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ORIGINAL ARTICLE

Role of erector spinae plane block versus paravertebral block in postoperative pain management of mastectomy.

Noor Fatima[1], Naseem Ahmed[2], Komal Mumtaz[3], Khalid Mahmood[4]

ABSTRACT… Objective: To determine the role of erector spinae plane block versus paravertebral block by finding the time to need the first rescue analgesia in postoperative pain management of Mastectomy. **Study Design:** Randomized Controlled Trial. **Setting:** Department of Anesthesia, Fauji Foundation Hospital Rawalpindi. **Period:** October 2024 to March 2025. **Methods:** A total of 220 females (aged 18-65 years) undergoing unilateral modified radical mastectomy with axillary dissection were randomly assigned (1:1) to receive either erector spinae plane block (Group ESPB) or paravertebral block (Group PVB). Under ultrasound guidance at T4-T5, patients in Group ESPB received 20-25mL of 0.25%-0.375% bupivacaine with epinephrine into the erector spinae plane, while patients in Group PVB received the same solution injected into the paravertebral space at multiple levels. The primary outcome was time to first rescue analgesia (triggered at pain score ≥4 on Visual analogue scale 0-10). Secondary outcomes included 24-hour total rescue analgesia consumption, pain scores at 8, 12, and 24 hours. A p-value <0.05, established the statistical significance. **Results:** The results of primary outcomes established no significant difference between the Group ESPB and Group PVB in terms of time to need first recue analgesia (5.95±0.63 hours Vs 6.11±0.66 hours respectively, p=0.07). Total morphine consumption was comparable between the two groups (7.1±1.61 mg vs. 7.05 ± 1.64 mg, p=0.82). Higher pain scores was observed at 8 hours in the ESPB group compared to Group PVB (6.1 ± 0.88 vs. 5.83 ± 0.78, p=0.02), with no differences at 12 and 24h. **Conclusion:** Both techniques showed similar time to first rescue analgesia after mastectomy and total morphine use during 24 hours. Paravertebral block provided better early pain control at 8h; analgesia was, however, comparable beyond 12h.

Key words: Analgesia, Erector Spinae Muscles, Mastectomy, Nerve Block, Paravertebral Block.

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INTRODUCTION

Breast cancer (BC) is among the common types of malignancies reported in women, as approximately 24.5% of total cancer in females at global level are caused by BC. The severity of the situation can be assessed by the data from year 2020 that showed an estimated global figure of BC to be 2.3 which claimed the lives of over 685,000 individuals.[1,2]

Mastectomy is a primary surgical intervention for these cases performed in 37 to 40% women with BC and serve as a life-saving procedure. Patients, however, experience some serious post-treatment problems related to social, psychological, and sexual well-being. The surgical procedure may cause treatment related side effects, like post-operative pain (POP), lymphedema, and mastectomy scars.[3]

One of the most serious sides effect faced by 50% of these women undergoing mastectomy is the post mastectomy pain syndrome (PMPS) documented after 20 to 68% of mastectomy procedures. Inadequate pain management, reported to lead chronic postoperative pain in 25–60% of cases. Reported symptoms related to this complication include numbness, pressure, and burning sensations, primarily affecting the axilla, pectoral and lateral thoracic areas, and upper legs. Pain arises from inflammation due to tissue damage, while neuropathic pain results from the disruption of the 2nd to 6th intercostal nerves (typically T2-T6). Consequently, this leads to prolonged hospital stays and an increase in postsurgical hospital admissions, causing significant distress.[4,5] Management of POP following mastectomy therefore presents a significant challenge to the health care professionals to ensure a reduced opioid consumption, facilitate early mobilization and enhancing patient comfort.[6]

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Use of regional anesthesia techniques have gained prominence as key components of multimodal analgesic approaches during recent years as these are found to reduce these post-surgical concerns in BC. Among these techniques, the Paravertebral Block (PVB) has long been taken as the gold standard, while the Erector Spinae Plane block (ESPB) in newer alternative with promising results reported in some studies.[7]

In PVB, local anesthetic was administered near the thoracic vertebrae at the point where spinal nerves exit through the intervertebral foramina. The technique offered effective unilateral analgesia by blocking the spinal nerves' dorsal and ventral rami, along with the sympathetic chain. PVB has shown excellent efficacy in controlling PMPS, with the advantages of reduced opioid consumption, lower pain scores, and faster recovery following mastectomy. PVB is, however, technically challenging to perform, requires significant expertise, and carries risks of some serious complications including pneumothorax, vascular puncture, and epidural or intrathecal spread of local anesthetic.[8]

The ESPB a relatively novel approach, firstly mentioned in 2016, is an interfascial plane technique hypothesized to work through diffusion of local anesthetic to the spinal nerves' dorsal and ventral rami. In this technique, local anesthetic is deposited deep to the erector spinae muscle group, superficial to the transverse processes of the vertebrae, which results in widespread cranio-caudal diffusion of the anesthetic, providing both visceral and somatic analgesia. The benefits of ESPB include its easier administration under ultrasound guidance, lower risk of complications, and effective analgesia after mastectomy. It also offers opioid-sparing effects and reduces the chances of systemic side effects found with commonly used techniques.[9,10]

Recent comparative studies have yielded varying results regarding efficacy of PVB and ESPB, where some researchers suggest near-equivalent analgesic efficacy, while other studies indicate superior pain control with PVB. On one hand, the technical simplicity of ESPB makes it an attractive option, particularly in settings with limited resources or expertise. On the other hand, the more established track record regarding efficacy, targeted nerve blockade and potentially consistent dermatomal coverage continue to supports its use as a primary approach in mastectomy procedures.[9] Hence, the relative efficacy of ESPB versus PVB in POP management remains an area of active investigation. This study was therefore aimed to compare the analgesic efficacy of ESPB and PVB after mastectomy evaluated in terms of time to first request for analgesia. The outcomes of our work will be help to find the comparison of this POP in our local population to help the clinicians in making evidence based decisions.

METHODS

This randomized controlled trial was conducted at the department of Anesthesia, Fauji Foundation Hospital Rawalpindi from October 2024 to March 2025 over a period of 6 months after getting approval from the ethical review committee of the hospital (No.713/ERC/FFH/RWP.0/8/25).

Sample size was calculated as per following assumptions:
α=5% (two-sided), power: 90%.
m_1 (mean time to first rescue analgesia with PVB) = 6.35 + 0.42 hours
m_2 (mean time to first rescue analgesia with ESPB) = 6.5 + 0.60 hours.[11]
The estimated sample size n_1 = 107, n_2=107.
We however selected a total of 220 patients with 110 patients in each group.

A total of 220 females aged 18-65 years with American Society of Anesthesiologists (ASA) physical status I or II, scheduled for unilateral modified radical mastectomy (MRM) with axillary dissection under general anesthesia were included in this study through consecutive sampling.

Exclusion criteria comprised of patient suffering from coagulopathy, liver or renal failure, or serious respiratory or cardiac conditions. Women with severe obesity (BMI >35 kg/m^2) which can complicate regional blocks and hinder anesthetic diffusion were also excluded. Additionally, patients with local infection at the injection site, with anatomical abnormalities (such as spine or chest wall deformities), allergy to local anesthetics, chronic

pain syndromes, psychiatric conditions affecting pain assessment, were also part of exclusion criteria.

All women gave their informed consent prior to inclusion in the study.

These 220 women were randomly allocated in a 1:1 ratio to be managed by either by ESPB (Group ESPB) or by PVB (Group PVB) using a computer-generated randomization.

All the base line demographics and medical history related to this surgical procedure was collected.

All the patients received standardized general anesthesia with a premedication including midazolam (0.02–0.03 mg/kg) and fentanyl (2 µg/kg) for anxiolysis and analgesia. Propofol (2 mg/kg) was used to induce anesthesia in order to make endotracheal intubation easier. Maintenance was achieved with sevoflurane in an oxygen-air mixture, with fentanyl boluses (1 µg/kg) as per need. Standard intraoperative monitoring was ensured during the procedure.

In the ESPB group, patients were positioned laterally keeping surgical side uppermost. A high-frequency ultra-sonographic probe was positioned in a parasagittal plane at the T4–T5 transverse process, approximately 3 cm lateral to the spinous process. A 22-gauge needle under sterile conditions, was advanced in-plane to reach the erector spinae muscle plane. A 20–25 mL of local anesthetic (0.25%–0.375% bupivacaine) with epinephrine was injected while elevating the erector spinae muscle from the surface of the transverse process.

In the PVB group, a high-frequency ultrasound probe was placed lateral to the T4–T5 transverse process to identify the paravertebral space. With an in-plane method, a 22-gauge needle was advanced until the tip approached the space. Placement was confirmed with negative aspiration and pleural movement, and 20–25 mL of local anesthetic (0.25%–0.375% bupivacaine) was then administered with epinephrine, injected at multiple levels.

Tracheal extubation was performed after meeting the extubation criteria. All the patients received paracetamol (Intravenous 1 g) every 6 hours.

POP was assessed on the Visual analog scale VAS 0-10. (Where zero meant, no pain and 10 meant, worst imaginable pain pain). POP was assessed on arrival at the post-anesthesia care unit and then at 2, 4, 6, 8, 12, 18 and 24 hours after surgery.

Rescue analgesia (Intravenous morphine 1 gm) was administered by nursing staff promptly when requested by the patients for breakthrough pain (pain score ≥4 on VAS) while ensuring a minimum interval of 10 minutes between doses. All analgesic requests and administrations were noted and documented including time of first request and dose administered.

The primary outcome set for the study was the time to need the first rescue analgesia (asked by the patients when pain score ≥4 as on VAS). The secondary outcomes included total dose of rescue analgesia required during first 24 hours, pain scores (at 8, 12 and 24 hours). Additionally, we also compared the incidence of complications during first 24 hours postoperatively (Including postoperative nausea and vomiting (PONV) and any adverse effects associated with the administered drugs or procedural techniques, such as pneumothorax or local anesthetic toxicity).
SPSS version 26 was used for data analysis. Continuous variables including (e.g. time to first rescue analgesia and total morphine dose) were expressed as mean ± standard deviation or median (interquartile range) based on normality as assessed by Shapiro-Wilk test. Categorical variables (e.g., PONV incidence) were presented as frequencies and percentages. Comparison between the groups was made using independent t-tests or Mann-Whitney U tests for continues variables while independent t-tests or Mann-Whitney U tests were employed for categorical variables. A p-value <0.05, established the statistical significance for all these comparisons.

RESULTS

The mean age of women in this study was 51.53±6.7 years (ranging from 36 to 64 Years). The group wise demographics and clinical features are shown in Table-I.

TABLE-I			
Demographic details and clinical features n= 220			
Demographics and Clinical Features		**Group ESPB**	**Group PVB**
Age (Mean±SD) years		50.74±6.76	52.32±6.5
Marital status n (%)	Married n (%)	105 (95.5)	107 (97.3)
	Unmarried n (%)	5 (4.5)	3 (2.7)
ASA	I n (%)	58 (52.7)	51 (46.4)
	II n (%)	52 (47.3)	59 (53.6)
BMI (Mean±SD) Kg/m^2		27.45±3.73	26.98±3.7
Duration of surgery (Mean±SD) minutes		126.32±13.75	130.5±13.02

The results of primary outcomes of the study showed no significant difference between the Group ESPB and Group PVB in terms of time to need first recue analgesia (p=0.07). Among the secondary outcomes, total morphine consumption was also comparable between the two groups (p=0.82), while the results showed higher pain scores on VAS at 8 hours in the Group ESPB compared to Group PVB (p=0.02). No difference in pain score was, however, observed at 12 hours and 24 hours as shown in Table-II.

TABLE-II			
Comparison of the efficacy between ESPB and PVB n= 220			
Outcomes Variables	**Group ESPB**	**Group PVB**	**P-Value**
Primary Outcomes			
Time to first rescue analgesia (Mean±SD) hours	5.95±0.63	6.11±0.66	0.07
Secondary Outcomes			
Total morphine consumption (mg) (Mean±SD)	7.1±1.61	7.05±1.64	0.82
Pain score at 8 hours on VAS (Mean±SD)	6.1±0.88	5.83±0.78	0.02
Pain score at 12 hours on VAS (Mean±SD)	5.54±0.60	5.46±0.60	0.32
Pain score at 24 hours on VAS (Mean±SD)	3.46±0.71	3.42±0.75	0.69

Post-operative complication between the two groups were also recorded, where the incidence of PONV were comparable (p=0.35). No cases of pneumothorax, block failure, or local anesthetic toxicity were observed in either group as shown in Table-III.

TABLE-III			
Incidence of complications n= 220			
Incidence of Post-operative Complications	**Group ESPB (n=110)**	**Group PVB (n=110)**	**P-Value**
PONV n (%)	5 (4.5)	9 (8.2)	0.35
Pneumothorax n (%)	0 (0)	0 (0)	N/A
Block failure n (%)	0 (0)	0 (0)	N/A
Local Anesthetic Toxicity	0 (0)	0 (0)	N/A

DISCUSSION

The results of primary outcomes showed no statistically significant difference between the Group ESPB and Group PVB in terms of time to need first recue analgesia (5.95±0.63 hours Vs 6.11±0.66 hours respectively, p=0.07). Among the secondary outcomes, total morphine consumption was also comparable between the two groups (7.1±1.61 mg vs. 7.05 ± 1.64 mg, p=0.82). Higher pain scores was observed at 8 hours in the ESPB group compared to Group PVB (6.1 ± 0.88 vs. 5.83 ± 0.78, p=0.02), with no differences at 12 and 24h. Comparison of the incidence of complication between the two groups showed that the incidence of PONV (4.5% vs. 8.2%, p=0.35), were comparable and no cases of pneumothorax, block failure, or local anesthetic toxicity were observed in either group. Our findings contribute to the ongoing debate regarding the comparative efficacy of these two techniques for POP management after mastectomy which share mixed results in the medical literature.

The comparison between PVB and ESPB was made by El Ghamry MR and Amer AF in 70 women undergoing mastectomy. Results showed comparable time for the need of first analgesia (p= 0.075), 24-hour morphine use (P=0.32), pain scores, and complications. The study concluded that PVB

and ESPB are equally effective for post-mastectomy pain control and opioid-sparing without significant differences in safety or efficacy.[11] Similar to El Ghamry, Gürkan et al. found comparable efficacy between the two techniques, with some differences in temporal pain control patterns. Gürkan Y et al. compared the postoperative analgesic effects of ESPB and PVB in breast surgery. Both ESP and PVB significantly reduced 24-hour morphine consumption compared to the control ($p < 0.001$), with no difference between ESP and PVB ($p > 0.05$). PVB showed lower pain scores at 1st and 6th hours ($p = 0.018$, $p = 0.027$), while the ESPB has lower risk of complications compared to PVB.[12]

Amr SA et al. studied the efficacy of ESPB, PVB and control group in acute and chronic pain in post-mastectomy women. Time to need for first analgesia dose (morphine) was significantly lower in the ESPB compared to the PVB (8.13 ± 1.75 Vs. 10.64 ± 1.8 hours respectively, p=0.03). Similarly more morphine was consumed in the ESPB group compared to the PVB group (8.17 ±1.7 Vs. 5.7±1.9 mg respectively, $p < 0.001$). The mean pain score on VAS was also higher in the ESPB group compared PVB group at 12 and 24 hours after surgery (p=0.02 and p=0.01 respectively). PVB hence proved to be more effective in the acute pain management. However, both techniques were equally effective over chronic pain relief at 1, 3 and 6 month time.[13]

Contradictory to the findings of comparable efficacy, some previous research found superior results with ESPB compared to PVB in POP management. A study by Eldemrdash AM and Abdelzaam E-SM. compared ESPB and PVB for postoperative analgesia after radical mastectomy. ESB provided longer analgesia (416 ± 68 min vs. 371 ± 67 min), lower morphine requirement (4 ± 2 mg vs. 6 ± 2 mg), and fewer complications than PVB. Conclusively, ESB was narrated to be more effective, safer, and technically easier than PVB for managing POP.[14]

Premachandra A et al. compared ESPB and PVB for preventing acute POP in BC surgery. Among 94 matched patients, morphine use was significantly higher with ESPB (74.5%) than TPVB (41.5%), showing a 33% difference ($p < 0.001$). While ESPB had no complications, PVB proved more effective in reducing the postoperative opioid need during early hours after surgery.[15]

Despite these individual studies showing variable results, a comprehensive systematic review conducted by Weng WT et al. provides important perspective on the overall body of evidence. This meta-analysis also aligns with our findings, demonstrating that ESPB and PVB provide comparable analgesic efficacy for breast surgery with no statistical difference between ESPB and PVB in opioid consumption, pain scores, or side effects. Despite moderate heterogeneity, results confirm ESPB as a viable alternative to PVB, offering equivalent POP relief without increased complications, supporting their interchangeable use in clinical practice.[16]

The limitations of this study include the short duration of follow-up, which did not assess long-term pain outcomes. Future studies with longer follow up time will add up in this useful data regarding POP in women undergoing mastectomy.

CONCLUSION

Both ESPB and PVB offer effective POP control following mastectomy in terms of first rescue analgesia needed and the total morphine consumption. However, PVB demonstrated superior analgesia during early hours, indicating deeper sensory blockade. With these similar efficacy results, ESPB remains advantageous due to its technical ease, which make it suitable in resource-limited settings. The study underscores the individualized technique selection based on patient needs and clinical context.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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1	**Noor Fatima:** Manuscript writing.
2	**Naseem Ahmed:** Data analysis.
3	**Komal Mumtaz:** Data entry.
4	**Khalid Mahmood:** Revisions.