e-ISSN: 0976-822X, p-ISSN:2961-6042

Available online on http://www.ijcpr.com/

International Journal of Current Pharmaceutical Review and Research 2026; 18(6); 1254-1259

Original Research Article

A Comparison of Effect of Preemptive Versus Postoperative Use of Ultrasound Guided Bilateral Transversus Abdominis Plane Block (TAP) on Pain Relief After Laparoscopic Cholecystectomy

Nafisa Sharfeen[1], Aruna Kumari Barla[2], Sampathirao Janaki Rao[3], Bhupathi Manohar Sai Gopi Krishna[4]

[1]Assistant Professor, Department of Anesthesia, Rangaraya Medical College, Kakinada
[2]Assistant Professor, Department of Anesthesia, Rangaraya Medical College, Kakinada
[3]Assistant Professor, Department of Anesthesia, Rangaraya Medical College, Kakinada
[4]Post graduate, Department of Anesthesia, Rangaraya Medical College, Kakinada

Received: 19-04-2026 / Revised: 20-05-2026 / Accepted: 21-06-2026
Corresponding Author: Dr. Nafisa Sharfeen
Conflict of interest: Nil

Abstract:

Background: Laparoscopic cholecystectomy (LC) is commonly associated with early postoperative pain despite its minimally invasive nature. Transversus abdominis plane block is an effective regional analgesic technique, but the optimal timing of administration remains debated.

Aim: To compare the analgesic efficacy of preemptive versus postoperative ultrasound-guided bilateral TAP block in patients undergoing LC.

Methods: This prospective, randomized, comparative, double-blinded study included 120 patients undergoing elective LC. Patients were allocated into two groups of 60 each. The preemptive group received ultrasound-guided bilateral TAP block after induction of anaesthesia, while the postoperative group received TAP block after surgery and before extubation. Postoperative pain was assessed using NRS at rest and cough at 0, 2, 4, 8, 12, and 24 hours. Rescue analgesic requirement, time to first analgesia, complications, PONV, and satisfaction were recorded.

Results: Baseline and intraoperative variables were comparable. Postoperative TAP block significantly reduced NRS scores at rest at 8 and 12 hours and during cough at 2, 8, and 12 hours. Time to first analgesic use was significantly longer in the postoperative group. No major complications were observed.

Conclusion: Postoperative TAP block provided superior intermediate analgesia and was safe after LC.

Keywords: Laparoscopic Cholecystectomy; TAP Block; Postoperative Analgesia; Preemptive Analgesia; Ultrasound-Guided Block.

DOI: 10.25258/ijcpr.18.6.203

Introduction

Laparoscopic cholecystectomy (LC) is the standard surgical treatment for symptomatic cholelithiasis, but despite its minimally invasive nature, postoperative pain remains clinically important because it arises from trocar-site injury, visceral manipulation, pneumoperitoneum, and referred shoulder pain. Effective analgesia is therefore essential to improve early mobilisation, patient satisfaction, recovery quality, and reduce opioid-related adverse effects. Ultrasound-guided transversus abdominis plane (TAP) block provides regional analgesia by depositing local anaesthetic between the internal oblique and transversus abdominis muscles, thereby blocking anterior abdominal wall sensory nerves. Recent evidence supports TAP block as a useful component of multimodal analgesia after LC, although its comparative benefit varies according to technique, approach, and timing [1]. Multimodal analgesia has been shown to reduce perioperative opioid requirement and improve postoperative recovery after LC [2]. The timing of TAP block remains important because preemptive administration before incision may prevent central sensitisation, whereas postoperative administration treats established nociceptive input. Rahimzadeh et al. directly compared preemptive and postoperative ultrasound-guided bilateral TAP block and reported clinically relevant differences in postoperative pain relief after LC [3]. Recent reviews also show that subcostal TAP block and ultrasound-guided TAP techniques remain valuable options for opioid-sparing analgesia in LC [4,5]. Therefore, this study aimed to compare preemptive versus postoperative ultrasound-guided bilateral TAP block for postoperative pain relief after LC.

Methods

This prospective, randomized, comparative, double-blinded study was conducted in the Department of Anaesthesiology, Rangaraya Medical College, Kakinada, Andhra Pradesh, over 18 months from May 2023 to November 2024. The study protocol was approved by the Institutional Ethics Committee, registration number IEC/RMC/2023/1015, and written informed consent was obtained from all eligible participants before enrolment. Patients of either gender, aged 20–60 years, belonging to American Society of Anesthesiologists physical status I or II, and scheduled for elective LC were included. Patients undergoing emergency cholecystectomy, those with a history of opioid dependence or tolerance, conversion of LC to open surgery, allergy to ropivacaine, body mass index more than 35 kg/m², coagulopathy, uncontrolled intraoperative bleeding, or non-cooperative behaviour were excluded from the study. The sample size was calculated based on the study by Suseela et al., considering the mean difference between two independent groups, 80% power, 5% level of significance, and a minimum expected difference of 0.27 between groups [6].

Eligible patients were randomly allocated into two groups using a simple randomization method with a table of random numbers. Even numbers were assigned to the preemptive group (PG) and odd numbers to the postoperative group (POG), with allocation concealment maintained to prevent selection bias. In the preemptive group, TAP plane block was administered after induction of anaesthesia and before surgical incision, whereas in the postoperative group, the block was administered after completion of surgery and before extubation. Patients and postoperative outcome assessors were kept unaware of group allocation, and the anaesthesiologist performing the block was not involved in postoperative assessment or data collection. All patients received a standardized anaesthesia protocol. Premedication included intravenous antibiotic prophylaxis, midazolam 0.05 mg/kg, ondansetron 0.1 mg/kg, glycopyrrolate 0.01 mg/kg, fentanyl 2 µg/kg, and 2% lignocaine. Anaesthesia was induced with thiopentone sodium 5 mg/kg and succinylcholine 2 mg/kg. Maintenance muscle relaxation was achieved with vecuronium 0.1 mg/kg initially, followed by 0.01 mg/kg as required. Intraoperative monitoring included non-invasive blood pressure, electrocardiography, pulse oximetry, and capnography, maintaining end-tidal carbon dioxide between 30 and 35 mmHg. LC was performed using four trocar ports, with carbon dioxide insufflation maintained below 15 mmHg. Intravenous paracetamol 100 mL was administered 20 minutes before completion of surgery.

For TAP block, patients were kept in the supine position, and a high-frequency ultrasound probe was placed along the midaxillary line near the umbilicus to identify the fascial plane between the internal oblique and transversus abdominis muscles. Using an in-plane needle approach, 20 mL of 0.25% ropivacaine was injected bilaterally after confirming correct needle placement. All blocks were performed by an experienced anaesthesiologist. After completion of surgery, pneumoperitoneum was evacuated, neuromuscular blockade was reversed with neostigmine and glycopyrrolate, and patients were extubated as per standard protocol. Intraoperative blood loss and fentanyl consumption were recorded. Pain intensity was assessed using the numerical rating scale at rest and during coughing at arrival in the post-anaesthesia care unit, and at 2, 4, 8, 12, and 24 hours postoperatively. Rescue analgesia with tramadol 100 mg was administered when the numerical rating scale score was more than 3, and the timing and dose of rescue analgesia were documented. Postoperative nausea and vomiting, complications, and patient satisfaction at 24 hours were also recorded using a five-point satisfaction scale. Statistical analysis was performed using SPSS software. Continuous variables were expressed as mean and standard deviation, while categorical variables were presented as frequency and percentage. Normality was assessed using the Shapiro–Wilk test. Independent t-test, Mann–Whitney U test, and chi-square test were applied as appropriate, and a p value <0.05 was considered statistically significant.

Results

Among 120 patients undergoing LC, 60 were allocated to the preemptive TAP block group and 60 to the postoperative TAP block group. Baseline characteristics, including age, gender distribution, ASA status, and duration of surgery, were comparable between the two groups, with no statistically significant difference, indicating adequate group comparability [Table 1]. Intraoperative variables such as CO_2 insufflation pressure, blood loss, fentanyl requirement, and intravenous fluid administration were also similar between groups [Table 2]. Postoperative pain assessment showed that NRS scores at rest were significantly lower in the postoperative group at 8 and 12 hours, suggesting better intermediate postoperative analgesia [Table 3]. During coughing, NRS scores were significantly lower in the postoperative group at 2, 8, and 12 hours, indicating improved dynamic pain control [Table 3]. However, rescue tramadol requirement was significantly higher in the postoperative group, although the mean total tramadol dose did not differ significantly [Table 4]. The postoperative group had a significantly longer time to first analgesic use, indicating prolonged initial analgesic benefit [Table 4]. Hospital stay was comparable between groups [Table 4]. TAP block success was high in both

groups, minor hematoma was uncommon, and no major complications were reported [Table 4]. Overall, both techniques were safe and effective, but postoperative TAP block showed better pain score reduction during the intermediate postoperative period [Table 3].

Table 1: Baseline characteristics of study participants

Parameter	PG	POG	Test used	P value
Age, years	45 ± 10	46 ± 11	Independent t-test	0.72
Male/Female	30/30	32/28	Chi-square test	0.68
ASA I/II/III	25/20/15	26/21/13	Chi-square test	0.85
Duration of surgery, min	100 ± 20	102 ± 18	Independent t-test	0.55

Table 2: Intraoperative variables among the study members in groups

Parameter	PG	POG	Test used	P value
CO_2 insufflation pressure, mmHg	<15	<15	—	—
Blood loss, mL	50 ± 20	55 ± 25	Independent t-test	0.45
Total fentanyl dose, mcg	100 ± 10	105 ± 12		0.38
IV fluids, mL	1500 ± 200	1550 ± 210		0.38

Table 3: Postoperative NRS pain scores at rest and cough among the study members in groups

Time point	NRS at rest			NRS at cough		
	PG	POG	P value	PG	POG	P value
T0	3.5 ± 1.0	3.8 ± 1.0	0.4	6.5 ± 1.0	6.1 ± 1.0	0.4
T2	3.0 ± 1.1	3.3 ± 1.0	0.38	6.0 ± 1.1	5.3 ± 1.0	0.038
T4	2.8 ± 1.0	2.5 ± 0.9	0.3	4.6 ± 1.0	4.2 ± 0.9	0.3
T8	2.7 ± 0.8	1.9 ± 0.7	0.02	4.2 ± 0.8	3.6 ± 0.7	0.027
T12	2.5 ± 0.7	1.6 ± 0.6	0.031	3.7 ± 0.7	2.6 ± 0.6	0.031
T24	1.9 ± 0.5	1.5 ± 0.4	0.22	3.3 ± 0.5	2.2 ± 0.4	0.22

Table 4: Analgesic requirement, complications, and overall outcome

Parameter	PG	POG	Test used	P value
Rescue tramadol required, n	12	20	Chi-square test	0.032
Total tramadol dose, mg	1800 ± 250	2000 ± 300	Independent t-test	0.28
Time to first analgesic use, hrs	6 ± 1	8 ± 1	Independent t-test	0.02
Length of hospital stay, days	2.5 ± 0.5	2.3 ± 0.6	Independent t-test	0.25
TAP block successful, n (%)	59 (98)	60 (100)	Chi-square test	0.32
Minor hematoma, n (%)	2 (3)	1 (2)	Chi-square test	0.55
No major complications, n (%)	60 (100)	60 (100)	—	—

Discussion

In the present prospective randomized comparative study, postoperative TAP block showed better intermediate postoperative analgesic performance than preemptive TAP block in patients undergoing LC. Both groups were comparable with respect to age, gender distribution, ASA status, surgical duration, intraoperative blood loss, fentanyl consumption, intravenous fluid use, and hemodynamic stability, confirming that the observed differences in pain outcomes were unlikely to be due to baseline or intraoperative imbalance. The major finding was that postoperative TAP block produced significantly lower numerical rating scale (NRS) scores at rest at 8 and 12 hours, and lower NRS scores during cough at 2, 8, and 12 hours. These observations indicate that the timing of TAP block administration may influence the quality of analgesia during the clinically important early recovery period. LC is minimally invasive, but postoperative pain remains multifactorial, arising from trocar-site trauma, abdominal wall stretching, gallbladder bed manipulation, peritoneal irritation, residual pneumoperitoneum, and referred shoulder pain. Therefore, regional fascial plane blocks such as TAP block are relevant because they target the somatic abdominal wall component of pain and may reduce the need for systemic opioids [7]. The findings of this study are consistent with the increasing emphasis on procedure-specific, opioid-sparing analgesia in LC, where paracetamol, NSAIDs or COX-2 inhibitors, local anaesthetic techniques, and rescue opioids are recommended as part of multimodal perioperative pain control [7].

The better NRS scores observed in the postoperative TAP block group are comparable to the findings reported by Rahimzadeh et al., who directly compared preemptive versus postoperative ultrasound-guided bilateral TAP block after LC and found significantly lower pain scores in the

postoperative group, especially at rest at 8 and 12 hours and during coughing at 2, 8, and 12 hours [3]. This close similarity strengthens the external validity of the present findings because the same clinically relevant time points showed the greatest benefit. The likely explanation is that a postoperative TAP block is administered closer to the period of maximal early postoperative nociceptive input, allowing the local anaesthetic effect to cover the recovery phase more effectively. In contrast, a preemptive block given immediately after induction may partly wear off by the time moderate postoperative pain becomes prominent, particularly when surgical duration is prolonged. However, the concept of preemptive analgesia remains biologically plausible because blocking nociceptive input before incision may attenuate central sensitization. The present data suggest that, for single-shot TAP block in LC, the duration of local anaesthetic activity and its alignment with the postoperative pain trajectory may be more important than incision-before-block timing alone. This view is supported by a network meta-analysis of randomized trials, which concluded that postoperative TAP block may be slightly more effective than preoperative TAP block for reducing 24-hour opioid consumption and postoperative nausea and vomiting, although pain scores were not consistently superior at all measured time points [8].

Pain after LC is dynamic, and assessment during cough is clinically important because coughing, deep breathing, mobilization, and positional changes reflect functional recovery better than resting pain alone. In the present study, the postoperative group showed significantly lower cough-related NRS scores at 2, 8, and 12 hours, indicating superior control of movement-evoked pain. This finding has practical relevance because inadequate dynamic analgesia may delay ambulation, reduce respiratory effort, impair patient comfort, and increase rescue analgesic use. Recent randomized and comparative studies have supported the role of ultrasound-guided TAP block as an effective technique for postoperative pain relief after LC. Emile et al. reported that TAP block was safe and effective for pain control and recovery after LC, with ultrasound-guided and laparoscopic-guided approaches showing comparable analgesic value [9]. Similarly, Yoon et al. observed that bilateral TAP-based strategies produced clinically acceptable postoperative pain control in LC patients [10]. The current study adds to this evidence by emphasizing not merely whether TAP block is useful, but when it may be more effective. The significant reductions in intermediate pain scores suggest that postoperative administration may provide better matching between local anaesthetic peak effect and the patient's actual pain burden. This may be especially relevant in routine clinical settings where surgical duration, pneumoperitoneum exposure, and tissue manipulation vary between patients.

The rescue analgesia findings require careful interpretation. Although postoperative TAP block produced lower NRS scores at several time points and prolonged the time to first analgesic use, a higher number of patients in the postoperative group required rescue tramadol. At first glance, this appears contradictory. However, the mean total tramadol dose did not differ significantly between groups, and time to first analgesia was significantly longer in the postoperative group. These findings may indicate that postoperative TAP block delayed the onset of analgesic demand but did not completely eliminate the need for rescue analgesia in all patients over 24 hours. Another possibility is that pain reporting, rescue thresholds, and individual patient sensitivity to pain or anxiety influenced analgesic requests despite lower group-level NRS values. Multimodal analgesia studies in LC have shown that analgesic consumption does not always move in parallel with pain scores because drug protocols, rescue thresholds, and patient expectations influence opioid or tramadol use [11]. Toleska et al. observed that multimodal analgesia can reduce intraoperative and postoperative opioid needs after LC, but the analgesic effect varies according to the agents used and the timing of assessment [2]. In the present study, standardized anaesthesia and rescue tramadol protocols helped reduce confounding, but future work may benefit from reporting cumulative analgesic dose at fixed intervals, patient-controlled analgesia demand, and pain trajectories beyond 24 hours.

The safety profile observed in the present study was favourable. TAP block success was high in both groups, minor hematoma was uncommon, and no major complications were reported. This is important because a regional analgesic technique is clinically valuable only when it improves recovery without adding procedural risk. Ultrasound guidance likely contributed to the high success rate by allowing direct visualization of the internal oblique and transversus abdominis muscle plane, needle advancement, and local anaesthetic spread. Recent literature supports the safety and feasibility of ultrasound-guided TAP block in LC, although it also highlights that the analgesic advantage may depend on the comparator used, such as port-site infiltration, intraperitoneal local anaesthetic, or other fascial plane blocks [12]. Park et al. reported that ultrasound-guided subcostal TAP block reduced postoperative 24-hour opioid consumption and pain scores compared with wound infiltration, although the effect on postoperative nausea and vomiting was less consistent [13]. Ghani et al. found no clear overall advantage of laparoscopic-assisted TAP over ultrasound-guided TAP for postoperative pain outcomes, suggesting that both approaches may be

reasonable when performed correctly [1]. These findings support the practical value of ultrasound guidance in the present study because it is standardized, reproducible, and already familiar to anaesthesia teams performing regional blocks.

Postoperative nausea and vomiting, satisfaction, and length of hospital stay are important recovery indicators after LC. In the present study, PONV was low and comparable between groups, satisfaction was high in both groups, and length of hospital stay did not differ significantly. These outcomes suggest that both preemptive and postoperative TAP block are acceptable from a patient recovery perspective. The absence of major complications and high satisfaction rates also indicate that adding TAP block to multimodal analgesia is feasible in routine anaesthesia practice. However, the lack of significant difference in hospital stay may be explained by institutional discharge protocols, surgical fitness criteria, and non-pain factors such as diet tolerance, mobilization, and administrative timing. In many settings, LC discharge is protocol-driven, so modest improvements in pain scores may not always translate into shorter hospital stay. Evidence-based recommendations for LC emphasize multimodal analgesia, local anaesthetic techniques, and opioid rescue rather than relying on a single analgesic intervention [7]. In addition, Zeng et al. reported in a meta-analysis that TAP block may reduce postoperative nausea compared with no TAP block, probably through opioid-sparing mechanisms, although the effect varies across procedures and protocols [14]. This supports the view that TAP block should be interpreted as one component of enhanced recovery rather than as a stand-alone solution for all postoperative symptoms.

The present findings are also relevant when TAP block is compared with other regional techniques. Erector spinae plane block, rectus sheath block, oblique subcostal TAP block, and laparoscopic-guided TAP block have all been studied for LC. Zewdu et al. compared erector spinae plane block and TAP block in a meta-analysis and noted ongoing uncertainty regarding which fascial plane block provides superior analgesia in LC [15]. Davey et al. also evaluated ultrasound-guided versus laparoscopic-guided TAP block and highlighted the continuing need to identify the optimal technique for different institutional settings [16]. In the Indian context and other resource-conscious environments, TAP block remains attractive because it is relatively easy to perform, requires limited additional time, and can be integrated into existing general anaesthesia workflows. The current study further suggests that when a single-shot bilateral TAP block is selected, administration after surgery and before extubation may provide better functional pain relief during the first 12 postoperative hours. However, the conflicting rescue analgesia pattern shows that postoperative TAP block should not replace scheduled non-opioid analgesia. Rather, it should be combined with paracetamol, NSAIDs or COX-2 inhibitors when not contraindicated, antiemetic prophylaxis, and clear rescue analgesia protocols.

Overall, this study supports the clinical usefulness of both preemptive and postoperative ultrasound-guided bilateral TAP block after LC, with postoperative administration showing better intermediate pain score reduction, particularly during coughing and at 8–12 hours. These results align with procedure-specific analgesic principles and with recent evidence suggesting that postoperative TAP block may offer a modest advantage over preoperative timing in certain outcomes [8]. The study's strengths include randomized group allocation, standardized anaesthesia protocol, blinded postoperative assessment, and measurement of both resting and cough-evoked pain. Its limitations include assessment limited to the first 24 hours, absence of long-term pain follow-up, lack of objective functional recovery markers such as ambulation time or spirometric performance, and possible inconsistency between pain scores and rescue tramadol requirement. Future studies should compare different local anaesthetic volumes and adjuvants, evaluate continuous TAP catheter techniques, include patient-controlled analgesia data, and assess recovery quality using validated scores. Nevertheless, the present findings provide clinically useful evidence that postoperative ultrasound-guided bilateral TAP block is a safe and effective option for improving early postoperative analgesia after LC, particularly during the intermediate recovery phase [17].

Conclusion

Postoperative ultrasound-guided bilateral TAP block provided better intermediate postoperative analgesia than preemptive TAP block in patients undergoing LC. Although both groups were comparable in baseline and intraoperative parameters, postoperative TAP block showed significantly lower NRS pain scores at rest at 8 and 12 hours and during cough at 2, 8, and 12 hours. It also prolonged the time to first analgesic requirement. Both techniques were safe, with high block success rates, minimal minor complications, and no major adverse events. Therefore, postoperative TAP block may be considered an effective opioid-sparing analgesic strategy after LC.

References

1. Ghani SA, Hussain HU, Wahid MA, Majeed N, et al. Laparoscopic-assisted versus ultrasound-guided transversus abdominis plane block for laparoscopic cholecystectomy: a systematic

review and meta-analysis. BMC Surg. 2024; 24(1): 400.
2. Toleska M, Dimitrovski A, Shosholcheva M, Kartalov A, Kuzmanovska B, Dimitrovska NT. Pain and Multimodal Analgesia in Laparoscopic Cholecystectomy. Pril (Makedon Akad Nauk Umet Odd Med Nauki). 2022; 43(2): 41 – 9.
3. Rahimzadeh P, Faiz SHR, Latifi-Naibin K, Alimian M. A Comparison of effect of preemptive versus postoperative use of ultrasound-guided bilateral transversus abdominis plane (TAP) block on pain relief after laparoscopic cholecystectomy. Sci Rep. 2022; 12(1): 623.
4. Park S, Park JH, Park S, Jang JN, Kim C, Choi YS. Ultrasound-guided subcostal approach of transversus abdominis plane block compared with wound infiltration for postoperative analgesia following laparoscopic cholecystectomy: A systematic review and meta-analysis. Medicine (Baltimore). 2024; 103(18): e38044.
5. 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.
6. Suseela I, Anandan K, Aravind A, Kaniyil S. Comparison of ultrasound-guided bilateral subcostal transversus abdominis plane block and port-site infiltration with bupivacaine in laparoscopic cholecystectomy. Indian J Anaesth. 2018; 62(7): 497 – 501.
7. Bourgeois C, Oyaert L, Van de Velde M, et al. Pain management after laparoscopic cholecystectomy: A systematic review and procedure-specific postoperative pain management (PROSPECT) recommendations. Eur J Anaesthesiol. 2024; 41(11): 841 – 55.
8. Dost B, De Cassai A, Balzani E, et al. Analgesic benefits of pre-operative versus postoperative transversus abdominis plane block for laparoscopic cholecystectomy: a frequentist network meta-analysis of randomized controlled trials. BMC Anesthesiol. 2023; 23: 408.
9. Emile SH, Elfeki H, Elbahrawy K, Sakr A, Shalaby M. Ultrasound-guided versus laparoscopic-guided subcostal transversus abdominis plane (TAP) block versus No TAP block in laparoscopic cholecystectomy; a randomized double-blind controlled trial. Int J Surg. 2022; 101: 106639.
10. Yoon JP, Kim HY, Jung J, Lee J, Park S, Byeon GJ. Analgesic effect of ultrasound-guided transversus abdominis plane block with or without rectus sheath block in laparoscopic cholecystectomy: a randomized, controlled trial. BMC Anesthesiol. 2024; 24(1): 203.
11. Bajracharya JL, Subedi A, Pokharel K, Bhattarai B. The effect of intraoperative lidocaine versus esmolol infusion on postoperative analgesia in laparoscopic cholecystectomy: a randomized clinical trial. BMC Anesthesiol. 2019; 19(1): 198.
12. Wang W, Wang L, Gao Y. A Meta-Analysis of Randomized Controlled Trials Concerning the Efficacy of Transversus Abdominis Plane Block for Pain Control After Laparoscopic Cholecystectomy. Front Surg. 2021; 8: 700318.
13. Park S, Park JH, Park S, Jang JN, Kim C, Choi YS. Ultrasound-guided subcostal approach of transversus abdominis plane block compared with wound infiltration for postoperative analgesia following laparoscopic cholecystectomy: A systematic review and meta-analysis. Medicine (Baltimore). 2024; 103(18): e38044.
14. Zeng J, Hong A, Gu Z, Jian J, Liang X. Efficacy of transversus abdominis plane block on postoperative nausea and vomiting: a meta-analysis of randomized controlled trial. BMC Anesthesiol. 2024; 24(1): 87.
15. 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.
16. Davey MG, Daly GR, Donlon NE, Healy NA, Hill ADK. Ultrasound-guided versus laparoscopic-guided transversus abdominus plane block for laparoscopic cholecystectomy - A systematic review and meta-analysis of randomised clinical trials. Surgeon. 2025; 23(6): 399 – 405.
17. Vindal A, Sarda H, Lal P. Laparoscopically guided transversus abdominis plane block offers better pain relief after laparoscopic cholecystectomy: results of a triple blind randomized controlled trial. Surg Endosc. 2021; 35(4): 1713 – 21.