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Original Article

Comparative Study Between Thoracic Segmental Block and Thoracic Paravertebral Block in Mastectomy Surgery

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ABSTRACT

Background: Postoperative pain after mastectomy is often inadequately controlled with systemic analgesics alone. Regional anesthetic techniques, including thoracic segmental block (TSB) and thoracic paravertebral block (PVB), may improve analgesia. This study compared their block characteristics, postoperative analgesic efficacy, and complication profiles. **Methods & Materials:** This comparative analytical study was conducted n the Department of Anaesthesia, Rangpur Medical College Hospital, Rangpur, Bangladesh, from January 2023 to December 2023 and comprised 60 female patients undergoing mastectomy, divided into two groups of 30 patients each (TSB and PVB). The two groups were compared with respect to sociodemographic and clinical variables, block-related characteristics, postoperative pain scores at 1, 6, 12, and 24 hours, and analgesic requirement and recovery outcomes. Data were entered and analyzed using SPSS version 26. **Results:** No major differences have been found between the two groups in age, residence, occupation, ASA status, BMI, comorbidities, or surgical characteristics. The success rate was high in both groups (93.3% TSB vs 90% PVB). TSB was associated with quicker block time (≤10 minutes in 73.3% compared with 43.3%), higher patient satisfaction (86.7% vs 70%), and reduced need for supplemental intraoperative analgesics (16.7% vs 26.7%). TSB had lower pain scores at all postoperative time points. The time to first rescue analgesia was significantly longer in TSB patients (60.0% vs 30.0%, OR 3.50, p = 0.021), and fewer TSB patients required multiple doses of rescue analgesia (23.3% vs 53.3%, OR 3.75, p = 0.019). TSB had a higher level of satisfaction with its patients than did the other banks (86.7% compared to 70%). **Conclusions:** TSB achieved a quicker onset of block, greater patient comfort, and longer, effective postoperative analgesia than PVB in mastectomy surgery, while maintaining a similar safety profile.

Keywords: *Thoracic segmental block; Thoracic paravertebral block; Mastectomy; Postoperative analgesia*

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INTRODUCTION

Breast cancer is the most common cancer in women globally, with about 2.3 million new cases reported each year and it is the leading cause of cancer-related death among women [1]. Breast cancer is also a significant and increasing public health problem in Bangladesh, with a large proportion of patients diagnosed at late stages and undergoing surgical treatment, typically modified radical mastectomy or simple mastectomy [2]. Although surgical technique has improved, mastectomy still causes a lot of acute postoperative pain, due to the extensive dissection of tissue, the injury of the intercostobrachial nerve and the dissection of the axillary nerves, and poorly managed acute pain is a known risk factor for the development of persistent post-mastectomy pain syndrome, which affects a significant number of survivors and negatively impacts long-term quality of life [3]. Although systemic opioids have been used for perioperative pain management for a long time, they are associated with side effects including sedation, nausea, vomiting and delayed recovery, and there is increasing interest in regional anesthetic techniques as an adjunct to general anesthetic for breast surgery [4]. Thoracic paravertebral block (PVB) is the most widely used and studied regional block for mastectomy, which offers unilateral somatic and sympathetic blockade with good analgesic effect, but is not always easy to perform due to the need to be close to the pleura, has a risk of pneumothorax and vascular puncture, and the dermatomal spread of the block varies depending on the technique used for injection [5]. Systematic evaluation has shown that paravertebral blockade (with or without sedation) provides better perioperative pain control than general anesthesia alone in women undergoing breast cancer surgery [6]. Recently, other regional and neuraxial techniques have been investigated to overcome the technical requirements and variability of paravertebral blockade. In patients undergoing breast cancer surgery, segmental thoracic spinal anesthesia (STSA) at the mid-thoracic level has been demonstrated to provide reliable dense sensory blockade with satisfactory postoperative analgesia, with variable motor blockade of the lower limbs [7]. Interfascial plane blocks, like the erector spinae plane block, have also been found to reduce postoperative opioid use and pain scores following modified radical mastectomy, and single-shot blocks have been proven to be effective and technically simple for postoperative analgesia after mastectomy [8,9]. Comparative data on the thoracic segmental block versus the well-established paravertebral block in mastectomy patients, however, are still relatively scarce, with only a few prospective trials directly comparing these two techniques concerning block characteristics, onset, and postoperative analgesic results and a few observational studies describing the practical utility of the thoracic segmental block in women undergoing modified radical mastectomy [10,11]. Given the high clinical relevance of choosing an anesthetic technique that is fast, reliable, comfortable for the patient, and has a good side-effect profile, there remains a need for direct comparative evidence between thoracic segmental and thoracic paravertebral blocks in the mastectomy population. The objective of this study was therefore to compare the characteristics of the blocks, the postoperative pain course, the analgesic needs, and the complication profile of thoracic segmental block and thoracic

paravertebral block in women undergoing mastectomy.

METHODS & MATERIALS

This comparative analytical study was conducted n the Department of Anaesthesia, Rangpur Medical College Hospital, Rangpur, Bangladesh, from January 2023 to December 2023. On 60 adult female patients undergoing elective mastectomy under general anesthetic, randomly divided into two groups of 30 patients each, who received thoracic segmental block (TSB) and thoracic paravertebral block (PVB) before induction of anesthetic. Patients were eligible for inclusion if they were adult females with American Society of Anesthesiologists (ASA) physical status I-III and were scheduled for unilateral modified radical mastectomy or simple mastectomy with or without axillary dissection for histologically confirmed carcinoma of the breast, and gave informed written consent to participate. Patients were excluded if they had a known allergy to local anesthetic agents, coagulopathy or current anticoagulant therapy, local infection at the proposed injection site, spinal deformity or previous thoracic spine surgery, severe cardiopulmonary or hepatorenal impairment, pregnancy, or inability to understand the pain-scoring system used in the study. Sociodemographic factors (age, residence, occupation), baseline clinical profile (ASA status, BMI, hypertension, diabetes mellitus, previous chemotherapy), disease and surgical factors (clinical stage, type of surgery, axillary dissection, duration of surgery, intraoperative blood loss), block-related factors (block success, time to perform block, onset of sensory block, adequacy of surgical analgesia, need for supplemental analgesia, patient comfort), postoperative pain scores (VAS at 1, 6, 12 and 24 hours), and postoperative analgesic requirement and recovery profile (time to first rescue analgesia, total rescue analgesic requirement, nausea/vomiting, shoulder/axillary discomfort, patient satisfaction, length of hospital stay). Data were entered and analyzed with SPSS version 26. Categorical variables were presented as frequencies and percentages, and compared between the two groups by the Chi-square test or Fisher's exact test as appropriate, and the association between block technique and perioperative outcomes was further evaluated by odds ratios with 95% confidence intervals; p-values <0.05 were considered statistically significant.

RESULTS

The sociodemographic profile of the 60 patients in the study is represented in *Table I*, which shows that the patients were split into two groups, TSB and PVB, with equal numbers. The age distribution of the patients was similar in both groups, with 70.0% of patients in the TSB group and 70.0% in the PVB group being aged between 41 and 60 years. All patients were female. Most lived in urban areas (60.0% in TSB, 56.7% in PVB), with homemakers the largest occupational group in both groups (63.3% and 66.7%, respectively), followed by service holders, business/self-employed, and others.

Table I
Sociodemographic characteristics of the study patients, *n* = 60.

Variable	Category	TSB group, n = 30, n (%)	PVB group, n = 30, n (%)
Age group	18-40 years	4 (13.3)	3 (10.0)
	41-50 years	9 (30.0)	8 (26.7)
	51-60 years	12 (40.0)	13 (43.3)
	≥61 years	5 (16.7)	6 (20.0)
Sex	Female	30 (100.0)	30 (100.0)
Residence	Urban	18 (60.0)	17 (56.7)
	Rural	12 (40.0)	13 (43.3)
Occupation	Homemaker	19 (63.3)	20 (66.7)
	Service holder	5 (16.7)	4 (13.3)
	Business/self-employed	3 (10.0)	3 (10.0)
	Others	3 (10.0)	3 (10.0)

Table II shows the baseline clinical characteristics of the study population. ASA physical status II was the most prevalent in both groups (60% TSB, 56.7% PVB). The highest BMI group was overweight patients (46.7% TSB, 50% PVB). The prevalence of hypertension was 36.7% in TSB and 40% in PVB patients, and diabetes mellitus was present in 30% and 26.7% of patients, respectively. 43% of TSB and 40% of PVB patients had received previous chemotherapy, and surgery was performed slightly more often on the right breast than the left in both groups.

Table II
Baseline clinical profile of the study patients, *n* = 60.

Variable	Category	TSB group, n = 30, n (%)	PVB group, n = 30, n (%)
ASA physical status	ASA I	7 (23.3)	6 (20.0)
	ASA II	18 (60.0)	17 (56.7)
	ASA III	5 (16.7)	7 (23.3)
BMI category	Normal	10 (33.3)	9 (30.0)
	Overweight	14 (46.7)	15 (50.0)
	Obese	6 (20.0)	6 (20.0)
Hypertension	Present	11 (36.7)	12 (40.0)
	Absent	19 (63.3)	18 (60.0)
Diabetes mellitus	Present	9 (30.0)	8 (26.7)
	Absent	21 (70.0)	22 (73.3)
Previous chemotherapy	Yes	13 (43.3)	12 (40.0)
	No	17 (56.7)	18 (60.0)
Side of surgery	Right breast	16 (53.3)	15 (50.0)
	Left breast	14 (46.7)	15 (50.0)

Disease and surgical characteristics are summarized in *Table III*. The diagnosis of carcinoma of the breast was made in all patients. Most patients in clinical stage II (60.0% TSB, 56.7% PVB) underwent modified radical mastectomy, while most patients in clinical stage III (60.0% TSB, 66.7% PVB) underwent axillary dissection. The most common surgical duration was 91-120 minutes in both groups, and the majority of patients had less than 200 mL of blood loss during surgery (70.0% TSB, 66.7% PVB).

Table III
Disease and surgical characteristics, *n* = 60.

Variable	Category	TSB group, n = 30, n (%)	PVB group, n = 30, n (%)
Diagnosis	Carcinoma breast	30 (100.0)	30 (100.0)
Clinical stage	Stage I	3 (10.0)	4 (13.3)
	Stage II	18 (60.0)	17 (56.7)
	Stage III	9 (30.0)	9 (30.0)
Type of surgery	Modified radical mastectomy	24 (80.0)	25 (83.3)
	Simple mastectomy	6 (20.0)	5 (16.7)
Axillary dissection	Done	25 (83.3)	26 (86.7)
	Not done	5 (16.7)	4 (13.3)
Duration of surgery	≤90 minutes	8 (26.7)	7 (23.3)
	91-120 minutes	16 (53.3)	17 (56.7)
	>120 minutes	6 (20.0)	6 (20.0)
Intraoperative blood loss	<200 mL	21 (70.0)	20 (66.7)
	≥200 mL	9 (30.0)	10 (33.3)

Block related characteristics are summarized in *Table IV*. The success rate for block was 93.3% for TSB and 90.0% for PVB patients. In 73.3% of TSB patients, the block was performed within 10 minutes, while in 43.3% of PVB patients the block was performed within 10 minutes; sensory onset was reached within 15 minutes in 70.0% and 60.0% of TSB and PVB patients, respectively. Surgical analgesia was reported as adequate in 90.0% of TSB and 86.7% of PVB patients, and supplemental intraoperative analgesics were used less frequently in TSB (16.7%) than PVB (26.7%). Patient comfort during the block was satisfactory in 86.7% of TSB patients compared to 70.0% of PVB patients.

Table IV
Block-related characteristics, *n* = 60.

Variable	Category	TSB group, n = 30, n (%)	PVB group, n = 30, n (%)
Block success	Successful	28 (93.3)	27 (90.0)
	Failed/partial	2 (6.7)	3 (10.0)
Time to perform the block	≤10 minutes	22 (73.3)	13 (43.3)
	>10 minutes	8 (26.7)	17 (56.7)
Onset of sensory block	≤15 minutes	21 (70.0)	18 (60.0)
	>15 minutes	9 (30.0)	12 (40.0)
Adequate surgical analgesia	Yes	27 (90.0)	26 (86.7)
	No	3 (10.0)	4 (13.3)
Need for supplemental intraoperative analgesics	Required	5 (16.7)	8 (26.7)
	Not required	25 (83.3)	22 (73.3)
Patient comfort during the block	Satisfactory	26 (86.7)	21 (70.0)
	Unsatisfactory	4 (13.3)	9 (30.0)

Postoperative pain scores are shown in *Table V* at four intervals of follow-up. Mild pain was the most common in both groups at 1 hour (83.3% TSB, 73.3% PVB) and no severe pain was reported. This trend continued at 6 and 12 hours, with a decreasing percentage of participants in both groups reporting mild pain, more significantly in the PVB group. At 24 hours, 53.3% of TSB patients and 36.7% of PVB patients reported mild pain, and 6.7% of TSB patients and 13.3% of PVB patients reported severe pain.

Table V
Postoperative pain score category at different follow-up times, *n* = 60.

Follow-up time	Pain score category, VAS	TSB group, n = 30, n (%)	PVB group, n = 30, n (%)
1 hour	Mild pain, VAS 0-3	25 (83.3)	22 (73.3)
	Moderate pain, VAS 4-6	5 (16.7)	8 (26.7)
	Severe pain, VAS 7-10	0 (0.0)	0 (0.0)
6 hours	Mild pain, VAS 0-3	23 (76.7)	18 (60.0)
	Moderate pain, VAS 4-6	7 (23.3)	12 (40.0)
	Severe pain, VAS 7-10	0 (0.0)	0 (0.0)
12 hours	Mild pain, VAS 0-3	19 (63.3)	14 (46.7)
	Moderate pain, VAS 4-6	10 (33.3)	14 (46.7)
	Severe pain, VAS 7-10	1 (3.3)	2 (6.7)
24 hours	Mild pain, VAS 0-3	16 (53.3)	11 (36.7)
	Moderate pain, VAS 4-6	12 (40.0)	15 (50.0)
	Severe pain, VAS 7-10	2 (6.7)	4 (13.3)

Postoperative Analgesic Requirements and Recovery Outcomes are summarized in *Table VI*. The time to first rescue analgesia was >12 hours in 60.0% of TSB patients and 30.0% of PVB patients. Twenty-three percent of TSB patients and 13.3% of PVB patients did not require a rescue analgesic within 24 hours, and 23.3% of TSB patients and 53.3% of PVB patients required 2 or more doses of rescue analgesic within 24 hours. The incidence of postoperative nausea/vomiting, shoulder discomfort, and patient satisfaction was all lower in the TSB group, and 80.0% of TSB patients and 73.3% of PVB patients had a hospital stay of three days or less.

Table VI
Postoperative analgesic requirement and recovery profile, *n* = 60.

Variable	Category	TSB group, n = 30, n (%)	PVB group, n = 30, n (%)
Time to first rescue analgesia	≤6 hours	4 (13.3)	9 (30.0)
	7-12 hours	8 (26.7)	12 (40.0)
	>12 hours	18 (60.0)	9 (30.0)
Total rescue analgesic in 24 hours	None	7 (23.3)	4 (13.3)
	Once	16 (53.3)	10 (33.3)
	Twice or more	7 (23.3)	16 (53.3)
Postoperative nausea/vomiting	Present	3 (10.0)	6 (20.0)
	Absent	27 (90.0)	24 (80.0)
Shoulder/axillary discomfort	Present	6 (20.0)	8 (26.7)
	Absent	24 (80.0)	22 (73.3)
Patient satisfaction	Satisfactory	26 (86.7)	21 (70.0)
	Unsatisfactory	4 (13.3)	9 (30.0)
Length of hospital stay	≤3 days	24 (80.0)	22 (73.3)
	>3 days	6 (20.0)	8 (26.7)

Table VII shows the odds ratios for key perioperative outcomes and block technique. Prolonged analgesia beyond 12 hours was significantly associated with TSB (OR 3.50, 95% CI 1.20-10.20; p = 0.021), as was the avoidance of multiple rescue analgesic doses (OR 3.75, 95% CI 1.24-11.36; p = 0.019). The odds ratios for block success, need for rescue analgesic within 6 hours, satisfactory patient comfort, and block-related complications were in favor of TSB, but were not statistically significant (p > 0.05 for each).

Table VII
Association of block technique with selected perioperative outcomes, *n* = 60.

Outcome variable	Category	TSB group, n = 30, n (%)	PVB group, n = 30, n (%)	Odds ratio, 95% CI	p-value
Block success	Successful	28 (93.3)	27 (90.0)	1.56, 0.24-10.16	0.640
	Failed/partial	2 (6.7)	3 (10.0)	Baseline	
Rescue analgesic requirement within 6 hours	Not required	26 (86.7)	21 (70.0)	2.79, 0.75-10.36	0.123
	Required	4 (13.3)	9 (30.0)	Baseline	
Prolonged analgesia	>12 hours	18 (60.0)	9 (30.0)	3.50, 1.20-10.20	0.021
	≤12 hours	12 (40.0)	21 (70.0)	Baseline	
Multiple rescue analgesic doses	No	23 (76.7)	14 (46.7)	3.75, 1.24-11.36	0.019
	Yes	7 (23.3)	16 (53.3)	Baseline	
Satisfactory patient comfort	Yes	26 (86.7)	21 (70.0)	2.79, 0.75-10.36	0.123
	No	4 (13.3)	9 (30.0)	Baseline	
Any block-related complication	No	28 (93.3)	25 (83.3)	2.80, 0.50-15.58	0.228
	Yes	2 (6.7)	5 (16.7)	Baseline	

DISCUSSION

This study found that thoracic segmental block (TSB) resulted in faster block performance, greater patient comfort, reduced requirement for supplemental intraoperative analgesics, and more prolonged and effective postoperative analgesia, which are largely consistent with and extend the growing comparative literature on regional anesthetic techniques for mastectomy. Santonastaso et al. compared the alternative interfacial and paravertebral techniques for mastectomy and have also found that newer or simpler regional techniques can be as effective as paravertebral blockade for analgesia [12]. A prospective comparison of bi-level erector spinae plane block with bi-level paravertebral block in modified radical mastectomy showed that PVB had lower pain scores in the early postoperative period but not at later time points, and a subsequent randomized comparison of the two blocks in breast surgery demonstrated similar analgesic efficacy after the first 24 hours [13]. The results of these studies are consistent with the objective of our study, which is that alternatives to paravertebral blockade, such as neuraxial-based techniques like TSB, can provide non-inferior and, in some outcome domains, superior postoperative analgesia. The lower requirement for supplemental analgesia and higher patient comfort with TSB in this study also align with Gabriel et al. and Habib et al., in which paravertebral block was associated with lower recovery-room pain scores and lower opioid consumption compared with pectoralis-II block in a large randomized noninferiority trial and lower opioid consumption compared with serratus anterior plane block in a separate trial [14, 15]. These evidences indicate that the choice of block has a significant effect on the early postoperative course of pain and that blocks with more rapid and reliable onset of action, like TSB in our study, may lead to more comfortable early recovery. This is clinically relevant, as the significantly increased risk of prolonged time to first rescue analgesia and decreased need for multiple rescue doses seen with TSB is an established risk factor for the development of severe acute and persistent pain after breast cancer surgery [16]. These concerns have led to authors warning that the choice of the analgesic technique should be tailored to each patient and each outcome

domain, as different blocks may offer benefits in different areas of outcome and in different patient groups [17]. A systematic review and meta-analysis of erector spinae plane block in breast cancer surgery also showed that there were significant reductions in 24-hour opioid consumption, pain scores, and requirement for rescue analgesia compared with general anesthesia alone, which is consistent with Zhang et al., suggesting that TSB may provide further benefit over PVB [18]. Adjunct techniques have also been investigated to prolong the duration of block, such as the use of dexmedetomidine with erector spinae plane block to significantly extend the duration of analgesia and decrease opioid requirement after modified radical mastectomy and the combination of pectoserratus and erector spinae plane blocks with opioid-sparing regimens to decrease postoperative opioid consumption and pain scores after breast surgery [19, 20]. A further meta-analysis of the use of erector spinae plane block for breast surgery analgesia confirmed that pooled trials showed a consistent reduction in early postoperative pain and opioid consumption, and a pilot comparison of deep versus superficial plane variants of a single block technique showed that even technical modifications within the same block family can materially alter analgesic outcomes [21, 22], suggesting that technique-specific and even sub-technique-specific factors may account for some of the between-group differences observed in our study. Lastly, comparative studies have shown that ultrasound-guided plane blocks can provide an equivalent perioperative analgesic effect to thoracic epidural analgesia (TEA), but with a more favorable side-effect profile, which is relevant to the more selective sympathetic and motor blockade that occurs with TSB compared to PVB in the present cohort [23].

LIMITATIONS

This was a single-center study with a small number of patients (N=60), and long-term outcomes (chronic post-mastectomy pain beyond the immediate postoperative period) were not evaluated.

CONCLUSION

Thoracic segmental block was found to have better block performance, intraoperative patient comfort and reduced requirement for supplemental analgesia compared to thoracic paravertebral block in women undergoing mastectomy. Thoracic segmental block consistently resulted in lower pain scores throughout the 24-hour follow-up period. Thoracic segmental block patients had a significantly longer time to first rescue analgesia and fewer repeated rescue doses of analgesia. Thoracic segmental block was more effective compared to paravertebral block in terms of patient satisfaction and overall recovery profile, such as nausea/vomiting and shoulder discomfort. The rates of complications related to the block were negligible and similar for both techniques. Thoracic segmental block seems to be a good and tolerable alternative to thoracic paravertebral block for perioperative analgesia in mastectomy surgery overall.

RECOMMENDATIONS

Further large, multicentric, randomized trials with longer follow-up are suggested to validate these results and to assess the effects of thoracic segmental block on chronic post-mastectomy pain and quality of life.

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CONFLICT OF INTEREST

None declared

ETHICAL APPROVAL

The study was approved by the Institutional Ethics Committee

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