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Comparison of Perioperative Analgesia between Pecs Block and Erector Spinae Block in Patients Undergoing Modified Radical Mastectomy

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Abstract: ***Background: Breast cancer is one of the common malignancies among women and surgical resection of the tumor with axillary clearance is one of the main modalities of treatment. Various regional analgesic techniques have been described to provide analgesia after breast surgery. Pectoral plane (PECS) block is one of them in which drug is deposited in the interfascial plane among pectoralis major/minor and serratus anterior muscles. Erector spinae plane (ESP) block is a relatively novel analgesic technique in which drug is deposited beneath erector spinae muscle. Objective: To assess the onset of analgesia, extent of sensory block, intraoperative analgesic efficacy and duration of analgesia between ultrasound guided ESP block and PECS block in patients undergoing MRM and to assess the 24hour opioid requirement postoperatively in the two study groups. Methods: A total of 60 patients belonging to ASA PS I and II undergoing MRM were prospectively allocated to two groups -group E and group P. Group E (n=30) received ultrasound guided ESP block with 30ml 0.2% ropivacaine with 0.5µg/kg dexmedetomidine and group P received ultrasound guided PECS block with 30ml 0.2% ropivacaine with 0.5µg/kg dexmedetomidine, 30 minutes before induction of anesthesia. General anesthesia was administered in a standardized manner. Both groups received Tramadol 50mg IV as rescue analgesic postoperatively based on NRS pain scores. Intraoperative hemodynamics and postoperative 24 hour tramadol requirement, NRS pain scores and duration of analgesia were recorded and compared. Results: The onset of analgesia was faster in PECS block, with better dermatomal spread to T2 (22 patients in PECS block v/s 15 patients in ESP block) and increased duration of analgesia for PECS block. The postoperative 24- hour opioid requirement and pain scores were also significantly lower in patients receiving PECS block. Conclusion: Among the two regional analgesic techniques observed, PECS block has better analgesic efficacy in comparison with thoracic ESP block as evident from better pain scores and lesser postoperative opioid requirement.***

Keywords: Breast cancer surgery, PECS block analgesia, Erector spinae block, Postoperative pain relief, Opioid requirement

1. Introduction

Breast cancer is one of the common malignancies among women accounting for 25-35% of all female cancers in India.(1)The increase in number of breast surgeries due to malignancies and as a part of cosmetic concern has resulted in an increased incidence of anesthetic techniques with improved pain reduction and safety and fewer complications.(2)

In breast surgery, acute post operative pain from injured muscles and nerves as a consistent risk factor for chronic pain in association with its severity. Management of acute postoperative pain is required for better outcome and patient satisfaction. Regional techniques are regarded as the best choice to reduce acute postoperative pain and incidence of chronic pain after breast surgery.(2)

Various regional anesthesia techniques such as local wound infiltration, thoracic epidural, thoracic para vertebral block (TPVB) and intercostal nerve block and more recently USG guided fascial plane blocks have been used to provide analgesia in breast surgery. Regional anesthetic techniques like thoracic epidural and paravertebral blocks were considered gold standard analgesic techniques till date. These techniques may be associated with problems like pneumothorax, vascular puncture, nerve damage, etc. (3) As an alternative to these blocks some newer techniques have been designed with better safety profile and comparable pain relief. Pectoral (PECS) block is one of them in which the drug is deposited into the inter-fascial plane between pectoralis major and minor/pectoralis minor and serratus anterior muscles.(4)

Recently, in 2016, Forero et al. described ultrasound guided erector spinae block as a novel analgesic technique in which local anesthetic is injected beneath the erector spinae muscle. The target is the transverse process, which is easily identifiable and is relatively distant from neural or major vascular structures and the pleura.(5)

2. Materials and Methods

This observational study was conducted after obtaining clearance from the Institutional Ethics committee, conducted for a period of 1 year. 60 females belonging to ASA PS I and II undergoing modified radical mastectomy under general anesthesia within age group of 20-60 years were included in the study. Patients with local anesthetic allergy, relevant drug allergy, locally advanced breast malignancies with skin ulceration or infiltration of chest wall/expected duration of surgery more than 2 hours, bleeding disorders, patients on anti-coagulants, morbidly obese patients (BMI>40kg/m^2), bilateral breast surgery, opioid dependence, patients with advanced cardiovascular disease, conduction blocks or bradycardia, those with psychiatric illness that would interfere with perception and assessment of pain and patients with spine abnormalities were excluded from the study. All patients were explained regarding the procedure and informed written consent obtained.

All patients were preoperatively educated on how to define pain using the Numerical Rating Scale NRS 0-10, 0=no pain, 1-3=mild pain, 4-6=moderate pain, 7-10=severe pain.

On arrival in operating room intravenous access with 18 G I.V cannula was established on the side contralateral to the side of resection. Patient was connected to multichannel monitor which recorded heart rate, non-invasive blood

pressure, pulse oximetry, electrocardiography and end tidal carbon dioxide. The blocks were performed under aseptic precautions 30 minutes before surgery using ultrasound machine (Sonosite™, Inc.,Bothell, WA, USA).

Group E included patients who received ultrasound guided Erector spinae block which was performed by the anaesthetist. Under strict asepsis and guidance of linear US probe with a frequency range of 6-13 MHz, ESP block was performed with the patient in sitting position. The block was done at T4 level of the spine with the probe placed 2-3 cm lateral to the spine with a sagittal approach. After identifying the three muscles trapezius, rhomboid major, and erector spinae superficial to the hyperechoic transverse process, the probe was turned 90^0 longitudinally. After infiltrating 2 ml of 2% lignocaine, the block needle was inserted in a cephalo caudad direction to contact the transverse process. 30 ml of 0.2% ropivacaine and 0.5 µg/kg dexmedetomidine was injected. The correct placement is indicated by linear fluid spread that lifts the erector spinae muscle off the underlying transverse processes and intercostal muscles.

In the second group (P), PECS block was performed unilaterally. Patient was placed in supine position with their ipsilateral upper limbs abducted 90^0 below the lateral third of clavicle. After identification of axillary vessels, the US-probe was turned inferolaterally till the serratus anterior and the two pectoralis muscles (major and minor) were detected in one plane. The needle was inserted in the interfascial plane between the two pectoralis muscles; 10ml of the same study solution was injected. After that, the probe was turned towards the axilla and as the serratus anterior muscle is recognised above the third and fourth ribs, 20ml of that study solution was injected above this muscle.

The decision regarding who would receive which kind of block was taken by the medical officer in charge.

The patients were observed for 30 minutes after performing the block. The level of sensory blockade was assessed with pin-prick sensation in each side from T1 to T8. The patient's ECG and SpO_2 was monitored continuously, and heart rate and NIBP recorded at baseline after performing the block and every 5 minutes for 30 minutes.

Prior to induction patients received Inj Midazolam 1mg IV, Inj Ondansetron 0.1mg/kg, Inj Fentanyl 2µg/kg.After preoxygenation with 100% oxygen for 3 minutes anaesthesia was induced with Inj Propofol 1 to 2 mg/kg. Endotracheal intubation was facilitated by Inj Vecuronium 0.1 mg/kg. After confirming bilateral air entry endotracheal tube was fixed.Anaesthesia was maintained using controlled ventilation with nitrous oxide and oxygen in the ratio 2:1 and isoflurane 0.2 to 1%. Any further rise in blood pressure or heart rate over 20% of baseline was treated by intravenous Paracetamol 15mg/kg. Neuromuscular blockade was achieved with bolus doses of vecuronium.After reversal from anaesthesia patient was extubated and shifted to the post anaesthesia care unit.

All patients were monitored in the post-operative ward for 24 hours. They were asked to check for pain at rest and on movement of ipsilateral (side of surgery) arm during the postoperative period, when they feel pain for the first time after surgery followed by every 6 hourly for next 24 hours which were observed by the investigator. NRS was recorded by the patient or care giver as taught on the day prior to surgery. They were asked to report at the nursing station when the NRS is greater than 3 and if they developed any complications following the procedure. Rescue analgesics (IV Tramadol 50mg) were given when NRS was greater than 3 by the nursing staff. The time of rescue analgesia was also noted.

The following outcomes were analysed

1) The duration of analgesia (time of first rescue analgesia after extubation)
2) Total cumulative dose of Tramadol (used as rescue analgesic) for the first 24 hours to maintain NRS less than 3.
3) Severity of postoperative pain. Pain was assessed and treated by NRS at rest and movement (pain on moving the ipsilateral arm) one hour (from the time patient woke up) after surgery and thereafter every 6 hours for the next 24 hours.

Any adverse effects like local anaesthetic toxicity, hemodynamic instability, respiratory depression, sedation, paraesthesia, pneumothorax, hematoma, re-exploration, nausea and vomiting were also recorded.

Data was coded and entered into excel software and analysed using appropriate statistical softwares like SPSS/epiinfo. Association between various factors were assessed using chi square test for qualitative variables and unpaired t test for quantitative variables. The level of statistical significance was p value less than 0.001.

3. Results

There were no significant difference among the two groups regarding demographic data.

In the intraoperative period, the mean heart rate, systolic and diastolic blood pressure values showed no significant difference between both the groups at different time intervals.

The mean heart rate value, systolic and diastolic pressure values in the postoperative period did not show any significant difference between two groups at different time intervals.

The mean time of onset of analgesia was found to be 18.97±2.26 minutes in E group while it was 4.78±1.07 minutes in P group.

Groups	N	Onset of analgesia (min)			Mann Whitney U Value	p Value
		Mean	SD	Median (IQR)		
Erector Spinae	30	18.97	2.26	19.25 (17.00-20.63)	0.000	<0.001
PECs	30	4.78	1.07	5.00 (4.00-5.63)		

The spread to upper dermatome T2 was seen in 22 patients in P group v/s 15 patients in E group, while the spread to

lower dermatome T6 was seen in 28 patients in P group compared to 19 patients in E group.

The mean time at first rescue analgesia was less in E group (6.93±0.48 hours) compared to P group (8.41±0.51 hours).

Groups	N	Time at first analgesia used		t Value	p Value
		Mean	SD		
Erector Spinae	30	6.93	0.48	11.61	<0.001
PECs	30	8.41	0.51		

The mean dose of tramadol was less in P group: 41.67±34.95 mg in 24 hours after surgery, while that in E group was 68.33±35.92mg. This difference was statistically significant (p=0.005).

The mean duration of analgesia in participants of E group was 15.28±1.95 hours while in P was 18.95±1.95 hours. This difference was statistically significant (p<0.001).

Groups	N	Duration of analgesia		t Value	p Value
		Mean	SD		
Erector Spinae	30	15.28	1.95	7.28	<0.001
PECs	30	18.95	1.95		

The NRS scores at rest were significantly lower in P group at all time intervals except at 0 hour. The score was lower at this time point also but this difference was not statistically significant.

The NRS scores at movement were significantly lower in P group at all time intervals except at 0 hour, 12 hours and 24 hours. The scores were lower at this time points also but this difference was not statistically significant.

4. Discussion

The present study findings suggest that P group had lower postoperative tramadol consumption and more duration of analgesia than E group. The pain scores and requirement of rescue analgesia were also significantly lower in P group. There were no significant difference between the hemodynamic parameters and intraoperative opioid consumption between the two groups.

Hence, PECS block is superior to ESP block for perioperative analgesia in patients scheduled for MRM surgeries.

Blanco and colleagues described PECS block in 50 patients undergoing MRM, which involves deposition of LA at the interfascial planes among the pectoralis major, minor and serratus anterior muscles.(4)

ESP block is a modification of paravertebral block described by Forero et al.(5) It is a safe alternative to paravertebral block as it uses transverse process as a barrier so that injury to pleura by needle can be avoided.(80) LA is deposited between the two muscles rhomboides major and erector spinae, that penetrate anteriorly through costotransverse foramina to the thoracic paravertebral space blocking the dorsal and ventral rami and rami communicants.

In our study, the onset time of analgesia for PECS block was an average of 4 minutes, which was similar to an average of 3 minutes as observed by Blanco and colleagues.(4) In a study conducted by Malawat et al to assess the feasibility of ESP block for complete surgical anesthesia and perioperative analgesia in breast surgeries, the onset time of analgesia was an average of 31.5 minutes, with the average duration to perform the block procedure being 8.93 minutes.(81) Kimachi et al reported a case where ESP block was used to provide complete surgical anesthesia to a patient with high cardiovascular risk, in which they accomplished complete analgesia within 20 minutes.(82) These findings were similar to our study where the onset time of analgesia was 18.97 minutes for ESP block.

The dermatomal spread in PECS block involved T2-T6 dermatomes in our study. Blanco and colleagues observed similar spread to T2-T4 dermatomes with variable spread to T6.(4) In ESP block, the spread included T3-T8 dermatomes with less cephalad and more caudal spread of the LA. In a study conducted by Barrios et al, the mean dermatomal spread was 9, variably involving T1-T9 dermatomes.(83) The spread of LA varies depending on different patient positions, concentration and volume of drug used and the direction of needle tip. In our study, the ESP block was performed in sitting position while PECS block was done in supine position, which might have resulted in more caudal spread of the LA in ESP block.

The duration of analgesia was upto 8 hours for PECS block as described by Blanco et al, which was comparable to our study wherein the duration was 8.41±0.51 hours. Recent studies done by Bashandy et al. and Khemka et al. also describes the role of PECS block for analgesia in patients undergoing MRM.(84,85) In a study conducted by Agarwal et al to compare the efficacy of paravertebral block and ESP block for analgesic efficacy in MRM surgeries, the mean duration of analgesia for ESP block was 232 minutes (3.86 hours). (86) The duration of analgesia for ESP block recorded in our study was 6.93 hours. This increased duration of analgesia may be attributed to the volume and concentration of LA used along with addition of dexmedetomidine as an adjuvant to the blockade.

Wahba et al. conducted a study involving 60 patients undergoing MRM and reported lesser opioid consumption and more duration of analgesia in patients receiving PECS block when compared to paravertebral block.(67) These results were similar to our study.

Bakshi et al. reported difficulty in surgery following PECS block due to fluid filled spaces(68), which was not encountered in any of the patients during our study. This may be due to the time gap between administration of block and surgery (> 30 minutes) that could have led to the absorption of LA.

Kulhari et al. have compared PECS block and thoracic paravertebral block and concluded that PECS block is better in terms of analgesia in patients undergoing MRM.(66)

Gurkan et al. performed ESP block in patients undergoing unilateral breast surgeries with 20ml 0.2% ropivacaine and

compared with no intervention group; reported that ESP group required less morphine postoperatively compared to other group.(87)

Altiparmik et al. compared ESP block with PECS block in 40 patients undergoing MRM and reported better analgesia and lower tramadol consumption in PECS group. These results were similar to our study. They concluded that better analgesia was due to the blockade of medial pectoral, lateral pectoral nerves, thoracodorsal nerve and long thoracic nerves.(65) Unlike their study, we administered the block before induction of anesthesia assessing the extent of sensory blockade in thoracic wall correlating with the duration of analgesia.

Sinha et al. compared ESP block and PECS block in 64 patients undergoing MRM and concluded that PECS block is more effective in terms of postoperative morphine consumption and duration of analgesia, which were similar to our study.(64) They used a volume of 20ml 0.2% ropivacaine with no additives unlike our study.

Gad et al. compared PECS block and ESP block in 50 patients undergoing MRM, with LA volume of 30ml 0.25% levobupivacaine with 0.5µg/kg dexmedetomidine and concluded significantly lower postoperative morphine consumption and stress hormone levels in PECS block compared with ESP block.(17) The hormones assessed were postoperative levels of cortisol and prolactin, which are produced in response to surgical stress and postoperative pain. The addition of dexmedetomidine has an attenuating effect which provides better postoperative analgesic efficacy and reduces stress response as observed by Nasr and Abdelhamid.(88)

Similar studies conducted by Singariya et al and Abraham et al comparing PECS block and ESP block also concluded PECS block to have more analgesic efficacy than ESP block in terms of postoperative opioid consumption and better pain scores.(89,90)

5. Limitations

There were some limitations in our study. First, the patients were not blinded. The block was performed before induction of anesthesia to assess the level of sensory block in awake patient. Second, the effect of these blocks on follow up of patients or patients presenting with chronic post surgical pain have not been studied. Third, NRS of pain will vary among patients. Fourth, these patients were monitored postoperatively in wards rather than ICUs, so we had to completely rely on information provided by patients and care takers.

6. Conclusion

Among the two regional analgesic techniques observed, PECS block has better analgesic efficacy in comparison with thoracic ESP block as evident from better pain scores and lesser postoperative opioid requirement.

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