Original Research Paper

Volume - 15 | Issue - 04 | April - 2025 | PRINT ISSN No. 2249 - 555X | DOI : 10.36106/ijar

Anaesthesiology

"EVALUATION OF ULTRASOUND-GUIDED ERECTOR SPINAE PLANE BLOCK FOR POSTOPERATIVE ANALGESIA IN LAPAROSCOPIC CHOLECYSTECTOMY: A PROSPECTIVE, COMPARATIVE STUDY"

Priyanka Sanganagoudar	Anaesthetist, Community Health Center, Hunasagi, Yadgir, Karnataka. ORCID ID: 0009-0009-6423-2613
Keerti	Anaesthetist & Intensivist, United Hospital, Kalaburagi, Karnataka. ORCID ID: 0009-0009-5666-220X
Soundarya S V	Senior Resident, Siddaganga Medical College and Research Institute, Tumakuru, Karnataka. ORCID ID: 0009-0007-7548-6550.
Yogesh*	Post Graduate, MRMC Medical College, Kalaburagi, Karnataka. ORCID ID: 0009-0004-9580-0517 *Corresponding Author

ABSTRACT **Background:** Erector Spinae Plane Block (ESPB) is a peri-paravertebral regional anesthetic technique that has since been reported as an effective technique for the prevention of postoperative pain in various surgeries. ESPB is performed under ultrasonographic guidance, provides extensive analgesia with a single puncture. **Methodology:** This study was conducted on 50 patients between 20 to 65 years old, ASA I and II, undergoing laparoscopic cholecystectomy under general anesthesia. They were randomly divided into two equal groups. Group A received Erector Spinae Plane Block (ESPB) and group B received no intervention before induction. Intraoperatively the patients were assessed for vitals at the time of trocar placement, CO2 insufflation, gallbladder extraction, extubation and postoperatively for vitals, NRS at rest, NRS with cough, Postoperative nausea vomiting (PONV) and shoulder pain at 20, 40, 60 mins, 3, 6, 12, 18 and 24 hrs. **Results:** The NRS at rest and NRS with cough were found to be lower and statistically significant in the group A till 24 hrs of postoperative period. The difference in total routine and rescue analgesia between the two groups over 24 hrs was statistically significant. In group A, 10 patients skipped one dosage of Paracetamol as their NRS was < 2/10 and refused pain medication. Even though number of patients having PONV was lesser in group A, the difference was not statistically significant. Shoulder pain was absent in group A, but was statistically significant only at 20, 40, 60 mins. **Conclusion:** The present study has shown that bilateral single shot ultrasound guided ESPB with 0.375% Bupivacaine performed in patients undergoing laparoscopic cholecystectomy decreases postoperative (static and dynamic) pain intensity in addition to the requirement for opioids and other analgesic agents.

KEYWORDS : Erector Spinae Plane Block, Laparoscopic cholecystectomy, Postoperative pain, Postoperative Analgesia

INTRODUCTION:

Postoperative pain management is crucial, as pain has a number of undesirable physiological effects, including hemodynamic instability, adrenergic activation, inflammatory mediator activation, pulmonary problems, and postoperative ischemia episodes [1,2]. Barazanchi et al. suggested multimodal approaches to analgesia with opioids, paracetamol, dexamethasone, gabapentinoids, infiltration of local anesthetic in the sites of port insertion, transversus abdominis plane (TAP) block, blique subcostal transversus abdominis plane (OSTAP) block, and paravertebral block in the perioperative period following laparoscopic cholecystectomy due to the multiple sources of pain associated with the procedure. The pain alleviation was insufficient despite all of this [3].

Forero et al. first described ESPB in 2016 for the treatment of thoracic neuropathic pain. Since then, it has become more well-known. ESPB is a peri-paravertebral regional anesthesia treatment that has been shown to be successful in preventing postoperative pain in a variety of surgical procedures [4].

The local anesthetic used in ESPB is administered in the fascial plane between the transverse process and the erector spinae muscle [4,5]. An extensive multi-dermatome sensory block of the posterior, lateral, and anterior thoracic wall is achieved when the injected local anesthetic diffuses anteriorly to the paravertebral space through the apertures in the anterior sheath wall, reaching the dorsal and ventral rami of spinal nerves [6,7]. Furthermore, the thoracolumbar fascia, which runs the length of the posterior thorax and abdomen in continuity with the nuchal fascia of the neck superiorly, aids in the dissemination of both craniocaudal local anesthetics. There have also been reports of sympathetic block [8,9].

Local anesthetics will spread via epidural and neural foraminal routes, and further intercostal dissemination results in more widespread analgesia [10,11]. Numerous disorders have been treated with ESPB, including thoracic and abdominal pain management, rib fractures, severe burns, breast surgery, shoulder girdle surgery, thoracotomy, cardiac surgery, spine surgery, laparoscopic/open renal and perirenal procedures, and more [12.13]. Hence, the present study assessed the effectiveness of Erector Spinae Plane Block for postoperative analgesia in laparoscopic cholecystectomy.

Objectives:

To compare patients undergoing laparoscopic cholecystectomy **with** ESPB and **without** ESPB.

Primary Objectives:

1. To assess postoperative pain at rest and with cough
2. Requirement of routine and rescue analgesia in first 24 hours

Secondary Objectives:

1. Presence or absence of Post-Operative Nausea and Vomiting (PONV)
2. Presence or absence of shoulder pain
3. To assess intraoperative pain

MATERIALS AND METHODS:

The prospective, comparative study was conducted over a year in the Department of Anaesthesiology at St. Martha's Hospital, Bengaluru. The study was conducted on patients scheduled for elective laparoscopic cholecystectomy.

Inclusion Criteria

- ASA grade I and II patients.
- Age between 20-65 years.
- Patients undergoing laparoscopic cholecystectomy.

Exclusion Criteria

- History of allergy to local anaesthetics.
- Bleeding diathesis.
- Patient on anticoagulants and corticosteroids
- Psychiatric disorders or use of psychiatric medications
- Conversion to open cholecystectomy
- Emergency laparoscopic cholecystectomy

Sample Size:

Considering the study done by Serkan Tulgar et al, as reference, sample size was calculated with 95% confidence limits [14].

Sample size= N = Z2 *(Mean)2

• (Expected difference in mean)2

• Z = Z score for 95% confidence interval = 1.96
• Mean = rescue analgesic in first 12 hours = 7
• Expected mean difference or = 2
• Maximum allowable error

N = (1.96)2 *(7)2
(2)2
= 3.84 * 49
4
= 47

Calculated sample size is 47. Hence, 50 study participants were selected and split into two equal groups for the convenience of an equal distribution of study subjects.

Study Methodology:
Using computer randomization, patients were divided into two groups: Group A (ESPB) and Group B (no intervention). Before being included in the study, consent was obtained. Through an interview, the patients' name, age, gender, and medical history were gathered. The physical examination was carried out. A proforma that had already been created was used to document these findings.

Prior To Anesthesia Examination And Preparation: Prior to surgery, a pre-anesthesia examination was conducted. Laboratory tests and evaluations for any systemic disorders were performed on the patients.

Operation Room Setup: The anesthesia machine was examined. A working laryngoscope with medium and large blades, a stylet, a working suction device, and endotracheal tubes of the proper size were prepared prior to the procedure.

Anaesthesia Procedure: IV fluid was started and an IV line was established prior to surgery. Standard monitors, including an electrocardiograph (ECG), pulse oximeter, and non-invasive blood pressure (NIBP) 61, were connected when the patient was moved to the operating room. Oxygen saturation (SPO2), MAP, HR, baseline systolic and diastolic blood pressure, and blood pressure were all measured. Both groups received intravenous midazolam (1 mg), glycopyrrolate (0.2 mg), and ondansetron (4 mg) as premedication.

Group A: Prior to induction, ESPB was conducted. Under stringent asepsis, ESPB was carried out under ultrasonographic supervision utilizing a linear 6-megahertz to 10-megahertz ultrasound probe (GE LOGIQ e R7 Ultrasound system) after routine monitoring and premedication. Three centimeters laterally to the T9 spinous process, the linear transducer was positioned in a longitudinal parasagittal orientation. The muscles of the erector spinae were found to be superficial to the T9 transverse process tip. Three milliliters of 2% lidocaine were used to anesthetize the patient's skin. An in-plane superior to inferior technique was used to implant a 21-gauge needle. The needle's tip was inserted into the deep (anterior) fascial plane of the erector spinae muscle.

On ultrasound imaging, the erector spinae muscle was lifted off the bone silhouette of the transverse process by a visible fluid spread, confirming the needle tip's position. On the opposite side, the process was repeated. Twenty milliliters of 0.375% buprevacaine were administered.

Group B: ESPB-free general anesthesia. Patients were preoxygenated with 100% oxygen following premedication, and Propofol 2 mg/kg body weight was used for induction to provide analgesia. Vecuronium was utilized as a muscle relaxant at 0.1 mg/kg and fentanyl at 2 mcg/kg. For the maintenance, 0.8–1% isoflurane was utilized. In accordance with the hemodynamic parameters, 1g of intravenous paracetamol was administered. At the conclusion of operation, the pneumoperitoneum was removed from every patient.

Neostigmine 50 mcg/kg and glycopyrrolate 10 mcg/kg were used to reverse the patients appropriately. Once sufficient muscle strength was achieved, the patients were extubated and taken to the recovery room. Both groups were evaluated and compared for postoperative pain, HR, MAP, the amount of routine (Paracetamol) and rescue (Fentanyl and Tramadol) analgesia consumed, the presence or absence of PONV, and shoulder discomfort at 20, 40, and 60 minutes in the recovery room and 3, 6, 9, 12, 18, and 24 hours in the ward.

Postoperative analgesia for first 24 hrs in Group A and B:
Routine analgesia: Paracetamol 1 gm IV 8th hourly

If NRS< 2/10 and the patient refused pain medication, this dosage was skipped.

Rescue Analgesia:
1. In recovery room: if NRS> 4/10, Fentanyl 25 mcg slow IV.
If NRS> 4/10 even after, repeat Fentanyl 25 mcg slow IV every 20 minutes.
2. In ward: if NRS> 4/10, Tramadol 50 mg intramuscular.

Statistical Analysis:
The Statistical Package for Social Sciences (SPSS) for Windows software (version 22.0; SPSS Inc., Chicago) was used to analyze the data after it had been imported into Microsoft Excel (Windows 7; Version 2007). For continuous data, descriptive statistics like mean and standard deviation (SD) were computed, while for categorical variables, frequencies and percentages were calculated. The Chi-Square test for categorical variables was used to examine the relationship between the variables. The means of the quantitative variables in the two research groups were compared using the unpaired t test. The analyzed data was visually represented using pie charts and bar charts. A significance level of 0.05 was established.

RESULTS:
Total of 50 patients undergoing laparoscopic cholecystectomy were included in the study and were allocated into 2 equal groups.
Group A: Erector Spinae Plane Block
Group B: No intervention

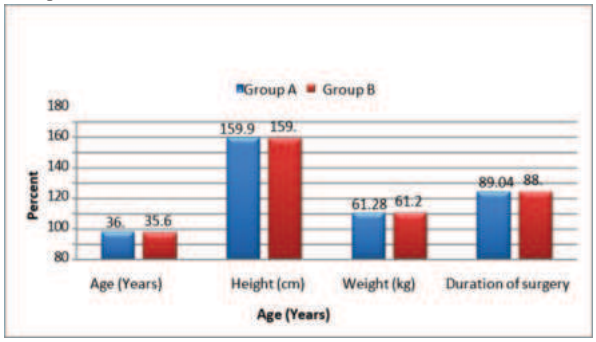

Figure 1. Comparison of Age, Height, Weight, Duration of Surgery

The age distribution in the present study ranged from 18 to 65 years. Mean age, height, weight, and duration of surgery were compared using an unpaired t-test. There was no statistically significant difference between the two groups. The gender distribution between the two study groups was compared using Chi-Square test and there was no significant difference between the groups with a P value of 0.637.

Sixty percent (60%) of patients in group A and 60% of patients in group B belonged to ASA I group. Forty (40%) patients in group A and 40% patients in group B belonged to ASA II group. The difference between two groups with regard to distribution of ASA status was not statistically significant with P = 1.000.

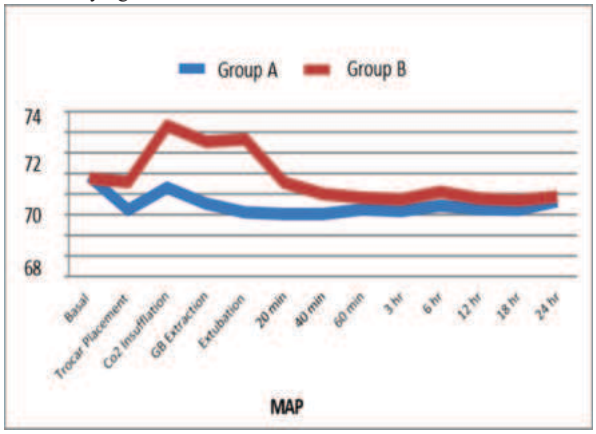

Figure 2. Comparison Of Heart Rate Between Group A And Group B

Table 1. Gender And ASA Class Distribution Among Group A And Group B

Parameters	Group A (n=25) n (%)	Group B (n=25) n (%)	P value
Gender Female Male	22 (88.0) 3 (12.0)	23 (92.0) 2 (8.0)	0.637
ASA I II	15 (60.0) 10 (40.0)	15 (60.0) 10 (40.0)	1.000
Chi-square test, p value not significant			

The Heart rate during trocar placement, CO_2 insufflation, gallbladder extraction, extubation and at 20, 40, 60 mins and 3, 6, 12 hrs of postoperative period were compared and found out to be statistically significant and those of recorded at baseline, 18 and 24 hrs were not statistically significant **(figure 2).**

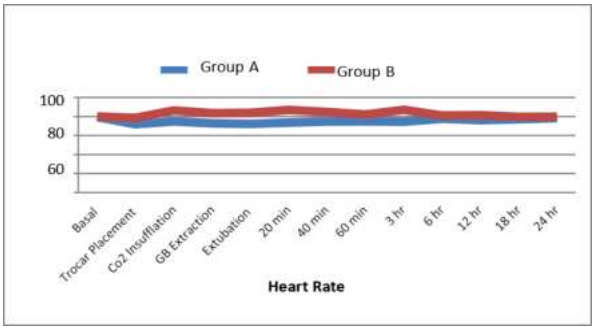

Figure 3. Comparison Of Mean Arterial Pressure (MAP) Between Group A And Group B

The MAP during trocar placement, CO_2 insufflation, gallbladder extraction, extubation and at 20 mins of postoperative period were compared and found out to be statistically significant and those of recorded at baseline, 40, 60 mins and 3, 6, 12, 18 and 24 hrs of postoperative period were not significant **(figure 3)**.

In the present study, the mean SPO_2 between the two groups was compared using an Unpaired t test, no significant variations were noticed.

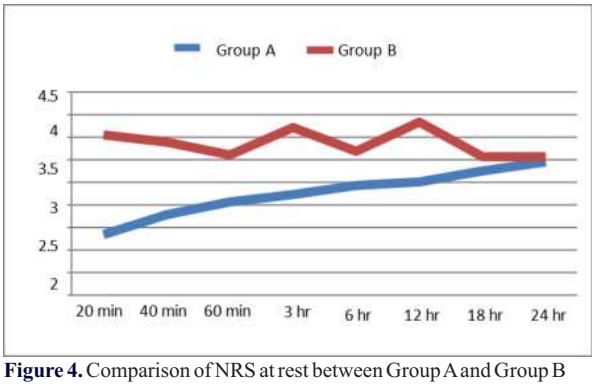

Figure 4. Comparison of NRS at rest between Group A and Group B

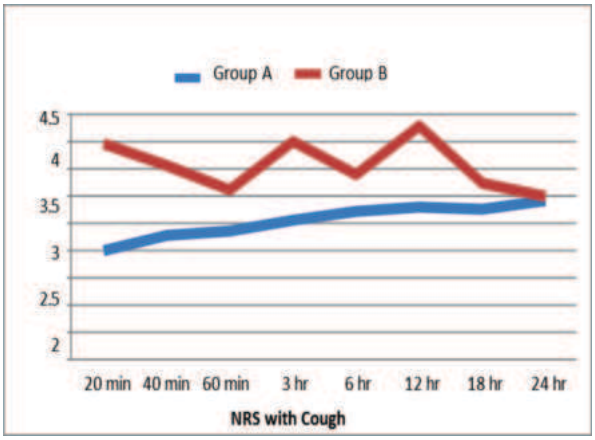

Figure 5. Comparison of NRS at cough between Group A and Group B

Numerical Rating Scale (NRS) at rest was recorded for both groups at predetermined intervals over 24 hrs postoperatively. In Group A, the mean NRS score was found to be rising slowly from 20 mins to reach maximum at 24 hrs postoperatively, with the mean NRS reaching 3, nearing the mild pain spectrum. In Group B, the mean NRS score was found to be 3.5 at 20 mins of the postoperative period and decreasing a little at the next 40 mins. Nearing the moderate pain spectrum at 3 hrs and 12 hrs. The mean for these results was compared using the unpaired t-test and was found to be significant at all the intervals with a p value of <0.05, except at 24 hrs. The NRS scores were found to be lower in the group receiving ESPB as compared to the group receiving no intervention till 24 hrs postoperatively **(figure 4).**

Numerical Rating Scale (NRS) with cough was recorded for both groups at predetermined intervals over 24 hrs postoperatively.

Figure 5 shows NRS score at cough was significant at all the intervals with a p value of <0.05, except at 24 hrs. The NRS scores were found to be lower in the group receiving ESPB as compared to the group receiving no intervention till 24 hrs post-operatively.

Table 2. Comparison Of Total Routine And Rescue Analgesia Between Study Groups

Analgesia and time frame	Group A (n=25) Mean (SD)	Group B (n=25) Mean (SD)	P Value
Paracetamol (gm) 1st 24 hrs	2.60 (0.50)	3.00 (0.00)	<0.001*
Fentanyl (mcg) in recovery room	4.00 (9.35)	16.00 (18.93)	0.007*
Tramadol (1st 12 hrs)	6.00 (16.58)	40.00 (25.0)	<0.001*
Tramadol (2nd 12 hrs)	6.00 (16.58)	40.00 (28.86)	<0.001*
Unpaired t Test, P Value * Significant			

The mean routine analgesia requirement between the two groups were analyzed by unpaired t test and was found to be statistically significant. The mean Paracetamol requirement is 2.60 + (0.50) gm in group A and 3.0 + (0.0) gm in group B. 10 patients in group A skipped one dosage of Paracetamol, as their NRS was < 2/10 and refused pain medication. The mean rescue analgesia requirement in recovery room between the two groups were analyzed by unpaired t test and was found to be statistically significant. The mean Fentanyl requirement is 4.0 + (9.35) mcg in group A and 16.0 + (18.93) mcg in group B. The mean Tramadol requirement in first 12 hrs is 6.0 + (16.58) mg in group A and 40.0 + (25.0) mg in group B. The mean Tramadol requirement in second 12 hrs is 6.0 + (16.58) mg in group A and 40.0 + (28.86) mg in group B **(table 2).**

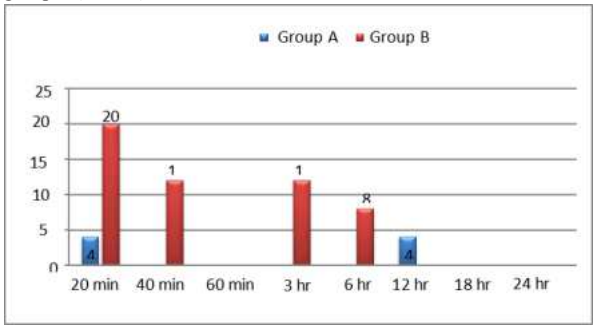

Figure 6. Comparison of Post Operative Nausea Vomiting (PONV) between Groups

As shown in **figure 6**, an incidence of postoperative nausea and vomiting was recorded at different time intervals and compared. In group A, 2 patients experienced PONV at 20 mins and 12 hrs. In group B, 5 patients experienced PONV at 20 mins and 3 patients at 40mins, 3 hrs and 2 at 6 hrs. There were no PONV recorded after 12 hrs in both the groups. The mean incidences of PONV were calculated using Chi-Square test and were not found to be statistically significant.

In Group A, no patient complained of shoulder pain at any interval. Group B, 5 patients complained of shoulder pain at 20 mins, 4 at 40 and 60 mins, 3 at 3 hrs post- operatively. The mean incidences of shoulder pain, calculated using Chi-Square test were found out to be statistically significant.

DISCUSSION:

In the present study, 50 patients between 20 to 65 years old, ASA I and

II, undergoing laparoscopic cholecystectomy under general anesthesia were randomly divided into two equal groups. There was no significant difference in gender distribution, height, weight, duration of surgery between the two groups. Hence the demographic characteristics are similar and comparable in both the groups. The change in heart rate, MAP (Mean Arterial Pressure), SPO_2 were recorded at trocar placement, CO_2 insufflation, gallbladder extraction, extubation, and till 24 hrs of the postoperative period. The changes seen in heart rate were statistically significant till 12 hrs and that of MAP were till 20 mins of the postoperative period. But changes in SPO_2 were almost similar in both the groups and were not statistically significant.

The NRS scores were recorded postoperatively, found to be lower in the group receiving ESPB as compared to the group receiving no intervention till 24 hours operatively. The mean routine and rescue analgesia requirement were significantly lower in group A for 24 hours. 10 patients in group A skipped one dosage of Paracetamol, as their NRS was < 2/10 and refused pain medication.

Altiparmak B et al, compared two different concentrations of bupivacaine, i.e., 0.375% (Group I) and 0.25% (Group II) with ESPB for mastectomy surgeries. In their study, the median NRS scores of patients were statistically high in Group II compared to Group I at the postoperative 15th, 30th, 60th, 120th minutes, 12th and 24th hrs [15].

Verma R et al, studied ultrasound guided ESPB in laparoscopic cholecystectomy. The static and dynamic VAS from first hour to 24 hours after surgery were statistically significant and was less than 4. This was comparable to our study [16].

We used NRS which was also < 4/10, and the mean NRS reaching 3 till 24 hrs of postoperative period. Serkan Tulgar et al, defined block failure as NRS > 6 in first hour or requirement of rescue analgesia when ESPB is used as a component of multimodal analgesia. considering this, in our study NRS was not > 6, but 7 patients in group A received rescue analgesia in 24 hours of postoperative period [14].

No side effects or complications occurred in our study as we used ultrasound guided ESPB and Bupivacaine dose less than 2 mg/kg body weight.

Postoperative analgesia should include strategies to reduce side effects. Intravenous analgesics are generally considered to be adequate for pain management in laparoscopic cholecystectomy [17]. However, opioids can lead to nausea, vomiting and itching while NSAID's affect the gastric, hepatic and renal systems and wound healing. Multimodal analgesics including peripheral blocks decrease the use of other analgesics and therefore reduce side effects [18].

Limitations of the study:

The exact volume and concentration of local anaesthetic to be used in ESPB is not well established in the present study. We used 20 ml of 0.375% bupivacaine for ESBP. There were some block failures. We did not increase the concentration for the fear of toxicity.

Complications, contraindications and unexpected side effects of ESPB have yet to be reported.

It will require extensive, larger studies to understand the contraindications, complications, unexpected effects of ESPB.

CONCLUSION:

The present study has shown that bilateral single shot ultrasound guided ESPB with 0.375% Bupivacaine performed in patients undergoing laparoscopic cholecystectomy decreases postoperative (static and dynamic) pain intensity in addition to requirement for opioids and other analgesic agents. In addition, ESPB also aided in decreasing hemodynamic response at predetermined intervals intraoperatively. ESPB may become a routine part of multimodal analgesia and aid in length of recovery, hospital stay and cost effectiveness.

Author Contribution:

Priyanka sanganagoudar , Keerti, Soundarya S V, Yogesh : Study concept and design, literature search, data acquisition, analysis, interpretation of results, manuscript preparation, and manuscript editing.

Priyanka sanganagoudar , Keerti : Study concept and design, data acquisition, manuscript editing, and review.

Keerti, Soundarya S V, Yogesh : Data analysis, interpretation of results, manuscript preparation, and editing.

Priyanka sanganagoudar , Keerti, Soundarya S V, Yogesh: Manuscript preparation, editing, and review.

Financial Support:
This study received no financial support or funding.

Conflicts Of Interest: Nil

REFERENCES:

1. Barrios A, Camelo J, Gomez J, Forero M, Peng P, Visbal K, Cadavid A. Evaluation of sensory mapping of erector spinae plane block. Pain Physician. 2020;23(3):E289.
2. Barazanchi AW, MacFater WS, Rahiri JL, Tutone S, Hill AG, Joshi GP. Evidence- based management of pain after laparoscopic cholecystectomy: A PROSPECT review update. Br J Anaesth. 2018; 121: 787-803.
3. Forero M, Adhikary S, Sarwani N, 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.
4. Altiparmak B, Toker MK, Uysal Aİ, Demirbilek SG. Comparison of the efficacy of erector spinae plane block performed with different concentrations of bupivacaine on postoperative analgesia after mastectomy surgery: randomized, prospective, double blinded trial. BMC anaesthesiology. 2019; 19(1): 3.
5. Seelam S, Nair AS, Christopher A, Upputuri O, Naik V, Rayani BK. Efficacy of single-shot ultrasound-guided erector spinae plane block for postoperative analgesia after mastectomy: A randomized controlled study. Saudi Journal of Anaesthesia. 2020; 14(1): 22-27.
6. Elyazed MM, Mostafa SF, Abdelghany MS, Eid GM. Ultrasound-guided erector spinae plane block in patients undergoing open epigastric hernia repair: a prospective randomized controlled study. Anesthesia & Analgesia. 2019; 129(1): 235-40.
7. Hamed MA, Goda AS, Basiony MM, Fargaly OS, Abdelhady MA. Erector spinae plane block for postoperative analgesia in patients undergoing total abdominal hysterectomy: a randomized controlled study original study. Journal of pain research. 2019; 12: 1393-8.
8. Singh S, Choudhary NK, Lalin D, Verma VK. Bilateral ultrasound-guided erector spinae plane block for postoperative analgesia in lumbar spine surgery: a randomized control trial. Journal of neurosurgical anaesthesiology. 2020; 32(4): 330-4.
9. Yao Y, Fu S, Dai S, Yun J, Zeng M, Li H, et al. Impact of ultrasound-guided erector spinae plane block on postoperative quality of recovery in video-assisted thoracic surgery: A prospective, randomized, controlled trial. Journal of Clinical Anesthesia. 2020; 63: 109783.
10. 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 Journal of Anaesthesia. 2019; 63(12): 1008-1014
11. Fang B, Wang Z, Huang X. Ultrasound-guided preoperative single-dose erector spinae plane block provides comparable analgesia to thoracic paravertebral block following thoracotomy: a single centre randomized controlled double-blind study. Annals of translational medicine. 2019; 7(8).174-81
12. Tulgar S, Selvi O, Senturk O, Serifsoy TE, Thomas DT. Ultrasound-guided Erector Spinae Plane Block: Indications, Complications, and Effects on Acute and Chronic Pain Based on a Single-centre Experience. Cureus. 2019; 11(1): e3815.
13. Huang J, Liu JC. Ultrasound-guided erector spinae plane block for postoperative analgesia: a meta-analysis of randomized controlled trials. BMC anesthesiology. 2020 ; 20:1-8.
14. Serkan Tulgar, Mahmut Sertan Kapakli, Ozgur Senturk, Onur Selvi, Talat Ercan Serifsoy, Zeliha Ozer, Journal of Clinical Anaesthesia. 2018; 49: 101-106.
15. Altiparmak B, Toker MK, Uysal Aİ, Demirbilek SG. Efficacy of ultrasound-guided erector spinae plane block for analgesia after laparoscopic cholecystectomy: a randomized controlled trial. Brazilian Journal of Anaesthesiology. 2019; 69 (6): 561-568.
16. Verma R, Srivastava D, Saxena R, Singh TK, Gupta D, Agarwal A, Mishra P. Ultrasound-guided bilateral erector spinae plane block for postoperative analgesia in laparoscopic cholecystectomy: A randomized controlled trial. Anesth Essays Res. 2020;14: 226-32.
17. Ibrahim M. Erector spinae plane block in laparoscopic cholecystectomy, is there a difference? A randomized controlled trial. Anesthesia Essays and Researches. 2020 ;14(1):119-26.
18. Adhikary SD, Bernard S, Lopez H, Chin KJ. Erector spinae plane block versus retrolaminar block: a magnetic resonance imaging and anatomical study. Regional Anesthesia & Pain Medicine. 2018 ; 43(7): 756-62.