Original Research Article

Pectoral block versus Thoracic paravertebral block for analgesia in breast surgeries: A prospective randomized study

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Abstract

Background: Breast surgeries are associated with postoperative pain and hence various regional blocks are tried for analgesia. **Aims:** In this study, we compared the effects of ultrasound-guided pectoral nerve block (PECS) block and thoracic paravertebral (TPVB) block on postoperative opioid consumption, pain scores, and intraoperative fentanyl consumption of patients undergoing unilateral modified radical mastectomy surgery. Setting and Design: This prospective randomized study was conducted in the Department of Anaesthesiology and Critical Care of a tertiary care centre. **Methods:** 50 patients of ASA physical status I and II of age group 18-65 years undergoing elective modified radical mastectomy under general anesthesia were randomly allocated into two groups using computer generated randomized list. In group 1 patients ultrasound guided pectoral block was performed and in group 2 paravertebral blocks were performed. Intraoperative fentanyl consumption and postoperative pain score (VAS score)were compared between two groups. Time to first rescue analgesia and total morphine requirement in 24 hours was also noted. **Statistical Analysis**: Student's independent t-test was employed for comparing continuous variables. Chi-Square test or Fisher's exact test was applied for comparing categorical variables. P-value<0.05 was considered significant. **Results:** Intraoperative analgesic consumption was more in paravertebral group (60%) than pectoral group (32%). Also the VAS scores were more in paravertebral group than pectoral group and were statistically significant (p<0.001) till 4 hours postoperatively and comparable after that till 24 hours. Postoperative morphine consumption was also more in paravertebral group (5.680±0.556 mg versus 4.280±0.678 mg). Efficacy of postoperative analgesia determined by time to first rescue analgesia (170±6.894 min versus 137.24±8.945 min) was more in pectoral block group and hence efficacy was better in pectoral group. **Conclusion:** Ultrasound guided pectoral block reduced postoperative morphine consumption and pain scores more effectively than thoracic paravertebral block. Intraoperative fentanyl consumption was also less in pectoral block group.

Key Word: pectoral block, paravertebral block, ultrasound guided analgesia, mastectomy, breast surgery, analgesia.

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INTRODUCTION

Breast cancer is the second most common cancer(16.1%) in women in Kashmir.[1]Breast surgeries are frequently associated with postoperative pain, nausea and vomiting, which lead not only to increased patient suffering, but also to a prolongation of hospital stay and related costs.[2,3] In addition to general anaesthesia, preoperative medications, neuropathic analgesia and local or regional anesthesia has been explored to reduce postoperative complications and increase perioperative pain control.[4,5]Among these, regional infiltration of anesthetic agents resulted in improved analgesia, decreased perioperative morbidity and shorter hospital stays.[6,7] In

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particular, thoracic paravertebral nerve block (TPVB) is considered a viable option to the classic multimodal analgesia as it offers benefits enhancing surgical anesthesia and postoperative analgesia. This technique has been associated with faster recovery rates after surgery, less postoperative pain and reduced postoperative analgesic requirements compared to general anaesthesia.[8,9]Pectoral nerve block (PECS) is a novel interfacial plane block which can provide analgesia for breast surgery. The PECS I block is single injection of local anesthetics between pectoralis major and pectoralis muscles to anesthetize the lateral (C_5, C_6, C_7) and medial pectoral nerves (C_8,T_1). The PECS II block is a modification of PECS I block in which first PECS I block is given then additionally by placement of local anesthetics between pectoralis minor and serratus anterior which blocks anteriocutaneous branches of intercostal nerves (T_2-T_6), the intercostobrachialis and the long thoracic nerves (C_5-C_7). In this study, we compared the effects of ultrasound-guided pectoral nerve block (PECS) block and thoracic paravertebral (TPVB) block on postoperative opioid consumption, pain score (VAS), and intra operative fentanyl consumption of patients undergoing unilateral modified radical mastectomy surgery as primary outcomes. The secondary outcomes seen were the patient satisfaction score, time to first rescue analgesia and complications if any.

METHODS

50 patients of American society of Anesthesiologists physical status I and II, scheduled for elective modified radical mastectomy in the age group of 18-65 years were included in this study after written informed consent and approval from the departmental review board. This study was done for a period of two years from July 2016 to June 2018. Patients were randomly divided into two groups of 25 each using computer generated randomized list, group 1 (pectoral block) and group 2 (para-vertebral block). Patients with history of sensitivity to local anesthetics, bleeding disorders, on anticoagulants, spine or chest wall deformities, morbid obesity and patients who refused were excluded from study.All patients underwent preoperative evaluation and necessary investigations like hemogram, chest x-ray, electrocardiogram and coagulogram. Pectoral block was given in supine position and para vertebral block in sitting position after proper sterilization of ultrasound and needle entry site. All the blocks were performed in the operating room where all resuscitation equipment was available with Aloka Prosound SSD-3500SX ultra-sound machine using 6-10 MHz probe. Patients were fully monitored by ECG, blood pressure and pulse oximetry.

Group 1: The Pectoral block was performed on the side of surgery after induction of general anaesthesia and securing the airway with Proseal LMA (laryngeal mask airway). With the patient in supine position and arm abducted, the ultrasound probe (6-10 MHz, linear transducer) was placed lateral to mid-clavicular line to locate the axillary artery and vein, and then moved laterally until pectoralis major, pectoralis minor and serratus anterior muscle along with the ribs were identified. After skin infiltration with 2% lidocaine, the needle was advanced in the plane of probe until tip entered between pectoralis major and minor and 0.25% of 10mL ropivacaine injected. After this, the needle was advanced further until it reached the potential space between pectoralis minor and serratus anterior muscles, and 15 mL of 0.25% ropivacaine deposited in this space. Any block related complications, such as hypotension, vascular puncture, and other complications were recorded.

Group 2: Thoracic paravertebral block was administered at T_3 level with the patient in sitting position, under complete aseptic precaution, 30 minutes before surgery. The skin was infiltrated with lidocaine 2% 2.5cm lateral to T_3 spinous process. An 18-G Tuohy needle was introduced 2.5 cm lateral to T3 spine using loss of resistance technique[10], seeking contact with the transverse process of the vertebra, then sliding the needle caudally for 1–1.5 cm into the para vertebral space and 20 mL of 0.25 % ropivacaine was injected. The single injection technique was used keeping in mind the cranio-caudal anatomical continuity of the paravertebral space at the thoracic level which results in blocking the thoracic dermatomes above and below the injection site. Moreover single injection technique had better patient compliance and satisfaction. General anesthesia was induced in both the groups with fentanyl 2mcg.kg^{-1} intravenous (i.v) followed by propofol 1.5-2.5 mg.kg^{-1}. Proseal LMA size 3 and 4 was used as per the weight of the patient. Anesthesia was maintained with nitrous oxide, oxygen and isoflurane (MAC 1.2-1.3). The patient was ventilated with positive pressure ventilation to maintain end-tidal carbon dioxide between 35 to 40 mmHg. The patients were monitored for ECG, non-invasive blood pressure, SpO_2 and received a continuous infusion of Ringer lactate at a rate of 5-10 mL.kg^{-1}.h^{-1} during surgery. Fentanyl 25 μg in bolus doses was given intravenously if the mean blood pressure (MBP) or heart rate exceeded 20%of the preoperative value and intra operative fentanyl consumption by each patient was documented. Hypotension(Systolic BP <90 mmHg)was treated with boluses of normal saline, if required ephedrine 3-6 mg i.v was used. All patients received anti-emetic prophylaxis with ondansetron 0.1mg.kg^{-1} before completion of surgery. LMA was removed once spontaneous and adequate breathing was restored and patient was shifted to post anesthesia care unit (PACU). The patients were monitored for 24 hours after surgery for primary outcomes as pain score and analgesic consumption which was measured by amount of morphine consumed (in mg) by the patient during the first 24 hours. Pain was measured on visual analog scale[11,12](VAS)and VAS score was documented at different intervals of time (0h, 1 h, 2h, 3 h, 4 h, 8h, 12 h, 16 h, 20 h, 24 h) after the completion of surgery. The secondary measures included time to first rescue analgesia, postoperative complications and patient satisfaction score. Adverse effects like hypotension, respiratory depression and post-operative nausea and/or vomiting were also documented. Overall patient satisfaction was determined by satisfaction score on a scale of 0-10. In case of hypotension (mean arterial pressure less than 20% of pre-anesthetic value), 500ml of normal saline was given in 10 minutes. If hypotension persisted, ephedrine boluses of 6 mg were administered.

Statistical Analysis: The recorded data was compiled and entered in a spreadsheet (Microsoft excel) and then exported to data editor of SPSS version 20.0(SPSSInc.,Chicago, Illinios, USA). All the continuous variables were represented by descriptive statistics and the categorical variables were represented in terms of frequency and percentage. Graphically the data was presented by bar diagrams. Student's independent t-test was employed for comparing continuous variables. Chi-Square test or Fisher's exact test, whichever appropriate, was applied for comparing categorical variables. All the results were discussed at 5% level of significance i.e. p<0.05 was considered significant.

RESULTS

The demographic characteristics like age, weight and height and ASA distribution between two groups were comparable and statistically insignificant (Table 1). The mean duration of surgery in group 1 was 66.32±4.981 min and in group 2 was 64.96±5.287 min with a p-value of 0.535 and hence statistically insignificant (table 2). Intraoperatively need of additional analgesia in the form of fentanyl boluses were given when hemodynamic variables increased >20% from baseline. The number of patients who received additional boluses of fentanyl were 8 (32%) in group 1 and 15 (60%) in group 2 with a p <0.001 and the difference between two groups was statistically significant. Group 2 patients required more additional intraoperative analgesia than group 1 patients (table 2, fig 1). Comparing the postoperative VAS scores at 0, 1, 2, 3, 4, 8, 12, 16, 20 and 24 hours between two groups the pain scores were statistically significant at all intervals till 4 hours and insignificant after that at all study intervals (table 3).The mean VAS scores at 0, 1, 2, 3 and 4 hours in group 1 are 1.72±0.4583,2.28±0.4583, 2.40±0.5000, 4.16±0.3742 and 5.44±0.5066 and group 2 are 3.00±0.5000, 3.04±0.4560, 3.44±0.5066, 5.12±0.4397 and 5.84±0.3742 with p-values of <0.001, <0.001, <0.001, <0.001 and 0.0026 respectively. The comparison between the two groups shows that group 2 had statistically significant increased pain scores than group 1. At all intervals beyond four hours till end of study the comparison was statistically insignificant (table 3, fig 2). Analgesic efficacy was also measured in terms of time to first rescue analgesia, which was significantly longer in Group 1 patients as compared to Group 2 patients. The mean time for first rescue analgesia in group 1 was 170±6.894 and 137.24±8.945 min with p-value <0.001 (table 2).Mean amount of Morphine consumption during the 24-hour postoperative period was 4.28 ± 0.6782 mg in Group 1 as compared to 5.680 ± 0.5568 in group 2 patients (table 2, fig3). Thus patients receiving pectoral block required significantly lesser (p=<0.001) analgesia in postoperative period. At the end of 24 hours, patient satisfaction score was measured on a scale of 1 to 10. In group 1 it was 8.04 ± 0.4546 as compared to7.92 ± 0.4933 in Group 2 patients, which was not statistically significant (table 2). Patient satisfaction score was comparable in two groups. None of the patients in both groups had local anesthetic toxicity, vascular puncture, hemothorax, pneumothorax, lung injury or urinary retention. One patient (4%) in group 1 and three patients (12%) in group 2 had intra operative hypotension with p-value of 0.609 and comparison was statistically insignificant. Similarly one patient (4%) in group 1 and 2 patients (8%) in group 2 had postoperative nausea and vomiting with p-value of 1.000 and was comparable between two groups (table 4).

Table 1: Comparison of patient characteristics in two groups

Patient characteristics	Group 1 (n=25)	Group 2 (n=25)	P-value
Age(years)	46.48 ± 4.797	46.44 ± 5.393	0.978
Body weight(Kg)	57 ± 3.708	57.44 ± 3.906	00.684
Height (cm)	172.80 ± 8.87	171.30 ± 9.04	0.404
ASA-PS(I/II)	21/4	20/5	0.75

Value expressed as mean ± SD, ASA-PS: American society of anesthesiologist's physical status, SD: standard deviation

Table 2: Comparison of various study parameters between two groups

	Group 1 (n=25)	Group 2 (n=25)	P-value
Duration of surgery (min)	66.32±4.981	64.96±5.287	0.353
Number of patients who require fentanyl boluses intraoperatively (%)	8 (32%)	15 (60%)	0.047*
Time of first rescue analgesia (min)	170±6.894	137.24±8.945	<0.001*
Postoperative Morphine consumption (mg/24 h)	4.280±0.678	5.680±0.556	<0.001*
Patient Satisfaction Score (0-10)	8.04±0.454	7.92±0.493	0.3756

Value expressed as mean ± SD, *- statistically significant, SD: standard deviation

Table 3: Comparison of pain scores (Mean VAS score) at different intervals of time after surgery

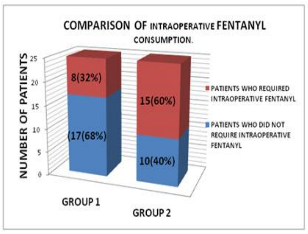
Time since surgery	GROUP 1 (Mean VAS score ± SD)	GROUP 2 (Mean VAS score ± SD)	P Value
0 h	1.72± 0.4583	3.00± 0.5000	<0.001 *
1h	2.28± 0.4583	3.04± 0.4560	<0.001*
2 h	2.40± 0.5000	3.44± 0.5066	<0.001*
3h	4.16± 0.3742	5.12± 0.4397	<0.001*
4h	5.44± 0.5066	5.84± 0.3742	0.0026*
8 h	3.88± 0.7810	4.04± 0.7348	0.4593
12 h	3.72 ± 0.4583	3.68± 0.4761	0.7635
16 h	3.44 ± 0.5066	3.56 ± 0.5066	0.4065
20 h	2.88± 0.6000	2.84 ± 0.5538	0.8078
24 h	1.88±0.4397	2.00 ± 0.4082	0.3220

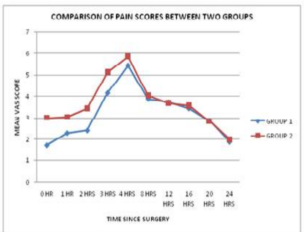
h- hours, SD-standard deviation, *-statistically significant, VAS- Visual analogue Scale

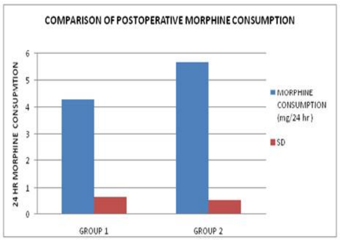
Table 4: Comparison of Complications between two groups

Complication	Group 1 (n=25)	Group 2 (n=25)	p-value
Local Anesthetic toxicity	**0**	**0**	**---**
Vascular puncture	**0**	**0**	**---**
Hemothorax/Pneumothorax	**0**	**0**	**---**
Lung Injury	**0**	**0**	**---**
Intraoperative hypotension	**1 (4%)**	**3 (12%)**	**0.609**
Urinary retention	**0**	**0**	**---**
PONV	**1 (4%)**	**2 (8%)**	**1.000**


Figure 1: Equipment used for thoracic paravertebral block, **Figure 2:** Equipment used for pectoral block







Graph 1: Comparison of intraoperative fentanyl consumption between two groups; **Graph 2:** Comparison of VAS Score between two groups postoperatively; **Graph 3:** Comparison of postoperative morphine consumption between two groups

DISCUSSION

Modified radical mastectomy, usually performed for the treatment of breast cancer is associated with considerable acute postoperative pain and restricted shoulder mobility. Different modalities of pain management like oral and intravenous analgesics, transdermal patches, patient control analgesia and 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. We did a prospective randomized study where we compared thoracic paravertebral block and pectoral block in terms of analgesic efficacy, complication rate and patient satisfaction. Our study included 50 patients undergoing modified radical mastectomy (MRM), out of which 25 patients in Group 1 received pectoral block and 25 patients in Group 2 received paravertebral block. The demographic characteristics like age, weight and height was comparable between two groups and statistically insignificant. S.S Wahba*et al*[13]and Ashok Kumar *et al*[14]also reported similar pattern of demographic characteristics between pectoral and paravertebral groups. In terms of ASA grading, the difference between the two groups was also in significant.S. Kulhari*et al*[15] reported in their study of 40 patients a ratio of ASA I/ASA II = 9: 11 in the pectoral group (20 patients) versus ASA I/ASA II =14:6 in the paravertebral group and this difference was also statistically insignificant. The duration of surgery was comparable between the two groups. S Kulhari *et al*[15] reported almost similar operating time in their study where duration of surgery in the pectoral group was 66 minutes as compared to 58 minutes in the paravertebral group and this difference in duration of surgery was not statistically significant. In a study done by S.S Wahba*et al*[13] operating time was considerably longer; 108.4 minutes in the pectoral group versus 109.6 minutes in the paravertebral group but again the difference was not statistically significant. Number of patients requiring intra operative fentanyl bolus was significantly less in Group 1 (8/25) as compared to Group 2 (15/25) and this difference was statistically significant (p= 0.047). This showed that intra operative analgesia was better in pectoral group than the paravertebral block group. S.S Wahba *et al*[13] in their study, reported intra operative fentanyl consumption of 105 micrograms in the pectoral group versus 127.5 micrograms in the paravertebral group which was considerably higher than being consumed by patients in our study because we had a shorter duration of surgery in both the groups. Statistically this study also showed significantly less intra operative fentanyl consumption in the pectoral group. Analgesic efficacy was also measured in terms of time to first rescue analgesia, which was significantly longer in Group 1 patientsas compared to Group 2 patients. S.S Wahba *et al*[13] reported similar results in their study where time to first rescue analgesia was 175 minutes in the pectoral group versus 137.5 minutes in the paravertebral group and the difference was statistically significant. S. Kulhari *et al*[15] also reported significantly prolonged time to first rescue analgesia in the pectoral group (294.5mins) as compared to the paravertebral group (197.5mins) Postoperative pain scores were measured on visual analog scale (VAS) at different intervals of time after surgery and pain scores between the two groups were compared with each other. This difference in the pain scores was significantly low in Group 1 patients as compared to Group 2 patients in immediate postoperative period. Difference in pain scores after 4 hours of surgery showed no statistical significance. In a study done by S. Kulhari*et al*[15] pain score in the immediate post operative period was significantly low in the pectoral group as compared to the paravertebral group. After 4 hours of surgery pain scores were similar between the two groups as shown in our study also. Wahba and Kamal*et al*[13] also reported lower pain scoresat rest at 1, 6, and 12 h and on movement at 1 h in the Pectoral group compared with the paravertebral group (P<0.001). In another study, Sopena-Zubiriaand colleagues[16]showed that pain scores were significantly lower after breast surgery when a pectoralnerve block was combined with TPVB. However Ashok Kumar *et al*[14] in their study of 60 patients found significantly lesser pain in the paravertebral group as compared to the pectoral group. Mean amount of Morphine consumption during the 24-hour postoperative period was less in group 1 patients than group 2 patients.. S Kulhari*et al*[15] also reported significantly lesser amount of morphine consumed by patients in the pectoral group. In their study mean amount of morphine consumed by the patients in pectoral group was 3.90 ± 0.79 mg as compared to 5.30 ± 0.98 mg in the paravertebral group. Incidenceof complications was similar between the two groups. There were no local complications like local anaesthetic toxicity, pneumothorax or hemothorax and vascular puncture in either of the groups. Three patients in the Group 2 and one patient in Group 1 developed intraoperative hypotension, which was managed with administration of fluids and ephedrine. One patient in Group 1 and two patients in Group 2 had postoperative nausea and vomiting grade 2 and received ondansetron. There was no statistically significant difference between the two groups in terms of complications. SomiaM, *et al*[17] also reported similar rate of complication in the two groups with no evidence of pneumothorax, pruiritis, urinary retention and incidence of post operative nausea and vomiting was about 10% in pectoral group and 19% in paravertebral group. S Kulhari *et al*[15] also reported no evidence of any local complications, while as one patient in the Paravertebral group developed intra operative hypotension, and one patient in each group had post-operative nausea and vomiting grade 2. At the end of 24 hours, patient satisfaction score was better in group 1 patients than group 2 patients. Wahba*et al*[13] also reported similar rate of patient satisfaction between the two groups.

LIMITATIONS

Blinding was not done which may have lead to observer bias. The dosage of fentanyl used intraoperatively for each patient receiving fentanyl was not calculated, only the number of such patients was noted which would have given more accurate idea of intraoperative opioid consumption. Another lacuna is that we used single injection technique for paravertebral block which might have lead to its decreased efficacy.

CONCLUSION

Pectoral block is easy and reliable superficial block that targets the lateral and median pectoral nerves at an interfascial plane between the pectoralis major and minor muscles. Its advantages over the Thoracic paravertebral block are:

- Safer technique.
- Reduced intra operative and postoperative pain.
- Reduced intra operative and postoperative opioid consumption.

Thus, ultrasound-guided pectoral nerve block can be used for postoperative pain relief in patients undergoing modified radical mastectomy for carcinoma breast. It reduces the requirement of intravenous analgesia postoperatively. However, further studies are required to assess the efficacy of Pectoral block for preventing chronic postsurgical pain after radical mastectomy and evaluate its efficacy as a sole anesthetic technique.

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