Original Article

Postoperative Analgesia Following Modified Radical Mastectomy with and without Intraoperative Pectoral Nerve Block: A Prospective Observational Study

Neetha Jose[1], Sruthi A[1], Thusharendhu N[2], Raju Rajan[3]

[1]Assistant Professor, Department of Anesthesiology, Government Medical College, Thiruvananthapuram, Kerala, India. [2]Associate Professor, Department of Anaesthesiology, Government Medical College, Thiruvananthapuram, Kerala, India. [3]Professor, Department of Anaesthesiology, Government Medical College, Thiruvananthapuram, Kerala, India

Abstract

Background: Acute pain after modified radical mastectomy (MRM) can be substantial. An intraoperative pectoral nerve (PECS) block performed under direct vision may provide analgesia without ultrasound guidance. This study compared postoperative pain, rescue analgesic use and haemodynamic variables between patients receiving general anaesthesia (GA) alone and those receiving GA plus an intraoperative PECS block. **Material and Methods:** In this prospective observational study, 60 women with American Society of Anesthesiologists physical status I–II undergoing unilateral MRM received GA alone (n = 30) or GA plus a PECS block (n = 30). After tumour resection, 0.2% ropivacaine was injected into the relevant fascial planes under direct vision. Pain was assessed using a 100-mm visual analogue scale (VAS) at 1, 6, 12 and 24 h. Secondary outcomes were rescue tramadol use and haemodynamic variables. **Results:** Median VAS scores were lower in the PECS group at 1 h (0 vs 30 mm), 6 h (0 vs 50 mm) and 12 h (20 vs 60 mm) (all $P < 0.001$), but not at 24 h (60 vs 60 mm; $P = 0.678$). All patients in the GA-alone group received three rescue tramadol doses. In the PECS group, 30% did not require rescue analgesia; among those who did, the median time to first request was 18 h. Time to first rescue analgesia differed between groups (log-rank $P < 0.001$). One hour after extubation, heart rate and mean arterial pressure were lower in the PECS group (both $P < 0.001$). **Conclusion:** An intraoperative PECS block administered under direct vision after resection was associated with effective analgesia for approximately 12 h after MRM and reduced rescue opioid requirements. The absence of a between-group difference in pain scores at 24 h supports planning multimodal analgesia before the block effect is expected to wane.

Keywords: Analgesia, mastectomy, pectoral nerves, postoperative pain, ropivacaine, tramadol.

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Introduction

Breast cancer is the most commonly diagnosed cancer in women worldwide and in India.[1] and modified radical mastectomy (MRM) remains an important surgical treatment. Acute postoperative pain can be substantial, and poorly controlled early pain is associated with persistent post-mastectomy pain.[2] A pilot study has explored the analgesic and sensory effects of a PECS local anaesthetic block in patients with persistent pain after breast cancer surgery.[3] Opioids can provide effective analgesia but may cause nausea, vomiting and sedation, potentially hindering recovery.

Thoracic epidural and paravertebral blocks give reliable analgesia after breast surgery but carry risks such as pneumothorax, neuraxial spread and haematoma. In 2011, Blanco described the pectoral nerve (Pecs I) block, an interfascial injection between the pectoralis major and minor muscles.[4] He later extended it to the PECS II block, which adds a second injection over the serratus anterior to reach the lateral cutaneous branches of the intercostal nerves and the long thoracic nerve.[5] Randomised trials in patients undergoing mastectomy have reported lower pain scores and opioid use with PECS blocks than with GA alone.[6–13] Meta-analyses support a modest early analgesic benefit.[14,15] However, the results are not uniform. Makkar and colleagues found no benefit when a modified PECS block was added to balanced anaesthesia.[16] and paravertebral block outperformed PECS block in some comparisons.[7,8]

Most of this evidence concerns ultrasound-guided blocks performed by anaesthesiologists. In many high-volume Indian centres, ultrasound machines and trained operators are not always available in every theatre. After the tumour has been resected, the pectoral and serratus fascial planes are exposed in the operative field. Local anaesthetic can therefore be placed into them under direct vision with no extra equipment. A randomised trial from Thiruvananthapuram found that this

Address for correspondence: Dr. Neetha Jose
Assistant Professor, Department of Anesthesiology, Government Medical College, Thiruvananthapuram, Kerala, India
E-mail: neethajosef @gmail.com

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approach reduced pain scores and analgesic needs.[11] but data from routine practice are limited.

We therefore compared postoperative pain (primary outcome), time to first rescue analgesic, number of rescue doses and early haemodynamics between patients undergoing MRM under GA with and without an intraoperative PECS block given under direct vision.

Materials and Methods

Study design and ethics: This prospective observational study was conducted in the Department of Anaesthesiology, Government Medical College, Thiruvananthapuram, Kerala, India, between April 2023 and March 2024. The Human Ethics Committee, Government Medical College, Thiruvananthapuram, approved the study (HEC No. 06/05/2023/MCT, dated 4 April 2023). All participants gave written informed consent. The report follows the STROBE guidelines for observational studies.17

Participants: Women aged 30–70 years with American Society of Anesthesiologists (ASA) physical status I or II who were scheduled for elective unilateral MRM were eligible. Exclusion criteria were contraindications to regional anaesthesia (local infection, coagulopathy or allergy to local anaesthetics), a pre-existing neurological deficit in the operative area, or refusal to participate. Consecutive sampling was used: eligible patients were enrolled sequentially until the target sample size was reached. Group 1 received GA alone; Group 2 received GA plus a PECS block.

Anaesthesia and block technique: Both groups received a standardised general anaesthetic. Midazolam (1 mg intravenously) was administered for anxiolysis. Anaesthesia was induced intravenously with propofol and maintained with sevoflurane in a nitrous oxide–oxygen mixture. Intravenous atracurium was used for neuromuscular blockade, and the airway was secured with a cuffed endotracheal tube (internal diameter, 7.5 mm). Ondansetron was administered intravenously for antiemetic prophylaxis. Intraoperative analgesia comprised intravenous fentanyl citrate (2 µg/kg) and paracetamol (1 g by intravenous infusion). Increases in blood pressure or heart rate exceeding 20% of baseline were managed with incremental intravenous propofol boluses, as required. At the end of surgery, neuromuscular blockade was reversed with intravenous neostigmine (0.05 mg/kg) and glycopyrrolate (0.01 mg/kg).

In Group 2, after tumour resection and before skin closure, a pectoral nerve (Pecs) block was administered under direct vision using 0.2% ropivacaine. A total volume of 30 mL was injected at two sites: 20 mL into the fascial plane over the serratus anterior and 10 mL between the pectoralis major and minor muscles at the level of the third rib. Group 1 received no Pecs block.

Postoperative analgesia and outcomes: All patients received intravenous paracetamol 1 g every 8 h. Rescue analgesia was intravenous tramadol 2 mg/kg, given by ward nursing staff when the patient reported pain with a resting VAS score above 40 mm. Pain was measured on a 100-mm VAS (0 = no pain; 100 = worst pain imaginable) at 1 h in the post-anaesthesia care unit and at 6, 12 and 24 h after extubation. For descriptive purposes, scores were grouped as no pain (0), mild (10–30), moderate (40–60) and severe (70–100). The primary outcome was VAS score. Secondary outcomes were time from extubation to first rescue analgesic request, number of rescue doses in 24 h, and heart rate (HR), systolic (SBP), diastolic (DBP) and mean arterial pressure (MAP) before induction, at extubation and 1 h after extubation. MAP was calculated as (SBP + 2 × DBP)/3.

Sample size: Sample size was estimated using the formula for comparing two means, based on expected VAS values of 3.67 (SD 0.74) without a block and 1.33 (SD 0.74) with a block, reported by Kumar et al.10, with a two-sided α of 0.05 and 80% power. The calculated minimum was small; 30 participants were recruited per group to allow estimation of secondary outcomes with greater precision.

Statistical analysis: Continuous variables are summarised as mean ± standard deviation (SD) or median (interquartile range [IQR]), as appropriate; categorical variables are reported as number (%). Normally distributed continuous variables were compared using independent-samples t-tests. VAS scores and rescue-dose counts were compared using the Mann–Whitney U test; Hodges–Lehmann estimates were used to summarise between-group differences in VAS scores. Categorical variables were compared using the χ^2 test or Fisher's exact test, as appropriate. Time to first rescue analgesic was analysed using Kaplan–Meier methods and compared with the log-rank test; patients who did not request rescue analgesia were censored at 24 h. A two-sided P value < 0.05 was considered statistically significant. Analyses were performed using SPSS version 27.0 (IBM Corp., Armonk, NY, USA).

Results

Sixty patients were included in the analysis (30 per group), with no losses to follow-up. All participants were women. Age, body mass index (BMI), and American Society of Anaesthesiologists (ASA) physical status were comparable between the groups.. Mean duration of surgery was longer in the PECS group than in the GA-alone group (123.3 ± 24.8 vs 105.0 ± 17.4 min; P = 0.002) [Table 1].

Table 1: Baseline characteristics

Characteristic	GA alone (n = 30)	GA + Pecs (n = 30)	P value
Age (years), mean ± SD	55.9 ± 6.5	54.7 ± 10.7	0.60
≤50 years	10 (33.3)	8 (26.7)	0.67†
51–60 years	13 (43.3)	12 (40.0)	
61–70 years	7 (23.3)	10 (33.3)	
BMI (kg/m²), mean ± SD	25.7 ± 2.0	25.6 ± 4.0	0.90
Underweight (<18.5)	0	1 (3.3)	0.30†

Normal (18.5–24.9)	12 (40.0)	13 (43.3)	
Overweight (25–29.9)	17 (56.7)	12 (40.0)	
Obese (≥30)	1 (3.3)	4 (13.3)	
ASA physical status I / II	0 / 30	1 / 29	1.00‡
Duration of surgery (min), mean ± SD	105.0 ± 17.4	123.3 ± 24.8	0.002

Values are n (%) unless stated. P values from independent t-test unless marked: †χ^2 test; ‡Fisher's exact test. GA, general anaesthesia; BMI, body mass index; ASA, American Society of Anesthesiologists.

Postoperative pain: All participants in the PECS group were pain-free at 1 h, compared with none in the GA-alone group. At 6 h, 24 (80%) participants in the PECS group remained pain-free, whereas all participants in the GA-alone group reported moderate pain. VAS scores were lower in the PECS group at 1, 6 and 12 h (all P < 0.001), with Hodges–Lehmann estimates of the median difference ranging from −30 to −40 mm [Table 2; Figure 1]. At 24 h, the between-group difference was not statistically significant (median 60 mm in each group; P = 0.678). The estimated mean difference was −7.3 mm (95% CI −17.2 to 2.5).

At 24 h, pain scores in the PECS group varied according to rescue analgesic use. The nine participants who did not require rescue analgesia had low scores (median 20 mm, IQR 20–20), whereas the 21 who required rescue analgesia had higher scores (median 70 mm, IQR 60–80). By this time, participants in the GA-alone group had received three tramadol doses. This pattern is descriptive and should not be interpreted as a causal comparison between these subgroups.

Table 2: Postoperative VAS pain scores (0–100 mm)

Time	GA alone (n = 30)	GA + Pecs (n = 30)	HL difference	P value*
1 h				
Median (IQR)	30 (20–30)	0 (0–0)	−30	<0.001
Mean ± SD	25.3 ± 8.2	0 ± 0		
None / mild / moderate / severe	0 / 28 / 2 / 0	30 / 0 / 0 / 0		
6 h				
Median (IQR)	50 (40–50)	0 (0–0)	−40	<0.001
Mean ± SD	46.7 ± 6.1	2.7 ± 5.8		
None / mild / moderate / severe	0 / 0 / 30 / 0	24 / 6 / 0 / 0		
12 h				
Median (IQR)	60 (50–60)	20 (10–27.5)	−40	<0.001
Mean ± SD	55.7 ± 8.2	18.3 ± 14.9		
None / mild / moderate / severe	0 / 0 / 28 / 2	7 / 19 / 4 / 0		
24 h				
Median (IQR)	60 (60–60)	60 (22.5–70)	0	0.68
Mean ± SD	60.3 ± 4.9	53.0 ± 26.0		
None / mild / moderate / severe	0 / 0 / 26 / 4	1 / 8 / 7 / 14		

*Mann–Whitney U test. HL, Hodges–Lehmann estimate of the median difference (Pecs minus GA alone), mm. Pain categories: none 0; mild 10–30; moderate 40–60; severe 70–100 mm.

Rescue analgesia: All 30 participants in the GA-alone group received rescue tramadol, with three doses per participant during the first 24 h. In the PECS group, 21/30 (70%) required rescue analgesia (P = 0.002); 20 received one dose and one received two doses. The mean number of doses was 0.73 per participant in the PECS group and 3.0 in the GA-alone group (P < 0.001). Among PECS-group participants who required rescue analgesia, the median time to first request was 18 h (IQR 17–20). In the Kaplan–Meier analysis, with participants who did not request rescue analgesia censored at 24 h, the median time to first rescue was 20 h in the PECS group and 6 h in the GA-alone group (log-rank P < 0.001; [Table 3; Figure 2]).

Table 3: Rescue analgesic requirement in the first 24 h

Outcome	GA alone (n = 30)	GA + Pecs (n = 30)	P value
Required any rescue analgesic, n (%)	30 (100)	21 (70.0)	0.002†
Number of tramadol doses, n (%)			<0.001*
0	0	9 (30.0)	
1	0	20 (66.7)	
2	0	1 (3.3)	
3	30 (100)	0	
Time to first rescue (h), median (IQR)‡	6 (6–6)	18 (17–20)	<0.001§
Kaplan–Meier median time to first rescue (h)	6	20	

†Fisher's exact test; *Mann–Whitney U test; ‡among patients who needed rescue (GA n = 30, Pecs n = 21); §log-rank test with patients who needed no rescue censored at 24 h. Rescue analgesic: intravenous tramadol 2 mg/kg.

Haemodynamic variables: HR, SBP, DBP, and MAP were comparable between the groups before induction and at

extubation. At 1 h after extubation, the PECS group had lower HR (73.9 ± 9.3 vs 81.7 ± 5.7 beats/min), SBP (125.1 ± 9.7 vs 135.3 ± 5.4 mmHg) and MAP (92.8 ± 7.8 vs 99.2 ± 5.0 mmHg; all P < 0.001), as well as lower DBP (76.6 ± 7.7 vs 81.1 ± 6.0 mmHg; P = 0.014) [Table 4; Figure 3].

Table 4: Perioperative haemodynamic variables

Variable / time	GA alone (n = 30)	GA + Pecs (n = 30)	t	P value
Heart rate (beats/min)				
Pre-induction	84.8 ± 9.2	81.9 ± 12.3	1.04	0.30
At extubation	81.1 ± 4.8	81.3 ± 11.4	0.09	0.93
1 h after extubation	81.7 ± 5.7	73.9 ± 9.3	3.95	<0.001
Systolic blood pressure (mmHg)				
Pre-induction	136.3 ± 11.2	139.8 ± 15.4	1.01	0.31
At extubation	133.3 ± 5.3	133.7 ± 13.2	0.17	0.87
1 h after extubation	135.3 ± 5.4	125.1 ± 9.7	5.06	<0.001
Diastolic blood pressure (mmHg)				
Pre-induction	80.9 ± 6.4	80.7 ± 10.2	0.09	0.93
At extubation	79.2 ± 6.2	79.5 ± 9.3	0.13	0.90
1 h after extubation	81.1 ± 6.0	76.6 ± 7.7	2.54	0.014
Mean arterial pressure (mmHg)				
Pre-induction	99.4 ± 7.3	100.4 ± 10.7	0.44	0.66
At extubation	97.1 ± 9.8	97.6 ± 9.8	0.18	0.86
1 h after extubation	99.2 ± 5.0	92.8 ± 7.8	3.81	<0.001

Values are mean ± SD; independent-samples t-test (absolute t shown). MAP = (SBP + 2 × DBP)/3.

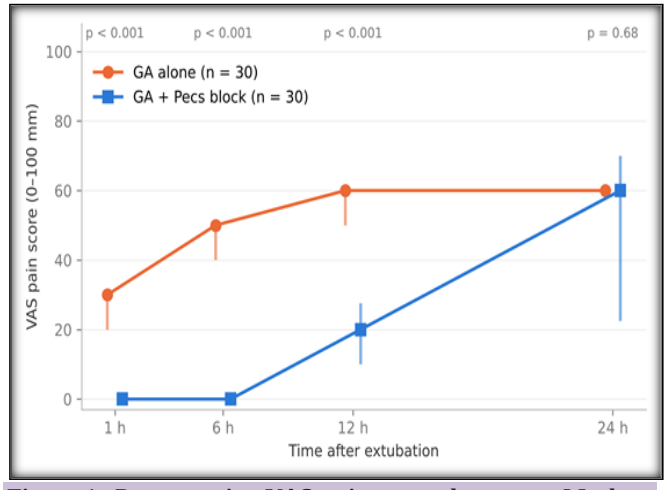


Figure 1: Postoperative VAS pain scores by group. Markers show medians; vertical bars show interquartile ranges. P values from the Mann–Whitney U test.

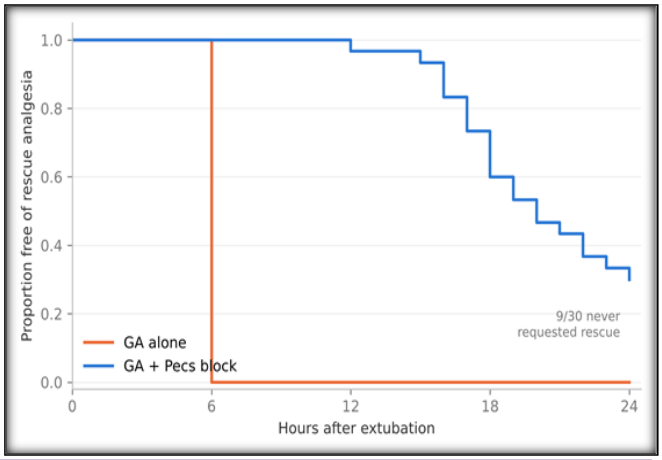


Figure 2: Kaplan–Meier curves for time to first rescue analgesic. Patients who did not need rescue were censored at 24 h. Log-rank P < 0.001.

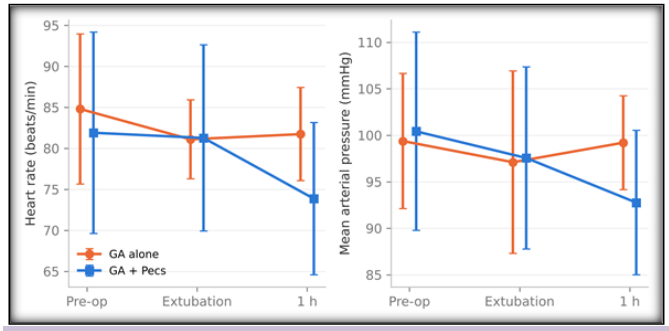


Figure 3: Heart rate (left) and mean arterial pressure (right) before induction, at extubation and 1 h after extubation. Markers show means; error bars show ±1 SD.

Discussion

In this prospective observational study, an intraoperative PECS block administered under direct vision during MRM was associated with lower pain scores at 1, 6 and 12 h, delayed and reduced use of rescue tramadol, and lower HR and blood pressure 1 h after extubation. The between-group difference in pain scores was not statistically significant at 24 h.

Our findings are broadly consistent with randomised trials of ultrasound-guided PECS blocks in breast surgery. Versyck et al. reported lower pain scores and opioid use in the post-anaesthesia care unit with PECS II than with placebo.[9] Kumar et al. found lower resting and movement-related VAS scores and reduced tramadol use after PECS block was added to GA.[10] Similar findings have been reported by Senapathi et al,.[13] Meta-analyses have also found reductions in early postoperative pain and opioid consumption with PECS or serratus plane blocks compared with no regional technique.[14,15] The magnitude of the differences in the present study should be interpreted cautiously because allocation was not randomised, blinding was not used, rescue analgesia followed a uniform regimen in the control group, and a relatively large volume of local anaesthetic was injected directly into exposed fascial

planes. The results are also consistent with the randomised trial by Thomas et al., which evaluated an intraoperative PECS block under direct vision in the same city.[11] These findings support the feasibility of the technique in settings where ultrasound equipment or specialist regional anaesthesia expertise may not be consistently available.

Makkar and colleagues, in contrast, found no analgesic benefit from a modified PECS block given after induction of GA.16 Differences in block timing, volume, the background multimodal regimen and outcome definitions may explain this. Trials comparing Pecs with paravertebral block have generally favoured paravertebral block for the quality and duration of analgesia.[7,8] so the PECS block should be seen as a safer, simpler alternative rather than a better one.

Rescue analgesic use showed a similar pattern. No participant in the GA-alone group avoided rescue tramadol, whereas nearly one-third of participants in the PECS group required none during the first 24 h. Among PECS-group participants who required rescue, the first request occurred at a median of 18 h. The observed duration is compatible with the expected duration of a single injection of ropivacaine, although duration was not measured directly. The fact that every control participant received rescue at 6 h and received exactly three doses raises the possibility that administration was influenced by local practice or a fixed schedule rather than being strictly patient-triggered; this limits interpretation of the time-to-first-request comparison.

The absence of a statistically significant between-group difference at 24 h should not be interpreted as evidence that the block had no earlier benefit. By this time, participants in the GA-alone group had received three tramadol doses, whereas most participants in the PECS group had received one dose or none. In the PECS group, the nine participants who did not require rescue analgesia had low 24-h pain scores, while the 21 who did require rescue had higher scores (median 70 mm, IQR 60–80). This heterogeneous pattern may be compatible with pain returning as the block effect wanes. Rebound pain is a recognised phenomenon after single-injection peripheral nerve blocks.[18,19] but it cannot be established definitively from these observational data. A practical implication is to plan multimodal analgesia before the expected decline in block effect, rather than relying solely on rescue medication.

In our institution, where the surgical caseload is high and operating room turnover is an important consideration, performing the PECS block under direct vision during surgery may offer practical advantages. An ultrasound-guided approach may require additional time for equipment setup and block.

Conclusion

In women undergoing MRM, an intraoperative PECS block administered under direct vision in addition to GA was associated with lower pain scores through 12 h, delayed and reduced rescue analgesic use, and lower haemodynamic measurements 1 h after extubation. The between-group difference in pain scores was not statistically significant at 24 h. These findings support further evaluation in a sufficiently powered randomised study with blinded outcome assessment, standardised rescue analgesia, and longer follow-up.

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Conflicts of interest

There are no conflicts of interest.

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