Original Article

Ultrasound-guided subtransverse interligamentary (STIL) block versus erector spinae plane (ESP) block for postoperative analgesia in patients undergoing modified radical mastectomy (MRM) – A randomised comparative study

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ABSTRACT

Background and Aims: Ultrasound-guided regional anaesthesia has led to the development of various paraspinal block techniques, with the most notable being the erector spinae plane (ESP) block and the subtransverse interligamentary (STIL) block. The objective of this study was to assess and compare the analgesic efficacy of STIL block with ESP block in patients undergoing modified radical mastectomy (MRM) surgery, in terms of postoperative pain scores, 24-h opioid consumption, rescue analgesia requirements and adverse effects. **Methods:** One hundred twenty female patients, aged 18-65 years, scheduled to undergo MRM, were randomised to receive either ESP (Group I) or STIL (Group II) blocks with 20 mL of 0.25% levobupivacaine and dexamethasone 4 mg. The primary outcome was pain scores at 12 h. The secondary outcomes were 24-h opioid requirement, total duration of analgesia and number of rescue analgesia doses required. Paired Student's *t*-test was used to compare normally distributed quantitative data, while Mann–Whitney *U* test was conducted to analyse non-normally distributed quantitative variables. The Chi-square test was employed to assess the association between categorical variables. A *P* value of less than 0.05 was considered statistically significant. **Results:** The median Numerical Rating Scale (NRS) scores were significantly lower in Group II compared to Group I at 2, 6, 12 h ($P < 0.001$) and 24 h ($P < 0.008$). The total opioid requirement ($P < 0.0001$) and the number of rescue analgesia doses ($P < 0.001$) were significantly lower in Group II. The duration of analgesia was significantly longer in Group II ($P < 0.001$). The time taken to perform the procedure was significantly less in Group I ($P < 0.001$). **Conclusion:** The STIL block is associated with a lower NRS score and decreased postoperative opioid consumption compared to the ESP block in patients undergoing MRM.

Keywords: Analgesia, erector spinae plane block, ESP block, mastectomy, nerve block, opioid, subtransverse interligamentary block, pain, postoperative pain, STIL block, ultrasonography, ultrasound guidance

INTRODUCTION

Breast carcinoma is a common malignancy in females, with modified radical mastectomy (MRM) being the most frequently performed surgery.[1] Postoperative pain can lead to significant morbidity, including chronic pain syndrome and reduced quality of life.[2] Various regional anaesthesia techniques, such

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as thoracic paravertebral block (TPVB) and newer ultrasound-guided blocks, have been developed to improve post-mastectomy analgesia while minimising complications. Ultrasound-guided regional anaesthesia has led to the development of novel blocks that target thoracic nerves without entering the paravertebral space, reducing complications associated with TPVB.[3-5] These 'paravertebral by proxy' blocks[4] include the erector spinae plane (ESP) block,[3] mid-point transverse process to pleura (MTP) block,[6] multiple injection costotransverse block (MICB),[7] costotransverse foramen block (CTFB)[8] and subtransverse process interligamentary (STIL) block,[9] collectively known as intertransverse process (ITP) blocks.[10]

The recently introduced STIL block offers a safer alternative by targeting thoracic nerves without entering the paravertebral space.[9] However, studies comparing its efficacy with the widely used ESP block for postoperative MRM pain management are limited. We hypothesised that the STIL block would provide better postoperative analgesia than the ESP block in patients undergoing MRM without an increase in adverse effects. The primary objective was to score the pain level at 12 h. The secondary objective included cumulative opioid consumption during surgery duration, the number of rescue analgesia doses within 24 h, the duration of postoperative analgesia at 24 h and the total time taken to perform the block.

METHODS

Ethical clearance was obtained from the Institutional Review Board (vide approval number ECR/526/Inst/UP/2014/RR 20, No. dean/2022/EC/4066, dated 15 April 2023). The trial was registered with the Clinical Trials Registry-India (registration number CTRI/2023/05/052796, accessible at www.ctri.nic.in) prior to patient enrolment. The principles of the Declaration of Helsinki (2013) and the Good Clinical Practice guidelines were followed in this study. Informed written consent was obtained from all participants, and the study was conducted with permission to use the data for educational and research purposes. One hundred and twenty patients with carcinoma breast, aged 18–65 years, with American Society of Anesthesiologists (ASA) physical status I and II were included in the study. Patients' refusal or noncompliance, patients with a history of allergy to the study drugs or with severe pulmonary, cardiac, hepatic or renal diseases, those with uncontrolled diabetes mellitus or hypertension, obese patients (body mass index >35 kg/m^2), patients with vertebral deformity, evidence of infection or coagulation disorders, and haemodynamically unstable patients were excluded from the study.

Participants were randomly assigned to one of two groups using a computer-generated randomisation table (OpenEpi.com, Version 3, open-source calculator), with assignments sealed in opaque envelopes. The allocation ratio was 1:1. In both groups, patients received 20 mL of 0.25% levobupivacaine with dexamethasone 4 mg. Patients in Group I received an ultrasound-guided ESP block, while those in Group II were administered an ultrasound-guided STIL block.

Before surgery, patients were explained the Numerical Rating Scale (NRS) and the details of the procedure. On arrival in the operating room, intravenous (IV) access was established and standard ASA monitors were applied. The anaesthesiologists, who were well-versed in ultrasound-guided regional anaesthesia techniques, performed either the ESP or STIL block after the induction of general anaesthesia, according to the allocated groups. They were not involved in data collection, analysis, or interpretation. General anaesthesia was administered as per our institutional protocol.

Patients who received the ESP block were placed in the lateral decubitus position, with the operative site non-dependent. Under strict aseptic precautions, a high-frequency linear ultrasound probe (M-TURBO FUJIFILM Sonosite, Inc., Bothell, WA, USA) was placed in a parasagittal orientation at the T4–T5 thoracic level, and the erector spinae muscle plane was identified at the level of the transverse process (TP) [Figure 1]. A 22-gauge echogenic needle (Bbraun™ Stimuplex®, ultra 360®; Melsungen, Hessen, Germany) was inserted using an in-plane approach from a caudad-to-cephalad direction, and the correct needle tip position was confirmed by the administration of 1–2 mL of 0.9% normal saline solution. After confirmation of the plane and negative aspiration, 20 mL of 0.25% levobupivacaine with 4 mg dexamethasone was administered.

The STIL block was performed in the lateral position, with the operative site being non-dependent. Under strict aseptic precautions, the high-frequency linear ultrasound probe was placed in the parasagittal position at the T4–T5 thoracic level. TP was seen

as a square-shaped structure lying closer to the skin than the ribs. The superior costotransverse ligament (SCTL) was observed above the paravertebral space [Figure 2]. A 22-gauge echogenic needle was inserted in a caudad-to-cephalad direction, in-plane, with the needle tip directed toward the base of the T4 TP immediately posterior to the junction of SCTL and T4 TP. The correct needle tip position was confirmed by administering 1–2 mL of 0.9% normal saline solution. After confirming negative aspiration, 20 mL of 0.25% levobupivacaine with 4 mg dexamethasone was administered.

Intraoperatively, if there was an increase in heart rate by more than 20% of baseline, other causes of tachycardia were ruled out, and IV fentanyl 0.5 μg/kg was administered as a bolus and recorded. All patients received IV paracetamol at a dose of 15 mg/kg three times a day and ketorolac at 0.5 mg/kg twice daily during the first 48 h. Postoperatively, if the patient reported an NRS ≥3, IV tramadol 1.5 mg/kg was administered as a rescue analgesic, and frequencies were noted for the first 24 h.

The primary outcome was the measurement of postoperative pain using the NRS scale at 12 h. Pain assessment was done at 2, 6, 12 and 24 h following surgery. Secondary outcomes were the measurement of cumulative opioid consumption, the number of rescue analgesia doses, the duration of postoperative analgesia (defined as the time period recorded after emergence from anaesthesia till the requirement of the first dose of rescue analgesia) and the total time taken to perform the block (time from placement of transducer on the patient to the completion of drug injection). Complications related to blocks, if any, were also noted.

Postoperatively, at 2 h, the sensory blockade was assessed both longitudinally and anteroposteriorly using cold sensation and pin-prick testing to identify the dermatomes involved. Two reference lines were drawn to assess the extent of sensory blockade: anteriorly, the midclavicular line, and posteriorly, a line passing through the tip of the inferior angle of the scapula drawn parallel to the spinous processes of the spine.

The sample size was calculated using OpenEpi.com, Version 3, an opensource calculator, based on a pilot study on six patients, where the minimum expected difference in the mean NRS score at 12 h between two groups was found to be 25%: Group I- 2.71 [standard deviation (SD): 0.65] and Group II- 2.12 (SD: 0.58). For statistically significant results with $\alpha = 0.05$ and $\beta = 0.80$ with a 95% confidence interval, 49 patients were required in each group (Fleiss, Statistical Methods for Rates and Proportions). Assuming a 10% dropout rate, 60 patients were enroled in each group.

All data were compiled and analysed using Microsoft Excel (Office 365), GraphPad Prism 8.4.2, and Statistical Package for the Social Sciences version 27 (International Business Machines Corporation, Armonk, NY, USA). The normality of data distribution was tested using the Kolmogorov–Smirnov

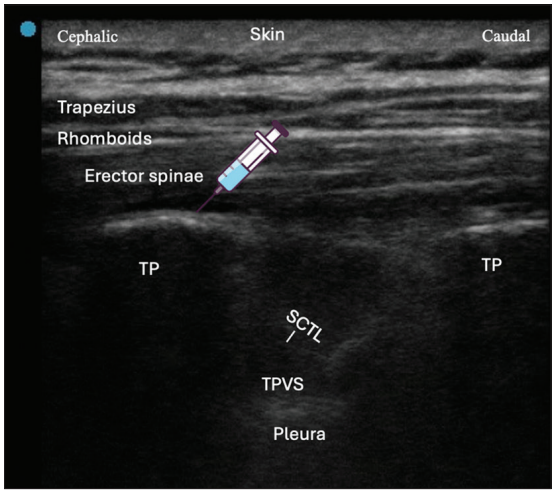

Figure 1: ESP block – ultrasonography image with needle position during injection. ESP= erector spinae plane, SCTL= superior costotransverse ligament, TP= transverse process, TPVS=Thoracic paravertebral space

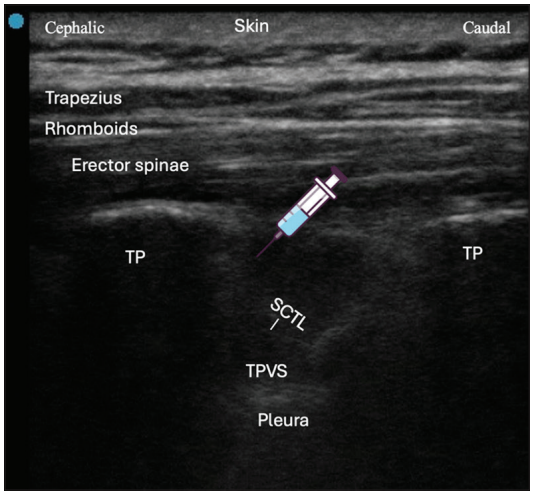

Figure 2: STIL block – ultrasonography image with needle position during injection. STIL= subtransverse interligamentary, SCTL= superior costotransverse ligament, TP= transverse process, TPVS=Thoracic paravertebral space

test. Descriptive statistics were shown as proportions for categorical variables (ASA) and mean (SD) for normal continuous quantitative variables (age, weight, height, heart rate, blood pressure, duration of analgesia, average duration to perform the block and total dose of fentanyl), which were compared using paired Student's *t*-test. Non-normally distributed quantitative variables (NRS) were expressed as the median and interquartile range (IQR) and compared using the Mann–Whitney *U* test. The effect size was calculated using Cohen's d. A two-tailed *P* value below 0.05 was considered significant. The Chi-squared test was applied to categorical data.

RESULTS

A total of 134 patients were assessed for eligibility; 14 were excluded, and 120 patients were finally included in the study [Figure 3]. There was no significant difference between the two groups in terms of baseline patient characteristics [Table 1].

Postoperative NRS scores were statistically significantly higher in Group I compared to Group II at the 12th hour (median 4 [IQR: 0–1] versus 2 [IQR: 0–1], $P < 0.001$; Table 2). The duration of analgesia (in hours) was significantly prolonged in Group II compared to Group I ($P < 0.001$). Total fentanyl consumption was found to be significantly higher in Group I than in Group II ($P < 0.0001$). The mean time taken to perform the ESP block (in minutes) was significantly shorter than that taken to perform the STIL block ($P < 0.001$) [Table 3]. Patients in Group I frequently required rescue analgesia doses compared to those in Group II, and the difference was statistically significant ($P < 0.001$) [Table 3]. The upper and lower limits of the dermatomes involved in Group I were T2–T3 and T5–T6, respectively and in Group II, were T1–T2 and T6–T7, respectively. A greater number of patients in Group II than in Group I exhibited medial to mid-clavicular line extension of the block (42 vs. 13, $P < 0.0001$). None of the patients in either group suffered any complications.

DISCUSSION

This randomised comparative study demonstrated the superior analgesic efficacy of the STIL block over the ESP block in MRM surgery under general anaesthesia. Patients receiving the STIL block experienced better postoperative pain control and prolonged analgesia, with reduced opioid and rescue analgesic

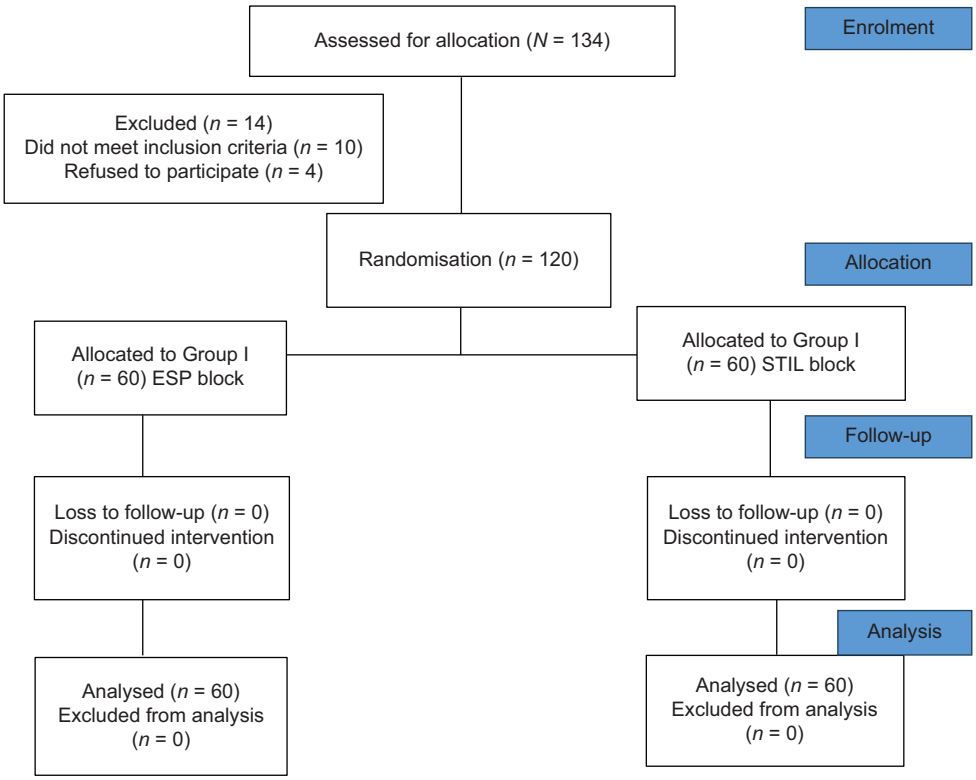

Figure 3: CONSORT flow diagram for participant enrolment (*n* = number of patients). CONSORT = Consolidated Standards of Reporting Trials, ESP = erector spinae plane, STIL = subtransverse interligamentary

Table 1: Baseline patient demographics

Parameters	Group I (*n*=60)	Group II (*n*=60)
Age (in years)	49.80 (7.34) (42.46, 57.14)	48.87 (6.75) (42.12, 55.62)
Weight (in kg)	70.03 (14.35) (55.68,84.38)	73.48 (13.39)
Height (cm)	152.10 (6.62) (145.48, 158.72)	153.45 (5.45) (148, 158.9)
ASA (I/II) (*n*)	37/23	39/21
Heart-rate (beats/minute)	103.05 (16.12) (86.93, 119.17)	104.38 (24.14) (80.24, 128.52)
SBP (in mmHg)	128.18 (11.57) (116.61, 139.75)	129.13 (11.89) (117.24, 141.02)
DBP (in mmHg)	82.75 (7.33) (75.42, 90.08)	80.45 (8.68) (71.77, 89.13)
MAP (in mmHg), mean (SD) (95% CI)	97.89 (7.87) (90.02, 105.76)	96.67 (8.71) (87.96, 105.38)

Data expressed as mean (SD) (95% CI) or frequency. The haemodynamic parameters (HR, SBP, DBP, MAP) are the baseline values noted before induction of anaesthesia. Group I=patient received erector spinae plane block, Group II=patient received subtransverse interligamentary block. *n*=number of patients, ASA=American Society of Anesthesiologists physical status, CI=confidence interval, DBP=diastolic blood pressure, HR=heart rate, MAP=mean arterial pressure. SBP=systolic blood pressure, SD=standard deviation

Table 2: Comparison of NRS between two groups at various time intervals

Time points (h)	Group I (*n*=60)	Group II (*n*=60)	Effect size (Cohen's d) CI=95%	*P*
2	2 (0–1)	1 (0–2)	0.234	<0.001
6	3 (0–1)	2 (0–1)	1.436	<0.001
12	4 (0–1)	2 (0–1)	0.842	<0.001
24	4 (0–1)	3 (0–1)	0.969	<0.008

Data expressed as median (interquartile range). Group I=patient received erector spinae plane block, Group II=patient received subtransverse interligamentary block. CI=confidence interval, NRS=Numerical Rating Scale, *n*=number of patients

requirements. However, the ESP block was quicker to perform.

Managing pain in MRM surgery remains challenging due to the breast's complex innervation, often contributing to post-surgical pain syndrome.[11] The procedure-specific postoperative pain management (PROSPECT) guidelines recommend TPVB as the preferred regional analgesia technique for oncologic breast surgeries.[12] However, TPVB is an advanced procedure, leading to increasing use of fascial plane blocks, such as ESP and ITP, which offer comparable analgesia with fewer complications. While the ESP block is effective in breast surgeries, its precise mechanism remains debated.[13] Local anaesthetic (LA) diffusion into the paravertebral space has been suggested,[14] though cadaver studies show inconsistent results.[15] Some clinical studies indicate TPVB provides superior postoperative pain relief compared to ESP block, likely due to limited paravertebral spread of ESP block.[16,17] The STIL block was first described by Kilicalsan *et al*.[9] for thoracic spine surgery. They administered LA anterior to the ITL and posterior to the SCTL–TP junction within the retro-SCTL space.[9] It is believed to block both the dorsal and ventral rami due to the anterior diffusion of LA into the paravertebral space, similar to ESP. The SCTL's porous structure may facilitate this communication.[18] Ince *et al*.[19] reported significant postoperative pain relief with the STIL block in a lumpectomy case. To our knowledge, this is the first randomised controlled trial (RCT) evaluating the STIL block in MRM surgery and comparing it to the widely studied ESP block.

Intertransverse tissue complex (ITTC), comprising the intertransverse ligament, intertransverse and levatores costarum muscles and fatty tissue, connects the erector spinae muscle plane and the retro-SCTL space to the paravertebral space.[18] The superior analgesia and sensory coverage of the STIL block in this study is likely the result of more direct LA spread into the paravertebral space compared to the ESP block. In the ESP block, LA is deposited farther from the target site, resulting in dorsal rami blockade but inconsistent paravertebral diffusion, which depends on the volume and time.[20-22] Cadaver studies suggest that higher LA volumes do not necessarily enhance paravertebral spread.[23] Research on ITP blocks has consistently demonstrated paravertebral spread and involvement of sympathetic ganglia, similar to TPVB,[6-9] which supports the STIL block's superior analgesic effect. The ESP block's shorter procedure time may be attributed to its more superficial location, requiring fewer needle adjustments.

Among ITP block variants, the STIL block offers advantages. It provides a clearer drug deposition endpoint compared to the subjective midpoint targeting in the MTP block. MICB and CTFB, with LA deposited near the SCTL, pose risks of pneumothorax and vascular puncture, particularly for novices. Sethi *et al*.[24] found that while the MTP block and the ESP block had similar analgesic efficacy for the first 2 h postoperatively, the MTP block was inferior beyond the third hour due to inadequate intersegmental drug distribution. The STIL block's superior results in this

Table 3: Comparison of block characteristics, fentanyl consumption, duration of analgesia and dose of rescue analgesia needed between both groups

Parameters	Group I (*n*=60)	Group II (*n*=60)	*P*
Average duration to perform block (in min)	10.42 (2.12) (8.3, 12.54)	13.75 (1.84) (11.91, 15.59)	<0.001
Total dose of fentanyl (μg)	175.67 (16.21) (159.46, 191.88)	156.50 (10.73) (145.77, 167.23)	<0.0001
Duration of analgesia (in h)	11.41 (1.79) (9.62, 13.2)	17.49 (2.64) (14.85, 20.13)	<0.001
Number of doses of rescue analgesics			
0	6	22	χ^2=84.64
1	18	10	*P*<0.001
2	10	10	
3	26	18	

Data expressed as mean (SD) (95% CI) or frequency. Group I=patient received erector spinae plane block, Group II=patient received subtransverse interligamentary block. CI=confidence interval, SD=standard deviation, *n*=number of patients

study may be due to more effective intersegmental spread, as LA is deposited near the TP edge, facilitating better diffusion into the paravertebral space.

This study provides valuable insights into postoperative analgesia for breast surgery, with strengths including a clearly defined research question, rigorous RCT methodology, standardised pain assessment tools (NRS and opioid consumption) and multivariable statistical analysis to control confounders. However, limitations exist, including variability in patient characteristics, comorbidities, and surgical techniques that may introduce confounders despite statistical adjustments. A relatively small sample size limits generalisability and reliance on patient-reported outcomes poses potential recall bias. The short follow-up primarily assesses immediate postoperative effects, leaving long-term pain outcomes unexamined. Multiple operators performed the blocks, which may have affected the outcomes, although all were trained in ultrasound-guided techniques.

This study strengthens the current understanding of paravertebral anatomy and analgesia. Future research with larger, more diverse populations, extended follow-ups and patient-centred outcomes could further clarify the comparative benefits of the ESP and STIL blocks.

CONCLUSION

In patients undergoing MRM, the STIL block is associated with an improved NRS score at 12 h compared to the ESP block.

Study data availability

De-identified data may be requested with reasonable justification from the authors (via email to the corresponding author) and will be shared after approval in accordance with the author's institution's policy.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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REFERENCES

1. Ferlay J, Colombet M, Soerjomataram I, Parkin DM, Piñeros M, Znaor A, *et al*. Cancer statistics for the year 2020: An overview. Int J Cancer 2021. doi: 10.1002/ijc. 33588.
2. Villa G, Mandarano R, Scirè-Calabrisotto C, Rizzelli V, Del Duca M, Montin DP, *et al*. Chronic pain after breast surgery: Incidence, associated factors, and impact on quality of life, an observational prospective study. Perioper Med (Lond) 2021;10:6. doi: 10.1186/s13741-021-00176-6
3. 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;41:621-7.
4. Costache I, Pawa A, Abdallah FW. Paravertebral by proxy - time to redefine the paravertebral block. Anaesthesia 2018;73:1185-8.
5. Yang H, Dong Q, Liang L, Liu J, Jiang L, Liang H, *et al*. The comparison of ultrasound-guided thoracic paravertebral blockade and internal intercostal nerve block for non-intubated video-assisted thoracic surgery. J Thorac Dis 2019;11:3476-81.
6. Costache I, de Neumann L, Ramnanan CJ, Goodwin SL, Pawa A, Abdallah FW *et al*. The midpoint transverse process to pleura (MTP) block: A new endpoint for the thoracic paravertebral block. Anaesthesia 2017;72:1230–6.
7. Nielsen MV, Moriggl B, Hoermann R, Nielsen TD, Bendtsen TF, Børglum J. Are single-injection erector spinae plane block and multiple-injection costotransverse block equivalent to thoracic paravertebral block? Acta Anaesthesiol Scand 2019;139:16. doi: 10.1111/aas. 13424
8. Shibata Y, Kampitak W, Tansatit T. The novel costotransverse foramen block technique: Distribution characteristics of injectate compared with erector spinae plane block. Pain Physician 2020;23:E305-14.
9. Kilicalsan A, Sarkilar G, Altinok T, Tulgar S. A novel ultrasound-guided technique in peri-paravertebral area:

Subtransverse process interligamentary (STIL) plane block: The game has not ended yet. J Clin Anesth 2020; 60:76-7.
10. El-Boghdadly K, Wolmarans M, Stengel AD, Albrecht E, Chin KJ, Elsharkawy H, *et al*. Standardizing nomenclature in regional anesthesia: An ASRA-ESRA Delphi consensus study of abdominal wall, paraspinal, and chest wall blocks. Reg Anesth Pain Med 2021;46:571-80.
11. Chen VE, Greenberger BA, Shi Z, Gajjar S, Shi W, Mourad WF, *et al*. Post-mastectomy and post-breast conservation surgery pain syndrome: A review of etiologies, risk prediction, and trends in management. Transl Cancer Res 2020;9(Suppl 1):S77-85.
12. Jacobs A, Lemoine A, Joshi GP, Van de Velde M, Bonnet F; PROSPECT Working Group collaborators#. PROSPECT guideline for oncological breast surgery: A systematic review and procedure-specific postoperative pain management recommendations. Anaesthesia 2020;75:664-73.
13. Lonnqvist PA, Karmakar MK, Richardson J, Moriggl B. Daring discourse: Should the ESP block be renamed RIP II block? Reg Anesth Pain Med 2021;46:57-60.
14. Chin KJ, El-Boghdadly K. Mechanisms of action of the erector spinae plane (ESP) block: A narrative review. Can J Anesth 2021:68:387–408.
15. Govender S, Mohr D, Van Schoor AN, Bosenberg A. The extent of cranio-caudal spread within the erector spinae fascial plane space using computed tomography scanning in a neonatal cadaver. Paediatr Anaesth 2020;39:667-70.
16. Singh NP, Makkar JK, Kuberan A, Guffey R, Uppal V. Efficacy of regional anesthesia techniques for postoperative analgesia in patients undergoing major oncologic breast surgeries: A systematic review and network meta-analysis of randomized controlled trials. Can J Anaesth 2022;69:527-49.
17. Swisher MW, Wallace AM, Sztain JF, Said ET, Khatibi B, Abanobi M, *et al*. Erector spinae plane versus paravertebral nerve blocks for postoperative analgesia after breast surgery: A randomized clinical trial. Reg Anesth Pain Med 2020;45:260-6.
18. Cho T, Kim SH, Jehoon O, Kwon HJ, Kim KW, Yang HM. Anatomy of the thoracic paravertebral space: 3D micro-CT findings and their clinical implications for nerve blockade. Reg Anesth Pain Med 2021;46:699-703.
19. Ince I, Dostbil A, Ozmen O, Aksoy M, Karadeniz E. Subtransverse process interligamentary (STIL) plane block for postoperative pain management after breast surgery. J Clin Anesth 2020;61:109649. doi: 10.1016/j.jclinane. 2019.109649
20. Kot P, Rodriguez P, Granell M, Cano B, Rovira L, Morales J, *et al*. The erector spinae plane block: A narrative review. Korean J Anesthesiol 2019;72:209-20.
21. Saadawi M, Layera S, Aliste J, Bravo D, Leurcharusmee P, Tran Q. Erector spinae plane block: A narrative review with systematic analysis of the evidence pertaining to clinical indications and alternative truncal blocks. J Clin Anesth 2021;68:110063. doi: 10.1016/j.jclinane. 2020.110063
22. Elsharkawy H, Pawa A, Mariano ER. Interfascial plane blocks: Back to basics. Reg Anesth Pain Med 2018;43:341-6.
23. Choi YJ, Kwon HJ, O J, Cho TH, Won JY, Yang HM, *et al*. Influence of injectate volume on paravertebral spread in erector spinae plane block: An endoscopic and anatomical evaluation. PLoS One 2019;14:e0224487. doi: 10.1371/journal.pone. 0224487
24. Sethi P, Kaur M, Bhatia PK, Goyal S, Sharma A, Roy S, *et al*. Comparison of midpoint transverse process to pleura (MTP) block and erector spinae plane block (ESP) for postoperative analgesia in modified radical mastectomy patients: A double-blinded, randomized control trial. J Anaesthesiol Clin Pharmacol 2024;40:344-50.