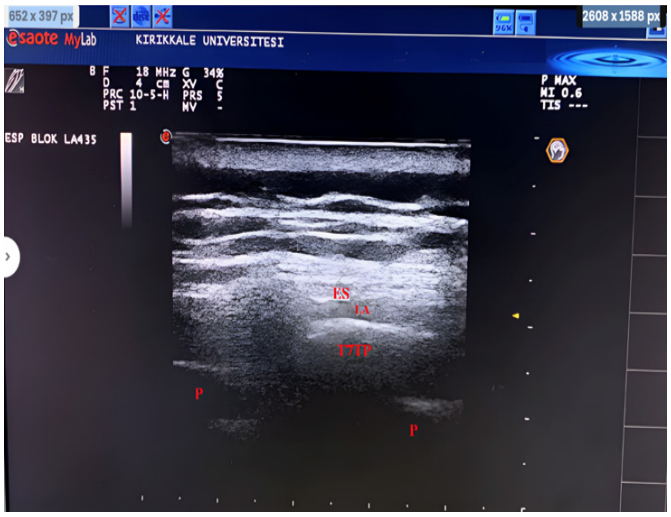

Figure 2. Ultrasonography image of local anesthetic distribution after ESPB
TRP: Trapezius muscle, ES: Erector spinae muscle, LA: Local anesthetic, TP: Transverse process

General Anesthesia Protocol

All patients in the three study groups underwent surgery under general anesthesia. Anesthesia induction was achieved with intravenous propofol at a dose of 2–3 mg/kg (Propofol®, Fresenius Kabi, Melsungen, Germany), fentanyl 1 µg/kg IV (Fentanyl Citrate®, Hospira, USA), and rocuronium 0.6 mg/kg IV (Esmeron®, Organon, Oss, the Netherlands). Anesthesia maintenance was provided with 2% sevoflurane (Sevorane®, Abbott, Chicago, USA) in a mixture of 50% oxygen and 50% air.

During the intraoperative period, remifentanil infusion (Rentanil®, Vem, İstanbul, Turkiye) was initiated at a dose of 0.05–0.2 µg/kg/min when an increase of ≥20% in heart rate or blood pressure compared with baseline values at the start of surgery was observed. Intraoperative opioid consumption was recorded for all patients. Toward the end of surgery, ondansetron 8 mg IV (Zofran®, GlaxoSmithKline S.p.A., Italy) was routinely administered to all patients.

At the completion of surgery, neuromuscular blockade was reversed with neostigmine 0.04 mg/kg IV (Neostigmine®, Adeka, Samsun, Turkiye) and atropine 0.015 mg/kg IV (Atropine sulfate®, Biofarma, İstanbul, Turkiye). After recovery of adequate muscle strength, patients were extubated and transferred to the post-anesthesia care unit, where they were monitored before being discharged to the general surgery ward.

VAS

Pain intensity is marked on a 10 cm ruler

0 1 2 3 4 5 6 7 8 9 10

where 0 indicated “no pain” and 10 indicated “worst imaginable pain.”

Patient Satisfaction Scale

Patient satisfaction was evaluated using a 5-point scale:

5: Very satisfied

4: Satisfied

3: Undecided

2: Dissatisfied

1: Very dissatisfied

Statistical Analysis

Data analysis was performed using the SPSS software package, version 21.0. Descriptive data were expressed as mean, median, standard deviation, minimum, maximum, and percentage values, as appropriate. The normality of data distribution was assessed using the Shapiro–Wilk test. Intergroup comparisons of normally distributed variables were performed using one-way analysis of variance (ANOVA). For variables not normally distributed, the Kruskal–Wallis test was used for intergroup comparisons, and the Mann–Whitney U test was applied for pairwise comparisons. A p value of <0.05 was considered statistically significant.

RESULTS

A total of 90 patients were included in the study. The patients were equally divided into three groups: those who did not receive a regional block (control group), those who received a block during the preoperative period (preoperative block group), and those who received a block during the postoperative period before extubation (postoperative block group). Data obtained from the patients were analyzed using intergroup comparative methods. Comparative analysis of demographic characteristics revealed no statistically significant differences among the groups in terms of age, sex, height, or ASA physical status scores (p>0.05) (Table 1, 2).

The mean body weight in the control group was 71.93±7.13 kg, whereas it was 78.86±9.09 kg in the preoperative block group and 77.40±9.41 kg in the postoperative block group. A statistically significant difference was observed among the groups (p=0.006). Pairwise comparisons showed no significant difference between the preoperative and postoperative block groups (p=0.787); however, mean body weight was significantly higher in both block groups compared with the control group (p<0.001) (Table 1, 3).

Similarly, the mean BMI was 25.79±2.65 kg/m² in the control group, 28.51±3.23 kg/m² in the preoperative block group, and 27.98±4.28 kg/m² in the postoperative block group. Intergroup analysis revealed a statistically significant difference in BMI values (p=0.007). Pairwise comparisons demonstrated

Table 1. Distribution and statistical comparison of demographic data among the groups

Group		Age	Height	Weight	BMI	ASA
Control group	Mean	42.900	167.200	71.933	25.794	1.766
	Median	46.500	165.000	72.500	25.955	2.000
	SD	15.159	8.014	7.138	2.654	0.626
	Minimum	20.000	155.000	60.000	21.220	1.000
	Maximum	65.000	182.000	85.000	31.220	3.000
Preoperative block group	Mean	43.566	166.500	78.866	28.513	1.566
	Median	41.000	166.000	79.000	28.220	1.500
	SD	12.350	7.426	9.092	3.238	0.626
	Minimum	19.000	155.000	62.000	23.050	1.000
	Maximum	65.000	184.000	95.000	35.160	3.000
Postoperative block group	Mean	49.000	166.933	77.400	27.980	1.666
	Median	50.000	165.000	76.000	27.955	2.000
	SD	12.398	9.288	9.412	4.283	0.660
	Minimum	24.000	150.000	62.000	20.060	1.000
	Maximum	65.000	184.000	97.000	37.460	3.000
p value (*ANOVA, Kruskal-Wallis test)		0.132	0.946	0.006*	0.007*	0.446

BMI: Body-mass index, ASA: American Society of Anesthesiologists, SD: Standard deviation, ANOVA: Analysis of Variance

Table 2. Intergroup comparison of demographic and study variables

		Control	Preoperative block group	Postoperative block group		
Variable		**Mean±SD/ median (min-max) n (%)**	**Mean±SD/ median (min-max) n (%)**	**Mean±SD/ median (min-max) n (%)**	**F/X²**	**p**
Age		46.50 (20.00-65.00)	41.00 (19.00-65.00)	50.00 (24.00-65.00)	4.057	0.132
Gender	Female	20 (66.6%)	25 (83.3%)	19 (63.3%)	3.316	0.191
	Male	10 (33.3%)	5 (16.7%)	11 (36.7)		
Height		165.00 (155.00-182.00)	166.00 (155.00-184.00)	165.00 (150.00-184.00)	0.111	0.946
Weight		71.93±7.13	78.86±9.09	77.40±9.41	5.407*	0.006*
BMI		25.79±2.65	28.51±3.23	27.98±4.28	5.205*	0.007*
ASA		2.00 (1.00-3.00)	1.50 (1.00-3.00)	2.00 (1.00-3.00)	1.616	0.446
Intraoperative analgesic requirement	Yes	30 (100.0%)	0	30 (100.0%)	89.000	<0.001
	No	0	30 (100.0%)	0		
Operation duration		60 (40-75)	60 (40-75)	60 (35-85)	1.124	0.570
VAS 0		5.5 (4-10)	0 (0-2)	2 (0-4)	71.186	<0.001
VAS 1		5 (4-8)	0.5 (0-2)	1 (0-3)	64.108	<0.001
VAS 2		4 (2-6)	0 (0-2)	1 (0-2)	65.995	<0.001
VAS 6		3 (1-6)	0 (0-1)	0 (0-1)	69.420	<0.001
VAS 12		2 (0-6)	0 (0-0)	0 (0-0)	80.876	<0.001
VAS 24		1 (0-4)	0 (0-1)	0 (0-0)	66.849	<0.001
Postoperative analgesic requirement	Yes	29 (96.7%)	0	2 (6.7%)	76.592	<0.001
	No	1 (3.3%)	30 (100.0%)	28 (93.3%)		
Satisfaction		2 (1-3)	5 (4-5)	5 (3-5)	73.294	<0.001

SD: Standard deviation, Min: Minimum, Max: Maximum, BMI: Body-mass index, ASA: American Society of Anesthesiologists, VAS: Visual Analog Scale, (*) ANOVA (Analysis of Variance) and Kruskal–Wallis tests (p<0.05)

no significant difference between the preoperative and postoperative block groups (p=0.882), whereas both block groups had significantly higher BMI values compared with the control group (p<0.001) (Table 1, 3).

None of the patients in the preoperative ESPB group required intraoperative opioid administration, whereas all patients in both the postoperative ESPB group and the control group required opioids during the intraoperative period. Accordingly, intraoperative opioid requirement was statistically significantly lower in patients who received preoperative ESPB compared with the other two groups (p<0.001) (Table 2, 3, 4, Figure 3).

None of the patients in the preoperative block group required postoperative opioid analgesia, whereas only 2 patients (6.7%) in the postoperative block group required postoperative analgesic treatment. In contrast, in the control group, 29 patients (96.7%) required postoperative analgesia, with only 1 patient (3.3%) not requiring analgesic treatment.

Intergroup comparison demonstrated that postoperative analgesic requirements were statistically significantly lower

Table 3. Pairwise comparison of the groups

Variable	Group (I/J)	Mean difference/Z	p
Weight	Control/pre-block group	-6.933*	0.007*
	Control/post-block group	-5.466*	0.042*
	Pre-block group/post-block group	1.466*	0.787*
BMI	Control/pre-block group	-2.718*	0.009*
	Control/post-block group	-2.185*	0.043*
	Pre-block group/post-block group	0.533*	0.882*
Intraoperative opioid requirement	Control/pre-block group	-7.681	<0.001
	Control/post-block group	0.000	1.000
	Pre-block group/post-block group	-7.681	<0.001
Operation duration	Control/pre-block group	-0.335	0.737
	Control/post-block group	-1.012	0.311
	Pre-block group/post-block group	-0.736	0.462
VAS 0	Control/pre-block group	-6.785	<0.001
	Control/post-block group	-6.624	<0.001
	Pre-block group/post-block group	-5.090	<0.001
VAS 1	Control/pre-block group	-6.692	<0.001
	Control/post-block group	-6.559	<0.001
	Pre-block group/post-block group	-3.261	<0.001
VAS 2	Control/pre-block group	-6.821	<0.001
	Control/post-block group	-6.765	<0.001
	Pre-block group/post-block group	-3.104	0.002
VAS 6	Control/pre-block group	-7.009	<0.001
	Control/post-block group	-6.724	<0.001
	Pre-block group/post-block group	-2.895	0.004
VAS 12	Control/pre-block group	-6.968	<0.001
	Control/post-block group	-6.968	<0.001
	Pre-block group/post-block group	0.000	1.000
VAS 24	Control/pre-block group	-6.230	<0.001
	Control/post-block group	-6.421	<0.001
	Pre-block group/post-block group	-1.000	0.317
Postoperative analgesia	Control/pre-block group	-7.429	<0.001
	Control/post-block group	-6.917	<0.001
	Pre-block group/post-block group	-1.426	0.154
Satisfaction	Control/pre-block group	-6.975	<0.001
	Control/post-blok group	-6.822	<0.001
	Pre-block group/post-block group	-5.185	<0.001

BMI: Body-mass index, VAS: Visual Analog Scale, (*) ANOVA (Analysis of Variance) and Mann–Whitney U tests (p<0.05)

Table 4. Distribution and statistical comparison of intraoperative opioid requirement among the groups

Intraoperative opioid requirement							
Group			**Frequency**	**Percent**	**Valid percent**	**Cumulative percent**	**p value (Kruskal-Wallis test)**
Control group	Valid	Yes	30	100.0	100.0	100.0	<0.001
		No	0	0	0	0	
Preop block group	Valid	Yes	0	0	0	0	
		No	30	100.0	100.0	100.0	
Postop block group	Valid	Yes	30	100.0	100.0	100.0	
		No	0	0	0	0	

in both the preoperative and postoperative block groups compared with the no-block control group (p<0.001). However, no statistically significant difference was observed between the preoperative and postoperative block groups with respect to postoperative analgesic requirement (p=0.154) (Table 2, 3, 5, Figure 4).

Postoperative patient satisfaction was scored on a scale ranging from 1 (lowest) to 5 (highest). The median satisfaction

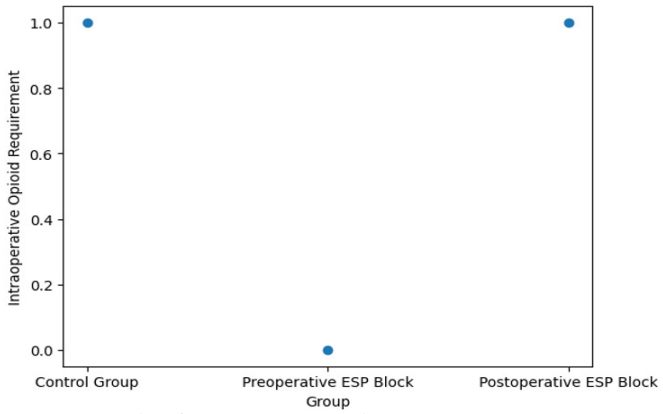

Figure 3. Box plot of intraoperative opioid requirement
ESP: Erector spinae plane

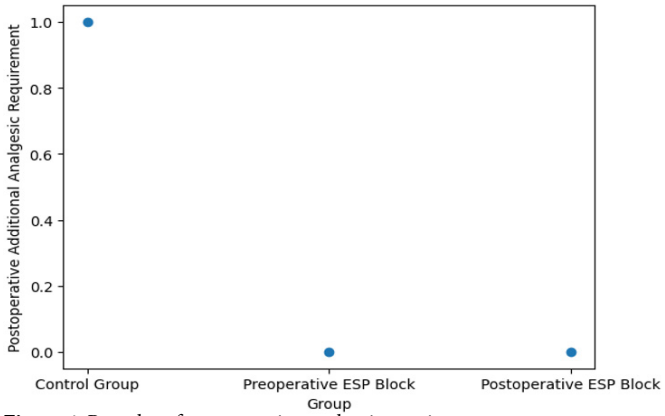

Figure 4. Box plot of postoperative analgesic requirement
ESP: Erector spinae plane

score in the control group was 2.00 (range: 1.00–3.00), whereas it was 5.00 (range: 4.00–5.00) in the preoperative block group and 5.00 (range: 3.00–5.00) in the postoperative block group.

Intergroup analysis demonstrated that patient satisfaction was significantly higher in both the preoperative and postoperative block groups compared with the no-block control group ($p<0.001$). Furthermore, when the preoperative and postoperative block groups were compared, patient satisfaction was significantly higher in the preoperative block group ($p<0.001$) (Table 2, 3, 6, Figure 5).

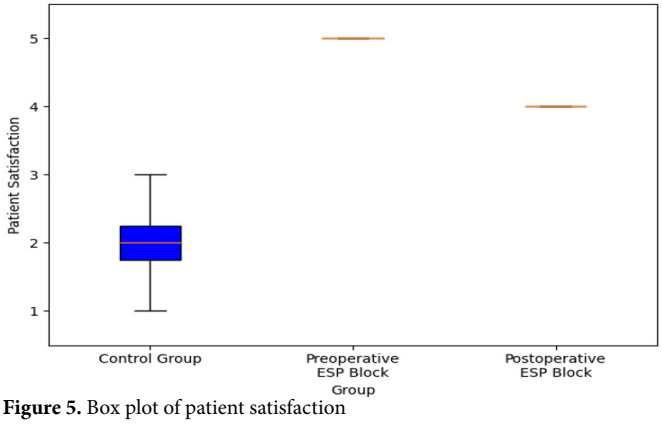

Figure 5. Box plot of patient satisfaction

Table 5. Distribution and statistical comparison of postoperative analgesic requirement among the groups

Postoperative additional analgesic requirement							
Group			**Frequency**	**Percent**	**Valid percent**	**Cumulatiand percent**	**p value (Kruskal-Wallis test)**
Control group	Valid	No	1	3.3	3.3	3.3	<0.001
		Yes	29	96.7	96.7	100.0	
		Total	30	100.0	100.0		
Preop block group	Valid	No	30	100.0	100.0	100.0	
		Yes	0	0	0	0	
		Total	30	100.0	100.0		
Postop block group	Valid	No	28	93.3	93.3	93.3	
		Yes	2	6.7	6.7	100.0	
		Total	30	100.0	100.0		

Table 6. Distribution and statistical comparison of patient satisfaction among the groups

Patient satisfaction							
Group			**Frequency**	**Percent**	**Valid percent**	**Cumulative percent**	**p value (Kruskal-Wallis test)**
Control group	Valid	1.00	14	46.7	46.7	46.7	<0.001
		2.00	14	46.7	46.7	93.3	
		3.00	2	6.7	6.7	100.0	
		Total	30	100.0	100.0		
Preop block group	Valid	4.00	6	20.0	20.0	20.0	
		5.00	24	80.0	80.0	100.0	
		Total	30	100.0	100.0		
Postop block group	Valid	3.00	5	16.7	16.7	16.7	
		4.00	21	70.0	70.0	86.7	
		5.00	4	13.3	13.3	100.0	
		Total	30	100.0	100.0		

DISCUSSION

In this study, we investigated the effects of ultrasound-guided ESPB on intraoperative opioid requirements, postoperative analgesic consumption, and patient satisfaction in patients undergoing LC.

The main finding of our study was that postoperative VAS scores at 0, 1, 2, and 6 hours were significantly lower in patients who received preoperative ESPB compared with those who received postoperative ESPB. In addition, intraoperative opioid requirements were significantly lower in the preoperative ESPB group than in the other two groups. Postoperative additional analgesic requirements were also lower in the preoperative ESPB group compared with the other groups. At postoperative 12 and 24 hours, VAS scores were similar between the two block groups. In contrast, VAS scores at 0, 1, 2, 6, 12, and 24 hours were significantly higher in the no-block control group compared with both block groups. Therefore, we believe that preoperative ESPB reduces intraoperative opioid requirements and, together with lower postoperative VAS scores, markedly improves patient satisfaction.

LC is currently preferred over open cholecystectomy due to reduced hospital stay, decreased loss of workforce, and lower postoperative morbidity. Although it is generally associated with less postoperative pain, severe pain may still occur if appropriate pain management is not provided. Consequently, various treatment strategies have been developed to reduce postoperative pain. Parietal pain observed in the postoperative period following LC is usually well localized by the patient and is characterized by sharp and sudden onset. Previous studies have demonstrated that local anesthetic infiltration at incision sites reduces parietal pain. In addition, bupivacaine administered at trocar sites has been reported to reduce postoperative pain, opioid consumption, and the need for additional analgesia in LC.[9]

Preemptive analgesia refers to all analgesic interventions applied before a painful stimulus, with the common goal of achieving early pain control before the development of central sensitization, improving patient comfort, and reducing postoperative opioid requirements.[10,11]

It is well known that postoperative pain increases the stress response to surgical trauma, which may lead to cardiac, pulmonary, and gastrointestinal complications. By employing preemptive analgesic strategies, complications secondary to postoperative pain may also be prevented. The pathogenesis of postoperative pain is considered to be multifactorial; therefore, analgesic management should be multimodal. With advances in pain management techniques, opioid use has been reduced and multimodal analgesia strategies have become increasingly widespread.[12,13]

For this reason, ESPB is most often performed preoperatively in the block room for patients undergoing LC in our clinic. Postoperative pain following laparoscopic surgery is predominantly visceral and is mainly attributed to diaphragmatic irritation caused by carbon dioxide insufflation. The somatic component of pain originates from trocar insertion sites and surgical incisions.[14] In addition, approximately one-third of patients experience shoulder pain in the postoperative period, similar in type and localization to pain observed in biliary colic.[15] Pain originating from the gallbladder is transmitted via nerves arising from the T8–T9 spinal segments. In our study, we believe that ESPB performed at the T7 level provides sufficient somatic and visceral analgesia between the T5 and T12 dermatomes, thereby ensuring adequate analgesia for LC.

In a cadaveric study conducted by Yang et al.[16] in 2018, 20 ml of contrast medium was injected at the T5 level to evaluate the spread of the local anesthetic used in ESPB. The contrast medium was observed to pass through the superior costotransverse ligament and spread into the paravertebral space and thoracic spinal nerves.[16] In another cadaveric study investigating the mechanism of ESPB, Ivanusic et al.[17] injected 20 ml of methylene blue and observed craniocaudal and lateral spread posterior to the costotransverse foramen; however, no spread to the dorsal or ventral rami was noted. In a magnetic resonance imaging study by Schwartzmann et al.,[18] injection of 30 ml of contrast medium at the T10 level resulted in spread to the paravertebral, epidural, and intervertebral foraminal spaces between T5 and T12. Importantly, this study demonstrated that unilateral injection crossed to the contralateral side and extended into the epidural space, thereby reducing both visceral and somatic pain. Similarly, Tulgar et al.[19] reported bilateral sensory blockade following unilateral ESPB performed at the T9 level. In light of these findings, we considered that unilateral ESPB performed at the T7 level in our study could provide sufficient analgesic efficacy by taking into account its potential bilateral spread.

With the increasing use of ultrasound guidance, nerve blocks have become more widely adopted in clinical practice. One of the major advantages of ultrasound guidance is the reduction of local anesthetic dosage, thereby minimizing potential complications. Ultrasound-guided regional anesthesia allows accurate needle placement and real-time visualization of local anesthetic spread.[20] Previous studies have described ESPB performed in parasagittal and transverse planes using both in-plane and out-of-plane approaches. When ESPB is performed in the parasagittal plane, craniocaudal spread of the local anesthetic can be more clearly visualized; therefore, many studies have preferred the in-plane parasagittal approach. Moreover, improved visualization of the block needle with the in-plane technique reduces the risk of pleural puncture and inadvertent entry into the neural foramina.[21] In our clinic, ESPB is routinely performed using an in-plane parasagittal approach. The use of ultrasound enabled clearer visualization of needle placement and simultaneous monitoring of local anesthetic spread, which contributed to the methodological strength of our study.

In a study conducted by Tulgar et al.,[19] bilateral ESPB was performed at the T9 level using 20 ml of 0.375% bupivacaine in patients undergoing LC and compared with a control group. Postoperative pain, opioid consumption, and additional analgesic requirements were evaluated. Opioid consumption and the need for additional analgesia were found to be significantly lower in the ESPB group; however, the authors did not recommend routine use of ESPB due to the need for further comparison with other regional anesthesia techniques and optimization of local anesthetic dose and concentration.[3] In a similar study by Aksu et al.,[22] bilateral ESPB performed

at the T8 level using 20 ml of 0.25% bupivacaine resulted in significantly reduced 24-hour morphine consumption and lower VAS scores. In another study by Altıparmak et al.,[23] patients undergoing LC were divided into two groups: the block group received ultrasound-guided bilateral ESPB at the T7 level using 40 ml of 0.25% bupivacaine immediately before extubation, whereas the control group received bilateral injections of 40 ml of normal saline at the same level. Intraoperative opioid consumption, postoperative VAS scores, and postoperative additional analgesic requirements were found to be significantly lower in the ESPB group. The main methodological difference between our study and these studies is that ESPB was performed unilaterally at the T7 level. Despite using a lower total volume and concentration of local anesthetic (20 ml of 0.5% bupivacaine), our VAS scores were lower, indicating comparable analgesic efficacy and supporting the clinical significance of our findings.

In a study by Verma et al.,[24] one group of patients undergoing LC received 20 ml of 0.375% ropivacaine at the T7 level, while the control group received 20 ml of normal saline. The results demonstrated that patients who received ESPB had significantly lower VAS scores from postoperative hour 1 up to 48 hours, reduced intraoperative opioid requirements, decreased postoperative analgesic consumption, and earlier unassisted mobilization. Similarly, in our study, unilateral ESPB performed at the same vertebral level resulted in reduced intraoperative opioid requirements, lower postoperative VAS scores, and higher patient satisfaction.

Several studies have shown that ESPB provides a rapid onset of analgesia, with sustained postoperative analgesic effects lasting up to the first 24 hours.[25] In our study, none of the patients in the preemptive ESPB group required intraoperative opioids. This finding may be explained by the rapid onset of block efficacy, which reduced anesthetic requirements. Moreover, evaluation of postoperative hour 0 VAS scores in this group revealed a maximum score of 2, indicating that patients awakened with minimal pain and further supporting the high analgesic efficacy of ESPB.

Numerous studies have demonstrated that effective postoperative pain control significantly improves patient satisfaction.[26] In line with these findings, we believe that ESPB, which is routinely applied in our clinic, has a substantial positive impact on patient satisfaction. In our study, patient satisfaction was significantly higher in both ESPB groups compared with the control group. This outcome may be attributed to improved patient comfort resulting from the high analgesic efficacy observed in the block groups.

Limitations

- In our study, a single-injection technique was used. Because a patient-controlled analgesia (PCA) device was not available in our clinic, catheter placement could not be performed.
- Since the methodology of this study was limited to the evaluation of VAS scores within the first 24 hours, the effect of the ESP block on chronic pain could not be assessed.
- The retrospective and observational design of the study precluded randomization of the patient groups, and group allocation was based on patient preference and routine clinical practice. This may have increased the risk of selection bias between the groups and limited the generalizability of the findings.
- Although a statistically significant difference in BMI was observed between the groups, the absence of multivariable analyses to control for the potential impact of BMI on the outcomes represents a significant methodological limitation of the study.
- Although multiple comparisons were performed in the study, effect sizes were not reported and additional statistical adjustment methods for multiple comparisons were not applied; therefore, the interpretation of the relationship between statistical significance and clinical relevance should be approached with caution.
- The single-center design and limited sample size are additional factors that may restrict the generalizability of the findings to different patient populations and clinical settings.

Despite these limitations, the study is considered to provide clinically meaningful data and to contribute to the existing literature regarding the analgesic efficacy of the ESPB in patients undergoing LC. Nevertheless, further randomized, prospective studies with larger sample sizes are required to validate these findings.

CONCLUSION

Preoperative unilateral ESPB performed at the T7 level eliminates the need for intraoperative opioid use and provides high patient satisfaction with low postoperative VAS scores. Additionally, ESPB performed at the end of surgery (immediately before extubation) also increases patient satisfaction in the postoperative period due to its high analgesic efficacy.

ETHICAL DECLARATIONS

Ethics Committee Approval

This study was approval from the Kırıkkale University Non-interventional Researches Ethics Committee (Date: 16.09.2021, Decision No: 2021.06.19).

Informed Consent

As this was a retrospective study, formal written informed consent was not required and was therefore not obtained.

Peer Review Process

This manuscript was subject to external peer review.

Conflict of Interest

The authors declare no conflicts of interest related to this study.

Financial Disclosure

The authors received no financial support for the conduct or publication of this research.

Author Contributions

Concept: D.A.T., G.A.; Design: D.A.T., A.T.Ş.; Control: G.A., E.P.; Data Collection and/or Processing: D.A.T, E.P., A.T.Ş., O.A., F.P.; Analysis and/or Interpretation: O.A., I.G., K.P., Z.N.A.; Literature Review: D.A.T., G.A.; Article Writing: G.A., D.A.T.; Critical Review: All authors.

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