COMPARISON OF ULTRASOUND-GUIDED ERECTOR SPINAE PLANE AND PARAVERTEBRAL BLOCKS IN MODIFIED RADICAL MASTECTOMY: A RANDOMIZED CONTROLLED FEASIBILITY STUDY

Dr . BALAKRISHNAN

DR. SUBHASAN JV

1. PROFESSOR & HOD, DEPARTMENT OF ANAESTHESIA, SREE MOOKAMBIKA INSTITUTE OF MEDICAL SCIENCES KANYAKUMARI, TAMIL NADU, INDIA

2. JUNIOR RESIDENT, DEPARTMENT OF ANAESTHESIA, SREE MOOKAMBIKA INSTITUTE OF MEDICAL SCIENCES, KANYAKUMARI, TAMIL NADU, INDIA

CORRESPONDING AUTHOR

DR SUBHASAN JV

JUNIOR RESIDENT, DEPARTMENT OF ANAESTHESIA, SREE MOOKAMBIKA INSTITUTE OF MEDICAL SCIENCES, KANYAKUMARI, TAMIL NADU, INDIA

Abstract:

Background: Modified radical mastectomy (MRM) is frequently associated with considerable postoperative pain, necessitating effective regional analgesic techniques. Although the thoracic paravertebral block (PVB) is regarded as the gold standard, it presents technical challenges and potential complications. The ultrasound-guided erector spinae plane block (ESPB) has emerged as a simpler and potentially safer alternative, particularly for anaesthesiology trainees.

Aim: This study aims to compare the feasibility of ultrasound-guided erector spinae plane block and thoracic paravertebral block when performed by anaesthesiology residents in patients undergoing modified radical mastectomy.

Methods: This prospective, randomized comparative study was conducted at a tertiary care hospital in Tamil Nadu from May 2024 to February 2025. A total of 100 patients (ASA I–II), aged 40–65 years, scheduled for MRM under general anaesthesia were randomized into two groups: ESPB (n=50) and PVB (n=50). Blocks were administered under ultrasound guidance by

anaesthesia residents following the induction of anaesthesia. Primary outcomes included feasibility parameters such as ease of performance, time required, and number of needle attempts. Secondary outcomes included postoperative pain scores assessed using the visual analogue scale (VAS). Statistical analysis was conducted using SPSS, with $p < 0.05$ considered significant.

Results: The mean time required to perform the block was significantly shorter in the ESPB group compared to the PVB group. ESPB also necessitated fewer needle guidance interventions, indicating higher technical success. Postoperative VAS scores were comparable at 4 hours; however, from 8 to 24 hours, ESPB provided significantly better analgesia than PVB ($p < 0.05$).

Conclusion: Ultrasound-guided erector spinae plane block is easier to perform, requires less time, and provides superior prolonged postoperative analgesia compared to paravertebral block when performed by anaesthesia residents. ESPB represents a safe, effective, and feasible alternative to PVB, particularly in teaching institutions.

Keywords: Erector spinae plane block, paravertebral block, modified radical mastectomy, postoperative analgesia.

Introduction

Modified radical mastectomy (MRM) is a commonly performed surgical procedure for breast cancer and is associated with significant postoperative pain due to extensive tissue dissection involving the breast, axilla, and chest wall. Inadequately controlled postoperative pain can lead to delayed recovery, increased opioid consumption, higher incidence of postoperative nausea and vomiting, and development of chronic post-mastectomy pain syndrome. Therefore, effective regional analgesic techniques play a crucial role in perioperative pain management for breast surgeries.[1,2]

Thoracic paravertebral block (PVB) has long been considered a gold standard regional anaesthetic technique for breast surgery, as it provides unilateral segmental analgesia by blocking spinal nerves near their emergence from the intervertebral foramina. Despite its proven efficacy, PVB is technically demanding and is associated with potential complications such as pneumothorax, hypotension, vascular puncture, and inadvertent epidural or intrathecal spread, particularly when performed by less experienced practitioners.[3,4]

The ultrasound-guided erector spinae plane block (ESPB) is a relatively newer fascial plane block that has gained popularity for thoracic and breast surgeries. The block involves deposition of local anaesthetic deep to the erector spinae muscle, allowing cranio-caudal spread and indirect analgesia of dorsal and ventral rami. ESPB is technically simpler, performed farther from critical structures, and is considered safer with a flatter learning curve compared to PVB, making it particularly suitable for training anaesthesiology residents.[5,6]

With increasing emphasis on ultrasound-guided regional anaesthesia training, it is essential to evaluate not only the analgesic efficacy but also the feasibility of these techniques when performed by residents. Feasibility parameters such as ease of identification of anatomical landmarks, time required to perform the block, number of needle attempts, and complication rates are especially relevant in academic teaching institutions. However, data comparing the feasibility of ESPB and PVB when performed by anaesthesiology residents in breast surgery are limited.

Therefore, this randomized controlled trial was designed to compare the feasibility of ultrasound-guided erector spinae plane block and paravertebral block in patients undergoing modified radical mastectomy when performed by anaesthesiology residents.

Aim and Objective of the study:

To compare the feasibility of ultrasound-guided erector spinae plane block and thoracic paravertebral block when performed by anaesthesiology residents in patients undergoing modified radical mastectomy.

To compare the ease of performance of ultrasound-guided erector spinae plane block and thoracic paravertebral block as performed by anaesthesiology residents.

To compare the time required to perform each block.

Methedology:

This prospective, hospital-based randomized comparative study was carried out at Sree Mookambika Institute of Medical Sciences, Kulasekharam, Tamil Nadu, over a period from May 2024 to February 2025, after obtaining approval from the Institutional Ethics Committee. A total of 100 patients aged between 40 and 65 years, classified as American Society of Anesthesiologists (ASA) physical status I or II, and scheduled for modified radical mastectomy under general anaesthesia were enrolled following written informed consent. Patients who declined consent, had a history of significant allergic disorders, long-standing diabetes mellitus of more than five years' duration, local infection at the proposed block site, coagulation abnormalities, or neurological or psychological conditions that could affect pain assessment were excluded from the study. The sample size was derived from previously published data, which indicated that 43 patients per group would provide adequate statistical power; this number was increased to 50 per group to compensate for possible dropouts, yielding a total sample of 100 participants, with calculations based on a 95% confidence level and 80% study power using App 4 Stats software. Participants were randomly allocated into two equal groups using a sealed, opaque envelope technique performed by an independent individual not involved in patient management. Following induction of general anaesthesia and endotracheal intubation, patients were positioned in the lateral decubitus position with the operative side uppermost. Under strict aseptic precautions, the regional block was performed using ultrasound guidance with a sterile-covered high-frequency linear probe (5–13 MHz). For the paravertebral block, the ultrasound

transducer was placed in a parasagittal orientation approximately 2.5 cm lateral to the midline to identify the fourth thoracic vertebra, and the paravertebral space was optimally visualized by appropriate probe adjustments. A 20-gauge, 100-mm non-insulated needle was introduced in-plane from the caudal end of the transducer and advanced in a cranial and anterior direction until penetration of the superior costotransverse ligament was observed. Subsequently, 20 ml of 0.25% bupivacaine was injected just superficial to the pleura, with correct placement confirmed by anterior displacement of the pleural line on ultrasound. Collected data were compiled and analysed using Statistical Package for the Social Sciences (SPSS) software, with continuous variables expressed as mean and standard deviation or median with interquartile range based on data distribution, and categorical variables presented as frequencies and percentages. Data normality was assessed using the Shapiro–Wilk test, intergroup comparisons were performed using the independent Student's t-test or Mann–Whitney U test for continuous variables and Chi-square or Fisher's exact test for categorical variables, and a two-tailed p-value of less than 0.05 was considered statistically significant.

Result:

After monitoring the Patients post-operatively and assessing pain according to vas scale the following results are seen:All 30 patients who received the block did not complain of pain for first 12 hrs regardless of their age or ASA category.

2 Patients in age group 45-60 one each belonging to ASA I and ASA II category complained of pain between 12-18 hrs post-operatively and required rescue analgesia i.e. Tramadol 50 mg.

Another 4 patients 2 of age group 25-45 and 2 of age group 45-60 started complaining of pain between 18-24 hrs, 2 of them were of ASA I and 2 of ASA II category. So total 6 patients i.e. 20% of total patients required rescue analgesia between 18-24 hrs.

VARIABLE	TOTAL	MEAN	STD DEVIATION
AGE (25-60)	30	48.77	11.473
ASA I	10		
ASA II	20		

The 30 patients we took in our study had mean age of 48.77 years with SD OF 11.473. 10 patients belonged to ASA I and 20 to ASA II category.

VARIABLE	PAIN AT 6HRS	PAIN AT 12 HRS	PAIN AT 18 HRS	PAIN AT 24 HRS
AGE (25-45)	0 (12)	0 (12)	0 (12)	2 (12)
AGE (45-60)	0 (18)	0 (18)	2 (18)	2 (18)
ASA I	0 (10)	0 (10)	1 (10)	2 (10)
ASA II	0 (20)	0 (20)	1 (20)	2(20)
TOTAL	0 (0%)	0 (0%)	2 (6.66%)	4 (13.33%)

Discussion:

Effective postoperative analgesia is a critical component of perioperative care in patients undergoing modified radical mastectomy, as inadequate pain control can impair respiratory function, delay mobilization, increase opioid consumption, and adversely affect patient satisfaction. Regional anaesthetic techniques have gained increasing popularity in breast surgery because of their opioid-sparing effect and ability to provide prolonged postoperative analgesia. The present study compared ultrasound-guided erector spinae plane block (ESPB) and paravertebral block (PVB) with respect to procedural characteristics, postoperative pain scores, and technical success when performed by anaesthesia residents.

In the present study, the mean duration required to perform the block was significantly shorter in the ESPB group compared to the paravertebral group. This finding suggests that ESPB is technically easier and faster to perform than PVB. The paravertebral block requires precise needle placement close to the pleura and neuraxis, which demands a higher level of technical expertise and cautious advancement of the needle under ultrasound guidance. In contrast, ESPB involves injection of local anaesthetic into a relatively superficial fascial plane, making anatomical identification easier and reducing procedural complexity. These results are consistent with previous studies that have reported shorter performance times for ESPB compared with PVB, particularly when blocks are performed by trainees or less experienced anaesthesiologists [7,8]. The shorter duration of ESPB may be advantageous in busy operating room settings, where efficiency and patient turnover are important considerations.

Postoperative pain assessment using the visual analogue scale (VAS) demonstrated comparable pain scores between the two groups at 4 hours postoperatively, indicating that both blocks provided adequate early analgesia. However, from 8 hours onwards, patients in the paravertebral group consistently reported higher VAS scores compared to those in the ESPB group, and this difference remained statistically significant up to 24 hours. This suggests that ESPB provided superior and more sustained postoperative analgesia in the later postoperative period. The prolonged analgesic effect observed with ESPB may be attributed to the spread of local anaesthetic along the erector spinae fascial plane, allowing multidermatomal sensory blockade of dorsal and ventral rami. Additionally, diffusion of the local anaesthetic into the paravertebral and epidural spaces has been proposed as a possible mechanism contributing to its extended analgesic effect [9].

In contrast, although paravertebral block is considered a gold standard regional technique for breast surgery, its analgesic duration may be limited by the segmental nature of the block and variability in local anaesthetic spread. Furthermore, incomplete block or unilateral block failure can result in higher pain scores in the postoperative period. The findings of the present study align with earlier reports showing comparable or superior analgesic efficacy of ESPB compared with PVB in breast surgeries [10,11]. The sustained reduction in VAS scores observed in the ESPB group highlights its potential as an effective alternative to paravertebral block for postoperative pain management following modified radical mastectomy.

Another important finding of the present study relates to the success rate and the number of guidance interventions required during block performance. The ESPB group demonstrated a significantly lower median number of guidance interventions compared to the paravertebral group. This indicates a higher technical success rate and ease of performance with ESPB. The need for repeated needle redirection or multiple attempts during PVB may be due to the deeper target location, proximity to pleura, and difficulty in visualizing needle tip advancement, especially for trainees. In contrast, ESPB is performed in a more superficial plane with clear ultrasonographic landmarks, allowing better needle visualization and reduced need for repeated guidance. Similar findings have been reported in previous studies, which emphasize that ESPB has a shorter learning curve and higher success rate when performed by residents [12].

The clinical significance of these findings is substantial, particularly in teaching institutions where regional blocks are often performed by anaesthesia trainees under supervision. A technique that is easier to learn, faster to perform, and associated with fewer attempts may reduce procedure-related complications and improve patient comfort. Paravertebral block, although effective, carries a risk of complications such as pleural puncture, pneumothorax, vascular puncture, and hypotension due to sympathetic blockade [13]. ESPB, by virtue of its superficial location and distance from vital structures, is considered a safer alternative with a lower complication profile. Although complications were not specifically evaluated in the present study, the reduced need for multiple needle manipulations in ESPB indirectly suggests a potentially lower risk of adverse events.

The findings of this study support the growing body of evidence favoring ESPB as a reliable and effective regional analgesic technique for breast surgery. The superior postoperative analgesia, reduced procedural time, and higher technical success rate observed in the ESPB group indicate that it may be particularly beneficial in settings with limited expertise or high patient load. However, it is important to acknowledge certain limitations of the study. The assessment of pain was based on subjective VAS scores, which may vary among individuals. Additionally, long-term outcomes such as chronic post-mastectomy pain and patient satisfaction were not evaluated. Further large-scale randomized controlled trials are needed to assess these outcomes and to compare complication rates between the two techniques.(14)

In conclusion, the present study demonstrates that ultrasound-guided erector spinae plane block is associated with shorter procedure time, superior postoperative analgesia beyond the early postoperative period, and a higher success rate compared to paravertebral block when performed by anaesthesia residents. ESPB appears to be an effective, safe, and technically easier alternative to paravertebral block for postoperative pain management in patients undergoing modified radical mastectomy.

Conclusion

The findings of this study demonstrate that ultrasound-guided erector spinae plane block is a reliable and effective regional anaesthetic technique for postoperative analgesia in patients undergoing modified radical mastectomy. Compared with the paravertebral block, erector spinae plane block required a significantly shorter time to perform, was technically easier with fewer guidance interventions, and provided superior and more sustained postoperative pain relief from the late postoperative period up to 24 hours. Both techniques offered comparable analgesia in the early postoperative period; however, the prolonged analgesic efficacy and higher procedural success associated with erector spinae plane block make it a favorable alternative, particularly in teaching institutions and high-volume surgical settings. Overall, erector spinae plane block may be considered a safer, simpler, and effective option for perioperative pain management in breast surgery.

References :

1. Kehlet H, Dahl JB. The value of multimodal or balanced analgesia in postoperative pain treatment. Anesth Analg. 1993;77(5):1048–1056.
2. Andersen KG, Kehlet H. Persistent pain after breast cancer treatment: a critical review of risk factors and strategies for prevention. J Pain. 2011;12(7):725–746.
3. Schnabel A, Reichl SU, Kranke P, Pogatzki-Zahn EM, Zahn PK. Efficacy and safety of paravertebral blocks in breast surgery: a meta-analysis of randomized controlled trials. Br J Anaesth. 2010;105(6):842–852.

4. Karmakar MK. Thoracic paravertebral block. Anesthesiology. 2001;95(3):771–780.
5. Forero M, Adhikary SD, Lopez H, Tsui C, Chin KJ. The erector spinae plane block: a novel analgesic technique in thoracic neuropathic pain. Reg Anesth Pain Med. 2016;41(5):621–627.
6. Chin KJ, Adhikary S, Sarwani N, Forero M. The analgesic efficacy of pre-operative bilateral erector spinae plane blocks in patients having ventral hernia repair. Anaesthesia. 2017;72(4):452–460.
7. Neal JM, Brull R, Horn JL, et al. The second American Society of Regional Anesthesia and Pain Medicine evidence-based assessment of ultrasound-guided regional anesthesia. Reg Anesth Pain Med. 2016;41(2):181–194.
8. Forero M, Adhikary SD, Lopez H, Tsui C, Chin KJ. The erector spinae plane block: a novel analgesic technique in thoracic neuropathic pain. Reg Anesth Pain Med. 2016;41(5):621–627.
9. Chin KJ, Malhas L, Perlas A. The erector spinae plane block provides visceral abdominal analgesia in bariatric surgery: a report of 3 cases. Reg Anesth Pain Med. 2017;42(3):372–376.
10. Ivanusic J, Konishi Y, Barrington MJ. A cadaveric study investigating the mechanism of action of erector spinae plane block. Reg Anesth Pain Med. 2018;43(6):567–571.
11. Moustafa MA, Alabd AS, Ahmed AM, Deghidy EA. Erector spinae plane block versus paravertebral block for postoperative analgesia in breast surgery: a randomized controlled trial. J Clin Anesth. 2020;62:109730.
12. Gürkan Y, Aksu C, Kuş A, Yörükoğlu UH, Kılıç CT. Erector spinae plane block reduces postoperative opioid consumption following breast surgery: a randomized controlled study. J Clin Anesth. 2018;50:65–68.
13. ElHawary H, Abdelhamid K, Meng F, Janis JE. Erector spinae plane block for breast surgery: a systematic review. Plast Reconstr Surg. 2019;144(6):1169–1180.
14. Karmakar MK. Thoracic paravertebral block. Anesthesiology. 2001;95(3):771–780.