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Comparison of Ultrasound-Guided Thoracic Paravertebral Block and Erector Spinae Plane Block for Postoperative Analgesia After Laparoscopic Cholecystectomy

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Abstract

BACKGROUND/AIMS: Many block methods have been applied for postoperative analgesia after laparoscopic cholecystectomy (LC). We aimed to compare the effectiveness and reliability of thoracic paravertebral block (TPVB) and erector spinae plane block (ESPB) performed with ultrasonography in elective LC cases on postoperative analgesia.

MATERIALS AND METHODS: This study was carried out as a randomized double-blinded prospective study. We divided 102 patients who would undergo elective LC into 2 groups (TPVB; group 1, and ESPB; group 2) using a website (www.randomizer.org) with 51 patients each. We applied the blocks unilaterally with 20 mL of 0.25% bupivacaine at the T-8 level under the guidance of ultrasound. Postoperative visual analog scale scores, additional analgesic requirements up to the 24th hour, the duration of block application, postoperative nausea and vomiting data, and any developing complications were noted.

RESULTS: Hundred and two patients (51 patients in each group) were evaluated. We found no statistically significant differences in age, gender or comorbidities ($p>0.05$). Postoperative resting and dynamic visual analog scale scores did not differ statistically ($p>0.05$). When the presence of nausea and vomiting, complication rates, the duration of the block application and postoperative first analgesic requirements were compared, we found no significant difference between the groups ($p>0.05$ for each). The satisfaction score was found to be significantly higher in group 1 ($p=0.011$).

CONCLUSION: We determined that ultrasound guided TPVB and ESPB were not superior to each other in terms of postoperative analgesic potency in LC. However, ESPB is a newer block, simpler to administer and not inferior in analgesic efficacy compared to TPVB.

Keywords: Erector spinae plane block, laparoscopic cholecystectomy, postoperative analgesia, regional anesthesia, thoracic paravertebral block, visual analog scale

INTRODUCTION

The gold standard for cholecystectomy is laparoscopic cholecystectomy (LC), which is a frequently preferred surgical procedure because of its lower postoperative pain, lower hospital costs, and lower long-term morbidity.[1] The PROSPECT (*procedure specific postoperative pain management*) protocol recommends multimodal analgesia after LC, as in many surgeries.[2] The main goals in the treatment of pain after surgery include eliminating or reducing the discomfort and facilitating the healing process, avoiding the adverse effects of treatment.[3]

Due to the unfavorable effects of opioid analgesics on managing postoperative pain, various regional anesthesia procedures have recently gained popularity. Sellheim first described one of them, the

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thoracic paravertebral block (TPVB), in 1905. Kappis later modified it with a method closer to the one used today and this is now used for postoperative pain management after thoracic and abdominal surgeries. Erector spinae plane block (ESPB), is a new technique created for acute and persistent thoracic pain and it was defined by Forero et al.[4] in 2016. It is another regional anesthesia technique utilized in thoracic and abdominal procedures as an alternative to TPVB for postoperative analgesia.[5,6] In current publications, both block types are applied for analgesia after thoracic, abdominal, and spinal surgeries individually.

To date, there had not been a study which contrasted these two kinds of blocks in LC, as far as we were aware. We aimed to compare the effectiveness of TPVB and ESPB achieved with ultrasonography in elective LC cases on postoperative analgesia.

MATERIALS AND METHODS

This prospective, double-blinded, randomized, clinical trial was performed in Afyonkarahisar Health Sciences University Hospital Anesthesiology and Reanimation Clinic and a general surgery clinic after approval of the Afyonkarahisar Health Sciences University Faculty of Medicine Ethics Committee (approval number: 2021/3, date: 11.09.2020). All procedures carried out in this research involving human subjects were in accordance with the 2013 Helsinki Declaration and its later amendments or comparable ethical standards, as well as the ethical requirements of the institutional and/or national research committee.

The patients who were designated to take part in this study were included after a routine preoperative anesthetic evaluation. This study comprised patients who were scheduled for elective LC between March, 2021 and July, 2021 and had an American Society of Anesthesiologists (ASA) score of 1-2, had no mental defect, and were between the ages of 18 and 70 years. This study excluded individuals who were under or over the study's inclusion age, had ASA scores of 3 to 4, had a local or systemic infection, an arrhythmia, cardiac, hepatic, or renal failure, or a history of allergies to local anesthetics or any analgesic drugs. Informed consent was obtained from all participants. The VAS was explained to all patients who would take part in this study.

It was decided enumerate the patients according to their registration order. The site (www.randomizer.org) randomly divided the patient sequence numbers into two groups. Patients with TPVB were allocated to group 1, and patients with ESPB were allocated to group 2. We designated a research coordinator to distribute and preserve the randomization results.

The practitioner shared the order of patient enrollment with the coordinator, and the coordinator specified which block would be performed according to the randomization list. We performed unilaterally the blocks with the guidance of ultrasound (US), (Usmart®-3200T Nexgen, Terason). The participants were blinded to the allocation. The anesthetists who applied general anesthesia and followed up after the surgery and the surgeon had no information about which block was applied.

In the nerve block practice room, routine anesthetic monitoring was carried out, and a 0.9% saline infusion was started after establishing peripheral venous access. Following the detection of the processus spinosum in the cervical region after the most conspicuous C-7, we marked caudally one by one under US guidance. The patients were in a seated position with their heads angled slightly forward. The injection location was designated as being 2.5-3 cm to the right side lateral of the Th-8 spinous process and the relevant area was cleansed. 2 mL of 2% lidocaine was injected into the subcutaneous tissue at the location of the needle insertion.

The paravertebral area, subsequent transverse processes, pleura, and superior costotransverse ligament were all identified after the linear US probe was placed on the specified area for paravertebral block administration in the longitudinal plane. The superior costotransverse ligament was passed using the in-plane approach, which involved directing an 80 mm 22-gauge peripheral block needle (Stimuplex®, B Braun, Melsungen, Germany) into the thoracic paravertebral region. 3 mL of 0.9% saline was first administered in order to confirm the needle placement when it was determined that there was no vascular interference with aspiration. TPVB was provided by injecting 20 mL of 0.25% bupivacaine (Buvasin, Vem İlaç, İstanbul, Türkiye).

In group 2, with the in-plane technique, the block needle was directed, and we inserted the needle tip between the spinal transverse process and the anterior fascia of the erector spina muscle group. As soon as it was determined that there had been no vascular intervention, 3 mL of 0.9% saline was injected. After simultaneous monitoring of the hydro-dissection and distribution was also established, 20 mL of 0.25% bupivacaine was then injected to achieve ESPB.

The period between the block needle's insertion into the skin and its removal is referred to as the duration of block application. Complications defined as hypotension, bradycardia, vascular puncture, pneumothorax, paresthesia, total spinal block and local anesthetic toxicity were recorded if they occurred.

Twenty minutes after the block application, the sensory block was evaluated on the midclavicular line. Ice packs were used to test for cold sensations. If there was a sensory loss in the upper and lower two dermatomes at the Th-8 level, the block was deemed effective, and the patient was taken to the operating room.

General anesthesia induction was applied to all patients with 2 µg/kg fentanyl, 2-3 mg/kg propofol, and 0.6 mg/kg rocuronium bromide. We performed intubation with an appropriate size endotracheal tube 3 minutes after we administered the muscle relaxant. For the maintenance of anesthesia, 50% O_2 + 50% air and 6% desflurane (Suprane®, Baxter, USA) were used.

400 mg ibuprofen (Dorifen, Vem İlaç, İstanbul, Türkiye) i.v. was administered to all patients for postoperative analgesia approximately 10 minutes before the end of the operation. To prevent postoperative nausea and vomiting, 10 mg metoclopramide (Nastifran®, Menta Pharma, İstanbul, Türkiye) IV was administered to all patients. At the end of the surgery, the effect of the muscle relaxant was antagonized by using 2 mg/kg Sugammadex (Bridion®, Sanofi, Tekirdağ, Türkiye) after the removal of the inhaler agent and the patient was extubated, and then taken to the postoperative recovery room. Arrival time in the recovery room was accepted as the zero hour. An observer carried out the first VAS assessment there.

Afterward, the patients were followed up in the general surgery clinic. VAS scores up to the postoperative 24th-hour, 24-hour patient satisfaction and the presence of nausea or vomiting were analyzed and recorded. The time of the first analgesic requirement in the first 24 hours after

surgery was recorded. We performed postoperative pain assessment by the observer using the VAS. Patient satisfaction with analgesic therapy was recorded by a five-point Likert scale at the postoperative 24th hour with values between 1 (terrible) and 5 (very good).

When resting or dynamic VAS was greater than 4 in the postoperative follow-up, the patients received additional analgesic therapy. Pain severity categorized as 0-4 bearable pain; 5-6 mild pain; 7-8, moderate pain; 9-10 severe pain. According to the postoperative pain step treatment protocol, respectively, we used paracetamol for mild pain, tramadol for moderate pain, and meperidine for severe pain. If resting or dynamic VAS is still greater than 4 one hour after the analgesic application in the protocol, we switch to a higher-level analgesic.

Gender, age, height, weight, body mass index (BMI), ASA risk scores, and the operation times of the patients were recorded. Postoperative interventions were performed by a researcher who did not know to which study groups the patients belonged, and the data were recorded.

Statistical Analysis

Using the Kolmogorov-Smirnov test, Histogram, Skewness and Kurtosis coefficients, we investigated the normality assumptions of continuous variables. For continuous data, mean and standard deviation (mean ± standard deviation), and median (minimum-maximum) values are provided; for categorical variables, frequency (n) and percentage (%) values are provided. The connections between the categorical variables were examined using Pearson's chi-square (2) and Fisher's exact analysis, and the non-normally distributed continuous variables were compared with the two-level variables using the Mann-Whitney U test. All analyses were performed using the IBM SPSS.23 program, and the level of significance was agreed to be $p<0.05$.

The G*Power 3.1 (Faul, Erdfelder, Lang, and Buchner, 2007) application was used to calculate the necessary sample size prior to the data collection phase. The sample size was 51 for each group, for a total of 102, where the effect size was 0.5, the alpha level was 0.05, and the power was 80%.

RESULTS

Figure 1 shows the CONSORT diagram of enrollment for this study. Data from 102 patients, 61 (59.9%) women, and 41 (40.1%) men, were used in the final analysis. There were no statistically significant differences in the age, gender, weight, length, BMI, ASA scores, or comorbidity of the patients (Table 1).

The zero, 2nd, 4th, 8th, 12th, and 24th hour resting VAS scores did not differ

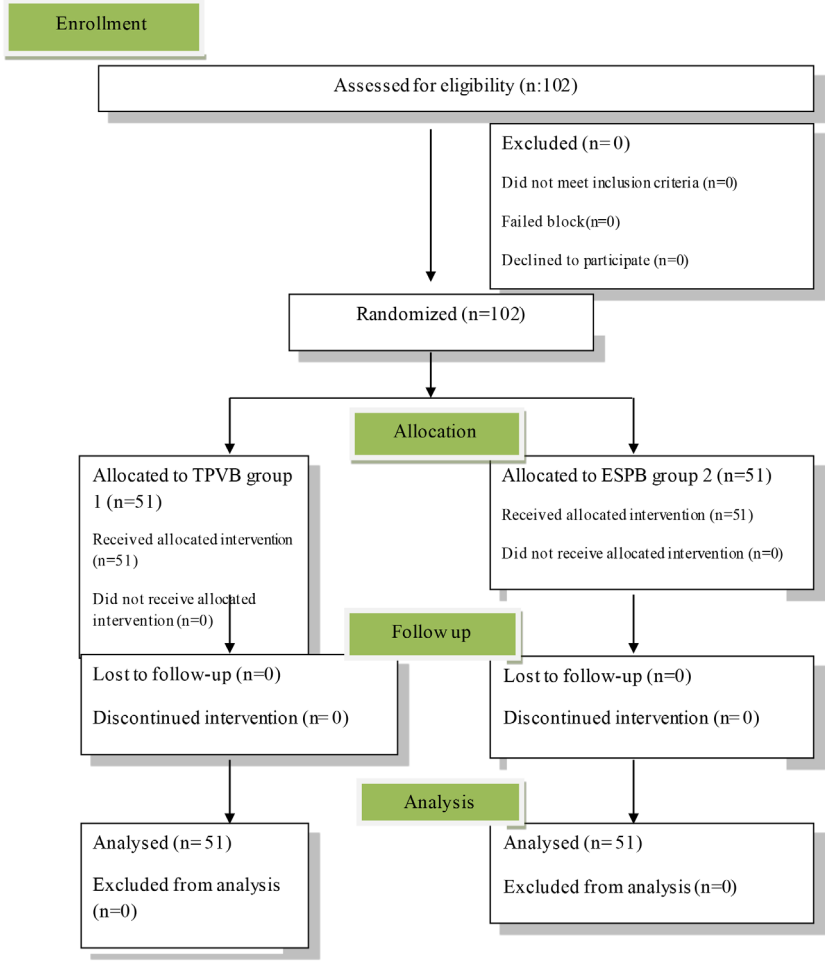

Figure 1. CONSORT flow chart describing participant progression through the study.

ESPB: Erector spinae plane block, TPVB: Thoracic paravertebral block.

statistically (p=0.131, 0.980, 0.888, 0.360, 0.217 and 0.301, respectively), and the dynamic VAS scores did not differ either (p=0.237, 0.750, 0.835, 0.479 0.422 and 0.489, respectively). Figure 2, 3 show mean resting and dynamic VAS scores according to block types.

The mean duration of block applications was 8.20±6.15 minutes in group 1, and 6.08±3.47 minutes in group 2 (p=0.156). The first analgesic requirement occurred at 3.57±5.46 hours postoperatively in group 1, while this value was 4.18±5.47 in group 2 (p=0.338).

There were no differences between the study groups regarding operation time (p=0.353), first mobilization time (p=0.054), or length of hospital stay (p=0.749). We found postoperative analgesia satisfaction scores to be considerably higher in group 1 (p<0.05) (Table 2).

In total, additional analgesic was given to 22 patients in group 1, and 28 patients in group 2. None of the patients needed a second dose of analgesic medication in either group. In group 1, paracetamol was administered to 14 (27.5%) patients for mild pain, and tramadol was administered to 8 (15.7%) patients for moderate pain. Since severe pain did not develop in group 1, meperidine was not administered. In addition, the number of patients who did not need analgesic treatment was 29 (56.9%) in group 1. In group 2, paracetamol was administered to 12 (23.5%) patients, tramadol was administered to 13 (25.5%) patients, and meperidine was administered to 3 (5.9%) patients. In group 2, 23 (45.1%) patients did not need analgesics (Table 3).

The number of patients with hypotension, bradycardia or both were equal in both groups. Shoulder pain was seen in 2 patients in group 1 postoperatively, while it was seen in 1 patient in group 2 (p=0.986). Nausea and vomiting occurred within the first 14 hours postoperatively. When the presence of nausea and vomiting and the time of nausea and vomiting were compared, we found no significant differences between the groups. Serious complications, such as local anesthetic toxicity, pneumothorax, and total spinal block were not experienced in either block type (Table 3).

Table 1. Sociodemographic and medical characteristics of the patients according to block types

	Group 1 (n=51)	Group 2 (n=51)	p
Gender (M/F)	24/27	17/34	0.161
Age	49.47±14.55	50.41±14.39	0.733
Weight (kg)	78.68±15.37	81.82±14.60	0.293
Length (cm)	166.82±9.68	165.07±8.19	0.328
BMI (kg/cm^2)	28.24±4.79	30.14±5.62	0.690
ASA score (1/2)	14/37	11/40	0.490
Comorbidity			0.249
None	15 (29.4)	11 (21.6)	
HT	6 (11.8)	8 (15.7)	
Asthma	1 (2.0)	3 (5.9)	
Anemia	2 (3.9)	0 (0.0)	
DM	1 (2.0)	5 (9.8)	
CAD	5 (9.8)	2 (3.9)	
Obesity	5 (9.8)	7 (13.7)	
HT + DM	5 (9.8)	4 (7.8)	
Other	11 (21.5)	11 (21.5)	

Values are expressed as frequency or mean ± standard deviation. M: Male, F: Female, BMI: Body mass index, ASA: American Society of Anesthesiologist class, HT: Hypertension, CAD: Coronary artery disease, DM: Diabetes mellitus, chi-square test was used.

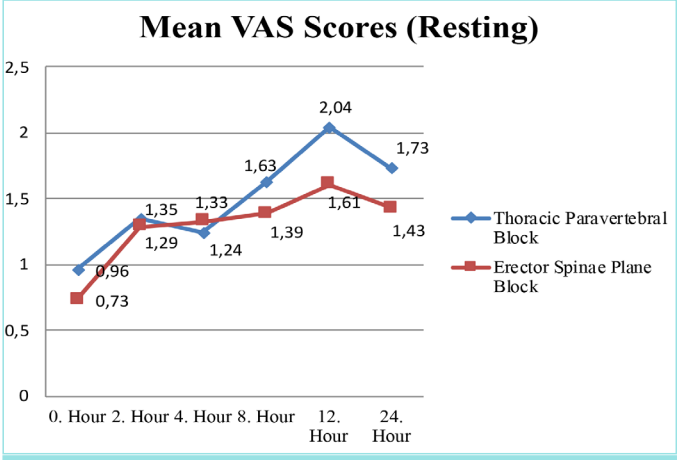

Figure 2. Mean resting VAS scores according to block types.
VAS: Visual analog scale.

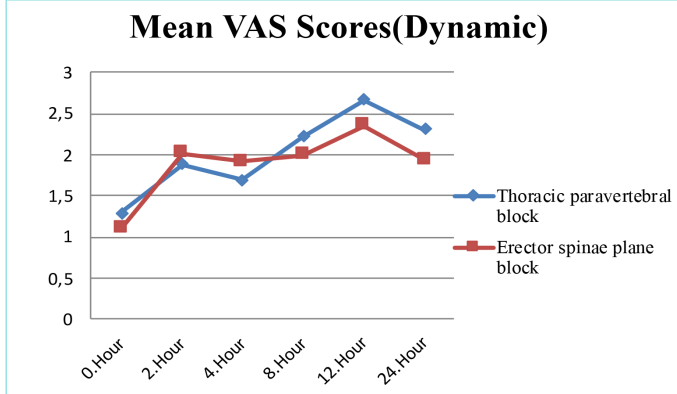

Figure 3. Mean dynamic VAS scores according to block types.
VAS; Visual Analog Scale.

Table 2. Comparison of medical characteristics of patients according to block types

	Group 1 Mean ± SD	Group 2 Mean ± SD	p
Duration of block application (minute)	8.20±6.15	6.08±3.47	0.156
Time of first analgesic requirement (hour)	3.57±5.46	4.18±5.47	0.338
Operation time (minute)	82.22±24.28	87.14±26.44	0.353
First mobilization time (hour)	7.24±1.80	6.56±1.29	0.054
Length of stay in hospital (day)	29.49±4.30	29.57±4.97	0.749
Patient satisfaction	**4.49±0.86**	**4.14±0.85**	**0.011**

Values are expressed as mean ± standard deviation. Mann-Whitney U test was used. SD: Standard deviation.

Table 3. Some medical characteristics of patients after block application according to block types

	Group 1	Group 2	Total	p
	n (%)	n (%)	n (%)	
Type of complication*				0.986
None	43 (84.3)	44 (86.3)	87 (85.3)	
Bradycardia	3 (5.9)	3 (5.9)	6 (5.9)	
Hypotension	1 (2.0)	1 (2.0)	2 (2.0)	
Bradycardia + hypotension	2 (3.9)	2 (3.9)	4 (3.9)	
Shoulder pain	2 (3.9)	1 (2.0)	3 (2.9)	
Performed analgesic drug*				0.102
None	29 (56.9)	23 (45.1)	52 (51.0)	
Paracetamol	14 (27.5)	12 (23.5)	26 (25.5)	
Tramadol	8 (15.7)	13 (25.5)	21 (20.6)	
Meperidine	0 (0.0)	3 (5.9)	3 (2.9)	
Presence of nausea*				0.603
Absence	41 (80.4)	43 (84.3)	84 (82.4)	
Presence	10 (19.6)	8 (15.7)	18 (17.6)	
Time of nausea*				0.378
1st hour	2 (20.0)	0 (0.0)	2 (11.1)	
2nd hour	3 (30.0)	1 (12.5)	4 (22.2)	
4th hour	3 (30.0)	3 (37.5)	6 (33.3)	
6th hour	0 (0.0)	1 (12.5)	1 (5.6)	
8th hour	1 (10.0)	2 (25.0)	3 (16.7)	
14th hour	1 (10.0)	1 (12.5)	2 (11.1)	
Presence of vomiting†				0.715
Absence	46 (90.2)	48 (94.1)	94 (92.2)	
Presence	5 (9.8)	3 (5.9)	8 (7.8)	
Time of vomiting*				0.407
2nd hour	2 (40.0)	1 (33.3)	3 (37.5)	
4th hour	1 (20.0)	1 (33.3)	2 (25.0)	
6th hour	1 (20.0)	0 (0.0)	1 (12.5)	
8th hour	1 (20.0)	0 (0.0)	1 (12.5)	
14th hour	0 (0.0)	1 (33.3)	1 (12.5)	

Values are expressed as frequency or percentage. *Pearson's chi-square test was used. †Fisher's exact test was used.

DISCUSSION

In this randomized clinical trial, the postoperative analgesic efficacy of US-guided TPVB and ESPB in LC was compared, and we showed both to have similar efficacy. There were no significant differences between the postoperative zero, 2nd, 4th, 8th, 12th, and 24th-hour resting and dynamic VAS scores. We found no significant differences in terms of comparisons of analgesic consumptions, the duration of block application, or postoperative nausea and vomiting.

There are many studies comparing these two block types in different operations, such as breast surgery and video-assisted thoracoscopic surgery (VATS). Although there are studies investigating the postoperative analgesic effects of these blocks separately in LC cases, we could not find any study comparing them.

It has been proven that the effects of both blocks on perioperative and postoperative analgesic efficiency, VAS scores, and additional analgesic requirements are significantly superior to control groups.[7,8] However, it has been reported that there is no statistically significant difference between the two blocks.[9,10] In another study comparing these two blocks in VATS, the authors reported that patients who underwent TPVB at the 1st, 2nd, and 24th hours postoperatively had lower resting pain scores, and dynamic pain scores were similar in both block groups.[11] In our study, there were no significant differences in terms of analgesic requirements or VAS scores. Although not statistically significant, the mean VAS scores increased up to the 12th hour postoperatively in both types of block.

In the study of El Ghamry and Amer[12] in which they compared both blocks in modified radical mastectomy operations, the superiority of the blocks over each other could not be shown. They concluded both blocks reduced intra-operative and postoperative opioid consumption.[12] No significant difference was found in another study between the blocks in modified radical mastectomies comparing the first analgesic requirement, the total dose of rescue analgesia, and pain scores.[13]

A published meta-analysis suggested that the type of operation may play a role when comparing the analgesic efficacy of these blocks. According to the results of that study, it was emphasized that TPVB was good in thoracic surgeries, while the analgesic efficacies of these two blocks were found to be similar in breast surgeries.[14]

It was reported that postoperative pain scores with TPVB applied at Th-6 and Th-7 levels in LC were significantly lower in a TPVB group compared to a control group, and TPVB also reduced postoperative tramadol consumption.[15,16] Li et al.[17] showed that in LC, TPVB application provided better peri-operative analgesia and prolonged block time in patient groups who underwent TPVB with the addition of an adjuvant.

In the study by Tulgar et al.[18], in which they examined the postoperative analgesic effects of ESPB in LC, they concluded that the postoperative first 3 hours of pain scores were lower in the block group than in the control group. Tramadol requirement in the first 12 hours postoperatively was found to be lower in the block group.[18] In our study, postoperative analgesic requirements were similar in both block groups.

Since a TPVB is more invasive, the duration of block administration has been found to be significantly longer in many studies.[8,14] Although it was not statistically significant in our study, the mean duration of block application was longer in the TPVB group.

In a case report published by Beyaz et al.[19], TPVB was performed on two patients who underwent cholecystectomy, and complications such as bradycardia and hypotension developed. In our study, we observed very few cases with hypotension and bradycardia.

Study Limitations

The fact that so few patients were enrolled was the primary drawback of the current study. In order to verify these findings, a larger sample is needed. In addition, if we had used a patient-controlled analgesia device, we could have produced more objective results.

CONCLUSION

Postoperative pain management is essential for a swift recovery from surgery, a brief hospital stay, and a quick return to regular activities. In

our research, we found that the postoperative analgesic effectiveness of ESPB and US-guided TPVB were comparable in LC. We believe that because of its analgesic quality and simplicity of administration, ESPB is a practical alternative to TPVB for postoperative pain control.

MAIN POINTS

- Laparoscopic cholecystectomy, which is frequently carried out today, requires postoperative analgesia.
- Nowadays, regional anesthesia methods are more and more common.
- Since ESPB carries a lower anatomical risk than TPVB, it is a better choice when compared with TPVB. In our study, no significant block-related side effects were observed.

ETHICS

Ethics Committee Approval: This study was approved by the Ethics Committee of Afyonkarahisar Health Sciences University Faculty of Medicine Ethics Committee (approval number: 2021/3, date: 11.09.2020).

Informed Consent: Informed consent was obtained from all participants.

Authorship Contributions

Surgical and Medical Practices: B.A.B., R.S., M.A., E.D.B., Concept: B.A.B., R.S., M.A., E.D.B., Design: B.A.B., R.S., M.A., E.D.B., Data Collection and/or Processing: B.A.B., M.A., Analysis and/or Interpretation: B.A.B., R.S., E.D.B., Literature Search: B.A.B., R.S., Writing: B.A.B., R.S., M.A., E.D.B.

DISCLOSURES

Conflict of Interest: No conflict of interest was declared by the authors.

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REFERENCES

1. Kim EJ, Koo BN, Choi SH, Park K, Kim MS. Ultrasonographic optic nerve sheath diameter for predicting elevated intracranial pressure during laparoscopic surgery: a systematic review and meta-analysis. Surg Endosc. 2018; 32(1): 175-82.
2. Barazanchi AWH, MacFater WS, Rahiri JL, Tutone S, Hill AG, Joshi GP, et al. Evidence-based management of pain after laparoscopic cholecystectomy: a PROSPECT review update. Br J Anaesth. 2018; 121(4): 787-803.
3. Buvanendran A, Kroin JS. Multimodal analgesia for controlling acute postoperative pain. Curr Opin Anaesthesiol. 2009; 22(5): 588-93.
4. Forero M, Adhikary SD, Lopez H, Tsui C, Chin KJ. The Erector Spinae Plane Block: A Novel Analgesic Technique in Thoracic Neuropathic Pain. Reg Anesth Pain Med. 2016; 41(5): 621-7.
5. Tulgar S, Ahiskalioglu A, De Cassai A, Gurkan Y. Efficacy of bilateral erector spinae plane block in the management of pain: current insights. J Pain Res. 2019; 12: 2613.
6. Bang S. Erector spinae plane block: an innovation or a delusion? Korean J Anesthesiol. 2019; 72(1): 1-3.
7. Yavuz G, Aksu C, Kuş A, Yörükoğlu UH. Erector spinae plane block and thoracic paravertebral block for breast surgery compared to IV-morphine: a randomized controlled trial. J Clin Anesth. 2020; 59: 84-8.
8. Çiftçi B, Ekinci M, Çelik EC, Tukaç İC, Gölboyu BE, Günlüoğlu MZ, et al. Ultrasound-guided erector spinae plane block and thoracic paravertebral block for postoperative analgesia management following video-assisted thoracic surgery: A prospective, randomized, controlled study. Anesthesiol Reanim Spec Soc. 2020; 28(3): 170-8.
9. Gürkan Y, Aksu C, Kuş A, Yörükoğlu UH. Erector spinae plane block and thoracic paravertebral block for breast surgery compared to IV-morphine: A randomized controlled trial. J Clin Anesth. 2020; 59: 84-8.
10. Zhao H, Xin L, Feng Y. The effect of preoperative erector spinae plane vs. paravertebral blocks on patient-controlled oxycodone consumption after video-assisted thoracic surgery: A prospective randomized, blinded, non-inferiority study. J Clin Anesth. 2020; 62: 109737.
11. Taketa Y, Irisawa Y, Fujitani T. Comparison of ultrasound-guided erector spinae plane block and thoracic paravertebral block for postoperative analgesia after video-assisted thoracic surgery: a randomized controlled non-inferiority clinical trial. Reg Anesth Pain Med. 2019: 100827.
12. El Ghamry MR, Amer AF. Role of erector spinae plane block versus paravertebral block in pain control after modified radical mastectomy. A prospective randomised trial. Indian J Anaesth. 2019; 63(12): 1008-14.
13. Agarwal S, Bharati SJ, Bhatnagar S, Mishra S, Garg R, Gupta N, et al. The comparison of the efficacy of ultrasound-guided paravertebral block versus erector spinae plane block for postoperative analgesia in modified radical mastectomy: A randomized controlled trial. Saudi J Anaesth. 2021; 15(2): 137-43.
14. Xiong C, Han C, Zhao D, Peng W, Xu D, Lan Z. Postoperative analgesic effects of paravertebral block versus erector spinae plane block for thoracic and breast surgery: A meta-analysis. PLoS One. 2021; 16(8):e0256611.
15. Gündost L, Koltka K, Sivrikoz N, Turhan Ö, Hündür D, Yavru HA, et al. Effects of paravertebral block and intravenous analgesic methods on postoperative pain management and opioid consumption in laparoscopic cholecystectomies]. Agri. 2020; 32(4): 202-7.
16. Aydin G, Aydin O. The Efficacy of Ultrasound-Guided Paravertebral Block in Laparoscopic Cholecystectomy. Medicina (Kaunas) 2018; 54(5): 75.
17. Li J, Li L, Zhang X, Li C, He D, Zhang J, et al. Paravertebral Block with Compound Betamethasone in Laparoscopic Cholecystectomy: A Double-blind Randomized Controlled Trial. Cureus 2019; 11(10): e6023.
18. Tulgar S, Kapakli MS, Senturk O, Selvi O, Serifsoy TE, Ozer Z. Evaluation of ultrasound-guided erector spinae plane block for postoperative analgesia in laparoscopic cholecystectomy: A prospective, randomized, controlled clinical trial. J Clin Anesth. 2018; 49: 101-6.
19. Beyaz SG, Özocak H, Ergönenç T, Erdem AF. The thoracic paravertebral block performed for open cholecystectomy operation in order to anesthesia: Two cases. Anesth Essays Res. 2014; 8(2): 239-42.