ARAŞTIRMA MAKALESİ / *RESEARCH ARTICLE*

Comparative Analysis of the Postoperative Effects of Erector Spina Plane Block and Transversus Abdominal Plane Block in Patients Undergoing Laparoscopic Surgery

Laparoskopik Cerrahi Geçiren Hastalarda Erektör Spina Düzlem Bloğu ve Transversus Abdominal Düzlem Bloğunun Postoperatif Etkilerinin Karşılaştırmalı Analizi

Umit Karatepe[1], Mesut Oterkus[2]

[1]Department of Anesthesiology and Reanimation, Elazig Fethi Sekin City Hospital, Elazig; [2]Department of Anesthesiology and Reanimation, Malatya Turgut Ozal University Faculty of Medicine, Malatya, Türkiye

ABSTRACT

Aim: *In the postoperative period, nerve blocks are increasingly used as alternatives to systemic medications for factors such as pain, nausea and vomiting, opioid consumption, and early mobilization. We aimed to compare the effects of Erector Spina Plane (ESP) Block and Transversus Abdominal Plane (TAP) Block on factors such as pain, nausea and vomiting, and opioid consumption in the postoperative period.*

Materials and methods: *Demographic data, postoperative pain score, nausea and vomiting, opioid consumption, mobilization time, and patient satisfaction data of patients who underwent laparoscopic cholecystectomy (LC) and received ESP and TAP blocks were recorded.*

Results: *In our study, which included 185 cases, both groups showed similar demographic characteristics. In the ESP group, postoperative pain, nausea and vomiting, opioid consumption, and mobilization time were shorter, and the time to first analgesia and patient satisfaction were higher.*

Conclusion: *ESP block provides more effective analgesia than TAP block in patients undergoing LC surgery, reducing opioid requirements and increasing patient satisfaction.*

Key words: *erector spina plane block; transversus abdominal plane block; postoperative analgesia; laparoscopic cholecystectomy; patient satisfaction; postoperative nausea and vomiting*

ÖZET

Amaç: *Ameliyat sonrası dönemde, ağrı, bulantı ve kusma, opioid tüketimi ve erken mobilizasyon gibi faktörler için sistemik ilaçlara alternatif olarak sinir blokları giderek daha fazla kullanılmaktadır. Bu çalışmada, ameliyat sonrası dönemde ağrı, bulantı ve kusma ve opioid tüketimi gibi faktörler üzerindeki etkilerini karşılaştırmak amacıyla Erector Spina Plane (ESP) Bloğu ve Transversus Abdominal Plane (TAP) Bloğu'nun etkilerini karşılaştırmayı amaçladık.*

Gereç ve Yöntem: *Laparoskopik kolesistektomi (LC) geçiren ve ESP ve TAP blokları uygulanan hastaların demografik verileri, ameliyat sonrası ağrı skoru, bulantı ve kusma, opioid tüketimi, mobilizasyon süresi ve hasta memnuniyeti verileri kaydedildi.*

Bulgular: *Toplam 185 vakayı içeren araştırmamızda, her iki grup da demografik veriler açısından benzerlikler gösterdi. Erector Spina Plane grubunda, postoperatif ağrı, bulantı ve kusma, opioid tüketimi, mobilizasyon süresi daha kısa, ilk analjeziye başlama süresi ve hasta memnuniyeti ise daha yüksekti.*

Sonuç: *ESP bloğu, LC ameliyatı geçiren hastalarda TAP bloğuna göre daha etkili analjezi sağlar, opioid ihtiyacını azaltır ve hasta memnuniyetini artırır.*

Anahtar kelimeler: *erector spina plane bloğu; transversus abdominal plane bloğu; postoperatif analjezi; laparoskopik kolesistektomi; hasta memnuniyeti; postoperatif bulantı ve kusma*

İletişim/Contact: *Mesut Öterkuş, Malatya Turgut Özal University Faculty of Medicine, Department of Anesthesiology and Reanimation, Malatya, Türkiye* • ***Tel:*** *+90 05438550954* • ***E-mail:*** *oterkusmesut1@gmail.com* • ***Geliş/Received:*** *03.04.2026* • ***Kabul/Accepted:*** *29.06.2026*

ORCID: *Ümit Karatepe : 0000-0001-8561-4455* • *Mesut Öterkuş: 0000-0003-1025-7662*

Kafkas J Med Sci 2026; 16(2):232–238
doi: 10.5505/kjms.2026.03185

Introduction

Laparoscopic surgery is preferred over open surgery for many procedures, especially cholecystectomy, due to its less invasive nature and shorter rehabilitation period. As with all surgical procedures, postoperative analgesia is a fundamental element of anesthesia. In laparoscopic cholecystectomy (LC), relieving postoperative pain caused by incision pain, pneumoperitoneum pain, shoulder blade pain, and atelectasis due to pain-induced respiratory restriction contributes to increased patient satisfaction by shortening recovery and hospital stay (1,2). In addition, early mobilization reduces gastrointestinal complications and thromboembolic events (3,4).

Although the usual general method for postoperative analgesia in LC is the use of systemic nonsteroidal anti-inflammatory drugs (NSAIDs) and/or opioids, the side effect profile of these drugs, along with the increasing use of ultrasonography, has led to a rise in the practical use of regional methods such as Erector Spina Plane Block (ESP) and Transversus Abdominal Plane Block (TAP).

In the TAP block, first described by Rafi et al., the aim is to provide analgesia in the anterior and lateral abdominal walls by blocking the spinal nerves in the T6-L1 vertebral space (5). The ESP block, first described by Forero et al., is a paraspinal block that extends paravertebrally and can cause both somatic and visceral pain (6)

The goal of this study is to compare the effects of the ESP block and TAP block, used as alternatives to systemic analgesics, on pain, postoperative nausea and vomiting (PONV), need for additional analgesia, mobilization time, and patient satisfaction.

Materials and Methods

Study Design

This study was designed as a retrospective cohort study and was initiated in accordance with the Declaration of Helsinki and STROBE after obtaining approval from the local ethics committee (date: 05.12.2024, no: 2024/5–21). Informed consent was obtained from all patients and/or their legal representatives. Data for the study were obtained from medical records, the automation system, and anesthesia follow-up forms. Patients were classified into two groups: cases who underwent Erector Spina Plane (ESP) block and Transversus Abdominal Plane (TAP) block.

Study Population

The study included cases that underwent cholecystectomy via laparoscopic surgery (LC) and those who underwent Erector Spina Plane (ESP) block and Transversus Abdominal Plane Block (TAP) following surgery, with ASA (American Society of Anesthesiologists) physical status scores I-III, aged 18–65 years. Cases with local anesthetic allergies, advanced renal, cardiac, and hepatic impairment that could affect the duration of local anesthetic, patients for whom data were unavailable, and patients with neurological deficits were excluded from this research (Fig. 1)

Block Procedure

After the LC procedure was completed, while the cases were still under general anesthesia, the area to be blocked was disinfected with 10% povidone-iodine and covered with sterile drapes. To ensure standardization across both groups, 20 cc of 0.25% 50 mg bupivacaine was prepared.

In the ESP group, a linear USG probe was positioned parasagittal to visualize the transverse processes and the erector spinae muscle (ESM). The block was applied unilaterally and was performed at the T7–T9 vertebral levels. A Tuohy needle was then used to inject local anesthetic between the transverse process and the deep fascia of the ESM, and hydro dissection was performed to separate the transverse process.

In the TAP block group, the linear USG probe was positioned transversely along the anterior axillary line, between the subcostal margin and the iliac crest, to visualize the external oblique muscle, the internal oblique muscle, the transversus abdominis muscle, and the peritoneum. The block was applied unilaterally. Using the in-plane method, a Tuohy needle was used to inject local anesthetic between the fascia of the internal oblique muscle and the fascia of the transversus abdominis muscle, and hydro dissection was performed to separate both fascias. Patients requiring additional analgesia in the postoperative period received tramadol and/or an NSAID (dexketoprofen).

Measurements

Demographic data of the patients, time to first anesthetic administration, analgesic doses, nausea and vomiting at 6 and 12 hours postoperatively, need for antiemetics, time of mobilization and time of oral initiation, pain levels at rest and during movement at 0,

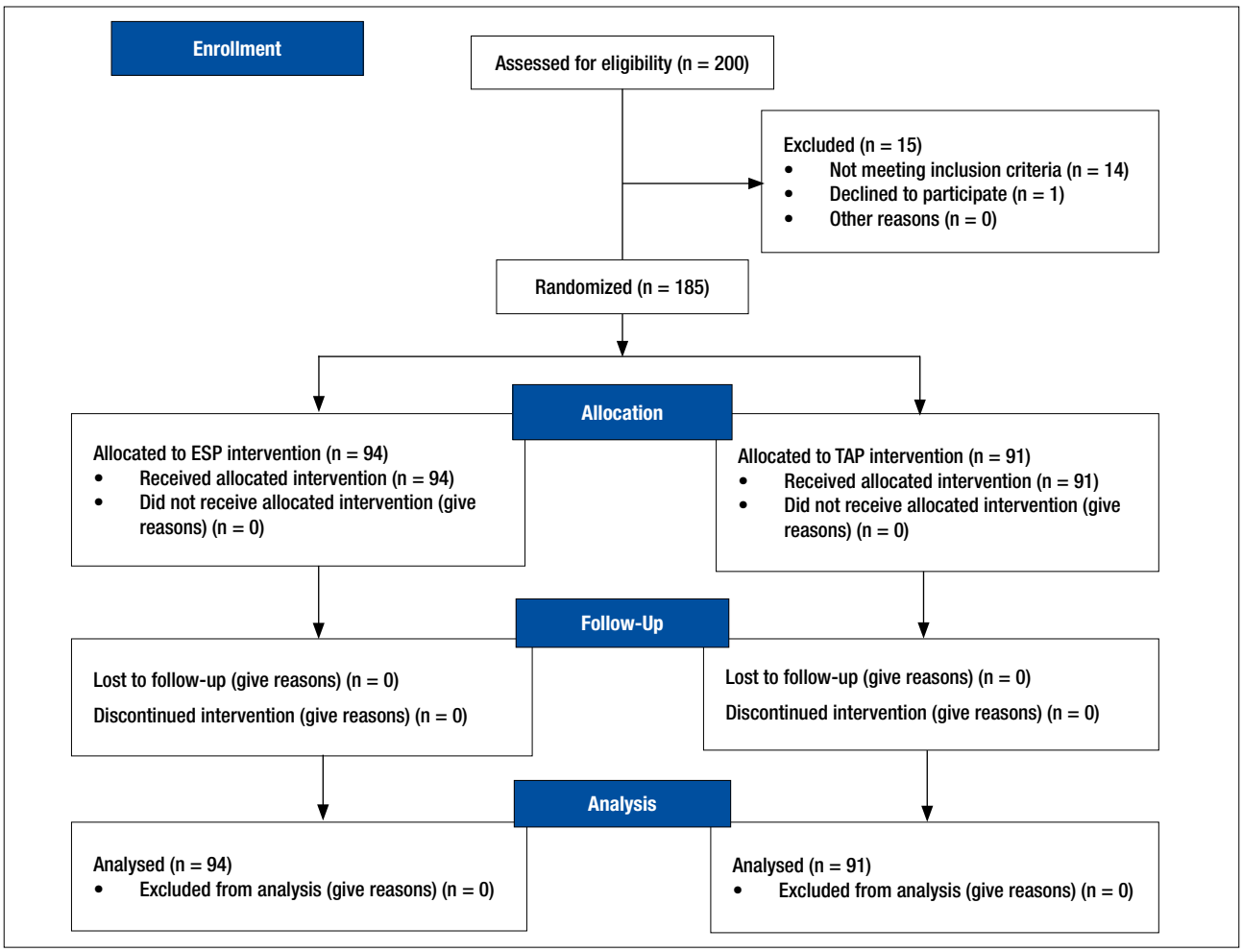


Figure 1. *Flow Diagram*

1, 2, 4, 6, 8, 12 and 24 hours postoperatively using the Visual Analog Scale (VAS), and complications were recorded. Patient satisfaction was evaluated postoperatively using a five-point Likert scale, ranging from 1 (very dissatisfied) to 5 (very satisfied).

Statistical Methods

Statistical analyses were performed using IBM Statistical Package for Social Sciences (SPSS) program version 25.0 (IBM Corp., Armonk, NY, USA). Continuous variables were assessed for normality using the Shapiro-Wilk test. Normally distributed continuous variables were expressed as mean ± standard deviation (SD) and compared between groups using the independent samples t-test. Non-normally distributed continuous variables were presented as medians with interquartile ranges (IQRs) and analyzed using the Mann-Whitney U test. Categorical variables were expressed as frequencies and percentages, and comparisons were made using Pearson's chi-square test. A p-value of less than 0.05 was considered statistically significant for all analyses.

Results

A total of 185 cases were added to the study, with 94 in the ESP group and 91 in the TAP group. Demographic and clinical characteristics of the study population are presented in Table 1. There were no significant differences between the two groups in terms of gender dispersion, mean age or ASA classification

Postoperative nausea and vomiting (PONV) rates at 6 hours postoperatively were lower in the ESP group (12.8% vs. 24.2%, p=0.045). However, 24-hour PONV rates were similar between the groups (8.5% vs. 12.1%, p=0.423). The need for antiemetics was lower in the ESP group (P=0.015). The time to initiation of oral feeding and mobilization was also shorter in the ESP group than in the TAP group (p <0.001). Patient

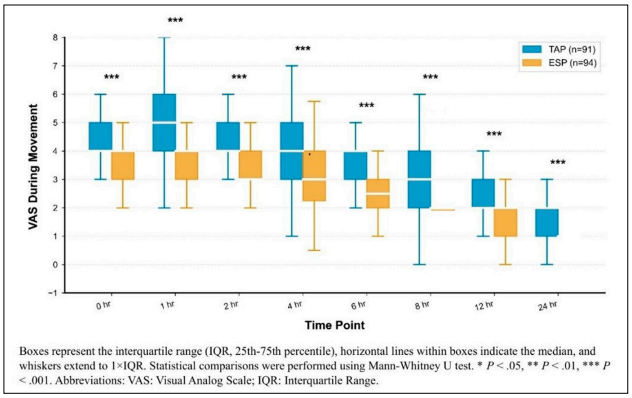
Table 1. *Demographic and clinical characteristics of the study population*

Variable	ESP (n=94)	TAP (n=91)	p-value
Gender, n (%)			0.638
Male	20 (21.3)	22 (24.2)	
Female	74 (78.7)	69 (75.8)	
Age (years), Mean ± SD	46.78 ± 10.09	47.73 ± 11.54	0.552
ASA Classification, n (%)			0.576
ASA I	38 (40.4)	38 (41.8)	
ASA II	47 (50.0)	48 (52.7)	
ASA III	9 (9.6)	5 (5.5)	
Co-morbidities, n (%)			0.352
Absent	35 (37.2)	40 (44.0)	
Present	59 (62.8)	51 (56.0)	

Data are presented as n (%)[Pearson Chi-square] or mean ± standard deviation [t test].
ESP: erector spinae plane block; TAP: transversus abdominis plane block; ASA: American Society of Anesthesiologists physical status classification.
Comorbid diseases: Hypertension, diabetes mellitus, ischemic heart disease, asthma, etc.

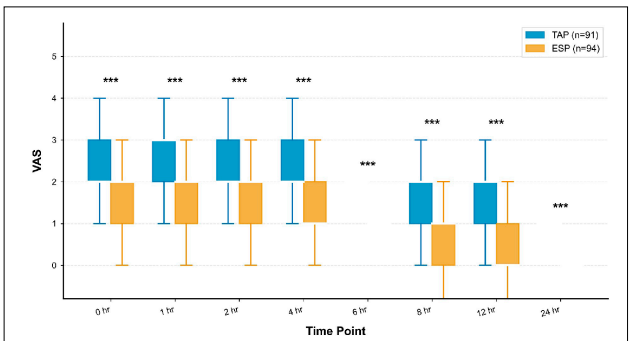
satisfaction scores were higher in the ESP group than in the TAP group (p <0.001). Shoulder tip pain at 1 hour postoperatively was lower in the ESP group (Table 2).

Pain scores with VAS at rest and during movement are presented in Table 3. At all measured time points, the ESP group demonstrated lower VAS scores than the TAP group (all p <0.001). A maximum VAS score over the 24 hours was lower in the ESP group than in the TAP group (p <0.001). (Table 3, Fig. 2, Fig. 3).



Boxes represent the interquartile range (IQR, 25th-75th percentile), horizontal lines within boxes indicate the median, and whiskers extend to 1×IQR. Statistical comparisons were performed using Mann-Whitney U test. * $P < .05$, ** $P < .01$, *** $P < .001$. Abbreviations: VAS: Visual Analog Scale; IQR: Interquartile Range.

Figure 2. *VAS During Movement Comparison Between Groups*



Boxes represent the interquartile range (IQR, 25th-75th percentile), horizontal lines within boxes indicate the median, and whiskers extend to 1×IQR. Boxplots could not be displayed at the 6th and 24th hours because the interquartile range (IQR) was zero. Statistical comparisons were performed using Mann-Whitney U test. * $P < .05$, ** $P < .01$, *** $P < .001$.
Abbreviations: VAS: Visual Analog Scale; IQR: Interquartile Range.

Figure 3. *VAS Rest Comparison Between Groups.*

Table 2. *Postoperative clinical outcomes*

Variable	ESP (n=94)	TAP (n=91)	p-value
Time to first analgesic (min), Mean ± SD	662.10 ± 102.97	552.78 ± 132.17	**<0.001**
Tramadol consumption (mg), Median (IQR)	0.0 (50.0)	100.0 (100.0)	**<0.001**
NSAID consumption (mg), Median (IQR)	100.0 (100.0)	100.0 (100.0)	0.707
PONV 0-6 hours, n (%)	12 (12.8)	22 (24.2)	**0.045**
PONV 6-24 hours, n (%)	8 (8.5)	11 (12.1)	0.423
Antiemetic requirement, n (%)	19 (20.2)	33 (36.3)	**0.015**
Time to oral intake (hours), Median (IQR)	5.0 (2.0)	7.0 (2.0)	**<0.001**
Time to mobilization (hours), Median (IQR)	5.0 (2.0)	7.0 (2.0)	**<0.001**
Patient satisfaction score, Median (IQR)	5.0 (0.0)	4.0 (1.50)	**<0.001**
Shoulder tip pain NRS at 1h, Median (IQR)	0.0 (1.0)	2.0 (1.0)	**<0.001**

Data are presented as n (%) [Pearson Chi-Square test], mean ± standard deviation [T test], or median (interquartile range) [Mann-Whitney U test].
ESP: erector spinae plane block; TAP: transversus abdominis plane block; NSAID: nonsteroidal anti-inflammatory drug; PONV: postoperative nausea and vomiting; MME: morphine milligram equivalents; NRS: numerical rating scale.
P<0.05 is significant.

Table 3. *Visual analog scale (VAS) pain scores*

Time Point	ESP (n=94)	TAP (n=91)	p-value
VAS at Rest, Median (IQR)			
Immediate postoperative (0h)	2.00 (1.00)	2.00 (1.00)	**<0.001**
1 hour	2.00 (1.00)	3.00 (1.00)	**<0.001**
2 hours	2.00 (1.00)	2.00 (1.00)	**<0.001**
4 hours	1.00 (1.00)	2.00 (1.00)	**<0.001**
6 hours	1.00 (0.00)	2.00 (0.00)	**<0.001**
8 hours	1.00 (1.00)	2.00 (1.00)	**<0.001**
12 hours	0.00 (1.00)	2.00 (1.00)	**<0.001**
24 hours	0.00 (0.00)	1.00 (0.00)	**<0.001**
Maximum VAS 0-24h	2.00 (0.00)	3.00 (1.00)	**<0.001**
VAS During Movement, Median (IQR)			
Immediate postoperative (0h)	4.00 (1.00)	4.00 (1.00)	**<0.001**
1 hour	4.00 (1.00)	5.00 (2.00)	**<0.001**
2 hours	3.00 (1.00)	4.00 (1.00)	**<0.001**
4 hours	3.00 (1.75)	4.00 (2.00)	**<0.001**
6 hours	2.50 (1.00)	4.00 (1.00)	**<0.001**
8 hours	2.00 (0.00)	3.00 (2.00)	**<0.001**
12 hours	2.00 (1.00)	2.00 (1.00)	**<0.001**
24 hours	1.00 (0.00)	2.00 (1.00)	**<0.001**
Maximum VAS 0-24h	4.00 (1.00)	6.00 (1.00)	**<0.001**

Data are presented as median (interquartile range).
VAS: visual analog scale (0-10); ESP: erector spinae plane block; TAP: transversus abdominis plane block; IQR: interquartile range.
All comparisons between groups were statistically significant ($p < 0.001$).

Discussion

Although assessments of the ESP and TAP blocks in relation to systemic analgesics exist, studies comparing the two blocks are scarce. Therefore, we believe this study will contribute to the literature. Our results show that in the ESP block, the time to first analgesic administration, opioid amount, PONV at 6 hours, antiemetic requirement, mobilization, time to initiation of oral intake, patient satisfaction, shoulder tip pain, and VAS scores in both stationary and active states were significantly lower.

Although LC is a less invasive procedure with fewer complications compared to other surgeries, postoperative pain, PONV, and shoulder tip pain reduce patient satisfaction. While systemic analgesics, lower-pressure laparoscopy, and local analgesia at port sites are used to address these issues, the ESP and TAP blocks are considered more effective (7–10).

Postoperative pain management is an integral part of anesthesia. In our study, rather than classical methods, methods involving blocking of spinal nerves and their branches, such as the ESP and TAP blocks, are becoming increasingly common. Bava et al. found that the TAP block provided better analgesia and higher patient satisfaction than local anesthesia applied to the port catheter site in patients undergoing TAP block (11). In their 2022 article, Alsharari et al. evaluated the results of numerous studies and showed that the TAP block provides effective analgesia and reduces opioid consumption (12). In the same publication, they stated that this effectiveness is affected by dose and concentration, and recommended an application dose of 0.4 mg/kg, 20 cc. While long-acting bupivacaine was used most often, as in our study, it should not be forgotten that the local anesthetic's duration of action is also an important factor. However, López-Ruiz et al. stated that while the TAP block has analgesic efficacy, it is not an effective anesthesia method for postoperative analgesia and reducing opioid use (13).

Another group of research, the ESP block, is a block method used over the last 10 years and can be used in breast and lower and upper abdominal surgeries by blocking spinal nerves with paravertebral extension (14,15). Atici et al. indicated that ESP block in open nephrectomies reduced opioid use and increased patient satisfaction by providing adequate analgesia(16). Similar to other studies in the literature, they indicated that ESP blockade provides more effective analgesia (17,18). In their studies comparing paravertebral block (PVB), ESP block, and systemic analgesics, Yilmaz et al. showed that although both blocks reduced opioid use, PVB provided more effective analgesia than ESP block (19).

In our study, comparing analgesic efficacy, both the static and dynamic pain scores (VAS) were lower in the ESP group at all measurement times. Furthermore, opioid consumption and analgesic needs were significantly lower in the ESP group. As a natural consequence, cases in the ESP group mobilized earlier. While most studies generally measure pain and opioid consumption, mobilization is assessed later. It is expected that initiating mobilization earlier will minimize potential complications. Unfortunately, there are not enough studies comparing these two types of blocks.

Elshazly et al., in their study of 60 patients undergoing bariatric surgery, reported that patients in the ESP group experienced better analgesia and a greater reduction in opioid consumption compared to those undergoing TAP block, mirroring our study (20). Additionally, in these cases, the initial need for analgesia was longer in

the ESP group. Warner et al. reported that while there was no statistically significant difference between the TAP block and the ESP block, clinically significant pain and opioid consumption were lower in the ESP group (21). In a meta-analysis by Zewdu et al., the ESP block was more effective than the TAP block in LC, both at rest and during movement, and in reducing opioid consumption (22). Although the exact mechanism of action of the ESP block in analgesic efficacy is not fully understood, it may differ from the TAP block in that it provides both visceral and sensory block (23). However, contrary to other studies, Eksteen et al. reported that analgesic effectiveness and patient satisfaction were similar between the two blocks in their study of patients who underwent cesarean section (24).

Looking at the secondary outcomes of our study, PONV, shoulder tip pain, and time to oral initiation were lower in the ESP group. As a natural consequence of the lower PONV, the need for antiemetics was even lower in the ESP group. In their comparative meta-analysis of cesarean section operations, Hussain et al. found that TAP block significantly reduced PONV compared with intrathecal morphine, whereas ESP block showed no difference(25). In their 2024 study, Zewdu et al., unlike our research, stated that there was no difference in the effects of ESP block and TAP block on PONV (26). We believe that the effect of the ESP block on PONV compared to the TAP block in our study may be due to its greater reduction in opioid consumption, thereby decreasing the incidence of opioid side effects. Another study involving patients who underwent laparoscopic hysterectomy similarly found that both block methods had a similar effect on PONV (27).

Early mobilization is a crucial factor in improving healing and reducing the risk of side effects after surgery. In our study, we found better results with ESP block in early mobilization compared to TAP block. This effect stems from the fact that ESP block has a greater spread and therefore a greater analgesic potential. Furthermore, although more pronounced in the ESP block, reducing opioid consumption in both blocks also reduces gastric motility slowing, another side effect of opioids; therefore, earlier gas and stool expulsion and early initiation of oral intake accelerate the recovery process (28,29).

Our study has some limitations. Our primary limitation is that our study is single-center. Therefore, the number of cases and consequently the data are limited. Another limitation is the absence of a control group with systemic analgesics, although the main aim was to compare two groups.

Conclusion

Data analysis showed that ESP block reduced pain more effectively than TAP block, both at rest and during movement. While our study favored ESP for its effect on PONV, other studies do not support this. Additionally, early mobilization, reduced opioid consumption, shorter time to the first additional analgesic requirement, and improved patient satisfaction suggest that ESP block may be more successful.

References

1. Valencia L, Becerra-Bolaños Á, Rodríguez-Sánchez R, Ojeda N, Rodríguez-Pérez A. Postoperative pulmonary complications after laparoscopic surgery: risk factors and predictive scores. Medicina (Kaunas). 2025;61(9):1635. https://doi.org/10.3390/medicina61091635
2. Li X, Li K. Time characteristics of shoulder pain after laparoscopic surgery. JSLS. 2021;25(2):e2021. https://doi.org/10.4293/JSLS.2021.00027
3. Jamshidi M, Rahimi B, Gilani N. Laparoscopic and open surgery methods in managing surgical intussusceptions: A randomized clinical trial of postoperative complications. Asian J Endosc Surg. 2022;15(1):56–62. https://doi.org/10.1111/ases.12965
4. Kano D, Hu C, Thornley CJ, Cruz CY, Soper NJ, Preston JF. Risk factors associated with venous thromboembolism in laparoscopic surgery in non-obese patients with benign disease. Surg Endosc. 2023;37(1):592–606. https://doi.org/10.1007/s00464-022-09361-0
5. Rafi AN. Abdominal field block: a new approach via the lumbar triangle. Anaesthesia. 2001;56(10):1024–1026. https://doi.org/10.1111/j.1365-2044.2001.2279-40.x
6. 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):621–627. https://doi.org/10.1097/AAP.0000000000000451
7. Manıcı M, Kalyoncu I, Yılmaz MU, Mendeş E, Uymaz DS, Balık E, et al. Comparison of erector spinae plane block and rectus sheath block for postoperative analgesia in patients undergoing laparoscopic cholecystectomy: a retrospective non-inferiority study. Ulus Travma Acil Cerrahi Derg. 2025;31(3):242–248. https://doi.org/10.14744/tjtes.2024.77756
8. Hirsch M, Tariq L, Duffy JM. Effect of local anesthetics on postoperative pain in patients undergoing gynecologic laparoscopy: a systematic review and meta-analysis of randomized trials. J Minim Invasive Gynecol. 2021;28(10):1689–1698. https://doi.org/10.1016/j.jmig.2021.04.024

9. Asgari Z, Hosseini R, Rastad H, Hosseini L. Does peritoneal suction drainage reduce pain after gynecologic laparoscopy? Surg Laparosc Endosc Percutan Tech. 2018;28(2):73–76. https://doi.org/10.1097/SLE.0000000000000490
10. Ravndal C, Vandrevala T. Preemptive local anesthetic in gynecologic laparoscopy and postoperative movement-evoked pain: a randomized trial. J Minim Invasive Gynecol. 2016;23(5):775–780. https://doi.org/10.1016/j.jmig.2016.03.009
11. Bava EP, Ramachandran R, Rewari V, Bansal VK, Trikha A. Analgesic efficacy of ultrasound guided transversus abdominis plane block versus local anesthetic infiltration in adult patients undergoing single incision laparoscopic cholecystectomy: a randomized controlled trial. Anesth Essays Res. 2016;10(03):561–567. https://doi.org/10.4103/0259-1162.186620
12. Alsharari AF, Abuadas FH, Alnassrallah YS, Salihu D. Transversus abdominis plane block as a strategy for effective pain management in patients with pain during laparoscopic cholecystectomy: a systematic review. J Clin Med. 2022;11(23):6896. https://doi.org/10.3390/jcm11236896
13. López-Ruiz C, Orjuela JC, Rojas-Gualdrón DF, Jimenez-Arango M, Ríos JFL, Vásquez-Trespalacios EM, et al. Efficacy of transversus abdominis plane block in the reduction of pain and opioid requirement in laparoscopic and robot-assisted hysterectomy: a systematic review and meta-analysis. Rev Bras Ginecol Obstet. 2022;44(1):55–66. https://doi.org/10.1055/s-0041-1740595
14. Park JW, Kim EK, Park S, Han WK, Lee J, Lee JH, et al. Erector spinae plane block in laparoscopic colorectal surgery for reducing opioid requirement and facilitating early ambulation: a double-blind, randomized trial. Sci Rep. 2023;13(1):12056. https://doi.org/10.1038/s41598-023-39265-5
15. Solmaz Demirel H, Buyukbezirci G, Yılmaz R, Arıcan Ş, Eren Zeydoglu AS, Reisli R, et al. Investigation of efficacy of erector spinae plane block administered in different volumes on intraoperative opioid consumption and postoperative analgesia in breast surgery: randomized, prospective, double-blind study. Pain. 2024;36(3):146–155. https://doi.org/10.14744/agri.2023.82346
16. Atici E, Arslan Zİ, Yilmaz H. Effect of erector spinae plane block on postoperative intravenous morphine consumption in open subcostal nephrectomy: a prospective randomized clinical trial. pain. 2024;36(1):13–21. https://doi.org/10.14744/agri.2022.71602
17. Yazar VM, Gercek O, Topal K, Eren B, Bezen BA. The effect of erector spinae plane block on postoperative pain and quality of recovery in patients undergoing percutaneous nephrolithotomy. Sci Rep. 2024;14(1):25190. https://doi.org/10.1038/s41598-024-77075-5
18. Yang X, Zhang Y, Chen Y, Xu M, Lei X, Fu Q. Analgesic effect of erector spinae plane block in adults undergoing laparoscopic cholecystectomy: a systematic review and meta-analysis of randomized controlled trials. BMC Anesthesiol. 2023;23(1):7. https://doi.org/10.1186/s12871-023-01969-6
19. Yilmaz ET, Gulmez DD, Apan A, Keles BO, Coskun M, Doger C, et al. A novel comparison of erector spinae plane block and paravertebral block in laparoscopic cholecystectomy. Rev Assoc Med Bras. 2024;70(3):e20231457. https://doi.org/10.1590/1806-9282.20231457
20. Elshazly M, El-Halafawy YM, Mohamed DZ, Wahab KAE, Mohamed TMK. Feasibility and efficacy of erector spinae plane block versus transversus abdominis plane block in laparoscopic bariatric surgery: a randomized comparative trial. Korean J Anesthesiol. 2022;75(6):502–509. https://doi.org/10.4097/kja.22169
21. Warner M, Yeap YL, Rigueiro G, Zhang P, Kasper K. Erector spinae plane block versus transversus abdominis plane block in laparoscopic hysterectomy. Pain Manag. 2022;12(8):907–916. https://doi.org/10.2217/pmt-2022-0037
22. Zewdu D, Tantu T, Eanga S, Tilahun T. Analgesic efficacy of erector spinae plane block versus transversus abdominis plane block for laparoscopic cholecystectomy: a systematic review and meta-analysis of randomized controlled trial. Front Med (Lausanne). 2024;11:1399253. https://doi.org/10.3389/fmed.2024.1399253
23. Schwartzmann A, Peng P, Maciel MA, Forero M. Mechanism of the erector spinae plane block: insights from a magnetic resonance imaging study. Can J Anaesth. 2018;65:1165–1166. https://doi.org/10.1007/s12630-018-1187-y
24. Eksteen A, Wagner J, Kleyenstuber T, Kamerman P. Comparison of erector spinae plane and transversus abdominis plane block for postoperative analgesia after caesarean delivery under spinal anaesthesia: a randomised controlled trial. Int J Obstet Anesth. 2024;60:104259. https://doi.org/10.1016/j.ijoa.2024.104259
25. Hussain N, Brull R, Thaete L, Fuller S, D'Souza RS, Mankinen-Abdallah Y, et al. The analgesic effects of novel fascial plane blocks compared with intrathecal morphine after Caesarean delivery: a systematic review and meta-analysis. Br J Anaesth. 2025;134(5):1415–1431. https://doi.org/10.1016/j.bja.2025.01.032
26. Zewdu D, Tantu T, Eanga S, Tilahun T. Analgesic efficacy of erector spinae plane block versus transversus abdominis plane block for laparoscopic cholecystectomy: a systematic review and meta-analysis of randomized controlled trial. Front Med (Lausanne). 2024;11:1399253. https://doi.org/10.3389/fmed.2024.1399253
27. Dilsiz P, Gokbel I, Umutlu Y, Ertuğrul HA, Sari S. Effect of erector spinae plane block and transversus abdominis plane block on quality of recovery and postoperative pain after laparoscopic hysterectomy;randomized, double-blinded clinical trial. J Obstet Gynaecol Res. 2025;51(4):e16284. https://doi.org/10.1111/jog.16284
28. Mansour MA, Baradwan S, Shama AA, Mahmoud MA, Abouelnour AS, Mohamed AMA, et al. Erector spinae plane block versus transversus abdominis plane block for analgesia after cesarean section: a systematic review and meta-analysis. Braz J Anesthesiol. 2025;75(4):844606. https://doi.org/10.1016/j.bjane.2025.844606
29. Wafa A, Shagan A. Letter to the editor: optimizing postoperative analgesia in bariatric surgery -clinical implications of ESP vs TAP block for sleeve gastrectomy. Obes Surg. 2025;35(7):2772–2773. https://doi.org/10.1007/s11695-025-07963-w