PECTORAL NERVE BLOCK VERSUS THORACIC PARAVERTEBRAL BLOCK- COMPARISON OF ANALGESIC EFFICACY FOR POSTOPERATIVE PAIN RELIEF IN MODIFIED RADICAL MASTECTOMY SURGERIES

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ABSTRACT

BACKGROUND

Modified Radical Mastectomy (MRM) is the most common surgical procedure for operable breast malignancies. Postoperative pain has been severe in MRM cases and demands for pain relief are high. The technique of performing pectoral nerve block [PECS] using ultrasound guidance is increasing in popularity. We compared the postoperative analgesic profile of ultrasound-guided serratus plane block (SPB) and landmark-guided paravertebral block (PVB).

MATERIALS AND METHODS

This study was done as a double blind, randomised, controlled trial among 60 subjects with breast cancer posted for elective MRM, of which 30 subjects were put in PECS block group and 30 subjects in paravertebral block group. PVB was performed under complete aseptic precaution with low resistance technique. PECS block was performed in supine position with the U/S probe directly above 1st rib where pectoralis major and pectoralis minor muscles are located. Anaesthesia was maintained with sevoflurane 1% and O₂/N₂O mixture with a fraction of 50% inspired O₂. Postoperative pain was recorded using the Visual Analogue Scale (VAS) every one-hour up to 4 hours post-surgery.

RESULTS

The mean VAS scores were significantly lesser in the PECS group compared to the PVB group ($p < 0.05$). The mean heart rates in PECS group were significantly lower than PVB group throughout the procedure. There was no significant difference in the intra-OP MAP between both the groups.

CONCLUSION

Ultrasound-guided PECS block is an alternative analgesic technique to thoracic PVB for postop pain relief in MRM patients. It gives superior analgesia and has fewer complications.

KEYWORDS

Modified Radical Mastectomy, Paravertebral Block, Pectoral Nerve Block, Visual Analogue Score.

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BACKGROUND

Breast cancer has emerged as the most common cancer in India, and 2nd most common even in the rural area. Breast cancer accounts for 25% to 32% of all female cancers in all these cities. This implies, practically, one fourth of all female cancer cases are breast cancers.^[1] Of the several therapeutic options for breast cancer, Modified Radical Mastectomy (MRM) is the most common surgical procedure for operable breast malignancies. Postoperative pain has been severe in MRM cases and demands for pain relief are high.

Various strategies like non-steroidal anti-inflammatory drugs, opioids, peripheral nerve blocks, wound infiltration with local anaesthetics offered significant improvement in this aspect. Despite these improvements, several studies reported limited success in providing effective postoperative pain control. Time tested thoracic epidural has also aided in pain relief. However, the technique of performing pectoral nerve block [PECS] using ultrasound guidance is increasing in popularity. Kairaluoma^[2] et al (2006) in his study demonstrated the longterm beneficial effects of Paravertebral Block (PVB) on postoperative pain. Similar results were demonstrated by Saito^[3] et al (2001) and Terheggen M et al^[4] (2002).

A study done by Sopena Zubina^[5] et al (2012) compared thoracic paravertebral block vs. thoracic paravertebral block plus pectoral nerve block in reconstructive breast surgeries. Pectoral nerve block showed better results in reconstructive breast surgery, with better postoperative analgesic control in the immediate postoperative period and a lower requirement for sedation. Diab Faud Hetta^[6] et al (2015) also did a similar comparative study and suggested that Pectoralis-serratus

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interfascial plane block was safe and easy to perform and decreased intensity of post-mastectomy pain, but it was inferior to thoracic paravertebral block.

Objectives

- To compare the duration of postoperative analgesic efficacy between PECS and PVB blocks using Visual Analogue Scale (VAS) pain score.
- To evaluate intra-operative and postoperative haemodynamic complications and time for rescue analgesia.

MATERIALS AND METHODS

Study Design

This study was carried out as a double blind, randomised, controlled trial.

Study Area

This study was carried out in the Institute of Anaesthesiology of our Medical College Hospital, Chennai.

Study Population

All the patients with breast cancer who were posted for elective MRM were the study subjects.

Study Duration

This study was between January 2016 and May 2017.

Sample Size and Sampling

Based on intensive literature review, the mean time to rescue analgesic in a study done by SS Wahba^[7] was found to be 137.5 min. (S.D 12.5) in PVB group and 175 min. (S.D. 16.25) in PECS group. This difference between the groups was taken for calculating the sample size. At 95% level of significance and power of 80%, the sample size calculated was 4 in each group. In order to achieve better results, the sample size was calculated as 60, with 30 participants in each group.

Randomisation & Blinding

A double-blind randomisation was done in this study. Before the surgery, patients were randomly allocated to the computer-generated sequence into two equal groups. The sequence was generated as codes to which the study participants were allotted to. The investigator was provided with a sealed envelope consisting of the code specific for the intervention. In this study, both the participants and the investigator were blind to the allocation of the participants into group A and group B. Group A consisted of PVB = 30 patients while the group B consisted of PECS = 30 patients.

Inclusion Criteria

- Age between 30- 60 years.
- American Society of Anaesthesiologist (ASA) physical status I and II.
- Subjects who are posted for elective surgery.

Exclusion Criteria

- History of bleeding disorder or on anticoagulants.
- History of seizures or any neurological deficit.
- Difficult airway and poor lung compliance.
- Severe cardiovascular, respiratory, renal, hepatic diseases.

- Female subjects who are pregnant.
- History of smoking and alcohol consumption.
- Clinically significant abnormal laboratory values at the time of screening.
- Subjects who are participating in a clinical research trial within 30 days of our study.
- Individuals who are cognitively impaired and/or who are unable to give informed consent.
- Subjects who were allergic to the drugs used.

Ethical Approval and Informed Consent

Approval was obtained from the Institutional Ethics Committee prior to the commencement of data collection. Informed consent was obtained from the study subjects prior to the data collection.

Anaesthetic Technique

Group A

PVB was performed with the patient in sitting position at the level of 4th thoracic vertebra under complete aseptic precaution with low resistant technique with saline using an 18-G Tuohy needle seeking contact with the transverse process of the vertebra, then sliding the needle caudally for 1–1.5 cm into the paravertebral space and 15–20 mL of Bupivacaine 0.25% was injected.

Group B

PECS block was performed with the patient in supine position, placing the ipsilateral upper limb in abduction position with a 50-mm needle using a linear Ultrasound (US) probe of high frequency. The U/S probe was first placed at infraclavicular region after skin sterilisation and moved laterally to locate the axillary artery and vein directly above the 1st rib where Pectoralis major and Pectoralis minor muscles were identified at this U/S window. After infiltration of the skin at puncture site with 2 mL of Xylocaine 2%, the needle was inserted in plane with U/S probe to the fascial plane between pectoralis muscles and 10 mL of Bupivacaine 0.25% was injected. Then, the U/S probe was moved toward axilla till Serratus anterior muscle was identified above 2nd, 3rd and 4th ribs and then the needle was re-inserted into the fascial plane between Pectoralis minor muscle and Serratus anterior muscle and 20 mL of Bupivacaine 0.25% was injected in increments of 5 mL after aspiration.

The sensory level was tested with pinprick and icepack before induction of general anaesthesia. All patients received Midazolam 1–2 mg before the induction of anaesthesia and monitored with three leads electrocardiography, pulse oximetry, non-invasive blood pressure and capnography. General anaesthesia was induced with Fentanyl 2 mcg/kg, Thiopentone Sodium 3-5 mg/kg and tracheal tube was facilitated with Atracurium 0.5 mg/kg. Anaesthesia was maintained with Sevoflurane 1% and O₂/N₂O mixture with a fraction of 50% inspired O₂. Fentanyl 20 mcg in bolus doses was given intravenously when the Mean Arterial Pressure (MAP) or heart rate exceeded 20% of the preoperative value. After recovery from anaesthesia, patients were shifted to post-anaesthetic care unit (PACU) for the first 24 hrs.

Data Collection

Vitals were recorded during the pre, intra and postoperative period. Pain intensity was measured using VAS pain score. Nausea lasting more than 10 min. or vomiting was treated with Ondansetron 4 mg. Complications related to local anaesthetic drug and PVB technique like pneumothorax or epidural spread of local anaesthetics evidenced by test for sensory deficit on contralateral side were also recorded. Chest X-ray was requested for the patients in PVB group if they experience any difficulty in breathing, desaturation or diminished air entry at any time after the block.

Operational Definition

Pain scores were computed using the VAS score. Primary outcome was the time to first analgesia in minutes to first registration of VAS pain score >6. Secondary outcome measures were mean VAS scores, intra and postoperative haemodynamic variables and Postoperative Nausea and Vomiting (PONV).

Hypotension was defined as a decrease of more than 20% of the baseline MBP and was treated with increments of 6 mg bolus doses of Ephedrine IV and 250 mL fluid bolus.

Statistical Analysis

Data was entered and analysed using SPSS software version 16. Mean scores were computed for pain scores, heart rate and MAP and the differences between the groups were analysed using two-way repeated measures ANOVA. The difference in scores between the two groups was analysed using Independent sample t test.

RESULTS

This study was carried out as a comparative study between PVB and PECS group among 60 subjects (30 subjects in each group). The mean age of the participants in group A was 46.9 ± 4.8 years while that of Group B was 46.3 ± 5.9 years [Table 1]. The mean weight of the participants in Group A was 56.2 ± 4.8 kg, while the same for group B was 56.6 ± 6.1 kg. The mean time for first analgesia was 180 min. in PVB group, while the same was 240 min. in PECS group.

Sl. No.	Demographic Characteristics	Group A		Group B		p value
		Mean (N=60)	Standard Deviation	Mean	Standard Deviation	
1	Age (in years)	46.9	4.8	46.3	5.9	0.689
2	Weight (in kg)	56.2	4.8	56.6	6.1	0.728

Table 1. Demographic Characteristics of Subjects

The subjects were monitored for adverse effects. The prevalence of PONV is given in figure 1. It was observed that 30% in group A and 16.7% in group B had PONV.

Figure 1. Adverse Effects among the Study Subjects

Mean VAS Score

The mean VAS scores of both the groups are compared using independent samples t test. The mean VAS scores of Group A were significantly lesser than group B. The results were consistent over 4 hours and the difference was statistically significant ($p < 0.05$). [Table 2].

Sl. No.	Category	Group A Mean $\pm$ S.D	Group B Mean $\pm$ S.D	Mean Diff	S.E Mean Diff	95% Confidence Interval		p value
						Lower	Upper	
1	VAS 1 hr.	1.43 ± 0.504	1.00 ± 0.00	0.433	0.092	0.249	0.618	<0.01*
2	VAS 2 hrs.	3.53 ± 0.507	3.07 ± 0.69	0.467	0.157	0.153	0.78	<0.01*
3	VAS 3 hrs.	7.30 ± 0.46	4.8 ± 0.66	2.5	0.148	2.203	2.797	<0.01*
4	VAS 4 hrs.	4.77 ± 0.82	7.27 ± 0.45	-2.5	0.17	-2.841	-2.159	<0.01*

Table 2. Mean VAS Scores of Group A and Group B Subjects

*Indicates statistical significance.

Differences in the Haemodynamic Changes between the Two Groups

In this study, we have taken pre/post operation time points as dependent variable compared with group effects. The baseline differences that might have an effect on the outcome could be typical parameters like blood pressure, MAP and heart rate. Thus, the repeated measures ANOVA analyses the effect of the treatment while excluding the influence of different baseline levels of health when the trial began. In this study, the comparison for pre/post operation effects time

points were observed till two-hour pre-visit and post-visit. Between subjects factors, group effects were observed.

In Repeated measures for Group A and B, we can see clear significant difference in Time and between factors time* group for factors of heart rate, BP systolic, BP diastolic [Table 3, Table 4 and Table 5]. For MAP scores there were no significant difference between the two groups.

Source	Sum of Squares	Degree of Freedom	Mean squares	F	Sig
Time	1048.575	6.097	171.991	25.269	0.0001
Time*Group	199.082	6.097	32.654	4.797	0.0001
Error	2406.843	353.607	6.807		

Table 3. Repeated Measures for Pre/post Heart Rate for Group A and B

Figure-2: Mean Values of Pre/post Heart Rate from Baseline to Two Hours' Time Points.

Source	Sum of Squares	Degree of Freedom	Mean Squares	F	Sig
Time	93332.2	2.403	38844.43	2455.751	0.0001
Time*Group	69288.822	2.403	28838.101	123.124	0.0001
Error	2204.322	139.356	15.818		

Table 4. Repeated Measures for Pre/post BP Systolic for Group A and B

Figure 3. Mean Values of Pre/post BP Systolic from Baseline to Two Hours' Time Points

Source	Sum of Squares	Degree of Freedom	Mean squares	F	Sig
Time	415.056	2.107	1973.900	124.079	0.0001
Time*Group	82.289	2.107	39.064	2.456	0.087
Error	1943.656	122.178	15.908		

Table 5. Repeated Measures for Pre/post BP Diastolic for Group A and B

Figure 4. Mean Values of Pre/post BP Diastolic from Baseline to Two Hours' Time Points

Source	Sum of squares	Degree of Freedom	Mean squares	F	Sig
Time	4293.213	2.395	1792.810	104.11	0.0001
Time*Group	30.402	2.395	12.696	0.737	0.503
Error	2391.749	13.92	17.220		

Table 6. Repeated Measures for Pre/post MAP Scores for Group A and B

Figure-5: Mean Values of Pre/post MAP Scores from Baseline to Two Hours' Time Points.

DISCUSSION

Different modalities of regional techniques like local anaesthetic infiltration, intercostal nerve block, epidural block and paravertebral block have been used for management of postoperative pain after breast surgery. With the introduction of U/S in the use of nerve blocks and understanding of the neural supply of the anterior chest wall and breast, the gate for interfascial PECS block is being used efficiently. Based on anatomical structure, this block was initially performed as PECS I block, then it was modified as PECS II block to suit the extent of surgery. PECS II block favours mastectomy and axillary clearance, since long thoracic and thoracodorsal nerves are involved.

The results obtained in this study are similar to the study done by Sherif Samir Wahba^[7] et al in which they compared the analgesic efficacy of thoracic paravertebral block vs. pectoral nerve block for postoperative pain relief in modified radical mastectomy surgery for carcinoma breast which implies that pectoral nerve block is superior to paravertebral block in providing prolonged postoperative pain relief. Sherif Samir Wahba^[7] et al (2014) selected 60 patients and divided them into two groups. One group received thoracic paravertebral block with 15-20 mL 0.25% Levobupivacaine. The other group received ultrasound-guided pectoral nerve block with 30 mL 0.25% levobupivacaine. All patients were induced with Propofol and maintained with Isoflurane. Patients were monitored for intra and postoperative haemodynamics. Postoperative pain relief assessed by numerical rating score. The total dose of rescue analgesia and duration of analgesia were compared in all the cases. The study concluded that PECS block reduced postoperative morphine consumption in the first 24 hours and pain scores in the first 12 hours in comparison with PVB after mastectomy.

CONCLUSION

The administration of ultrasound-guided pectoral nerve block for patients undergoing modified radical breast

surgeries for carcinoma breast increases the duration of postoperative analgesia without producing any adverse effects compared to thoracic paravertebral block. Thus, ultrasound-guided pectoral nerve block can be used as an alternative technique for safe and prolonged pain relief in patients undergoing modified radical mastectomy for carcinoma breast.

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