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Original Research Article

Ultrasound guided erector Spinae plane block versus modified pectoral plane block in modified radical mastectomy: a prospective, randomized, single blinded study

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ABSTRACT

Background: Modified radical mastectomy (MRM) is the most common surgery for cancer breast that is associated with marked postoperative pain. Effective control of this pain suppresses the surgical stress response and decreases the need for opioids and general anesthetics. This study was aimed to compare ultrasound guided erector spinae block (US-ESP) with modified pectoralis nerve block (US-PECS) in terms of post-operative pain scores as the primary objective, in patients undergoing MRM. The secondary objectives of our study were to compare the time of first rescue analgesic, total analgesic consumption and side-effects between the two groups.
Methods: Group E comprised of patients receiving 20 mL of 0.2% ropivacaine plus 0.5 µ/kg dexmedetomidine and it was injected in-between erector spinae muscle and transverse process. Group P comprised of patients receiving 30 mL of 0.2% ropivacaine plus 0.5 µg/kg dexmedetomidine divided into 10 mL that was injected between the two pectoralis muscles in the inter-fascial plane and the remaining 20 mL was injected between the serratus anterior and the pectoralis minor muscle.
Results: Demographic profile was comparable between both groups. Both groups offered good analgesia, but PECS group took an upper hand up to the 6th post-operative hour ($p<0.05$). Beyond the 6th post-operative hour, analgesic efficacy of both groups was comparable
Conclusions: Modified pectoralis nerve block offered better analgesia over the erector spinae block technique up to 6th post-operative hour and it is more effective in terms of total rescue analgesic consumption and the time for request of first rescue analgesic, in patients posted for MRM.

Keywords: Cancer breast, MRM, Erector spinae block, Modified pectoral nerve block

INTRODUCTION

Breast cancer is the most common malignancy affecting women all over the world. The most common surgical procedure for cancer breast is MRM, which involves removal of the entire breast with axillary evacuation along with a generous amount of skin.[1] These patients experience marked acute pain postoperatively (around 60%). The axillary component is majorly responsible for this pain.[2] Effective control of this pain is very essential as it suppresses the surgical stress response and decreases the need for general anaesthetics and thus helps to preserve immune responses.[3] Over the years, a wide range of techniques in regional anaesthesia have been tried and tested like thoracic epidural and paravertebral blocks. These techniques maybe associated with complications like pneumothorax, vascular puncture, nerve damage etc.[4] Some newer techniques are now being increasingly practised with better safety profile and comparable postoperative analgesia. This study was

undertaken to compare two such novel ultrasound guided block techniques namely: erector spinae plane block (ESP) and modified pectoral nerve block (PECS).

Forero et al described USG guided erector spinae (US-ESP) as a newer technique in which local anaesthetic (LA) is injected beneath the erector spinae muscle.[5] PECS was described by Blanco et al as an effective alternative to paravertebral and neuraxial blocks in breast surgery. It is one of them in which the drug is deposited into the inter-fascial plane between the pectoralis major and minor and between the pectoralis minor and serratus anterior muscles.[6]

There have been very few studies comparing the efficacy of ESP with PECS in breast surgery. Hence, this study aimed to compare US-ESP with US-PECS with primary objective of post-op pain scores in patients undergoing MRM. The secondary objectives of our study were to compare time of 1st rescue analgesic, total analgesic consumption and side-effects between 2 groups.

METHODS

This randomized, single blinded, prospective study was conducted after obtaining approval of the institutional research board in state cancer institute, Gauhati medical college from April 2020 to April 2021. Sixty patients undergoing unilateral MRM aged 18-65 years and with American society of anaesthesiologists' physical status Classes I and II were randomly allocated and divided into two groups-Group E and group P by applying simple randomization using the sealed envelope technique. All the patients enrolled for the study were explained about the procedure and were taught about the assessment of pain by using the VAS (Visual analogue scale) pain score, and proper written and informed consent was taken. The procedure was performed by an experienced anaesthetist trained in ultrasound guided regional block, not involved in any analysis or data collection.

The exclusion criteria were: patient refusal, any known allergy to study drugs, pregnant or lactating patients, any coagulation disorders, bradycardia (heart rate<60/min), uncontrolled diabetes, severe cardiopulmonary disease or psychiatric disorder.

In the operation room (OR), ASA standard monitors which includes non-invasive blood pressure (NIBP), electrocardiogram (ECG), pulse oximeter (SpO_2) was attached and an intravenous (IV) line was secured. Ultrasound guided blocks were performed in all the patients in group E (ESB) and group P (PECS), thirty minutes prior to surgery. Under all aseptic precaution, ESPB was performed in the sitting position, using a high frequency linear ultrasound probe at T4 level with the probe placed 2-3 cm lateral to the spine with a sagittal approach. The relevant landmarks: T4 transverse process, the overlying trapezius, rhomboideus and erector spinae muscles were identified. After infiltrating the skin and subcutaneous tissue with 2 ml of 2% lignocaine, a 21-gauge block needle was inserted in-plane at an angle of 30-40 degree in the cranio-caudal direction until the tip contacted the T4 transverse process. The correct placement of needle tip was confirmed by hydro-dissection with 2-3 ml of isotonic saline after which 20ml of the study solution (0.2% ropivacaine plus 0.5 mic/kg dexmedetomidine) was injected in the inter-fascial plane between the rhomboideus major and erector spinae muscle. The spread of the local anaesthetic was visualised under ultrasound guidance in a longitudinal plane, that lifted off the underlying transverse process and intercostal muscles.

In the second group (P), PECS block was performed on the side of surgery with the patient in the supine position and the arm abducted. The probe is placed below the lateral third of the clavicle and after identifying the axillary vessels, the probe is turned infero-medially until the two pectoralis muscles (major and minor) and serratus anterior are identified in a single plane at the level of the third rib. Two ml of 2% lignocaine was used to infiltrate the skin and subcutaneous tissue. The block needle is then advanced obliquely until its tip was visualised between the pectoralis minor and serratus anterior and 20 ml of the study solution (0.2% ropivacaine plus 0.5 mic/kg dexmedetomidine) was deposited in between the muscles. The needle tip was then withdrawn till the tip was visualised between the pectoralis major and minor muscle and 10ml of the study solution was injected between the two muscle planes.

The patients in both groups E and P were observed for the next thirty minutes. The sensory level of block was assessed by pinprick from T1 to T8 dermatome (on each side) by an anaesthesiologist who was blinded to the technique of block. If the pinprick sensation was perceived in any segment up to 30 minutes, it was considered as block failure and patients were excluded from the study.

All the patients received the same anaesthesia and analgesia as per standard protocol. Patients were given standard general anaesthesia (GA) with IV fentanyl 2 mcg/kg, IV Propofol 2-2.5 mg/kg and neuromuscular blockade achieved with IV Vecuronium 0.1 mg/kg. Trachea was secured with appropriately sized endotracheal tube (ETT). Intra-operatively anaesthesia was managed with O_2:N_2O=50:50 and isoflurane 0.8-1%. IV Paracetamol 1 gm and IV Ondansetron 4 mg was administered intraoperatively. At the end of surgery, neuromuscular blockade was reversed with I.V. neostigmine 0.05 mg/kg and atropine 0.02 mg/kg and trachea were extubated.

All the patients were transferred to post-operative care unit (PACU) for further monitoring and followed up for 24 hours. In the postoperative period VAS pain score was noted at 0, 2, 6, 12 and 24 hours. All the patients received infusion Paracetamol 1 gm 8 hourly as per standard

protocol. IV tramadol 50 mg was given as rescue analgesia when VAS>4 and the time for first rescue analgesic was noted and the total analgesic consumption was recorded at the end of post-operative 24 hours. Side-effects, if any, in the postoperative 24 hrs were noted.

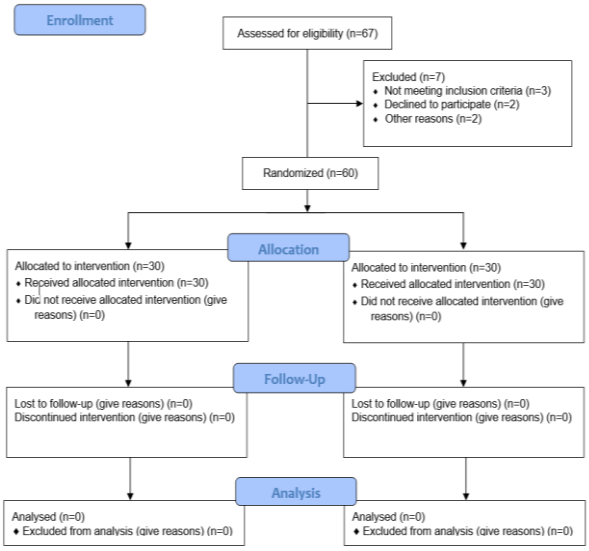

Figure 1: CONSORT flow diagram of study.

Statistical analysis

IBM SPSS V 21.0 is used to analyse the data. Normality test was done using Kolmogorov-Smirnova and Shapiro-Wilk test. For normal data, comparison between two groups was done using independent t test and for non-normal data, Mann Whitney test was used. A $p<0.05$ is considered as statistically significant at 95% CI level.

RESULTS

The demographic parameters and the operative duration of all patients of both the groups were comparable without any significant statistical difference ($p>0.05$) (Table 1). The HR, SBP and DBP in both the groups in the postoperative period were not statistically significant.

The VAS pain score was lower in patients of group P as compared to patients in group E up to at 6th postoperative hour and this difference in pain score was statistically significant. Beyond the 6th post-operative hour, however, the pain scores were comparable between 2 groups and median VAS was 2 for both groups (Table 2).

Total tramadol consumption in group E was 87.93±39.31 mg and group P was 62.50±22.61 mg and this difference was statistically significant ($p=0.040$). The time for request of 1st rescue analgesia for group E was 871.30±589.51 min and group P was 460±507.40 min and this difference was also statistically significant ($p=0.032$) (Table 3).

There were no side effects like bradycardia, sedation, nausea or vomiting in any patient in both groups.

Table 1: Comparison of demographic parameters between group P and group E.

Variables	Group P	Group E	P value
Age (Years)	50.10±8.75	47.23±8.32	0.199
Weight	55.80±7.41	56.37±8.41	0.783
Duration of Sx (min)	168±34.76	154±36.2	0.137

Table 2: Comparison of VAS between group P and group E.

VAS (Hours)	Group P			Group E			P value
	Mean	SD	Median (IQR)	Mean	SD	Median (IQR)	
0	1.30	0.95	2 (0-2)	2.70	1.82	2 (1.75-3.25)	0.002
2	1.50	1.11	2 (0.75-2)	2.70	1.97	2 (1-4)	0.020
6	1.77	1.07	2 (1-2.25)	3.03	2.09	2 (2-5)	0.029
12	2.10	1.21	2 (2-3)	2.30	1.92	2 (1-4)	0.970
24	1.77	1.10	2 (1-2)	1.97	1.59	2 (0.75-3.25)	0.771

Table 3: Comparison of the total analgesic, (tramadol) consumption and the time for first rescue analgesic.

Variables	Group P	Group E	P
Total tramadol consumption (mg)	62.50± 22.61	87.93± 39.31	0.04
Time for first rescue analgesic (minutes)	460.00± 507.40	871.30± 589.51	0.32

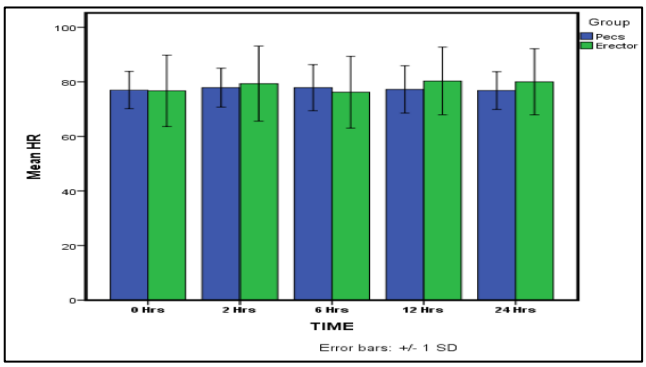

Figure 2: Comparison of heart rate between group P and group E.

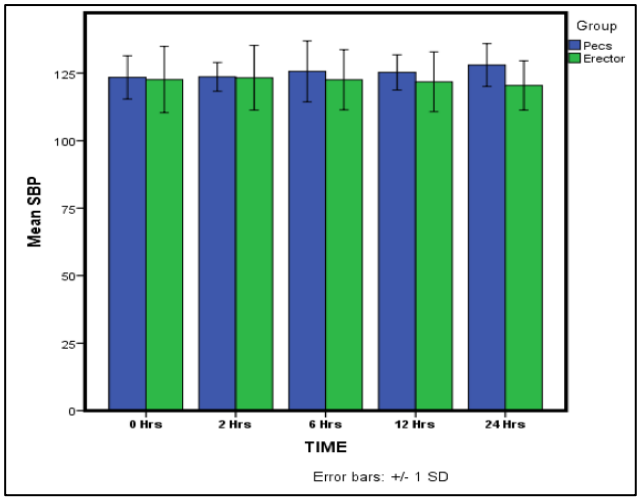

Figure 3: Comparison of systolic BP between group P and group E.

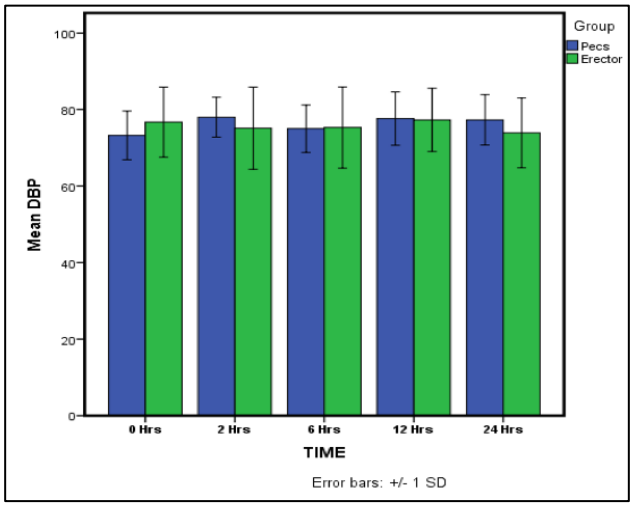

Figure 4: Comparison of diastolic BP between group P and group E.

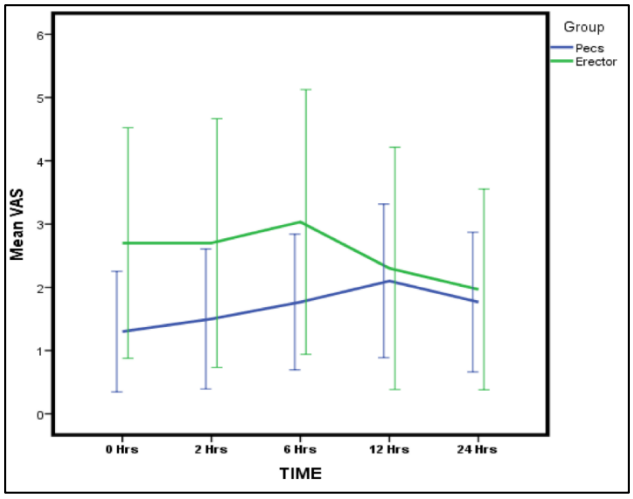

Figure 5: Comparison of VAS between group P and group E.

DISCUSSION

This prospective study shows that US-PECS block performed in patients posted for MRM results in better pain control in the initial postoperative period (up to first 6 hours). In addition, the total analgesic consumption and the time for request of first rescue analgesic were significantly lower in the P group as compared to the patients in E group in the first 24 hours.

The PECS block is a relatively new block which involves deposition of the local anaesthetic solution in the inter-fascial planes among the pectoralis major, minor and serratus anterior muscle. It was first described by Blanco.et al in 50 patients undergoing MRM and they reported good analgesia up to the first 8 hours postoperatively.[6] These findings are consistent to our study where the patients in the PECS group had lower pain scores for the first 6 hours postoperatively. The modified PECS block provides regional anaesthesia both for the chest wall and axillary areas as it blocks the lateral and medial pectoral nerves, intercostobrachial nerve, thoracic intercostal nerves and long thoracic nerves. The median and lateral pectoral nerves are implicated in post mastectomy surgical pain as they carry nociceptive and proprioceptive fibres. Also, the motor nerves supplying the chest wall carry post ganglionic fibres from cervical and thoracic ganglion and hence, long thoracic and thoracodorsal nerves also contribute to post mastectomy pain. Altiparmik et al compared PECS block with ESP in 40 patients undergoing MRM and had drawn similar conclusions like our study, in terms of lower pain scores and lower tramadol consumption.[9] Better analgesia in PECS block as compared to ESP has been attributed to the blockade of medial, lateral pectoral, long thoracic and thoracodorsal nerves. There have been similar studies by Bushadyet et al and Khemka et al in evaluating the role of PECS in patients undergoing MRM.[10,11] In our study, we observed that out of the 23 patients of group E complaining of pain (VAS>4), 15 patients had complained of pain only in the axillary area and not in the anterior chest wall while only 2 out of the 12 patients demanding rescue analgesic in group P had complained of pain in the axillary area. This might be implicated to sparing of dermatomes supplying the axillary area in ESP block, although, the exact reason remains unclear. In a study by Bakshi et al they reported difficulty of the surgeons while operating due to fluid filled spaces after giving the PECS block.[12] We did not encounter any such problem in our study maybe because we allowed a time gap of 30 minutes before surgery which might help in absorption of the local anaesthetic.

Another study by Kulhari et al had compared modified PECS block with thoracic paravertebral block (TPVB) and they concluded that PECS provides better analgesia along with lesser opioid consumption after radical mastectomy.[13] They have mentioned that they had performed the TPVB in the sitting position and the local anaesthetic spread occurred below the injection site while

the PECS was performed in the supine position and the spread of the local anaesthetic was both in the cephalad and caudal to the site of the injection. Likewise, in our study, the ESP was performed in the sitting position while the Modified pectoral nerve block was performed in the supine position and this positional difference between the two groups might be a factor affecting the cephalad spread of the local anaesthetic and hereby, resulting in a better quality of the block in the P group as compared to the E group.

The US-ESP is a myo-fascial plane block that provides analgesia for thoracic and abdominal segments depending on the level of injection.[14] It blocks the ventral and dorsal rami of spinal nerves and rami communicants and is also called an indirect paravertebral block with better cephalad and caudal spread. Ivanusic et al conducted a cadaveric study and reported that the injected dye mixture did not spread anteriorly to the paravertebral space to involve origins of the ventral and dorsal branches of the thoracic spinal nerves.[15] The dye was seen along the dorsal rami posterior to the costotransverse foramen. Hence, from this study, it can be concluded that the mechanism of action of the ESP is controversial and its effects vary according to the volume and concentration of the local anaesthetic.

Hypotension, bradycardia as well as sedation is some of the commonly known side effects with dexmedetomidine, although it is mostly reported with higher doses when used in the regional anaesthesia.[2,3] In our study no such side effects were reported in any patients in both the groups.

There are several limitations of our study. Firstly, it is a single hospital study, but for the purpose of evaluation of parameters that authors have used in our study (VAS scores, cardiac parameters and incidence of adverse effects), a multi hospital study is considered to be better. Secondly, we had performed the ESP in sitting position and the PECS in supine position and hence we could not eliminate the discrepancy of position affecting the cephalad spread of the local anaesthetic between the two groups. Thirdly, the study population was not blinded as the block was performed before giving general anaesthesia to assess the level of sensory block. Lastly, our study population was not large enough to assess safety of the two block techniques and no recommendations can be made regarding the safety profile of the two groups.

CONCLUSION

The modified PECS block is a novel regional analgesic technique and it offers better analgesia over the erector spinae block technique in the initial postoperative period and it is more effective in terms of total rescue analgesic consumption and the time for request of first rescue analgesic, in patients posted for MRM.

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