

ORIGINAL ARTICLE

Effectiveness of Ultrasonography Guided Pectoral Nerve Block and Paravertebral Block For Post-Operative Analgesia in Modified Radical Mastectomy

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Abstract

Background: Incomplete alleviation of postoperative pain in modified radical mastectomy surgery causes significant morbidity and patient dissatisfaction. General anaesthesia with postoperative NSAIDs and opioids commonly used technique for postoperative analgesia after breast surgeries. Along with regional anaesthesia various peripheral nerve blocks are performed to manage this problem. Paravertebral block and pectoral nerve block are exercised widely to reduce postoperative pain after modified radical mastectomy.

Objective: The aim of this study is to assess the effectiveness of ultrasonography guided paravertebral block and pectoral nerve block for postoperative analgesia for modified radical mastectomy.

Methods: This randomized control trial was conducted at Dhaka Medical College & Hospital, Dhaka from July 2020 to June 2021. Total 60 patients, scheduled for modified radical mastectomy and randomly divided into two groups having 30 patients in each (Group-A=paravertebral block and Group-B=pectoral nerve block). Among them, 5 patients were excluded from the study due to block failure (three in group A and two in group B). So, finally, data were calculated for the 55 patients (27 patients in group A and 28 in group B). Heart rate, systolic blood pressure, mean arterial pressure, the time of first analgesic demand and the total amount of analgesic consumption in the first 24 hours by VAS were recorded and compared between two groups during postoperative period. Statistical analysis was done by SPSS version 25. Chi-square test was done for qualitative variables and Student's t-test was done for quantitative variables. $P < 0.05$ was considered statistically significant.

Results: The demographic profile were well matched between two groups ($P > 0.05$). The mean VAS score was significantly lower in pectoral nerve block as compared to the paravertebral block at all-time intervals except at 12 hours and 20 hours ($P < 0.05$). Patients with pectoral nerve block had significantly late 1st analgesic demand (12.2 ± 2.1 hours' vs 8.3 ± 1.8 hours) ($P < 0.05$) and significantly less total opioid consumption (165.7 ± 18.2 mg vs 255.6 ± 15.8 mg) ($P < 0.05$) compared to patients with paravertebral block. Post-operative side effects were noted significantly more in patients with paravertebral block compared to pectoral nerve block.

Conclusion: Pectoral nerve block performed in patients scheduled for modified radical mastectomy results in better pain control, late first analgesic demand and less postoperative opioid consumption in the first 24 hours than paravertebral block.

Keywords: Modified radical mastectomy, Paravertebral block, Pectoral nerve block, Postoperative analgesia

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Introduction

Incomplete alleviation of postoperative pain in Modified radical mastectomy surgery causes significant morbidity and patient dissatisfaction. Breast cancer is the most common cancer in women worldwide¹. Modified radical mastectomy has traditionally been the standard of care for early-stage invasive breast cancers. Modified radical mastectomy under general anaesthesia causes more severe postoperative pain².

Acute postoperative pain due to ineffective pain control is a major risk factor for the development of chronic pain after breast surgery. This condition includes paresthesia, intercostobrachial neuralgia, neuroma pain and phantom breast pain and it overall affects 20-50% of the women who undergo breast surgery³. Postsurgical pain after breast surgery contributes to delayed patient mobilization and prolonged length of hospital stay⁴.

General anaesthesia with postoperative NSAIDs and opioids is a commonly used technique for postoperative analgesia after breast surgeries⁵. However, opioids are associated with significant risks and adverse effects such as pruritus, constipation, nausea/vomiting, urinary retention, oversedation and respiratory depression⁶. It is suggested in humans that the immune function is differently affected by morphine and tramadol. Analgesic drugs devoid of immunosuppressive effects might offer a good alternative to morphine for the treatment of postoperative pain⁷.

The American Society of Anaesthesiologists Task Force recommends routine use of multimodal analgesic strategies including NSAIDs, cyclooxygenase-2 inhibitors, acetaminophen and regional blockade with local anaesthetics⁸. Under regional block with local anaesthetics, Paravertebral block (PV block) for breast surgery has increasing popularity and considered a technique of choice for anaesthesia and postoperative analgesia during breast surgery^{9,10}. There are two common variations; first is a single site injection that involves larger volume at one paravertebral space and the second is a multiple site injection in which small volume is injected into multiple levels. The single paravertebral injection of

0.36ml/kg in adults provide unilateral sensory loss at least 4 dermatomes¹¹. The disadvantage is that, paravertebral block associated with few serious complications like; vascular puncture, epidural spread of local anaesthetic, nerve damage, accidental pneumothorax and Horner's syndrome¹². The block done preoperatively with the patient remaining awake can be uncomfortable for the patient owing to injections done at multiple levels¹³. These approaches do not block medial and lateral pectoral nerves as well as long thoracic and thoracodorsal nerves. So effective pain relief may not be suitable in all breast surgeries¹⁴.

Recently, ultrasonography (USG)-guided interfascial plane block—Pectoral nerve block described by Blanco in his observational study of fifty patients are novel approaches that block the pectoral, intercostobrachial, third-to-sixth intercostals and the long thoracic nerves¹⁵. They are simple, safe and easily performed blocks which provide good analgesia and are devoid of any predicted complication during and after breast surgery. Other advantages of Pectoral nerve block include absence of sympathetic block (associated with paravertebral) and less opioid requirement¹⁶.

The Pectoral nerve block is a superficial block that has been used effectively for surgical procedures such as placement of breast expanders and subpectoral prosthesis. The Pectoral nerve block [Pec I (local anaesthetics infiltration in between Pectoralis major and Pectoralis minor muscle) and Pec II (local anaesthetics infiltration in between Pectoralis minor and serratus anterior muscle)] favours mastectomy and axillary clearance, because long thoracic and thoracodorsal nerves are also blocked in addition to the lateral branches of the intercostal nerves that exit at the level of the mid-axillary line to innervate the mammary gland and the skin from T2 to T6¹⁷.

So, this study outlined to observe the effectiveness of ultrasonography-guided Pectoral nerve block with Paravertebral block for postoperative analgesia after Modified radical mastectomy.

Methods

Study place, participants and design

This randomized controlled trial was carried out in the Department of Anaesthesia, Analgesia, Palliative and Intensive Care Medicine in collaboration with department of surgery, Dhaka Medical College & Hospital, Dhaka July 2020 to June 2021. Patients with American Society of Anaesthesiologists (ASA) physical status I, II and III who underwent modified radical mastectomy due to breast cancer after fulfilling the inclusion criteria for the study and got admitted into the Department of Surgery of Dhaka Medical College & Hospital, Dhaka were included. Patients with known allergy or sensitivity to local anaesthetic agents, use of analgesics for more than 4 weeks or any psychiatric disorders, having chest wall and spine deformity and those with infection at the site of injection were excluded from this study.

During pre-anaesthetic visit the patients were selected according to inclusion and exclusion criteria for the study. Before the commencement of this study, the ethical committee approved the research protocol and informed written consent was obtained. Patients were educated about the 10 cm visual analogue scale (VAS) during the preoperative assessment (where 0 = no pain, 10 = worst pain).

Patients were randomly divided into two groups (group A= Paravertebral block and group B= Pectoral nerve block) by computer generated random number. Thirty patients were included in each group. On arrival in pre-anaesthetic room, patient's identification was done and informed consent was checked. Then short history had been taken from the patient and thorough clinical examination was done. With permission of the patients an intravenous line was introduced in the contralateral hand of the surgical side. The patients were attached with standard monitors that include a pulse oximeter, electrocardiography, noninvasive blood pressure device and a temperature probe. The skin was disinfected using 10% povidone iodine. The ultrasound machine and a high frequency linear (8-12 MHz) probe was used for the block. The ultrasound probe was used aseptically. Single shot paravertebral block was performed in group A under ultrasound guidance at the level of T4 with the patients in sitting position. The USG probe was placed 5 cm from

midline in the craniocaudal direction and moved medially to identify the transverse process and parietal pleura. The superior costotransverse ligament was identified as a collection of homogenous linear echogenic bands alternating with echo poor area running from transverse process to the next. Skin infiltration at puncture site was done by 3ml 2% lidocaine. The needle was inserted by USG-guidance in-plane technique at the area just medial to the medial end of the transducer. Under direct visualization of the tip of the needle after negative aspiration for blood 30 ml 0.25% Bupivacaine was deposited in space between pleura and costotransverse ligament. The distribution of LA monitored under real-time ultrasonograph. The pectoral nerve block was performed in Group-B patients under USG guidance. The patient was placed in supine position with the arm abducted. The USG probe was placed at the midclavicular level inferolaterally to locate the axillary artery and vein directly above 1st rib where pectoralis major and pectoralis minor muscles were identified. After infiltration of skin at puncture site with 3ml of 2% lidocaine, the needle was inserted in plane technique with USG probe to the fascial plane between pectoralis muscles and 10 ml 0.25% bupivacaine was injected. Then USG probe was moved laterally until pectoralis minor and serratus anterior muscles were identified at the level of 3rd rib and 20 ml 0.25% bupivacaine were injected.

We used cold and pinprick tests to confirm the sensory block area over T2 -T6 after 10 to 30 minutes of performing the block. Pulse oximeter reading, electrocardiography tracing, noninvasive blood pressure was measured and temperature was recorded after confirming the success of the block. If the sensory block area over T2- T6 had not achieved after 30 minutes in each group that was considered as block failure that patients were excluded from the study.

The patient was transferred to operation room, then the patient was pre- oxygenated appropriately and general anaesthesia was induced with inj propofol 2 mg/kg, fentanyl 2 mcg/kg and suxamethonium 1.5 mg/kg. General anaesthesia was maintained with halothane along with 40% O₂ and 60% N₂O. Vecuronium 0.1 mg /kg was given as part of anaesthesia for muscle relaxations. All patients received continuous infusion of normal saline 5-8

ml/kg/hr during surgery. At the end of surgery IV paracetamol 1 gm/100 ml was started and halothane was discontinued. Neostigmine 0.05 mg /kg and atropine 0.02 mg/kg were used to recover the patient. After full regaining of muscle power patient was extubated. When the patient opened eye in response to verbal command was transferred to the post-anaesthetic care unit (PACU).

Patient's postoperative data was collected by an anaesthesiologist in PACU who was unaware of the study procedures instructed how to fill up structured data collection form. On arrival in PACU, pain was assessed by Visual analogue scale (VAS) 2 hourly upto 24 hours. During this period the anaesthesiologist in PACU was instructed to give rescue analgesic if the patient complaint of moderate pain (VAS was > 4). The time when first dose of pethidine was given by the patient's request in post-operative period was recorded in hours.

Pethidine hydrochloride 1.5 mg/kg IM with anti-emetic injection Ondansetron 0.1mg/kg IV was given as first rescue analgesics if VAS was > 4 or patient complain moderate pain. The total amount of incremental intramuscular pethidine hydrochloride was recorded in mg. Postoperative recovery was assessed by modified Aldrete's scoring. When patient had reached the score 10 out of 10 then they were shifted from PACU. All data were collected by the investigators and recorded in data collection form.

Study measures

A preformed structured questionnaire was used for data collection.

Total Analgesic requirement

Total amount of Pethidine was required by the patient during the first 24 hours after surgery was measured in milligram.

First Rescue analgesia

Administration of the first dose of analgesic (Pethidine) agent as the patient complain pain after surgery in postoperative period (when VAS is > 4).

Block failure

The sensory block area over T2- T6 was not achieved after 30 min was block considered as block failure.

Ethical consideration

Before the commencement of this study, the local committee approved the research protocol. The aims and objective of the study along with its procedure, alternative diagnostic methods, risk and benefits were explained to the patients in an easily understandable local language and then informed consent was taken from each patient In this study, precaution was taken to protect the confidentiality of the participants.

Statistical analysis

Data were statistically described in terms of mean \pm standard deviation (SD) and percentages when appropriate. Comparison of numerical variables between the study groups were done using the Student's t-test. For comparing categorical data, Chi-square (X^2) test was performed. $P < 0.05$ were considered statistically significant. All statistical calculations were done using the computer programs SPSS (Statistical Package for the Social Science; SPSS Inc., Chicago, IL, USA) version 25 for Microsoft Windows.

Results

This clinical trial was conducted at Dhaka Medical College & Hospital, Dhaka. Total 60 patients, scheduled for Modified radical mastectomy under general anaesthesia belonging to ASA class I, ASA class II and ASA class III were included in this study. They were randomly divided into two groups with 30 patients in each group A and group B. Among them, 5 patients were excluded from the study due to block failure (three in group A and two in group B). So, finally, data were calculated for the 55 patients (27 patients in group A and 28 in group B).

The mean age of patient was (53.4 ± 6.6) years in Group-A and (54.7 ± 7.3) years in Group-B with majority belonged to 50-59 years of age (44.4% vs 39.2%) between the two groups. Maximum patient had ASA Class II in both groups (51.8% vs 60.7%). In case of staging of the patients (48.2% vs 39.2%) were in stage I and (51.8% vs 60.8%) were in stage II. There had no statistically significant difference in any characteristics of patients between two groups as $P > 0.05$. Average duration of surgery was (123.6 ± 13.7 vs 119.4 ± 14.2) minutes with no significant difference

Table I: Distribution of the patients by demographic characteristics, stage of cancer and duration of surgery

Characteristics		Group A (n=27)	Group B (n=28)	P value
Age	30-39 years	1(3.7%)	2(7.1%)	0.634
	40-49 years	8 (29.6%)	10 (35.7%)	
	50-59 years	12 (44.4%)	11(39.2%)	
	60 year and above	6 (22.2%)	5 (17.9%)	
	Mean±SD	53.4±6.6	54.7±7.3	
Weight (kg)		57.3±3.8	56.8±4.1	
Height (meter ²)		1.46±0.4	1.49±0.3	
ASA	Class I	7 (26%)	6(21.4%)	0.793
	Class II	14(51.8%)	17 (60.7%)	
	Class III	6(22.2%)	5 (17.8%)	
Stage	I	13 (48.2%)	11 (39.2%)	0.793
	II	14 (51.8%)	17 (60.8%)	
Duration of Surgery(min)		123.6±13.7	119.4±14.2	

between two groups (P = 0.793). Table 1 showed the demographic characteristics, stage of cancer and duration of surgery.

Values were expressed as Mean ± SD and within parenthesis percentage (%) over column in total.

Table II showed, there had been no significant difference in mean heart rate in base line, after block, after intubation and after extubation between two groups. There had been a significant difference in mean heart rate between the two groups at the end of

Table II: Perioperative heart rate of the patients

Heart rate (beat/min)	Group A (n=27)	Group B (n=28)	P-value
Baseline	79.8±6.3	77.3±7.6	0.81
After block	74.3±5.4	72.8±6.2	0.65
After intubation	82.9±8.5	80.6±7.9	0.79
After extubation	87.8±9.5	89.1±9.8	0.59
2nd hrs	74.6±5.2	73.9±4.9	0.82
4th hrs	73.7±6.9	73.2±5.6	0.73
6th hrs	75.1±5.6	74.4±5.8	0.80
8th hrs	86.8±6.3	74.7±7.3	0.038*
10th hrs	81.4±6.2	77.3±6.8	0.56
12th hrs	75.3±5.8	80.39±6.7	0.041*
14th hrs	74.41±5.93	76.2±5.1	0.69
16th hrs	82.2±6.5	74.1±6.4	0.035*
20th hrs	75.7±6.4	82.4±6.1	0.037*
24th hrs	76.3±5.3	75.6±5.9	0.82

Values were expressed as Mean ± SD.

the 8th, 12th, 16th, 20th and 24th hours during the postoperative period as P < 0.05.

There had been no significant difference in mean arterial pressure (MAP) during perioperative period between two groups (as P > 0.05). Table 3 revealed the perioperative mean arterial pressure of the two groups.

Table III: Perioperative mean arterial pressure of the patients

Heart rate (beat/min)	Group A (n=27)	Group B (n=28)	P-value
Baseline	79.8±6.3	77.3±7.6	0.81
After block	74.3±5.4	72.8±6.2	0.65
After intubation	82.9±8.5	80.6±7.9	0.79
After extubation	87.8±9.5	89.1±9.8	0.59
2nd hrs	74.6±5.2	73.9±4.9	0.82
4th hrs	73.7±6.9	73.2±5.6	0.73
6th hrs	75.1±5.6	74.4±5.8	0.80
8th hrs	86.8±6.3	74.7±7.3	0.038*
10th hrs	81.4±6.2	77.3±6.8	0.56
12th hrs	75.3±5.8	80.39±6.7	0.041*
14th hrs	74.41±5.93	76.2±5.1	0.69
16th hrs	82.2±6.5	74.1±6.4	0.035*
20th hrs	75.7±6.4	82.4±6.1	0.037*
24th hrs	76.3±5.3	75.6±5.9	0.82

Values were expressed as Mean ± SD.

The mean VAS score was low in Pectoral nerve block group as compared to Paravertebral block group at all-time interval except 12 hours and 20 hours. The mean VAS score was lower (VAS < 4) among group B at 8 hour, 16 hours and 24 hours in comperison to group A and it was statistically significant as P < 0.05. (Table IV)

Table IV: Comparison of VAS score of the patients between two groups

VAS score	Group A (n=27)	Group B (n=28)	P- value
2nd hrs	0.78±0.3	0.52±0.2	0.832
4th hrs	0.95±0.4	0.65±0.3	0.861
6th hrs	2.83±1.68	1.12±0.6	0.823
8th hrs	4.62±1.95	2.31±1.35	0.017*
10th hrs	2.52±1.53	3.34±1.45	0.541
12th hrs	2.28±1.75	4.83±1.40	0.015*
14th hrs	2.73±1.80	2.24±1.30	0.862
16th hrs	4.78±1.55	1.95±1.35	0.013*
18th hrs	2.83±1.60	2.74±1.65	0.851
20th hrs	2.35±1.45	4.48±1.70	0.021*
24th hrs	4.58±1.65	2.28±1.80	0.011*

Values were expressed as Mean ± SD.

Table V demonstrated the time of taking 1st analgesic demand was significantly longer in Pectoral nerve block group than Paravertebral block group. Patients with Pectoral nerve block had significantly lower opioid requirements compared to Paravertebral block in first 24 hours. Both value were statistically significant as $P < 0.05$.

Table V: Assessment of time of 1st dose of analgesic demand and total opioid consumption of the patients

	Group A (n=27)	Group B (n=28)	P value
1st analgesic demand (hour)	8.3±1.8	12.2±2.1	<0.018
Total opioid consumption (mg)	255.6±15.8	165.7±18.2	<0.024

Patients received paravertebral block had developed more post-operative side effects like nausea, vomiting and dizziness compared to pectoral nerve block and was statistically significant as $P < 0.05$. In group A 40.7% of the patient had complaints of nausea and 18.5% of patient had vomiting. The incidence of hypotension (14.8% vs 3.5%) and bradycardia (18.5% vs 7.1%) were also more in paravertebral block group than pectoral nerve block group. Frequency of adverse effects were shown in table VI.

Table VI: Postoperative side effects of the patients between two groups

Side Effects	Group A (n=27)	Group B (n=28)	P* value
Nausea	11 (40.7%)	3 (10.7%)	0.021*
Vomiting	5 (18.5%)	1 (3.5%)	0.032*
Hypotension	4(14.8%)	1 (3.5%)	0.034*
Bradycardia	5(18.5%)	2(7.1%)	0.033*
Dizziness	6(22.2%)	3(10.7%)	0.031*

Values were expressed in percentage (%) over column in total.

Discussion

This study was conducted among 55 (5 block failure) patients from July 2020 to June 2021 at Dhaka Medical College & Hospital to assess the effectiveness of Paravertebral block (PV) and Pectoral nerve (Pecs) block in patient underwent Modified radical mastectomy.

In this study the mean age of patients were 53.4 ± 6.6 years in group-A and 54.7 ± 7.3 years in group-B with

majority belonged to 50-59 years of age (44.4% vs 39.2%). Maximum patients had ASA Class II in both groups (51.8% vs 60.7%). In case of staging of the patients (48.2% vs 39.2%) were in stage I and (51.8% vs 60.8%) were in stage II. There had no statistically significant difference in any characteristics of patients between two groups as $P > 0.05$. Average duration of surgery was (123.6 ± 13.7 vs 119.4 ± 14.2) minutes with no significant difference between two groups ($P = 0.793$).

Another study also compared two groups in respect of age, BMI, ASA physical status and duration of surgery and found no significant difference between two groups ($P > 0.05$)^{14,18}.

This study showed that, there had been no significant difference in mean heart rate (HR) in base line, after block, after intubation and after extubation between two groups as $P > 0.05$. But there had been a significant difference in mean HR between the Pecs block group compared with PV block group at the end of the 8th and 12th hours during the postoperative period as $P < 0.05$.

In this study, there had been no significant difference in mean arterial pressure (MAP) during postoperative period between two groups (as $P > 0.05$).

A study showed that in postoperative ward pulse, systolic blood pressure (SBP) and diastolic blood pressure (DBP) were slightly lower in PV block group but was not statistically significant¹⁹.

This study showed that mean VAS score was low in Pecs block group as compared to PV block group at all-time interval except at 12th hours and 20th hours. In case of Pecs block group VAS score was low at 8th hour, 16th hours and 24th hours in comparison to PV block and was statistically significant ($P < 0.05$).

A study showed that patient had significantly lower pain score at 1st hour, 6th hour, and 12th hour in Pectoral nerve block group when at rest compared to Paravertebral block group as $P < 0.00119$ but at 18h hour and 24th hour it was significantly lower in PV block group than Pecs block group as $P < 0.05$. On the other hand, combined the pectoral nerve block together with Paravertebral block revealed more significant decrease in pain scores after breast

surgery²⁰. In this study time taking 1st analgesic demand was longer in Pecs block group than PV block group and was statistically significant as $P < 0.018$. Patients with Pectoral nerve block had significantly lower opioid requirements compared to Paravertebral block in first 24 hours and was statistically significant as $P < 0.024$.

Kulhari et al., 2016, showed that prolonged duration of first analgesic demand after breast surgeries in patients receiving Pecs I block compared to PV block (294.5 ± 52.76 versus 197.5 ± 31.35 min, respectively; $P < 0.0001$) and total opioids consumption was significantly lower in Pecs block group than PV block group as $P < 0.05$ ¹⁴.

Wahba and Kamal¹⁸, 2013 also found that duration of analgesia was significantly longer in the Pecs block group [175 (155–220) min] than in the PV block group [137.5 (115–165) min], $P < 0.001$ and significantly lower opioids consumption in Pecs block group than PV block group as $P < 0.05$.

Although various studies^{2,10,21} have shown better pain relief and a significant reduction in opioid consumption when the Paravertebral block was combined with general anaesthesia.

Patients received Paravertebral block had developed more post-operative complication like nausea, vomiting and dizziness compared to Pectoral nerve block. In Paravertebral block group 40.7% of the patient had nausea and 18.5% of patient had vomiting. The incidence of hypotension (14.8% vs 3.5%) and bradycardia (18.5% vs 7.1%) were also more in Paravertebral block group than Pectoral nerve block group. A Swedish study reported that the complications which occurred after performing Paravertebral block in 367 patients, included hypotension (4.6%); vascular puncture (3.8%); pleural- puncture (1.1%); and pneumothorax (0.5%). Pectoral nerve block is a less invasive technique and; hence, it is devoid of these complications²².

Conclusion

Paravertebral block and Pectoral nerve block performed in patients underwent Modified Radical Mastectomy results in better pain control and lower postoperative opioid consumption in the first 24

hours. But Pectoral nerve block was more effective than Paravertebral block for postoperative analgesia in patients scheduled for MRM surgeries.

Declaration

Ethics approval

The study was approved by the Ethical Review Committee of DMCH. Informed written consent was taken from the participants before inclusion.

Author contributions:

Conception and development of the idea *AA, MB, HB*

Writing *AA, SK*

Data analysis *AA, CSC*

Data collection *AA, NB, SA*

Review and Editing *AA, MMK, MB*

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Conflict of interests None

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