

Comparative Analysis of Ultrasound-Guided Serratus Anterior Plane Block and Pectoral Nerve Block for Postoperative Analgesia Following Modified Radical Mastectomy

Authors:

Dr. Divyashri C.N¹, Dr. Bharath M.S², Dr. Shruthi Jayaram³

¹Consultant Anaesthesiologist, Csi redfern mission hospital, Hassan.

²Associate professor, Adichunchanagiri institute of medical sciences, Karnataka.

³Associate professor, Hassan institute of medical sciences, Hassan.

Corresponding Author:

Dr. Divyashri C.N

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ABSTRACT

Background: Modified Radical Mastectomy (MRM) is associated with significant postoperative pain due to extensive tissue dissection involving the breast and axillary region. Effective analgesia is essential for early recovery, reduced opioid consumption, and improved patient satisfaction. Ultrasound-guided fascial plane blocks such as Serratus Anterior Plane Block (SAPB) and Pectoral Nerve Block (PECS block) are increasingly used as opioid-sparing analgesic techniques. This study aimed to compare the efficacy of SAPB and PECS block for postoperative analgesia following MRM. **Materials and Methods:** This prospective, randomized, comparative clinical study was conducted in the Department of Anaesthesiology, CSI Redfern Mission Hospital, Hassan, over a period of 2 years. A total of 80 patients undergoing elective Modified Radical Mastectomy under general anaesthesia were randomized into two groups of 40 each. Group S received ultrasound-guided Serratus Anterior Plane Block, while Group P received ultrasound-guided Pectoral Nerve Block. Postoperative pain was assessed using Visual Analogue Scale (VAS) at 0, 2, 4, 6, 12, and 24 hours. Duration of analgesia, rescue analgesic requirement, total analgesic consumption, hemodynamic parameters, patient satisfaction, and block-related complications were compared between both groups. **Results:** Demographic characteristics, baseline hemodynamic parameters, duration of surgery, and duration of anaesthesia were comparable between both groups. Patients in the SAPB group demonstrated significantly lower VAS pain scores at 2, 4, 6, and 12 hours postoperatively compared with the PECS group ($p < 0.05$). The duration of postoperative analgesia was significantly longer in the SAPB group (12.6 ± 2.5 hours) compared with the PECS group (10.2 ± 2.4 hours) ($p < 0.001$). Rescue analgesic requirement and total analgesic consumption during the first 24 hours were significantly lower in the SAPB group. Patient satisfaction scores were higher in the SAPB group, while intraoperative hemodynamic stability and complication rates were comparable between both groups. **Conclusion:** Ultrasound-guided Serratus Anterior Plane Block provides superior postoperative analgesia compared with Pectoral Nerve Block following Modified Radical Mastectomy. SAPB offers prolonged analgesia, reduced analgesic requirement, and improved patient satisfaction with comparable safety, making it an effective regional analgesic technique for breast surgery.

Keywords: Serratus Anterior Plane Block, Pectoral Nerve Block, Modified Radical Mastectomy, Ultrasound-guided Block, Postoperative Analgesia, VAS Pain Score.

INTRODUCTION

Breast cancer is one of the most common malignancies affecting women worldwide and represents a major cause of cancer-related morbidity and mortality. Modified Radical Mastectomy (MRM) remains an important surgical procedure for the treatment of breast carcinoma, particularly in patients requiring extensive

breast and axillary lymph node clearance. Despite advances in surgical and anaesthetic management, postoperative pain following MRM remains a significant clinical concern due to extensive tissue trauma involving the skin, breast parenchyma, pectoral muscles, and axillary region. Poorly controlled postoperative pain may result in delayed recovery, increased opioid consumption, restricted shoulder

movement, prolonged hospital stay, and development of chronic post-mastectomy pain syndrome (1,2).

Traditionally, postoperative analgesia after breast surgery has been managed with systemic opioids, non-steroidal anti-inflammatory drugs, and local anaesthetic infiltration. However, opioid administration is associated with several adverse effects, including nausea, vomiting, sedation, respiratory depression, and delayed postoperative recovery. Therefore, multimodal analgesia incorporating regional anaesthetic techniques has become an important component of enhanced recovery protocols for breast surgery (3).

Thoracic epidural analgesia and thoracic paravertebral block have been used extensively for postoperative pain management in breast surgery due to their effective analgesic properties. However, these techniques may be associated with technical challenges, risk of complications, sympathetic blockade, and patient discomfort. The introduction of ultrasound-guided fascial plane blocks has provided safer and technically simpler alternatives for providing effective postoperative analgesia (4).

Serratus Anterior Plane Block (SAPB) is an ultrasound-guided fascial plane block that provides analgesia by targeting the lateral cutaneous branches of thoracic intercostal nerves. The local anaesthetic deposited between the serratus anterior muscle and surrounding fascial planes allows blockade of multiple thoracic nerve branches, providing effective analgesia for procedures involving the anterolateral chest wall. Blanco et al. first described the serratus plane block and demonstrated its usefulness in thoracic wall analgesia (5).

The Pectoral Nerve Block (PECS block) is another ultrasound-guided regional anaesthetic technique developed specifically for breast surgery. PECS I block involves injection of local anaesthetic between the pectoralis major and pectoralis minor muscles, whereas PECS II block includes an additional injection between the pectoralis minor and serratus anterior muscles. This technique provides blockade of the pectoral nerves, intercostobrachial nerve, and lateral branches of thoracic intercostal nerves involved in breast surgical pain transmission (6).

Previous studies have demonstrated the effectiveness of SAPB in reducing postoperative pain and opioid consumption following breast surgery. Abdallah et al. reported that ultrasound-guided SAPB provided effective analgesia after breast surgery with reduced opioid requirement and improved postoperative pain control (7). Similarly, PECS block has been shown to provide effective analgesia after breast cancer surgery. Bashandy et al. demonstrated that PECS I and PECS II blocks significantly reduced postoperative opioid consumption and improved analgesic outcomes in patients undergoing breast surgery (8).

Hetta et al. compared pectoralis-serratus intercostal plane block and SAPB in patients undergoing Modified Radical Mastectomy and reported effective

analgesia with both techniques, although differences were observed in analgesic duration and postoperative pain control (9). Kulhari et al. also demonstrated that PECS block is an effective opioid-sparing technique for breast surgery analgesia when compared with thoracic paravertebral block (10).

Although both SAPB and PECS block have demonstrated promising results, the comparative efficacy of these techniques in patients undergoing Modified Radical Mastectomy remains unclear. SAPB may provide wider analgesic coverage of the lateral thoracic wall, while PECS block may provide better blockade of pectoral muscle-related pain. Therefore, the present study was conducted to compare ultrasound-guided Serratus Anterior Plane Block and Pectoral Nerve Block with respect to duration of postoperative analgesia, pain scores, rescue analgesic requirement, patient satisfaction, hemodynamic stability, and block-related complications in patients undergoing Modified Radical Mastectomy.

Although both Serratus Anterior Plane Block (SAPB) and Pectoral Nerve Block (PECS block) have demonstrated promising analgesic efficacy following breast surgery, direct comparative evidence remains limited, particularly in patients undergoing Modified Radical Mastectomy. Variations in study design, block techniques, local anaesthetic regimens, and outcome measures necessitate further prospective comparative studies to determine the optimal regional analgesic technique for postoperative pain management.

MATERIALS AND METHODS

Study Design and Setting

This prospective, randomised, comparative clinical study was conducted in the Department of Anaesthesiology, CSI Redfern Mission Hospital, Hassan. The study was carried out over a period of 2 years to compare the efficacy of ultrasound-guided Serratus Anterior Plane Block (SAPB) and Pectoral Nerve Block (PECS block) for postoperative analgesia in patients undergoing Modified Radical Mastectomy (MRM).

Study Population

A total of 80 patients scheduled for elective Modified Radical Mastectomy under general anaesthesia were enrolled in the study. Patients were randomly allocated into two equal groups of 40 each:

Group S (n=40): Patients receiving ultrasound-guided Serratus Anterior Plane Block.

Group P (n=40): Patients receiving ultrasound-guided Pectoral Nerve Block.

The sample size was calculated based on previous studies considering postoperative VAS score as the primary outcome, with a power of 80% and alpha error of 5%. A minimum of 36 patients per group was required. To compensate for possible dropouts, 40 patients were enrolled in each group.

Inclusion Criteria

- Patients fulfilling the following criteria were included:
- Patients aged 18–70 years.
- American Society of Anesthesiologists (ASA) physical status I and II.
- Patients undergoing elective Modified Radical Mastectomy.
- Patients providing written informed consent for participation.

Exclusion Criteria

- Patients were excluded if they had:
- Refusal to participate in the study.
- Known allergy to local anaesthetic agents.
- Coagulopathy or bleeding disorders.
- Local infection at the block site.
- Significant cardiac, hepatic, or renal dysfunction.
- Pre-existing neurological disorders affecting pain assessment.
- Inability to understand the pain assessment scale.

Preoperative Assessment

All patients underwent detailed preoperative evaluation including history, physical examination, airway assessment, and routine investigations. Baseline investigations included complete blood count, blood glucose estimation, renal function tests, liver function tests, serum electrolytes, coagulation profile (when indicated), electrocardiogram, and chest radiograph whenever clinically required.

Baseline parameters including heart rate, blood pressure, oxygen saturation, and body weight were recorded. Patients were kept fasting according to standard preoperative fasting guidelines.

Anaesthetic Technique

All patients received standardized general anaesthesia. After establishing intravenous access, standard monitoring including electrocardiography, non-invasive blood pressure, pulse oximetry, and capnography was applied.

Anaesthesia was induced with intravenous induction agents, opioid analgesics, and neuromuscular blocking agents as per institutional protocol. Maintenance of anaesthesia was achieved using inhalational anaesthetic agents and controlled ventilation. At the completion of surgery, neuromuscular blockade was reversed, and patients were extubated after fulfilling standard extubation criteria.

Ultrasound-Guided Regional Blocks

Group S: Serratus Anterior Plane Block

Patients received ultrasound-guided Serratus Anterior Plane Block after induction of anaesthesia. A high-frequency linear ultrasound probe was placed over the lateral thoracic wall at the level of the fifth rib. After

identifying the serratus anterior muscle and appropriate fascial plane, a needle was advanced under ultrasound guidance and local anaesthetic solution was deposited in the plane between the serratus anterior muscle and latissimus dorsi/serratus muscle according to standard technique.

Group P: Pectoral Nerve Block

Patients received ultrasound-guided Pectoral Nerve Block after induction of anaesthesia. The ultrasound probe was positioned in the infraclavicular region to identify the pectoralis major and pectoralis minor muscles. The local anaesthetic solution was injected between the appropriate fascial planes to achieve blockade of the pectoral nerves and associated sensory nerves.

Postoperative Analgesia Assessment

Postoperative pain intensity was assessed using the Visual Analogue Scale (VAS) at predefined time intervals:

Immediate postoperative period (0 hour)

- 2 hours
- 4 hours
- 6 hours
- 12 hours
- 24 hours

Hemodynamic parameters including heart rate, blood pressure, and oxygen saturation were recorded during the postoperative period.

Rescue Analgesia

Patients with VAS score ≥ 4 received rescue analgesia according to institutional protocol. The total requirement of rescue analgesics during the first 24 postoperative hours was recorded.

Outcome Parameters

The following parameters were compared between both groups:

Primary Outcome:

- Duration of postoperative analgesia.

Secondary Outcomes:

- Postoperative pain scores (VAS).
- Time to first rescue analgesic requirement.
- Total opioid/analgesic consumption during 24 hours.
- Intraoperative hemodynamic changes.
- Patient satisfaction scores.
- Incidence of block-related complications.

Statistical Analysis

Data collected were entered into Microsoft Excel and analysed using appropriate statistical software. Continuous variables were expressed as mean $\pm$ standard deviation, while categorical variables were presented as frequency and percentages. Independent-sample t-test, Mann–Whitney U test, Chi-square test,

or Fisher's exact test were applied wherever appropriate. A p-value <0.05 was considered statistically significant.

Written informed consent was obtained from all participants. The study was conducted in accordance with the Declaration of Helsinki.

Ethical Considerations

The study was approved by the Institutional Ethics Committee of CSI Redfern Mission Hospital, Hassan.

RESULTS AND OBSERVATIONS

A total of 80 patients undergoing elective Modified Radical Mastectomy were enrolled in the study. Patients were randomly divided into two groups of 40 each:

- **Group S (n=40):** Ultrasound-guided Serratus Anterior Plane Block (SAPB)
- **Group P (n=40):** Ultrasound-guided Pectoral Nerve Block (PECS block)

Table 1: Demographic Characteristics of Study Participants

Parameter	Group S (n=40)	Group P (n=40)	p-value
Age (years)	52.4 ± 8.6	51.8 ± 9.2	0.76
Weight (kg)	62.1 ± 7.8	61.6 ± 8.1	0.78
BMI (kg/m ²)	24.3 ± 2.9	24.6 ± 3.0	0.65
ASA Grade I/II (n)	18/22	17/23	0.82

Observation:

The demographic characteristics were comparable between both groups, with no statistically significant difference observed.

Table 2: Baseline Hemodynamic Parameters

Parameter	Group S	Group P	p-value
Heart Rate (beats/min)	78.5 ± 7.4	79.2 ± 7.1	0.67
Systolic Blood Pressure (mmHg)	125.2 ± 10.8	124.6 ± 11.1	0.81
Diastolic Blood Pressure (mmHg)	78.6 ± 6.7	79.1 ± 6.9	0.74
SpO ₂ (%)	98.3 ± 0.7	98.2 ± 0.8	0.59

Observation:

Baseline hemodynamic parameters were similar in both groups.

Table 3: Duration of Surgery and Anaesthesia

Parameter	Group S	Group P	p-value
Duration of surgery (minutes)	142.5 ± 18.6	144.2 ± 20.1	0.69
Duration of anaesthesia (minutes)	171.4 ± 21.5	173.6 ± 22.3	0.66

Observation:

The duration of surgery and anaesthesia was comparable between both groups.

Table 4: Postoperative Pain Scores (VAS)

Time Interval	Group S	Group P	p-value
0 hour	1.1 ± 0.6	1.3 ± 0.7	0.18
2 hours	1.7 ± 0.8	2.3 ± 0.9	0.002*
4 hours	2.0 ± 0.9	2.9 ± 1.0	<0.001*
6 hours	2.5 ± 1.0	3.5 ± 1.1	<0.001*
12 hours	3.1 ± 1.1	4.2 ± 1.2	<0.001*
24 hours	3.7 ± 1.3	4.1 ± 1.4	0.17

Observation:

Patients receiving SAPB showed significantly lower postoperative pain scores during the early postoperative period compared with PECS block.

Table 5: Duration of Postoperative Analgesia

Parameter	Group S	Group P	p-value
Time to first rescue analgesia (hours)	12.6 ± 2.5	10.2 ± 2.4	<0.001*

Observation:

The duration of postoperative analgesia was significantly prolonged in the SAPB group.

Table 6: Rescue Analgesic Requirement During First 24 Hours

Parameter	Group S (n=40)	Group P (n=40)	p-value
Patients requiring rescue analgesia	18 (45%)	30 (75%)	0.006*
Mean number of rescue doses	1.2 ± 0.8	2.1 ± 0.9	<0.001*
Total analgesic consumption (mg)	1040 ± 320	1420 ± 390	<0.001*

Observation:

Rescue analgesic requirement was significantly lower among patients receiving SAPB.

Table 7: Intraoperative Hemodynamic Changes

Parameter	Group S	Group P	p-value
Increase in HR (%)	8.1 ± 3.5	8.9 ± 3.7	0.31
Change in SBP (%)	7.5 ± 3.3	8.2 ± 3.6	0.36
Requirement of additional analgesic	3 (7.5%)	5 (12.5%)	0.45

Observation:

Both techniques maintained comparable intraoperative hemodynamic stability.

Table 8: Patient Satisfaction Score

Satisfaction Level	Group S (n=40)	Group P (n=40)
Excellent	25 (62.5%)	16 (40%)
Good	11 (27.5%)	15 (37.5%)
Fair	4 (10%)	9 (22.5%)

p-value = 0.03

Observation:

Patient satisfaction was significantly higher in the SAPB group.

Table 9: Postoperative Complications

Complication	Group S (n=40)	Group P (n=40)	p-value
Nausea and vomiting	4 (10%)	6 (15%)	0.50
Injection site pain	2 (5%)	3 (7.5%)	0.64
Hematoma	0	0	—
Pneumothorax	0	0	—

Observation:

No major block-related complications were observed in either group.

Table 10: Overall Comparison of Primary and Secondary Outcomes

Outcome	Group S	Group P	Statistical significance
Duration of analgesia	Longer	Shorter	Significant
VAS pain score	Lower	Higher	Significant
Rescue analgesic requirement	Reduced	Increased	Significant
Patient satisfaction	Higher	Lower	Significant
Hemodynamic stability	Comparable	Comparable	Not significant
Complications	Minimal	Minimal	Not significant

DISCUSSION

The present prospective randomized comparative study was conducted to evaluate and compare the effectiveness of ultrasound-guided Serratus Anterior Plane Block (SAPB) and Pectoral Nerve Block (PECS block) for postoperative analgesia following Modified Radical Mastectomy. A total of 80 patients were enrolled and randomly allocated into two groups of 40 patients each. The study demonstrated that both SAPB and PECS block provided effective postoperative analgesia; however, SAPB showed superior analgesic efficacy with longer duration of pain relief, lower postoperative pain scores, reduced rescue analgesic requirement, and higher patient satisfaction.

In the present study, demographic characteristics including age, body weight, BMI, ASA physical status, duration of surgery, and duration of anaesthesia were comparable between both groups. The similarity of baseline characteristics confirms adequate randomization and indicates that postoperative outcome differences were primarily related to the analgesic techniques used.

Postoperative pain assessment using the Visual Analogue Scale (VAS) demonstrated significantly lower pain scores in the SAPB group compared with the PECS group during the early postoperative period, particularly at 2, 4, 6, and 12 hours. The superior analgesic effect of SAPB may be explained by its anatomical mechanism, where local anaesthetic spread

along the serratus fascial plane blocks multiple thoracic intercostal nerve branches supplying the lateral and anterior chest wall. Blanco et al. described SAPB as an effective ultrasound-guided technique for thoracic wall analgesia by targeting lateral cutaneous branches of intercostal nerves (5).

The findings of the present study are consistent with Abdallah et al., who demonstrated that ultrasound-guided SAPB provided effective postoperative analgesia following breast surgery and significantly reduced opioid consumption compared with conventional analgesic methods (7). The wider sensory coverage achieved by SAPB may explain its effectiveness in extensive breast procedures such as Modified Radical Mastectomy.

PECS block has also been established as an effective regional analgesic technique for breast surgery. Blanco introduced the PECS block as a novel approach for providing analgesia after breast procedures by blocking the pectoral and associated sensory nerves (6). Bashandy et al. reported that PECS I and PECS II blocks significantly improved postoperative analgesia and reduced opioid requirements in patients undergoing breast cancer surgery (8).

However, in Modified Radical Mastectomy, extensive dissection involving the axillary region and lateral chest wall may require broader sensory blockade. In the present study, SAPB provided better pain control compared with PECS block, which may be attributed to its ability to block a wider distribution of thoracic nerve branches. Hetta et al. compared SAPB and pectoralis-serratus intercostal plane block in MRM patients and reported effective analgesia with both techniques, although variations were observed in analgesic performance (9).

The duration of postoperative analgesia was significantly longer in the SAPB group compared with the PECS group. Patients receiving SAPB required rescue analgesia later and had lower total analgesic consumption during the first 24 postoperative hours. These findings indicate that SAPB provides prolonged analgesic benefits and may reduce opioid exposure after major breast surgery.

Kulhari et al. demonstrated that PECS block provides effective opioid-sparing analgesia in breast surgery patients when compared with thoracic paravertebral block (10). The current study further suggests that while PECS block is effective, SAPB may offer additional advantages in procedures involving extensive chest wall dissection.

Intraoperative hemodynamic parameters, including heart rate and blood pressure changes, were comparable between both groups. Both techniques maintained stable intraoperative conditions without significant differences in additional analgesic requirement. This supports the safety profile of ultrasound-guided fascial plane blocks and their advantage over techniques associated with sympathetic blockade (4).

Patient satisfaction was significantly higher in the SAPB group, which may be attributed to improved pain relief, prolonged analgesia, and reduced requirement for rescue medications. Better postoperative analgesia facilitates early mobilization, improves patient comfort, and contributes to enhanced recovery following breast surgery.

No major block-related complications such as pneumothorax or hematoma were observed in either group. Minor complications including nausea, vomiting, and injection site discomfort occurred with similar frequency. These findings confirm that both SAPB and PECS block are safe when performed under ultrasound guidance.

Overall, the present study demonstrates that ultrasound-guided Serratus Anterior Plane Block provides superior postoperative analgesia compared with Pectoral Nerve Block in patients undergoing Modified Radical Mastectomy. SAPB resulted in prolonged analgesic duration, lower postoperative pain scores, decreased rescue analgesic requirement, and improved patient satisfaction while maintaining comparable safety.

The study has certain limitations, including single-centre design and limited sample size. Long-term outcomes such as prevention of chronic post-mastectomy pain were not evaluated. Further multicentric randomized controlled studies with larger sample sizes are required to validate these findings.

Future multicentre randomized controlled trials with larger sample sizes are recommended to evaluate long-term analgesic outcomes, prevention of chronic post-mastectomy pain syndrome, quality of recovery, functional shoulder outcomes, and cost-effectiveness of ultrasound-guided regional analgesic techniques.

Strengths of this study

Strengths of this study include its prospective randomized design, ultrasound-guided standardized block techniques, objective pain assessment, and comprehensive evaluation of postoperative analgesic outcomes.

Ethical Approval

Ethical approval was obtained from the Institutional Ethics Committee, and written informed consent was obtained from all participants.

CONCLUSION

Ultrasound-guided Serratus Anterior Plane Block provided superior postoperative analgesia compared with Pectoral Nerve Block in patients undergoing Modified Radical Mastectomy. SAPB resulted in prolonged duration of analgesia, lower postoperative pain scores, reduced rescue analgesic consumption, and higher patient satisfaction with comparable safety. Therefore, SAPB may be considered an effective and reliable regional analgesic technique for postoperative pain management following MRM.

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Conflict of Interest

The authors declare no conflict of interest.

Author Contributions

Dr. Divyashri C.N.: Conceptualization, study design, patient recruitment, supervision, manuscript drafting.

Dr. Bharath M.S.: Data collection, perioperative patient management, data interpretation, critical revision.

Dr. Shruthi Jayaram: Statistical analysis, literature review, manuscript preparation, critical revision.

All authors approved the final manuscript.

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Data Availability Statement

The datasets generated and analysed during the current study are available from the corresponding author upon reasonable request.

Abbreviations

ASA – American Society of Anesthesiologists

BMI – Body Mass Index

ECG – Electrocardiogram

MRM – Modified Radical Mastectomy

PECS – Pectoral Nerve Block

SAPB – Serratus Anterior Plane Block

SpO₂ – Peripheral Oxygen Saturation

VAS – Visual Analogue Scale

IEC – Institutional Ethics Committee

CTRI – Clinical Trials Registry India

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