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Research Article

Single Shot Pectoral Plane Block Type 2 (PECS II) Versus Serratus Anterior Plane Block for Postoperative Analgesia Following Modified Radical Mastectomy for Postoperative Acute and Long-Term Pain: A Randomized Clinical Trial

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ABSTRACT

Background: Effective management of postoperative pain in breast cancer surgery is crucial to enhance recovery and quality of life. Regional anesthesia techniques such as Pecs II and Serratus Anterior Plane Block (SAPB) have emerged as alternatives to systemic opioids. To compare the efficacy of single-shot Pecs II block and SAPB in terms of acute and long-term (up-to 2 months) postoperative analgesia following modified radical mastectomy.

Methods: A single-blind, randomized controlled trial was conducted on 46 ASA I-II female patients undergoing MRM, assigned to either Pecs II block (Group P) or SAPB (Group S), each with 30 mL of 0.25% bupivacaine. Numerical Rating Scale (NRS) scores at rest and during movement were recorded perioperatively and during 60-day follow-up. Secondary outcomes included time to first rescue analgesia, number of rescue analgesics in 48 hours, and adverse effects.

Results: Both blocks provided comparable acute pain relief in the first 48 hours ($p>0.05$). Group P showed significantly lower NRS scores at 15, 30, and 60 days at rest and on movement ($p<0.05$), indicating better long-term analgesia. There was no significant difference in rescue analgesic requirements or adverse effects.

Conclusion: Both Pecs II and SAPB offer effective acute postoperative pain control following MRM, while Pecs II provides superior long-term analgesia.

Introduction

Effective postoperative pain management is essential for recovery and the overall patient's quality of life in breast cancer surgery. In India, breast cancer accounts for 25%–30% of all female cancers, making it the most common malignancy among women. Modified radical mastectomy (MRM), though less extensive than earlier surgical procedures, is still associated with considerable postoperative discomfort. Patients often experience moderate to severe pain in the immediate postoperative phase, and many remain at risk of developing chronic pain conditions such as post-mastectomy pain syndrome (PMPS). This persistent postoperative pain, which is frequently neuropathic in nature, can markedly reduce quality of life by causing functional impairment, psychological distress, and prolonged dependence on opioid analgesics.

In recent years, regional anaesthesia techniques have become valuable tools for managing both acute and chronic postoperative pain. They offer effective analgesia while reducing the need for systemic opioids and their adverse effects, including nausea, excessive sedation, and respiratory depression. Among these, ultrasound-guided Pectoral Nerve Block type II (Pecs II) and Serratus Anterior Plane Block (SAPB) have gained wide

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acceptance for breast surgery because of their simplicity, safety, and reliable analgesic efficacy.

The Pecs II block involves deposition of local anaesthetic between the pectoralis minor and serratus anterior muscles, providing coverage to the intercostal nerves, intercostobrachial nerve, and long thoracic nerve. In contrast, the SAPB targets the lateral cutaneous branches of the intercostal nerves along the mid-axillary line, offering an alternative pathway for achieving effective analgesia following breast surgery.

Although both blocks have demonstrated favorable outcomes individually, comparative data on their efficacy, particularly regarding long-term pain control, remains limited. This study was therefore undertaken to evaluate and compare the analgesic efficacy of ultrasound-guided Pecs II and SAPB, with a primary objective of evaluating both acute and long-term postoperative pain relief following MRM.

Methods

This prospective, single-blind, randomized controlled trial was conducted at the Department of Anesthesiology, Dr. D. Y. Patil Medical College, Pune, over a period of 1.5 years. Ethics committee and CTRI approvals (CTRI/2024/08/072584) were obtained prior to patient recruitment.

Participants

Forty-six ASA I–II female patients aged 18–65 years scheduled for modified radical mastectomy under general anesthesia were enrolled after informed consent. Exclusion criteria included ASA grade >III, comorbid systemic illnesses, coagulation abnormalities, and emergency surgeries.

Randomization and Groups

Patients were single-blinded and randomized using a computer-generated sequence into Group P: PECS II block (n=23) & Group S: SAPB (n=23). Each patient received 30 mL of 0.25% bupivacaine at the end of surgery under ultrasound guidance.

Sample Size Estimation

Sample size was calculated based on the study by Jain et al. (Saudi J Anaesth. 2020;14(4):464–472), using standard deviations of 3.8 (PECS group) and 3.82 (SAPB group), with a mean difference in time to first rescue analgesia of 5.13, 95% power, 5% significance level, and a 10% attrition rate. The required sample size was 46 (23 per group), using WinPepi version 11.16.

Procedure

A preoperative assessment was conducted one day before surgery for patients undergoing modified radical mastectomy. A detailed history, physical examination, and routine laboratory investigations—including complete blood count (CBC), liver and renal function tests (LFT, RFT), serum electrolytes, urine analysis, and coagulation profile (PT-INR)—were performed. Preoperative Numeric Rating Scale (NRS) pain scores were documented for all patients. Participants were kept nil per os for six hours prior to surgery, and informed written consent was obtained. Baseline vital parameters were recorded, and intravenous access was secured using a 20-gauge cannula.

General anesthesia was administered using glycopyrrolate (0.004 mg/kg), midazolam (0.02 mg/kg), fentanyl (2 µg/kg), propofol (2 mg/kg), and vecuronium (0.1 mg/kg with top-ups). At the end of surgery and before extubation, ultrasound-guided blocks were performed under aseptic precautions.

Intervention Technique

Group P (PECS II block)

With the patient supine, a linear probe was used to identify the fourth rib, pectoral muscles, and serratus anterior. Bupivacaine 0.25% was injected in two planes: 10 mL between pectoralis major and minor and 20 mL between pectoralis minor and serratus anterior.

Group S (Serratus Plane block)

The transducer was placed at the fifth rib mid-axillary line. After identifying the serratus anterior muscle and pleura, a 1–3 mL test dose confirmed placement, followed by 30 mL of 0.25% bupivacaine injected deep to the serratus anterior. All injections were in 5 mL increments with aspiration. Postoperative vitals and NRS scores were recorded at 2, 4, 8, 12, 24, and 48 hours. Rescue analgesia (tramadol 1.5 mg/kg IV) was given when NRS ≥3. Time to first dose and total analgesic use in 48 hours were noted. Long-term pain was assessed via telephonic NRS scores on postoperative days 5, 15, 30, and 60.

Statistical Analysis

Data were analyzed using SPSS v27. Continuous variables were expressed as mean ± SD and compared using an independent t-test. Categorical variables were analyzed using the chi-square/Fisher's exact test. A P-value < 0.05 was considered statistically significant.

Outcomes

- Primary Outcome: Pain intensity measured by NRS at rest and on movement at predefined time points (2, 4, 8, 12, 24, 48 hours, and days 5, 15, 30, 60 post-op).
- Secondary Outcomes: Time to first rescue analgesic, total number of rescue analgesics within 48 hours, adverse effects.

Results

The study enrolled 46 female patients, with 23 in each group (PECS II- Group P and SAPB- Group S).

Demographic analysis

The demographic data and baseline characteristics of the patients were comparable between the two groups, with no statistically significant differences observed in terms of age, distribution, weight, or ASA grade (Figure1).

Hemodynamic Parameters

No significant intergroup differences were observed in perioperative heart rate, systolic/diastolic blood pressure, or oxygen saturation. (Figure 2-4).

Duration of Surgery (Mean+/-SD 2.49+/-0.41 and 2.28+/-0.31 hours in group P and group S respectively) and Duration of Anesthesia (Mean+/-SD 2.51+/-0.39 and 2.33+/-0.29 hours in group P and group S respectively) were comparable between group P and S, with no significant difference between them. The P-value for the duration of surgery 0.06 and for the duration anesthesia (0.0796) were less than 0.05, thus rendering group P and group S comparable.

Analgesic efficacy

Analgesic efficacy was compared between both groups using NRS scores at rest and on movement, assessed preoperatively by examination, and telephonically for long-term follow-up. At rest: No significant difference was seen in NRS preoperatively at rest and at 2 hours, 4 hours, 8 hours, 12 hours, 24 hours, 48 hours, 5 days, 10 days, between group P and S. Whereas a significant difference (P value<.05) was seen at 15 days (P value of 0.032), at 30 days (P value of 0.003) and at 60 days (P value of 0.037) indicating better long-term analgesia in patients (at rest) with PECS-2 block as compared to those with SAPB (Table 1).

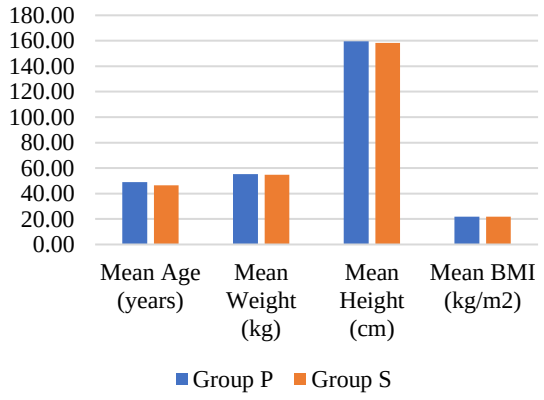

Figure 1- Demographic variables: Age (Mean+/-SD 49.09+/-11.05 years in group P and 46.52+/-13.01 years in group S respectively), BMI (Mean+/-SD of 21.85+/-3.51 and 21.92+/-3.1 kg/m^2 in group P and group S respectively), height (Mean+/-SD 159.52+/-7.94 and 158.44+/-5.88 cm in group P and group S respectively), weight (Mean in group P was 55.26kg and in group S 54.87 respectively).

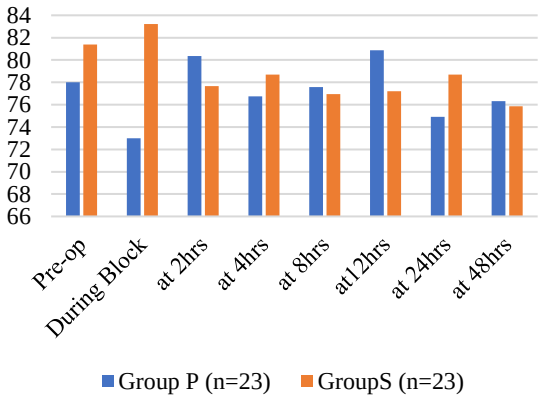

Figure 2- Perioperative Pulse Rate (PR) per min variation between Group P and S

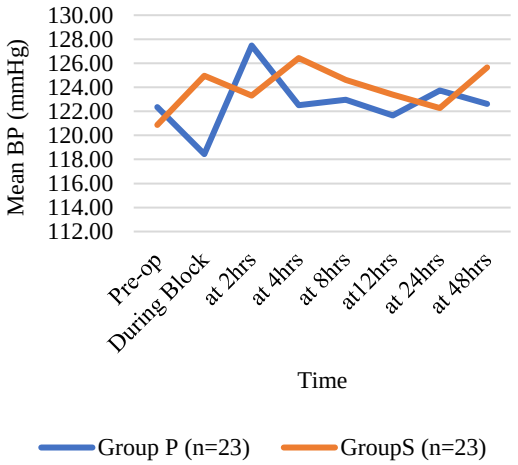

Figure 3- Perioperative Systolic BP (mmHg) variation between group P and S

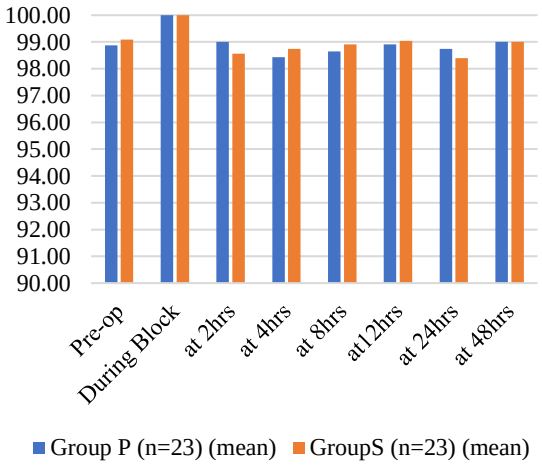

Figure 4- Perioperative SpO2 (%) variation between group P and S

Table 1- Comparison of postoperative NRS at rest between group P & group S

Time	Group P (n=23) Mean +/- SD	Group S (n=23) Mean +/- SD	P value
Pre-op	1.39 +/- 0.49	1.48 +/- 0.51	0.56*
at 2hrs	1.35 +/- 0.56	1.39 +/- 0.50	0.78*
at 4hrs	1.57 +/- 0.65	1.78 +/- 0.80	0.32*
at 8hrs	2.22 +/- 1.10	1.87 +/- 0.81	0.24*
at12hrs	2.39 +/- 0.37	2.9 +/- 0.67	0.16*
at 24hrs	2.35 +/- 0.96	2.00 +/- 0.85	0.21*
at 48hrs	1.87 +/- 0.68	1.96 +/- 0.88	0.71*
at 5 days	1.87 +/- 0.68	1.70 +/- 0.56	0.35*
at 10 days	1.61 +/- 0.64	1.70 +/- 0.70	**0.67***
at 15 days	1.52 +/- 0.58	2.00 +/- 0.85	**0.032***
at 30days	1.48 +/- 0.65	2.09 +/- 0.67	**0.003***
at 60days	1.52 +/- 0.77	2.13 +/- 1.10	**0.04***

*Independent t-test

On movement

No significant difference was seen in NRS pre-operatively on movement and at 2 hours 4 hours, 8 hours, 12 hours, 24 hours, 48 hours, 5 days, 10 days, between group P and S. Whereas a significant difference (P value<.05) was seen at 15 days (P value of 0.038), at 30 days (P value of 0.041) and at 60 days (P value of 0.021) indicating better long-term analgesia in patients (on movement) with PECS-2 block as compared to those with SAPB (Figure 5).

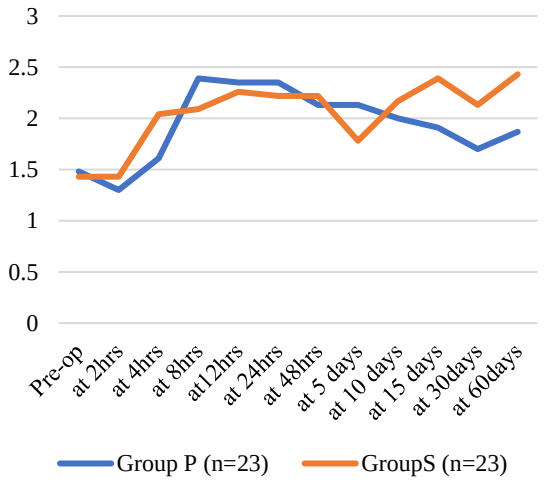

Figure 5- Comparison of NRS on movement between group P & group S

These findings suggest that both PECS II and SAPB are effective in acute pain control, while PECS II offers enhanced long-term analgesia following MRM, both at rest and on movement.

Rescue Analgesic Requirement

The PECS-2 group exhibited a longer interval before the need for rescue analgesia, averaging 9.09 ± 1.98 hours, which reflects a favorable analgesic profile. However, the difference between PECS-2 and SAP blocks in terms of time to the first analgesic request was statistically insignificant (mean ± SD: 9.09 ± 1.98 hours for group P vs. 8.65 ± 2.08 hours for group S; $p > 0.05$). (Table 2, Figure 6)

Table 2- Comparison of requirement of rescue analgesia in the first 48hours after administering block in group P and group S

Number of times rescue analgesia required in first 48 hours	Group P	Group S	Total
1	0	0	0%
2	10(43.47%)	11 (47.82%)	21 (45.65%)
3	9(39.13%)	6 (26.09%)	15 (32.61%)
4	4(17.39%)	6 (26.09%)	10 (21.74%)
Total	23(100%)	23 (100%)	46 (100%)

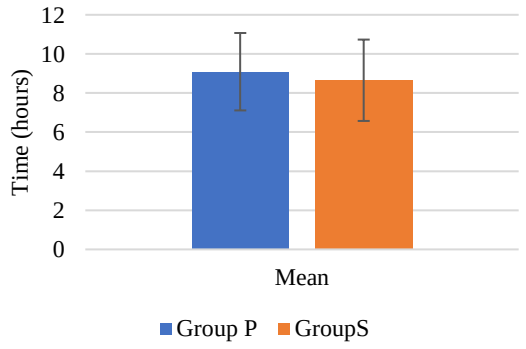

Figure 6- Comparison of Time to first rescue analgesia (hours) between group P and group S

Adverse Events

No instances of local anesthetic systemic toxicity (LAST) were reported in either group. Mild postoperative nausea and vomiting occurred in a few patients, managed symptomatically, with no statistical difference between groups. Incidences of nausea and vomiting were minimal (Group P:13.1% vs Group: S 4.3% for nausea; Group: P 4.3% vs Group: S 8.6% for vomiting), with no statistically significant difference (p=0.506) between the two groups.

Discussion

Modified Radical Mastectomy (MRM) is a widely performed surgical procedure for the treatment of breast cancer, involving excision of the breast tissue, pectoral fascia, and axillary lymph node clearance up to Level II [1]. While it offers effective oncological outcomes, it is associated with significant postoperative pain, which can impede recovery, limit mobility, and contribute to chronic pain conditions such as Post-Mastectomy Pain Syndrome (PMPS) [2-3].

Traditionally, Thoracic Paravertebral Block (TPVB) has been considered the gold standard for regional analgesia in breast surgeries, due to its ability to provide unilateral, multi-dermatomal anesthesia with minimal hemodynamic impact. However, TPVB carries risks such as pneumothorax, hypotension, and technical complexity, which have prompted the development of newer and safer alternatives [4]. Among these, the Pectoral Nerve Block Type II (PECS II) and the Serratus Anterior Plane Block (SAPB) have gained popularity due to their simplicity, safety profile, and efficacy in providing analgesia for breast surgery [5].

In our randomized study, we compared the analgesic efficacy and safety of ultrasound-guided PECS II and SAP blocks in 46 ASA I–II female patients undergoing MRM. Both blocks were administered in the postoperative period using 30 ml of 0.25% bupivacaine. Demographic variables, including age, body mass index (BMI), duration of surgery, and ASA physical status, were comparable between the two groups, thereby maintaining internal validity and reducing the likelihood of confounding factors.

Hemodynamic Stability

Perioperative hemodynamic parameters—such as heart rate, systolic and diastolic blood pressure, and oxygen saturation—remained stable in both groups throughout the study period. No statistically significant intergroup differences were noted at any recorded time point. These findings are consistent with those of Alshawadfy et al. [6], who compared SAPB and PECS II blocks in patients undergoing modified radical mastectomy and similarly observed no significant variations in hemodynamic parameters during either the intraoperative or postoperative periods. Similarly, Blanco et al. [7], who first described the Serratus Anterior Plane Block (SAPB), reported that it produced minimal cardiovascular changes owing to the absence of sympathetic blockade. Kaur et al. [3], in a comparative study of regional anaesthetic techniques, observed better hemodynamic stability in patients receiving the PECS II block. This was attributed

to effective blockade of the anterior cutaneous branches of the intercostal nerves, which play a major role in transmitting nociceptive stimuli during breast surgery. Preemptive interruption of these pathways helps attenuate intraoperative stress responses. Furthermore, Fajardo et al. [4], highlighted that the addition of dexamethasone to the PECS block could delay onset while prolonging the duration of analgesia, thereby contributing to greater hemodynamic stability.

Immediate Postoperative Pain Scoring

Pain scores measured via the Numerical Rating Scale (NRS) at rest and on movement at 2, 4, 8, 12, 24, and 48 hours postoperatively showed no significant differences between the two groups. Both blocks effectively reduced pain intensity in the immediate postoperative period.

These observations are consistent with those of Patel et al. [8], who conducted a case series of 40 patients receiving either PECS I or SAPB during bilateral mastectomy. They reported no significant differences in median NRS pain scores over the first three postoperative days, reaffirming the comparable efficacy of both blocks in providing early postoperative analgesia. Kaur et al. [3] similarly noted that patients in both SAPB and PECS groups demonstrated significantly lower pain scores than controls at 12 and 24 hours postoperatively. Although the SAPB group showed slightly better shoulder mobility during the early recovery period, overall analgesic outcomes were equivalent between the two techniques.

In another comparative study, Kulhari et al. [9] evaluated PECS II and thoracic paravertebral block (TPVB) in patients undergoing modified radical mastectomy and found that PECS II provided superior analgesia during the first two postoperative hours, with significantly lower median NRS scores in the PECS group (2 vs. 4; $p < 0.0001$). Findings from our study closely mirrored these results—both groups required a comparable number of rescue analgesic doses within the first 48 hours. Although the mean time to first rescue analgesia was marginally longer in the PECS group (9.09 ± 1.98 hours) compared to the SAPB group (8.65 ± 2.08 hours), the difference was not statistically significant ($p > 0.05$).

Long-Term Pain Control

A notable finding of our study was the superior long-term analgesic effect achieved with the PECS II block. NRS scores on movement at 15, 30, and 60 days postoperatively were significantly lower in the PECS group, indicating a reduced incidence of post-mastectomy pain syndrome (PMPS) and better functional recovery. De Cassai et al. [10], in a large prospective study involving 140 patients undergoing breast surgery, compared PECS II combined with general anesthesia to general anesthesia alone and demonstrated a significantly lower incidence of chronic postoperative pain in the PECS II group at three months (14.9% vs. 31.8%, $p = 0.039$). This underscores the block's role in PMPS prevention.

Similarly, Sheehan et al. [11] conducted a 2020 pilot study following 17 patients who received PECS blocks after mastectomy and found that none reported pain scores greater than 2 at six months, nor required ongoing analgesic therapy. These findings are consistent with our results and further support PECS II as a promising and effective technique for long-term pain control following breast surgery.

Opioid Consumption and Rescue Analgesia

Postoperative opioid requirement, in our study managed with tramadol, was similar in both groups, with no significant intergroup differences. In contrast, Jain et al. [12] reported differing outcomes, observing that patients in the SAPB group required significantly less postoperative fentanyl compared to those who received the PECS II block (415 µg vs. 644 µg; $p = 0.028$). However, the variation in results may be attributed to differences in study methodology, particularly the use of a different local anesthetic agent (ropivacaine) and opioid regimen, which could have influenced postoperative analgesic requirements.

Bashandy et al. [13], in a randomized controlled trial, demonstrated significantly lower intraoperative fentanyl use and postoperative morphine consumption in the PECS group compared to controls (115 µg vs. 252.5 µg and 2.9 mg vs. 6.9 mg, respectively; $p < 0.001$).

Likewise, Wang et al. [14] showed that PECS II reduced perioperative morphine requirements, reinforcing its opioid-sparing potential. In terms of rescue analgesia, the number of additional doses required in our study was minimal. Two doses were sufficient for most patients, with only a small proportion requiring four or more. These findings are in agreement with those of Aslan et al. [15], who demonstrated that the SAPB significantly prolonged the time to first analgesic request compared to the control group (5.5 hours vs. 1.29 hours; $p < 0.05$).

A meta-analysis by Zhen-Hao Li et al. [16] also confirmed that SAPB prolonged analgesia duration and reduced opioid need.

Side Effects and Safety

Both PECS II and SAP blocks exhibited excellent safety profiles in our study. The incidence of postoperative nausea and vomiting (PONV) was low and did not differ significantly between the two groups. These findings align with those of Alshawadfy et al. [6], who reported comparable rates of PONV among patients receiving either PECS II or SAPB.

Similarly, Ciftci et al. [17] observed that preoperative administration of PECS blocks significantly reduced the incidence of early postoperative vomiting compared to

controls. Bashandy et al. [13] also demonstrated markedly lower PONV scores in the PECS group (0.15 ± 0.366) compared with controls (1.65 ± 0.875; $p < 0.001$). Furthermore, Wang et al. [14] highlighted a reduced relative risk of nausea and vomiting in patients receiving PECS II blocks (RR: 0.22; 95% CI: 0.05–0.94). Collectively, these findings support the favorable safety and tolerability of both regional techniques.

Ultrasound guidance ensured safe and accurate administration of both blocks in our study. No procedural failures or major complications occurred.

This reflects the findings of Blanco et al. [5], who emphasized the technical ease and safety of SAPB in clinical practice.

Limitations

This single-center, single-blinded study comparing PECS II and SAPB has several limitations. The relatively small sample size (n = 46) reduces the statistical power and limits the generalizability of the findings, which may be influenced by institutional practices and population-specific characteristics. Although patients were blinded to group allocation, the administering anesthesiologists were not, introducing a potential source of observer bias.

Long-term pain outcomes were assessed via telephonic follow-up, which may have affected the precision of pain reporting. Tramadol was used as the primary postoperative analgesic, differing from studies that employed stronger opioids, thereby limiting direct comparability. Additionally, the study did not evaluate postoperative quality of life, which could have provided valuable insights into functional recovery. Since both blocks were administered postoperatively, intraoperative hemodynamic effects and opioid consumption could not be assessed. These factors should be considered when interpreting and extrapolating the present results.

Conclusion

Ultrasound-guided PECS II and Serratus Anterior Plane Block are both effective techniques for managing acute postoperative pain following modified radical mastectomy. However, the PECS II block demonstrated superior long-term analgesic benefits, suggesting its potential advantage in reducing persistent postoperative pain and promoting enhanced recovery. Future multicentric studies with larger sample sizes, intraoperative assessments, and quality-of-life evaluations are recommended to validate and expand upon these findings.

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