Original Article

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Erector Spinae Plane Block Versus Intercostal Block in Postoperative Pain

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ABSTRACT

Objectives: To compare the postoperative analgesic efficacy between erector spinae plane block and intercostal block following mastectomy.

Methodology: This randomized controlled trial study was conducted at Fauji Foundation Hospital, Rawalpindi, from Nov-2025 to Jan 2026. Sixty women undergoing elective mastectomy were randomized into two equal groups. Women in group ICNB received intercostal nerve block, while those in group ESPB received erector spinae plane block, using 0.125% bupivacaine (20 mL) under ultrasound (US) guidance. Numeric Rating Scale was used to assess the postoperative pain where the primary outcome was the pain score at 24 hours. Secondary outcomes included time to need first rescue analgesia and the total amount of opioid consumption during 24 hours.

Results: The mean age of women was 59.32±3.12 years which ranged from 51-65 years. The results showed a significantly lower pain score at 24 hours in Group ESPB compared to Group ICNB (2.27±0.58 vs 3.03±0.85, p<0.001) while this difference was also significantly lower at 6 hours (p<0.001), and 12 hours (p<0.001). Similarly, a prolonged duration of analgesia and reduced opioid consumption was demonstrated in Group ESPB compared to Group ICNB (P< 0.001 for both).

Conclusion: Erector spinae plane block provides superior postoperative analgesia with longer pain relief and reduced opioid requirements compared to intercostal block in patients undergoing mastectomy.

Keywords: Erector spinae plane block, Intercostal nerve block, Mastectomy, Postoperative pain.

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Introduction

Breast cancer (BC) is among the most prevalent malignancies, constituting approximately 23.8% of all cancer cases in women.[1] It is in fact ranked as the leading cause of cancer related mortality affecting women worldwide, as data show a global figure of 2.3 million new recorded cases, claiming over 666,000 lives in 2022.[2]

Despite recent advances including endocrine therapy, early detection strategies, and breast-conserving surgeries (lumpectomy followed by radiation), mastectomy remains a primary intervention, performed in approximately 37 to 40% of women with BC at the global level.[3] Mastectomy serves as a life-saving procedure, however, this surgery may cause treatment related side effects, like postoperative pain (POP), lymphedema, and mastectomy scarring. Moreover, patients may experience some serious issues in the post-treatment period related to social, psychological, and sexual well-being.[4]

Inadequate POP management after mastectomy may lead to chronic pain in approximately 25-60% of cases.[5] This pain arises from inflammation secondary to tissue damage and neuropathic mechanisms, involving disruption of the T2-T6 intercostal nerves (ICN). Reported symptoms include numbness, pressure, and burning sensations, primarily affecting the axilla, pectoral region, lateral thoracic region, and upper arm. Inadequate POP management leads to prolonged hospital stays, increased readmissions, and significant patient distress.[6] Moreover, if not addressed in the initial phase, a substantial proportion of 25-60% of patients may result in post-

mastectomy pain syndrome (PMPS).[7] Management of POP after mastectomy therefore remains a significant challenge for the surgeons and anesthesiologists to ensure minimal opioid consumption, facilitate early patient mobilization, and enhance patient comfort. Furthermore, timely intervention and adequate management during postoperative (postop) period play a crucial role in preventing the transition of this acute pain to chronic pain states.[8]

A multimodal analgesic approach with regional anesthesia has gained attention during recent years to reduce post-surgical pain concerns after mastectomy. Intercostal nerve block (ICNB) is a classical regional anesthesia technique that has been widely used for breast surgeries, including mastectomy. The technique provides segmental analgesia by blocking sensory transmission along the ICN at multiple levels (typically at T2-T6). However, its efficacy and utility are constrained due to a relatively short duration of action (4-6 hours) and the need for multiple injections. Additionally, the technique carries a potential risk of pneumothorax and local anesthetic toxicity, which represents a major limitation in cases where multiple injection sites are required.[9]

The Erector Spinae Plane Block (ESPB), a relatively new regional anesthesia approach first described in 2016, is an interfascial plane block (IFPB).[10] ESPB acts through the spread of local anesthetic to the dorsal and ventral rami of the spinal nerves. The local anesthetic is injected deep to the erector spinae muscle group and superficial to the transverse processes of the vertebrae, which results in extensive cranio-caudal diffusion and provides both visceral and somatic analgesia. ESPB offers ease of performance under US guidance with a lower risk of complications, and effective POP control after mastectomy. ESPB also provides opioid-sparing benefits and minimizes the likelihood of systemic adverse effects associated with conventional analgesic techniques such as ICNB.[10]

While the advantages and limitations of ICNB in post-mastectomy pain control are a well-established, its direct comparison with the newer ESPB technique is limited. This study was therefore designed to compare the analgesic efficacy of ESPB and ICNB after mastectomy, in terms of pain score at 24 hours, time to need first analgesia, and total opioid consumption during first 24 hours.

The outcomes of this research will provide the clinical evidence that may assist the clinicians in selecting the optimal regional anesthesia technique for POP management after mastectomy especially in our local population.

Methodology

This randomized controlled trial was conducted at the Department of Anesthesia, Fauji Foundation Hospital, Rawalpindi, from Nov 2025 to Apr 2026, over a period of 6 months. The approval of conducting the study was obtained from the ethical review committee of the hospital.

The sample size was calculated using OpenEpi calculator. Based on previously reported pain scores of 0.52±1.18 in ESPB group and 2.23±2.56 in ICNB group at 24 hours, a significance level 5%, and statistical power 80%, the sample size was calculated as 60 patients with 30 patients allocated to each group.[12]

A total of 60 female patients aged between 30 and 65 years, belonging to American Society of Anesthesiologists (ASA) status I/II and scheduled for elective modified radical mastectomy (MRM) with axillary lymph node dissection were enrolled in this study and randomly allocated to Group ICNB and Group ESPB, each having 30 patients, using computer generated randomization.

A written consent was received from each patient prior to their inclusion.

Pregnant women, those having known allergy to study medications, having a history of rib fractures or any pre-existing chronic or neuropathic pain were excluded from the study.

All the relevant demographic data and clinical history were taken and recorded for each patient. Patients underwent general anesthesia (GA) following standardized protocols where patients were premedicated intravenously (IV) with midazolam (0.03 mg/kg) and fentanyl (2 µg/kg). Propofol (2–2.5 mg/kg) was used for induction of GA followed by endotracheal intubation, then maintained with oxygen, air, and isoflurane (MAC 1.0). Following the intubation process, patients were positioned appropriately and regional blocks were performed prior to surgical incision.

Regional blocks were then performed where patients in Group ICNB received intercostal nerve block, while those in Group ESPB received erector spinae plane block under US guidance.

In Group ICNB, intercostal nerve blocks were administered at the second to sixth intercostal spaces using 0.125% bupivacaine (20 mL, where 4 ml injected at each level). The intercostal (IC) space, ribs, pleura, and

intercostal neurovascular bundle were identified by longitudinally placing a high-frequency linear US probe. An in-plane approach was used to insert a 22-gauge needle, and the local anesthetic was deposited after visualizing the internal intercostal (IC) membrane and confirming negative aspiration.

In Group ESPB, the erector spinae plane block was performed at the T5 vertebral level with the patient in the sitting position and a high-frequency linear US probe was placed in a parasagittal orientation. The targeted muscles including trapezius, rhomboid major, and erector spinae were identified superficial to the hyperechoic transverse process shadow and a 22-gauge needle was inserted using an in-plane technique while confirming its placement by visualization and 0.125% bupivacaine (20 mL was injected between the erector spinae muscle and the transverse process). Neuromuscular blockade was reversed after completion of surgery, and patients were subsequently transferred to the post-anesthesia care unit.

Pain intensity at rest was assessed at 6, 12, and 24 hours after extubation using a 10-point Numeric Rating Scale (NRS). Intravenous (IV) tramadol (50 mg) was used as rescue analgesia when the score at NRS was ≥4. The dose was repeated, if required, at every 6 hours. The primary outcome was the pain score recorded at 24 hours after extubation, while time to need for the first rescue analgesia and total opioid consumption (Tramadol) during 24 hours were recorded as secondary outcomes of the study.

Data were analyzed using SPSS 26. Descriptive statistics were employed to share the demographic data and clinical characteristics where quantitative variables were presented as mean ± standard deviation (SD) while qualitative variables were shown as frequencies and percentages. Independent sample t-test was applied (after checking the normality of data) to compare the continuous variables, while categorical variables were compared using chi-square test. A p-value of ≤0.05 was taken as statistically significant for all these comparisons.

Results

The mean age of women was 59.32±3.12 years that ranged from 51 to 65 years. Group wise demographic details and clinical characteristics are shared in Table I.

The results of primary outcomes of the study showed a significantly lower pain score at 24 hours postop at rest in Group ESPB compared to Group ICNB (p<0.001). This difference was also significant at 6 hours (p<0.001), and 12 hours (p<0.001), as shown in Table II.

The comparison between secondary outcomes showed a significantly prolonged duration of analgesia (P< 0.001), as assessed by time to need first rescue analgesia, and significantly lower opioid consumption (P< 0.001), in Group ESPB compared to Group ICNB as shown in Table III.

Discussion

These results demonstrated that ESPB provides superior postop analgesia compared to ICNB in women undergoing mastectomy as the ESPB group exhibited significantly lower pain scores at 24 hours postop (2.27±0.58 vs 3.03±0.85, p<0.001). This advantage was consistent during earlier observations recorded at 6, and 12 hours. Furthermore, ESPB also provided prolonged analgesic duration (delayed time to first rescue analgesia), and reduced total opioid consumption during the first 24 (p< 0.001 for both). These findings suggest clinically meaningful benefits offered by ESPB compared to conventional blocks in POP management. These findings of our study are consistent with previous studies evaluating ESPB in cases of thoracic and breast surgeries.

Table I: Demographics and clinical characteristics. (n= 60)

Demographics and clinical features		Group ICNB (n=30)	Group ESPB (n=30)	p-value
Age (Mean± SD) years		58.83±3.16	59.8±3.06	0.232
BMI (Mean± SD) Kg/m^2		25.83±3.24	26.20±3.03	0.650
ASA status	I n (%)	20 (66.67)	18 (60)	0.592
	II n (%)	10 (33.33)	12 (40)	

Table II: Postoperative pain score on NRS. (n= 60)

Pain score on NRS	Group ICNB (n=30)	Group ESPB (n=30)	p-value*
At 6 hours (Mean± SD)	4.77±1.19	3.83±0.87	<0.001
At 12 hours (Mean± SD)	3.7± 0.92	2.7±0.65	<0.001
At 24 hours (Mean± SD)	3.03±0.85	2.27±0.58	<0.001

Table III: Duration of analgesia and opioid consumption. (n = 60)

Secondary outcome variables	Group ICNB (n=30)	Group ESPB (n=30)	p-value*
Time to need first rescue analgesia (Mean± SD) hours	5.47±1.46	7.97±1.56	P< 0.001
Total opioid consumption during 24 hours (Mean± SD) mg	158.17±17.88	89.83±14.11	P< 0.001

However, despite a growing interest in ESPB for postop analgesia following mastectomy, very few studies have directly compared ESPB with ICNB, highlighting the clinical relevance of our findings in this specific indication. Fiorelli S et al. compared the US-guided ESPB with ICNB for POP and reported a consistently significant lower NRS pain scores than ICNB at 6 h (0.68 ± 1.24 vs 3.20± 2.91, <0.001), 12 h (0.45 ±1.05 vs 2.84 ±2.34, <0.001) and 24 h (0.52 ±1.18 vs 2.23 ± 2.56, p=0.003) and 48 h (0.8±1.55 vs 2.17 ±2.66).[12] ESPB also reduced the opioid consumption (p<0.05). The study therefore demonstrated that ESPB, as part of multimodal analgesia, provides superior POP control and reduces perioperative opioid consumption and rescue analgesic requirements compared with ICNB. Moreover, ESPB offers effective analgesia through a single injection site, making it a practical and viable option for perioperative pain management in thoracic surgery. Gams P et al. compared US -guided ESPB with ICNB for POP after surgical procedure related to lung surgery. ESPB provided superior postop analgesia compared to ICNB by exhibiting the lowered pain scores (1.19 ± 0.73 vs 1.77 ± 1.01; p=0.039) and reduced opioid consumption over 48 hours (21.64 ± 14.22 mg vs 38.34 ± 29.91 mg; p=0.035).[13]

Dabhi N et al. compared US-guided ESPB with multimodal IV analgesia for POP after MRM. ESPB significantly prolonged time to first rescue analgesia (15±4.18 vs 1.22±0.9 hours; p<0.0001), which was also reflected by improved patient satisfaction. USG-guided ESPB with GA provided a safe and effective postop analgesia modality with decreased opioid requirements and better patient satisfaction without any significant complications.[14] In a meta-analysis, Zhang Y et al. evaluated the efficacy of ESPB for POP after BC surgery. ESPB was found to significantly reduce 24-hour morphine consumption (MD −7.67 mg; 95% CI −10.35 to −5.00; p<0.01) and lowered the pain scores at 1, 6, 12, and 24 hours with a good acceptability profile.[15]

Similar to our findings, Sung CS et al. mentioned that the POP score was <4 at the postop 24 and 48 hours. Hence the efficacy was comparable between the groups while ESPB showed a trend toward reduced oral rescue analgesic use (0.4 ± 1.2 vs 1.0 ± 1.8) with a comparable use of morphine.[16] Ren D et al. worked on a meta-analysis to compare the ESPB vs paravertebral block for the management of POP. While VAS at 6 hours was comparable (MD −0.08; 95% CI −0.44 to 0.27), ESPB demonstrated lower VAS at rest at 12 hours. With similar analgesic outcomes, the meta-analysis overall recommended the use of ESPB for thoracic, breast, kidney, and abdominal surgeries.[17] Koo CH et al. also studied ESPB for POP after thoracic surgery and reported significantly reduced 24-hour opioid consumption (MD −17.49; 95% CI −26.87 to −8.12) and pain scores at rest (MD −0.82) and movement (MD −0.77). In comparison with other regional blocks, ESPB demonstrated comparable analgesic efficacy, which supports its role as an effective option for the management of POP.[18]

The superior analgesic effect of ESPB found in above mentioned evidence may be explained by the cranio-caudal spread of local anesthetic extensive along the fascial plane which allows blockade of both dorsal and ventral rami of thoracic spinal nerves. This broader coverage may provide more sustained and prolonged somatic and visceral analgesia in comparison to the segmental and shorter-acting blockade achieved while using multiple intercostal injections.

Nevertheless, efficacy and superiority is not uniformly supported by all available evidence. In contrast to our results, Ma G et al. shared the results of their systematic review based on 4 studies, which showed no difference in POP at 12 hours and 24 hours, or in opioid consumption. However, ESPB significantly reduced pain scores at 48 hours (p=0.04).[19]

In this scenario of mixed findings, Wu Y et al. have recently highlighted the need for comparative research on these two techniques and further meta-analysis is warranted. A systematic review is registered to determine whether ESPB provides superior POP compared to the ICNB in clinical practice.[20]

In short, our findings contribute to the evidence supporting the use of ESPB as an effective regional technique for POP management in women after mastectomy.

This was a single center study with a relatively small sample size, which may limit the generalizability of our results. Larger multicenter trials with standardized analgesic protocols may further help to establish these definite clinical recommendations.

Conclusion

ESPB offers effective postop analgesia in women undergoing mastectomy compared to the conventional ICNB. This efficacy is not only demonstrated by reduced POP, but also evidenced by prolonged duration of analgesia and lesser opioid dosages. These advantages may offer ease of performance, improved patient comfort

and reduced opioid related adverse effects in our resource constraint and heavily burdened healthcare settings.

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