Original Research Paper

Volume - 16 | Issue - 06 | June - 2026 | PRINT ISSN No. 2249 - 555X | DOI : 10.36106/ijar

Anaesthesiology

EFFICACY OF ULTRASOUND-GUIDED ERECTOR SPINAE PLANE BLOCK AND ULTRASOUND-GUIDED OBLIQUE SUBCOSTAL TRANSVERSUS ABDOMINIS PLANE BLOCK FOR POSTOPERATIVE ANALGESIA IN LAPAROSCOPIC CHOLECYSTECTOMY: A COMPARATIVE STUDY

Dr. Jaya Lalwani — Professor and Head, Dept. of Anaesthesiology and Pain Medicine, Pt. JNM Medical College Raipur, (CG) India

Dr. Shahida Khatoon* — Asst prof., Dept. of Anaesthesiology and Pain Medicine, Pt. JNM Medical College Raipur, (CG) India *Corresponding Author

Dr Amitesh Kumar Singh — Resident, Dept. of Anaesthesiology and Pain Medicine, Pt. JNM Medical College Raipur, (CG) India

ABSTRACT **Background:** Postoperative analgesia is essential for recovery after surgery, as it minimizes stress response, enhances patient satisfaction, promotes early mobility, supports rehabilitation. This study aims to compare the efficacy of erector spinae plane block (ESP) with oblique subcostal transversus abdominis plane block (OSTAP) for post operative analgesia after elective laparoscopic cholecystectomy (LC). This prospective, randomized single blind study was done on 38 adult patients aged between 18-70 years, scheduled for LC who were randomly allocated into two groups of 19 each. **Material and Method:** ESP Group received ultrasound guided erector spinae plane block and OSTAP Group received ultrasound guided oblique subcostal transversus abdominis plane block. The number of doses of rescue analgesic required during first 24 hrs postoperatively, time to first request for rescue analgesia, VAS pain scores, intraoperative opioid consumption were compared. Data were presented as mean ± standard deviation and percentages, compared using independent t-test and chi-square test. **Results:** The number of doses of tramadol required were significantly lower in the ESP group compared to the OSTAP group (p=0.028). The mean duration of analgesia was significantly longer in ESP group which was 852.63 ±322.23 mins while in OSTAP group it was 596.84±159.34 mins (p=0.008). VAS scores were significantly lower in ESP group at all time points except at 18hr and 24hr postoperatively. **Conclusion:** ESP block provided longer, more effective analgesia, reduced rescue analgesic consumption and improved patient satisfaction with fewer side effects as compared to OSTAP block after LC.

KEYWORDS : Ultrasonography; Erector Spinae Plane Block; Transversus Abdominis Plane Block; Cholecystectomy, Laparoscopic; Ropivacaine; Dexamethasone.

INTRODUCTION

Postoperative pain remains a concern following laparoscopic cholecystectomy (LC) despite its minimally invasive nature, with patients often experiencing mild to moderate pain that may persist for several days.[1] Conventional analgesic modalities show variable efficacy and are frequently associated with adverse effects.[2] Regional anaesthesia techniques have therefore gained importance as part of multimodal analgesia. The transversus abdominis plane (TAP) block is commonly used for elective abdominal surgeries and effectively reduces somatic and parietal pain. [3] However, its limited action on visceral afferent pathways may restrict its analgesic efficacy in LC, where visceral pain is a significant component. The erector spinae plane (ESP) block is a newer interfascial block that has demonstrated effective analgesia in thoracic and abdominal surgeries by targeting both dorsal and ventral rami of spinal nerves, thereby providing somatic and visceral pain relief. [4,5,6,7,8]

Although both ESP and oblique subcostal TAP (OSTAP) blocks are used for postoperative analgesia in LC, comparative evidence regarding their relative efficacy remains limited. Furthermore, data on the use of ropivacaine combined with dexamethasone in these blocks for prolonging postoperative analgesia are scarce. Therefore, this randomized controlled study was designed to compare the analgesic efficacy of ESP and OSTAP blocks using 0.2% ropivacaine with dexamethasone in patients undergoing elective laparoscopic cholecystectomy.

The primary objective of this study was to compare the analgesic efficacy of ultrasound-guided erector spinae plane block (ESPB) and ultrasound-guided oblique subcostal transversus abdominis plane block (OSTAP) in patients undergoing laparoscopic cholecystectomy, as measured by the total number of doses of first-line rescue analgesic required within the first 24 hours postoperatively. The secondary objectives were to compare the two techniques in terms of duration of analgesia (time to first rescue analgesic), postoperative pain intensity assessed using the Numerical Rating Scale at predefined time points, intraoperative opioid consumption, total number of second-line rescue analgesic doses within the first 24 hours, patient satisfaction evaluated using a 5-point Likert scale at 24 hours, and the incidence of block-related and postoperative complications occurring within the first 24 hours after surgery.

MATERIALAND METHODS

This was a single-blinded, prospective, randomized controlled study conducted at Dr. B.R.A.M. Hospital, Raipur (C.G.), after approval of the Institutional Scientific and Ethics Committee, between July 2024 to March 2025. It was registered in the Clinical Trials Registry of India (CTRI/2024/07/070260). Patients aged 18–70 years with American Society of Anaesthesiologists (ASA) physical status class I and II scheduled to undergo elective LC were included in this study. Sample size was calculated using G*power software 3.1.9.7. Based on the study by Basak Altiparmak et al. (2019)[1], the mean tramadol consumption was reported as 140 ± 22 mg in the ESP group and 170 ± 32 mg in the OSTAP group with a mean difference of 30 mg between the groups. A statistical test was conducted to compare the difference between two independent means across two groups. Assuming a two-sided test with an effect size of 1.09, a significance level of 0.05 and a power of 0.90, the analysis was performed. The minimum required sample size was 19 subjects in each group and total no. of minimum subjects were 38. Patients were randomly divided into two groups using a computer-generated random number sequence and allocation was done using the sealed opaque envelope technique. Group ESP received an ultrasound-guided erector spinae plane (ESP) block with 20 mL of 0.2% ropivacaine combined with 4 mg of dexamethasone on each side and Group OSTAP received an ultrasound-guided oblique subcostal transversus abdominis plane (OSTAP) block with the same volume and concentration of the anaesthetic solution. Both the blocks were administered after the induction of general anaesthesia but before the surgical incision.

All patients were kept nil per oral as per the ASA fasting guidelines (8 hours for solid food, 4 hours for liquids and 2 hours for clear liquids) prior to the surgery. On the day of surgery, after thorough evaluation and explanation of the procedure, written and informed consent was taken. Patients were shifted to the operation theatre and routine multipara monitor with pulse oximetry, non-invasive blood pressure and ECG was attached and baseline heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), respiratory rate (RR) and oxygen saturation (SpO2) were recorded. A large-bore 18G intravenous cannula was inserted into the non-dominant hand for intravenous fluid and medications.

All patients in both groups received premedication with intravenous (i.v.) midazolam (0.02 mg/kg), glycopyrrolate (0.01 mg/kg) and nalbuphine (0.1 mg/kg). Anaesthesia induction was carried out using

thiopentone (3–4 mg/kg) and succinylcholine (1.5 mg/kg), followed by endotracheal intubation. After securing the airway anaesthesia was maintained using oxygen and air mixture (40:60), isoflurane (1.2 -2%) and iv atracurium 0.3 mg/kg as loading dose followed by 0.1 mg/kg as required.

Ultrasound Guided Erector Spinae Plane Block

After the induction of anaesthesia, patient was positioned in the lateral decubitus position. Under aseptic conditions, the skin was prepared and a curvilinear ultrasound transducer (5–8 MHz) was placed longitudinally at the level of the T9 spinous process and subsequently moved 3 cm laterally from the midline. Ultrasound landmarks, including the T9 transverse process and the overlying erector spinae muscle, were identified. A 45 mm, 18-gauge intravenous cannula needle was introduced in-plane under aseptic precautions at a 30–40° cranial-to-caudal angle until the needle tip made contact with the T9 transverse process. Correct needle placement was confirmed by hydro-dissection using 2–3 mL of isotonic saline solution. Subsequently, 20 mL of the prepared solution (0.2% ropivacaine combined with 4 mg dexamethasone) was injected into the fascial plane between transverse process and erector spinae muscle. The same procedure was performed on the contralateral side using the same volume and concentration of the solution.

Ultrasound Guided Oblique Subcostal Transversus Abdominis Plane Block

Patients were positioned supine and ultrasound probe was positioned obliquely on the upper abdominal wall along the subcostal margin near the xiphoid process of the sternum, in the midline of the abdomen. The landmarks, including the rectus abdominis muscle and the underlying transversus abdominis muscle, were identified near the costal margin and xiphoid process. The probe was then moved laterally to visualize the aponeurosis of the external oblique, internal oblique and transversus abdominis muscles. On further lateral movement, the transversus abdominis muscle was identified. Under ultrasound guidance, a 45-mm, 18-gauge intravenous cannula needle was advanced toward the transversus abdominis fascia. Correct needle placement was confirmed by hydro-dissection using 2–3 mL of isotonic saline solution. A total of 20 mL of the prepared solution (0.2% ropivacaine combined with 4 mg dexamethasone) was injected into the fascial plane between the transversus abdominis and internal oblique muscles at the lateral edge of the rectus abdominis muscle. The procedure was repeated on the contralateral side using the same volume and concentration of the solution.

Following the administration of the blocks, surgery was started. Intraoperative vital monitoring was conducted at regular intervals and an additional dose of intravenous nalbuphine (0.05 mg/kg, not exceeding a total dose of 0.2 mg/kg) was administered if there was a 20% increase in heart rate or mean blood pressure from baseline values. At the end of the surgery, neuromuscular blockade was reversed. Extubation was performed once the patient regained consciousness and then the patient was transferred to the postoperative room. The total dose of nalbuphine administered intraoperatively was recorded.

Postoperative pain was assessed using the Visual Analogue Scale (VAS) score at specific time intervals: 0 min(baseline) then 0.5, 1, 3, 6, 9, 12, 15, 18, 21 and 24 hours in the postoperative room. When patients reported pain or had an NRS score >3, intravenous tramadol (1 mg/kg) was administered as the first rescue analgesic. If pain persisted or the VAS score remained >3 one hour after administration of the first rescue analgesic, intravenous paracetamol (1 g infusion) was administered as the second rescue analgesic. Pain monitoring was continued at specific time interval till first 24-hour post operative period.

The total number of tramadol doses administered during the first 24 postoperative hours; the duration of block analgesia, defined as the time from completion of surgery to the administration of the first rescue analgesic; the total number of paracetamol doses administered within 24 hours postoperatively; visual analogue scale (VAS) pain scores recorded at predefined postoperative time intervals; and intraoperative opioid consumption were assessed.

Postoperative patient satisfaction was measured using a 5-point Likert scale, where 1 indicates "very dissatisfied," 2 indicates "dissatisfied," 3 indicates "neither dissatisfied nor satisfied (neutral)," 4 indicates "satisfied," and 5 indicates "very satisfied." Any complications occurring within the first 24 hours were also recorded.

Statistical Analysis

The data was collected in a master chart in Excel which was exported to SPSS (Statistical Package for Social Sciences) 21.0 for statistical analysis. Numerical data i.e. demographic profile, and hemodynamic parameters (heart rate, blood pressure, oxygen saturation, and respiratory rate) were presented as mean ± standard deviation, and their inter-group comparisons were performed using the independent t-test. Categorical data i.e. number of doses of rescue analgesia and patient satisfaction score were expressed as percentages and compared using the chi-square test. The p-value < 0.05 was considered as statistically significant.

RESULT

A total of 44 subjects were enrolled considering 10% drop outs. Out of which, 2 patients were excluded as BMI exceeded 30 kg/m². During the course of the study, in the remaining 42 patients, 4 participants were excluded: 1 due to inoperability and 3 due to conversion of surgery to open cholecystectomy. Consequently, data from 38 (n=19) participants were analysed. The same is depicted in the CONSORT flow diagram (Figure 1).

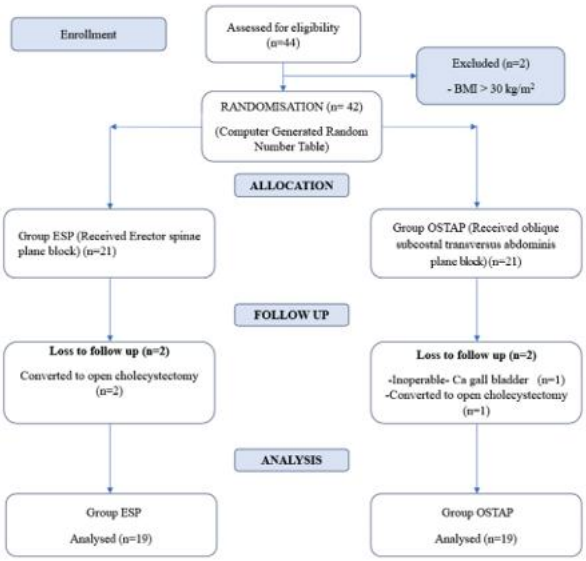


Figure 1: Consolidated Standards of Reporting Trials (CONSORT) Flow Diagram of Study

The demographic data and surgical duration were comparable between the two groups [Table-1].

Table – 1 Descriptive Variables of the Groups

Parameters		Group ESP	Group OSTAP	P- value
Age (years) (Mean±SD)		47.95±11.20	43.11±13.92	0.193
Sex (n, %)	0.676	Female	16 (84.2)	15(78.9)
		Male	3(15.8)	4 (21.1)
ASA grade (n, %)	0.252	I	16(84.2)	13(68.4)
		II	3(15.8)	6(31.6)
Height (m) (Mean±SD)		1.62±0.062	1.63±0.056	0.826
Weight(kg) (Mean±SD)		59.63±6.002	60.63±7.78	0.66
BMI kg/m2) (Mean±SD)		22.65± 1.96	22.89±2.56	0.439
Duration of Surgery (min) (Mean±SD)		122.26± 10.48	120.74± 12.99	0.587

The mean duration of analgesia was significantly longer in ESP Group than the OSTAP Group (p=0.008). The mean tramadol consumption during first 24 hours in OSTAP Group was significantly higher than in ESP Group (p=0.004) [Table-2].

Table – 2 Comparison of the Intraoperative and Postoperative Parameters Between the Study Groups

Parameters	Group ESP	Group OSTAP	P- value
Duration of Analgesia (min) (Mean±SD)	852.63± 322.23	596.84± 159.34	0.008**
Total Tramadol Consumption (mg) (Mean±SD)	70.11± 44.33	112.74± 34.86	0.004**

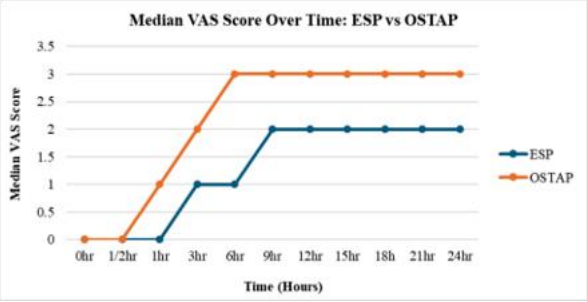
The number of doses of tramadol required during the 24-hour postoperative period were significantly lower in the ESP group

compared to the OSTAP group (P= 0.028) [Table-3].

Table – 3 Comparison of Postoperative Tramadol Requirement (1st Rescue Analgesic) Between the Groups

No. of doses of Tramadol	Group ESP (n, %)	Group OSTAP (n, %)	P- value
0	03 (15.8)	0 (0)	0.028*
1	10 (52.6)	05 (26.3)	
2	6 (31.6)	11 (57.9)	
3	0 (0)	03 (15.8)	

The ESP group consistently recorded lower median VAS scores compared to the OSTAP group across the majority of the 24-hour observation period. [Graph-1] [Table-4].

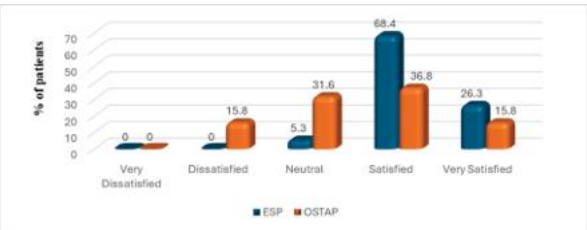


Graph 1: Comparison of VAS Score Between the Groups

Table – 4 Comparison of VAS Score Between the Groups

Time Point	ESP Group Median (IQR)	OSTAP Group Median (IQR)	P-value
0hr	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	0.040*
1/2hr	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.5)	0.019*
1hr	0.0 (0.0 - 0.0)	1.0 (1.0 - 2.0)	0.001*
3hr	1.0 (0.0 - 1.0)	2.0 (1.0 - 3.0)	0.001*
6hr	1.0 (1.0 - 2.0)	3.0 (2.0 - 3.0)	0.001*
9hr	2.0 (1.0 - 2.0)	3.0 (2.0 - 4.0)	0.012*
12hr	2.0 (1.0 - 4.0)	3.0 (2.0 - 4.0)	0.067
15hr	2.0 (1.0 - 2.0)	3.0 (2.0 - 3.0)	0.013*
18h	2.0 (2.0 - 3.5)	3.0 (2.5 - 3.0)	0.250
21hr	2.0 (2.0 - 3.0)	3.0 (3.0 - 4.0)	0.001*
24hr	2.0 (2.0 - 3.0)	3.0 (2.5 - 3.0)	0.078

There is a statistically significant difference at 0hr, 1/2hr, 1hr, 3hr, 6hr, 9hr, 15hr, and 21hr, with the ESP group maintaining lower pain scores. The p-values are particularly low (< 0.001) at 1hr, 3hr, and 6hr, indicating strong statistical evidence that the ESP block provides superior pain relief during this critical early period. Patients in ESP Group reported significantly higher satisfaction levels than those in OSTAP Group [Graph-2].



Graph 2: Comparison of Patient Satisfaction Score Between the Groups

In ESP Group, one patient had nausea (5.3%) whereas in OSTAP Group two patients had nausea (10.5%). None of the patients had pneumothorax, peritoneal and visceral injury. No other complications were found in our study.

DISCUSSION

Effective pain management is a critical component of postoperative care. It significantly contributes to improved recovery, reduced physiological stress, minimized opioid consumption and related side effects; enhanced patient satisfaction and shorter hospital stay. The advent of ultrasound technology has popularized regional anaesthesia by enhancing the safety and precision of fascial blocks, leading to increased adoption of these techniques.

In our study, the duration of analgesia was significantly shorter in the OSTAP group as compared to the ESP group. Also, patients in the OSTAP group required more frequent doses of tramadol and showed higher overall tramadol consumption within the first 24 hours post-surgery. Although both groups maintained a median VAS pain score below 4 over 24 hours, the ESP group demonstrated significantly lower VAS scores as compared to the OSTAP group. These findings were similar to previous studies reporting reduced opioid consumption and lower VAS score in the ESP group as compared to OSTAP group. [9,10] In contrast, no significant differences in opioid requirements or VAS scores between the two groups has also been reported, which might be due to differences in the concentrations and the local anaesthetic drugs used in the study.[11]

The superior postoperative analgesic efficacy of the ESP block can be attributed to its broader dermatomal coverage and its ability to address both somatic and visceral pain. A study highlighted the spread of the local anaesthetic into the paravertebral space with the ESP block, effectively targeting the ventral and dorsal rami of thoracic and lumbar spinal nerves as well as the sympathetic chain.[12] A cadaveric study corroborated the extensive drug spread achieved with the ESP block.[13] In contrast, the OSTAP block primarily targets the anterior and lateral cutaneous branches of the T6 to T10 spinal nerves and acts on somatic and parietal pain, with limited efficacy for visceral pain. Hebbard et al. emphasized that the OSTAP block is particularly effective for upper abdominal surgeries, where its targeted coverage is sufficient.[14]

Unilateral ultrasound-guided ESP block administered using 30 mL of anaesthetic solution in a patient undergoing open nephrectomy showed that along with the same side, the sensory block also extended to the contralateral side, affecting the T7 to T11 dorsal dermatomes and the T9 to T10 ventral dermatomes.[15] This was further validated by Schwartzmann et al., who used magnetic resonance imaging to confirm circumferential anaesthetic spread into the epidural space with unilateral ESP blocks.[16] Altiparmak et al. noted that increased intra-abdominal pressure during pneumoperitoneum might enhance epidural spread, potentially explaining unilateral ESP blocks causing contralateral sensory blockade.[17]

The efficacy of interfascial plane blocks like ESP and OSTAP is also influenced by the volume and concentration of the local anaesthetic used. It has been demonstrated that higher volumes and concentrations, such as 20 mL of 0.375% bupivacaine, provide longer-lasting analgesia, with the ESP block being consistently better as compared to the OSTAP block.[11,18,19] In contrast, we administered 20 ml of 0.2% ropivacaine along with 4mg dexamethasone as an adjuvant on each side and noted a significantly longer duration of analgesia in both groups than previous studies[18]. Similar to our findings, the addition of dexamethasone as an adjuvant has been shown to enhance analgesia duration and reduce opioid requirements.[20] On the contrary, lower volumes and concentrations were associated with shorter analgesia duration, emphasizing the need for precise dosing strategies.[21]

There remains no universal consensus on the optimal volume and concentration of anaesthetic drug for ESP and OSTAP blocks. A guideline proposes of 3.6 mL of local anaesthetic per vertebral level for effective dermatomal coverage [22], while Chin et al. postulated that drug spreads at least three segments cranially and four segments caudally from the site of deposition[4]. Recommendations are of injecting 20 mL of anaesthetic at the midpoint of the desired analgesic field. Injection of local anaesthetic between T7 and T9 resulting in the drug spreading across T6 to T12 segments have been reported.[23] Timing of block administration also plays a critical role; preoperative administration provides preemptive analgesia, preventing central sensitization and reducing postoperative pain. A longer duration of analgesia has been reported when blocks were administered preoperatively. [19] These findings collectively emphasize the importance of selecting appropriate block techniques, drug volume and concentration of anaesthetic drug, timing of administration and the inclusion of adjuvants like dexamethasone for optimal postoperative pain management post-surgery and enhancing overall patient recovery.

The main limitation of this study is the relatively small sample size, limiting the ability to thoroughly evaluate the efficacy of the blocks and identify any block-related complications. Sensory testing to determine dermatomal coverage for both the ESP and OSTAP block areas was not performed, leaving the possibility of patchy blocks undetermined, as the blocks were performed after the induction of

general anaesthesia. Additionally, differences in intraoperative opioid requirements could not be assessed, as intraoperative pain was inferred through changes in hemodynamic parameters, which may have been influenced by various confounding factors. Furthermore, imaging studies with contrast enhancement were not utilized, preventing the precise mapping of local anaesthetic spread in either block. Lastly, only VAS pain scores at rest were recorded; evaluating VAS scores during coughing or movement could have provided more detailed insights into the blocks' analgesic efficacy. Further studies could focus on determining optimal local anaesthetic concentrations and the efficacy of the blocks. Also, the potential benefits of combining different adjuvants with local anaesthetics for both blocks could be explored in future studies.

CONCLUSION

Erector Spinae Plane block under ultrasound-guidance for laparoscopic cholecystectomy provides longer and more effective postoperative analgesia, reduces postoperative opioid requirement with better patient satisfaction as compared to the Oblique Subcostal Transversus Abdominis Plane block. However, both blocks are safe and provide effective postoperative analgesia with minimal side effects.

REFERENCES

[1] Gupta R, Bogra J, Kothari N, Kohli M. Postoperative analgesia with intraperitoneal fentanyl and bupivacaine: a randomized control trial. Can J Med. 2010; 1:1-9.
[2] Barazanchi AW, 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] Shin HJ, Oh AY, Baik JS, Kim JH, Han SH, Hwang JW. Ultrasound-guided oblique subcostal transversus abdominis plane block for analgesia after laparoscopic cholecystectomy: a randomized, controlled, observer-blinded study. Minerva Anestesiol. 2014;80(2):185-93.
[4] Chin KJ, Adhikary S, Sarwani N, Forero M. The analgesic efficacy of pre.operative bilateral erector spinae plane (ESP) blocks in patients having ventral hernia repair. Anaesthesia. 2017;72(4):452-60.
[5] Chin KJ, Lewis S. Opioid-free analgesia for posterior spinal fusion surgery using erector spinae plane (ESP) blocks in a multimodal anaesthetic regimen. Spine. 2019; 44(6): E379-83.
[6] Hamilton DL, Manickam B. Erector spinae plane block for pain relief in rib fractures. Br J Anaesth. 2017;118(3):474-5.
[7] Kim E, Kwon W, Oh S, Bang S. The erector spinae plane block for postoperative analgesia after percutaneous nephrolithotomy. Chin Med J. 2018;131(15):1877-8.
[8] 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.
[9] Mounika V, Sahu L, Mishra K, Mohapatra PS. A comparative evaluation of post-operative pain management using erector spinae plane block and oblique transverse abdominis plane block in patients undergoing laparoscopic cholecystectomy. Cureus. 2023; 15(3).
[10] Sahu L, Behera SK, Satapathy GC, Saxena S, Priyadarshini S, Sahoo RK. Comparison of analgesic efficacy of erector spinae and oblique subcostal transverse abdominis plane block in laparoscopic cholecystectomy. J Clin Diagn Res. 2021;15(9)
[11] Altıparmak B, Toker MK, Uysal AI, Kuşçu Y, Demirbilek SG. Ultrasound-guided erector spinae plane block versus oblique subcostal transversus abdominis plane block for postoperative analgesia of adult patients undergoing laparoscopic cholecystectomy: randomized controlled trial. J Clin Anesth. 2019; 57:31-6.
[12] El-Boghdadly K, Pawa A. The erector spinae plane block: plane and simple. Anaesthesia 2017;72(4):434–8.
[13] Vidal E, Giménez H, Forero M, Fajardo M. Erector spinae plane block: a cadaver study to determine its mechanism of action. Rev Esp Anestesiol Reanim. 2018; 65:514-9.
[14] Hebbard PD, Barrington MJ, Vasey C. Ultrasound-guided continuous oblique subcostal transversus abdominis plane blockade: description of anatomy and clinical technique. Reg Anesth Pain Med. 2010;35(5):436-41.
[15] Tulgar S, Selvi O, Ahiskalioglu A, Ozer Z. Can unilateral erector spinae plane block result in bilateral sensory blockade? Can J Anaesth. 2019; 66:1001-2.
[16] 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; 65:1165-6.
[17] Altıparmak B, Korkmaz Toker M, Uysal AI. Potential mechanism for bilateral sensory effects after unilateral erector spinae plane blockade in patients undergoing laparoscopic cholecystectomy. Can J Anaesth. 2020; 67:161-2.
[18] Routray SS, Mohanty R, Pradhan K, Pani S. Evaluation of efficacy of ultrasound guided erector spinae plane block and oblique subcostal transversus abdominis plane block for postoperative analgesia in laparoscopic cholecystectomy. Panacea J Med Sci. 2020;10(2):128-34.
[19] Sahoo SP, Jayasingh SC, Routray SS, Mohapatra B. Laparoscopic cholecystectomy: comparison of two different techniques of ultrasound guided blocks for postoperative pain relief. Int J Health Clin Res. 2021;4(8):96-100.
[20] Sharma UD, Prateek, Tak H. Effect of addition of dexamethasone to ropivacaine on postoperative analgesia in ultrasonography-guided transversus abdominis plane block for inguinal hernia repair: a prospective, double-blind, randomised controlled trial. Indian J Anaesth. 2018;62(5):371-5.
[21] Ozdemir H, Araz C, Karaca O, Turk E. Comparison of ultrasound-guided erector spinae plane block and subcostal transversus abdominis plane block for postoperative analgesia after laparoscopic cholecystectomy: a randomized controlled trial. J Invest Surg. 2022;35(4):870-7.
[22] Kashani HH, Grocott HP. Clarity needed as to the optimal dose and volume of local anaesthetic for erector spinae plane blockade for posterior rib fractures. Am J Emerg Med. 2018; 36:1102-3.
[23] Hannig KE, Jessen C, Soni UK, Børglum J, Bendtsen TF. Erector spinae plane block for elective laparoscopic cholecystectomy in the ambulatory surgical setting. Case Rep Anesthesiol. 2018; 2018:5492527.