Original Article

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Comparison of Paravertebral Block and Interpleural Block in Patients Undergoing Breast Surgery Under General Anaesthesia

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Abstract

Background and Aims: Paravertebral and interpleural blocks are indicated for providing intraoperative and postoperative analgesia in unilateral surgeries of the chest and abdomen. The aim of this study was to evaluate the intraoperative analgesic requirement, efficacy and duration of postoperative analgesia, complications, if any and the time to discharge of patients receiving paravertebral block or interpleural block as an adjuvant to general anaesthesia in patients undergoing breast surgery. *Methods*: Sixty patients scheduled for breast surgery were randomly allocated into three groups after induction of general anaesthesia: Control group (Group C), paravertebral block group (Group PVB) and interpleural block group (Group IPB). The block was given with 20 ml of 0.5% bupivacaine and 2 µg/kg of clonidine. *Results*: Sixty five percent patients required intraoperative fentanyl supplements in group C while only 15% patients in group PVB and 35% patients in group IPB required intraoperative fentanyl supplements [P(C/PVB/IPB) <0.01, P(PVB/IPB) = 0.14]. Patients of PVB group had the longest time to first rescue analgesic requirement (13.8 hrs) followed by IPB group (9.6 hrs) and Control group (6.5 hrs). The mean VAS score at rest as well as on movement was significantly lower in PVB group and IPB group compared to Control group. None of the other complications were noted. *Conclusion*: The use of paravertebral block or interpleural block with bupivacaine and clonidine is a safe and effective technique to enhances the intraoperative and postoperative analgesia, in patients undergoing breast surgery, although the duration of analgesia provided by paravertebral block is more than interpleural block.

Keywords: Paravertebral Block; Interpleural Block; Bupivacaine; Clonidine; Breast Surgery.

Introduction

General anaesthesia has been a standard anaesthetic technique for breast surgery. However, general anaesthesia may be associated with unsatisfactory postoperative analgesia, nausea and vomiting which often results in extended recovery room stay, prolonged hospital admission for treatment and increases the health care costs [1]. Acute postoperative pain is also an important risk factor for the development of persistent chronic postoperative pain in women after breast surgery [2]. Various regional anaesthesia techniques described for breast surgery to decrease postoperative pain and opioid consumption with reduction in postoperative nausea and vomiting include paravertebral block, interpleural block, thoracic epidural block, intercostal nerve block and pectoral nerve block [3].

Thoracic paravertebral block results in ipsilateral somatic and sympathetic nerve blockade in multiple contiguous thoracic dermatomes above and below the site of injection [4[. Interpleural block produce ipsilateral somatic block of multiple thoracic dermatomes [5-6]. In this study an effort has been made to compare single injection paravertebral block or interpleural block with 20 ml of 0.5% bupivacaine

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and 2 μg/kg body weight of clonidine administered in conjunction with general anaesthesia with general anaesthesia alone in patients undergoing breast surgery.

Methods

The study was conducted in 60 American Society of Anaesthesiologists physical status I-II patients in the age group of 20-80 years scheduled for breast surgery after approval from the Hospital Ethical Committee and obtaining written informed consent from the patients. Primary aim of the study was to evaluate the intraoperative analgesic requirement, efficacy and duration of postoperative analgesia in patients receiving paravertebral block or interpleural block as an adjuvant to general anaesthesia in patients undergoing breast surgery. Secondary aim was to evaluate the time to discharge of same patients and note any complications, if they occur due to blocks. Patients with coagulation disorders, allergy to local anaesthetics, local infection at the site of planned injection, severe spine or chest wall deformity, pregnant/breast feeding females, body mass index >35 Kg/m^2 and psychiatric disease were excluded from the study. All patients underwent a detailed preanaesthetic check up with all relevant investigations. Linear Visual Analogue Scale (VAS) for determining the intensity of pain, using a 10 cm line with 0 at one end representing 'no pain' and 10 at the other representing 'worst pain imaginable' was explained to all the patients. Patients received tablet alprazolam 0.25 mg at 10 p.m. the night prior to surgery and 2 hours before surgery with 1-2 sips of water as premedication.

In the operating room, baseline heart rate, arterial pressure and oxygen saturation were recorded using standard non-invasive monitors. All patients received general anaesthesia by a standard technique. Anaesthesia was induced with midazolam 0.01mg/kg IV, fentanyl 2 μg/kg IV and propofol 2-3 mg/kg IV following which airway was secured by a proseal laryngeal mask airway of appropriate size. The patients were then randomly allocated to one of the three groups (20 patients each) using sealed envelopes technique: Patients of Control group (Group C) did not receive any block (either paravertebral or interpleural). Patients of paravertebral block group (Group PVB) received paravertebral block at T3-T4 intervertebral space and patients of interpleural block group (Group IPB) received interpleural block at 3^{rd}/4^{th} intercostal space in the mid axillary line. The blocks were given by anaesthesiologist with more than 3 years of experience in anaesthesia.

Surgery was allowed to start immediately after administration of the blocks and the patients were allowed to breathe spontaneously and maintained using 1 minimum alveolar concentration (MAC) of sevoflurane and 66% of nitrous oxide in oxygen. Intraoperatively fentanyl 10-20 μg IV increments were given by the anaesthesiologist whenever there was an increase in heart rate or mean arterial pressure of over 20% compared to baseline values or respiratory rate increased to more than 30 or patients showed signs of light anaesthesia like movement of any part of the body and vocalization. All patients received diclofenac 1.5 mg/kg IM and ondansetron 4 mg IV approximately 30 minutes before the end of surgery. Intraoperative fentanyl requirement in each group was recorded.

Technique of Paravertebral Block

The patients were placed in lateral position with the side to be blocked upward and paravertebral block was performed at T3-T4 intervertebral space. After identifying the thoracic spines T3-T4, the site of injection was marked 2.5 cm lateral to the midline on the corresponding side of the intervertebral line. Site to be blocked was cleaned and draped following all aseptic precautions. A 21-G insulated needle (10 cm) already attached to plexygon nerve stimulator (initial stimulating current 2.5-5mA, frequency 2 Hz, duration of stimulus 300μs, voltage 9V) was introduced perpendicular to the skin. A contraction of paraspinal muscles was initially observed. Then after piercing costotransverse ligament, an appropriate muscular response from the intercostal muscles of the corresponding level was sought and needle tip was manipulated into a position to allow the same muscular response while reducing the stimulating current to 0.4-0.6 mA. At this point 20 ml of 0.5% bupivacaine and 2 μg/kg of clonidine was injected, after negative aspiration of air, blood and cerebrospinal fluid. After performing the block patients were turned to supine position.

Technique of Interpleural Block

Patients were placed in supine position and interpleural block was performed at 3^{rd}/4^{th} intercostal space in the mid axillary line. Site to be blocked was cleaned and draped following all aseptic precautions. A 500 ml bag of saline with an infusion set was positioned approximately 60 cm above the patient level and infusion set was attached to the sideport of a standard three-way connector ensuring

sterility and primed with saline. The other port was kept closed. 18 G tuohy needle was inserted through the skin and connective tissue until the rib was touched. The stylet was then removed and a three-way connector was attached to the hub of the tuohy needle. The roller tap of the infusion set was then fully opened. At this point, a few drops were usually seen in the drip chamber of the giving set, but free flow did not occur. All further movements of the needle were carried out in the expiratory phase of patient's respiration. The anaesthesiologist then walked off the upper border of the rib, remembering to avoid angling the needle and accidentally entering the neurovascular bundle in the intercostal groove of the rib above. Further advance through the intercostal space was accompanied by a brisk flow of saline. With the guiding hand still gripping the needle and firmly rested on the patient's torso, the sideport of the three-way connector attached to the saline was closed and 20 ml of 0.5% bupivacaine and 2μg/kg of clonidine was injected through the other port, after negative aspiration of air and blood. After performing the interpleural block, the patients were positioned at 20° head-down tilt for 30 minutes.

At the end of surgery, N_2O and sevoflurane were discontinued and proseal laryngeal mask airway was removed when the patient was fully conscious and following commands. Earliest point of time at which the patient was able to communicate back was taken as '0 hour'. Postoperatively, patients were shifted to the post anaesthesia care unit for observation and monitoring for 2 hours and thereafter shifted to ward. SpO_2 (oxygen saturation) was monitored for 2 hours. Chest X-Ray PA view of any patient having significant fall in oxygen saturation or patient complaining of respiratory distress was done to rule out pulmonary complications.

Postoperatively, time elapsed between the induction of anaesthesia and administration of first rescue analgesic was recorded and was taken as duration of analgesia. Pain intensity using Visual Analogue Scale was recorded at 0 hour, ½ hour, 1 hour, 2 hours, 6 hours, 18 hours and 24 hours at rest and during a standardized movement (folding hands and moving both arms to an angle of 90° to the body). Rescue analgesic was given in the form of diclofenac 1.5 mg/kg IM when VAS score at rest was between 4-7 and tramadol 50 mg IV when VAS score at rest was >7. Total doses of rescue analgesic administered in first 24 hours and the time of each dose was recorded.

Degree of sedation was assessed using observer's assessment of alertness and sedation score [7], where 5 = patient responds readily to name spoken in normal voice; 4 = patient asleep but rousable to normal tone voice; 3 = patient asleep but rousable to loud or repeated verbal stimulation; 2 = patient asleep but rousable by mild prodding or shaking; 1 = comatose patient and post anaesthesia discharge score was also assessed using modified post anaesthesia discharge score (PADS) system [8] at 0 hour, ½ hour, 1 hour, 2 hours, 6 hours, 18 hours and 24 hours after surgery. The number of patients experiencing postoperative nausea and vomiting was also recorded and complications, if any like pneumothorax, systemic local anesthetic toxicity, epidural injection, Horner's syndrome were noted.

Statistical Analysis

As no previous similar study was available, post hoc power analysis was done. Considering the minimum difference of mean time of first rescue analgesic among the three groups as 3.11±1.10 hrs (Group C = 6.48±2.48 hrs, Group PVB = 13.80±4.60 hrs, Group IPB = 9.59±3.58 hrs) and by taking 20 as the number of patients in each group with $\alpha = 0.05$, the power of the study comes out to be 82%. The statistical data was analyzed using SPSS statistical software version 19.0. Chi square test/Fisher exact test was used for categorical data. For quantitative parameters, Analysis of variance (ANOVA) test/ Kruskalwallis test was used for comparison across the three groups and Sample T test/Mann whitney test was applied for comparison in between the two groups. $P \leq 0.05$ was considered as statistically significant.

Results

All the sixty enrolled patients completed the study protocol. The patient characteristics and the type of surgery performed were similar in the three groups (Table 1). The haemodynamic parameters were comparable and stable throughout the intraoperative period in the three groups.

Sixty five percent patients required intraoperative fentanyl supplements in group C while only 15% patients in group PVB and 35% patients in group IPB required intraoperative fentanyl supplements. This difference was found to be statistically significant across the three groups, but was not statistically significant between group PVB and IPB [Table 2]. It was found that the patients of PVB group had the longest time to first rescue analgesic requirement (13.8 hrs) followed by IPB group (9.59 hrs) and patients of Control group had the lowest time to first rescue

analgesic requirement (6.48 hrs).

All the twenty patients required diclofenac for pain relief in first 24 hrs in group C, while seven patients in group PVB and six patients in group IPB did not require any rescue analgesic in first 24 hours. This difference was statistically significant across the three groups ($P = 0.01$) but was not statistically significant between group PVB and group IPB (P=0.73) [Table 2]. Patients of PVB group had lowest requirement of diclofenac in first 24 hrs as they had the longest time to first rescue analgesic requirement followed by IPB group . Patients of Control group had the highest requirement as they had the quickest time to first rescue analgesic requirement.The mean VAS score at rest as well as on movement was significantly lower in PVB group and IPB group compared to Control group ($P = 0.00$) with VAS score in PVB group being the lowest at all points of observation.The mean VAS score at rest as well as on movement of group PVB and group IPB was clinically comparable at all points of time (Figure 1, 2).

The mean sedation score was more than 2 and comparable in all the three study groups at all points of time in the postoperative period. The post anaesthesia discharge score was less than 9 in all the patients in all the three study groups at 0 hr, ½hr, 1 hr, 2 hrs and none of the patient was dischargeable. The difference in PADS score was not statistically significant across the three groups at 6 hrs ($P = 0.11$), 18 hrs ($P = 0.07$) and 24 hrs ($P = 0.05$). However, at 24 hrs, 16 (80%) patients in group C, all 20 (100%) patients in group PVB and 19 (95%) patients in group IPB had a PADS score of more than or equal to 9 and were dischargeable.

The incidence of nausea and vomiting was similar in the three groups [5/20 (25%) patients in group C and group PVB and 4/20 (20%) patients in group IPB]. None of the patients in any of block groups hadany other complications like pneumothorax, local anesthetic toxicity, epidural injection and Horner's syndrome.

Table 1: Patient characteristics and the type of surgery

Variables	Group C	Group PVB	Group IPB	*P* value
Age (years)	40.05±12.51	42.25±13.95	43.55±13.37	0.70
Gender (F/M)	17/3	18/2	16/4	0.67
ASA grade (I/II)	17/3	17/3	17/3	1.00
Duration of surgery (min)	110.28±50.34	103.65±46.57	99.75±52.51	0.39
Modified radical mastectomy	12 (60%)	14(70%)	13 (65%)	0.80
Minor breast Surgery (simple mastectomy, fibroadenoma excision, gynaecomastia excision)	8 (40%)	6 (30%)	7 (35%)	0.80

Group C: Control group, Group PVB: Paravertebral block group, Group IPB: Interpleural block group; Data expressed as mean ± SD or number (percentage).

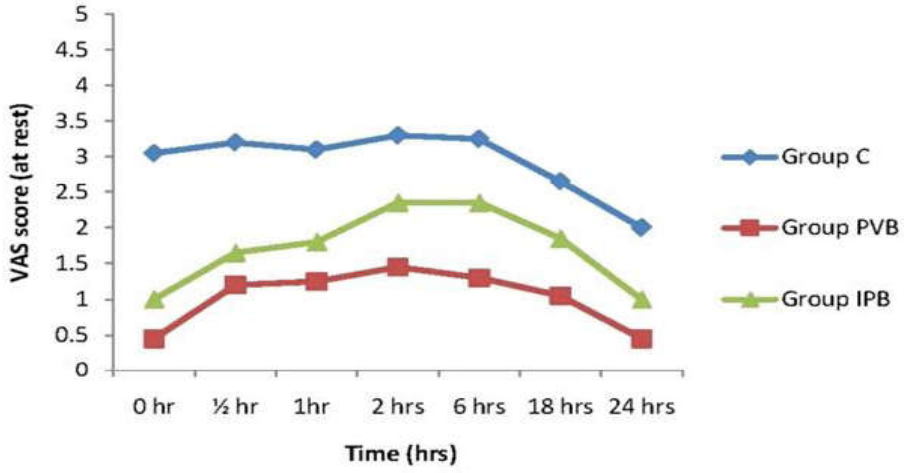

Fig. 1: Mean VAS Score at rest

Group C: Control group, Group PVB: Paravertebral block group, Group IPB: Interpleural block group

Table 2: Intraoperative and postoperative analgesia

	Group C	Group PVB	Group IPB	*P* Value			
				C/PVB/IPB	C/PVB	C/IPB	PVB/IPB
Number of patients requiring intra operative fentanyl	13/20 (65%)	3/20 (15%)	7/20 (35%)	0.00	0.00	0.05	0.14
Intraoperative fentanyl requirement(µg)	51.54±15.19	30.00±10.00	34.29±11.33	0.01	0.03	0.01	0.58
Time of 1st rescue analgesic (hrs)	6.48±2.48	13.80±4.60	9.59±3.58	0.00	0.00	0.00	0.01
Number of patients requiring diclofenac in 1st 24 hrs	20/20 (100%)	13/20 (65%)	14/20 (70%)	0.01	0.00	0.00	0.73
Diclofenac requirement in 1st 24 hrs(mg)	165.0±46.16	80.77±20.80	112.5±38.91	0.00	0.00	0.00	0.01
Number of patients requiring tramadol in 1st 24 hrs	5/20 (25%)	1/20 (5%)	1/20 (5%)	0.07	0.07	0.07	1.00

Group C: Control group, Group PVB: Paravertebral block group, Group IPB: Interpleural block group; Data expressed as mean ± SD or number (percentage)

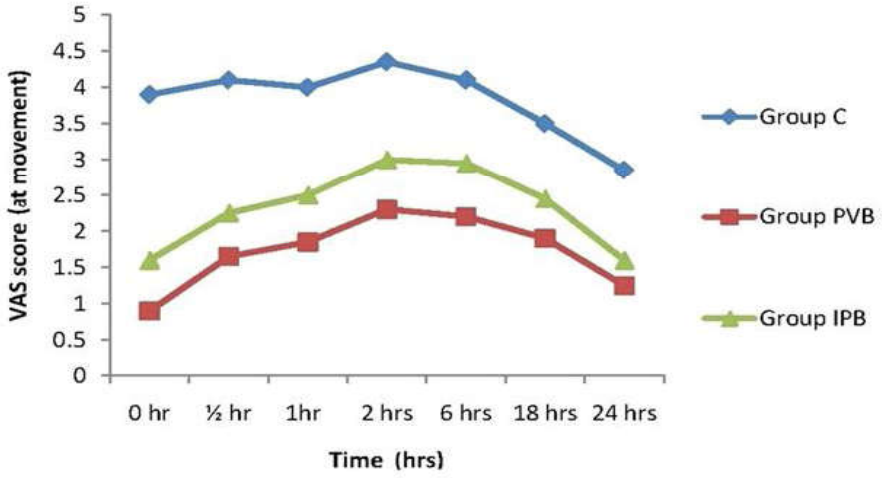

Fig. 2: Mean VAS Score at movement

Group C: Control group, Group PVB: Paravertebral block group, Group IPB: Interpleural block group

Discussion

A recently published study comparing paravertebral and interpleural block found that the lung functions are well preserved in patients undergoing modified radical mastectomy under general anaesthesia supplemented with PVB or IPB and IPB is as effective as PVB for postoperative pain relief [9]. To the best of our knowledge, no other study is available in literature comparing interpleural block and paravertebral block for breast surgery for intraoperative and postoperative analgesia under general anaesthesia. So, our results have been compared with isolated studies for both the blocks.

There was increased requirement of intraoperative fentanyl supplements and in 65% patients in the Control group (51.54 µg) compared to 15% patients in PVB group (30.00 µg) and in 35% patients in IPB group (34.29 µg) [Table 2] implying that blocks significantly reduce the anesthetic requirement intraoperatively. Moller JF et al.[10] in their study of multilevel paravertebral block performed before general anaesthesia in breast surgery found significantly less median consumption of intraoperative fentanyl in patients who received paravertebral block with ropivacaine compared to patients who received paravertebral block with saline (P<0.01). Another study in patients who received interpleural block with bupivacaine before induction of general anaesthesia for breast surgery found significantly reduced perioperative opiate requirement compared to patients who received general anaesthesia without block [11]. Dabbagh A et al. [12] in their study on patients scheduled for breast surgery found lower pain scores in paravertebral group compared to general anaesthesia group.This is similar to finding of our study. Our findings also corroborate with the findings of various previous studies [1,2,10,13,14,15] who reported lower

pain scores in patients receiving paravertebral block for breast surgery.

The median time for first analgesic demand was 9 hrs in a study in patients undergoing breast cancer surgery using single injection paravertebral block [16]. The longer duration of analgesia in both the block groups found in our study (13.80±4.60 hrs in group PVB and 9.59±3.58 hrs in group IPB) may be attributed to the use of adjuvant clonidine with bupivacaine for administration of blocks. The longer duration of analgesia in group PVB compared to group IPB in our study may be attributed to relative avascularity of the paravertebral space in PVB group [17] and rapid absorbtion of the drug through the large surface area of the pleura in IPB group.

The comparable mean sedation score of more than 2 in all the three study groups at all points of time in postoperative period showed that though clonidine has the potential to cause sedation, it did not cause any significant sedation in the dose used in our study. Bhatnagar S et al.[18] in their study in patients scheduled to undergo thoracotomy found significantly higher sedation scores in patients who received bupivacaine with clonidine compared to patients who received only bupivacaine in continuous paravertebral block. Higher sedation scores in their study may be attributed to higher dose of clonidine used (2 μg/kg bolus followed by infusion at 2 μg/kg/hr) by them compared to our study.

Coveney E et al. [19] in their analysis of patients undergoing breast cancer operations found that use of PVB resulted in a significantly shorter hospital stay and 96% of patients in PVB group could be discharged on the same day as compared to 76% of the patients in GA group. In contrast, our study didnot find significant difference in discharge score in the three groups which may be explained by the use of general anaesthesia in all the three groups.

Earlier investigators [1,13,19] in their studies on breast surgery patients have found that the number of patients experiencing postoperative nausea and vomiting was lower in paravertebral block with intraoperative sedation group as compared to general anaesthesia group. Similar incidence of nausea and vomiting in the three groups in our study may again be explained by the use of general anaesthesia in all the patients and the administration of antiemetic ondanseteron 4 mg in all the patients 30 minutes before the end of surgery. None of the other complications attributed to interpleural block or paravertebral block like pneumothorax, local anesthetic toxicity, epidural injection or Horner's syndrome were found in our study.

Conclusion

The use of either paravertebral block or interpleural block with bupivacaine and clonidine is a safe and effective technique for providing intraoperative and postoperative pain relief in patients undergoing breast surgery, although the duration of analgesia provided by paravertebral block is more than interpleural block. Both blocks enhances the intraoperative and postoperative analgesia, provides better mobility with minimal block related complications in patients undergoing breast surgery, when compared to general anaesthesia alone. However, there was no difference in time to discharge of patients receiving the blocks.

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