



RESEARCH ARTICLE

COMPARISON OF ULTRASOUND-GUIDED THORACIC PARAVERTEBRAL AND PECTORALIS INTERFASCIAL PLANE BLOCK FOR MODIFIED RADICAL MASTECTOMY

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Abstract

Aims and Objectives : To compare the efficacy of ultrasound-guided thoracic paravertebral block (TPVB) and ultrasound-guided pectoralis interfascial plane (PECS) block for Modified Radical Mastectomy (MRM). The primary objectives were to compare duration of post-operative analgesia and total post-operative analgesic consumption while the secondary objectives were to compare dermatomal spread, intraoperative anaesthesia requirement and patient satisfaction.

Materials And Methods: Sixty female patients of American Society of Anaesthesiologists (ASA) physical status I and II, undergoing MRM under general anaesthesia, were randomly recruited to receive ultrasound-guided TPVB (Group T) or ultrasound-guided PECS block (Group P) with 25ml of 0.25% bupivacaine, in a prospective, observer-blinded, randomized study. Data was statistically analysed using Statistical Package for Social Sciences (SPSS) version 21.0. Categorical variables were compared using the Chi-square test or Fisher's exact probability test; continuous variables compared using unpaired t-test or Mann-Whitney U test. Results: All demographic variables were comparable. Intraoperative fentanyl consumption was lower in patients who received PECS block (72.50±27.35) than those who received TPVB (104.17±46.92) (p=0.0023). NRS was comparable in both groups till 2 hours post operatively. However, from 4 hours onwards, till 18 hours the Numerical Rating Scale (NRS) was significantly higher in TPVB group. Dermatomeal spread was more extensive and postoperative analgesia requirement was lower in Group P. Patient satisfaction was comparable in both groups.

Conclusion: PECS block is associated with superior postoperative analgesia and reduced analgesic requirement. The cranial dermatomeal spread was better and intraoperative opioid requirement was less with PECS block.

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Introduction:-

Breast cancer surgeries, are performed under general anesthesia which is now supplemented with various regional blocks. These blocks not only take care of postoperative pain, but they also reduce intraoperative requirement of opioids⁽¹⁻³⁾.

With the advent of ultrasound, the options of regional anaesthesia are no longer limited to thoracic epidural but various fascial plane blocks are now routinely in these cases.

This study was aimed to compare ultrasound-guided thoracic paravertebral block (TPVB) and ultrasound-guided pectoralis interfascial plane block (PECS) for Modified Radical Mastectomy (MRM). The primary objectives were to compare duration of post-operative analgesia and total post-operative analgesic consumption while the secondary objectives were to compare dermatomal spread, intraoperative anesthesia requirement and patient satisfaction. We hypothesized that PECS block would be superior and safer as compared to TPVB.

Methodology:-

After obtaining clearance from Institutional Ethical committee (IEC) (Ref.SKNMC/Ethics/App/2015/60), this prospective, randomised, observer-blinded study was conducted on patients scheduled for modified radical mastectomy (MRM). Considering standardized effect size of 0.75 and 80% power (β), the sample size for each group was calculated as 30 for each group. Sixty female patients, in the age group of 30-60 years, American Society of Anaesthesiologists (ASA) physical status I or II were randomly recruited to either Group T or Group P (n=30 for each group). Patients in Group T received USG guided TPVB with 25 ml of 0.25% Bupivacaine while those in Group P received USG guided PECS block with 25 ml of 0.25% Bupivacaine. The blocks were performed under all aseptic precautions in the preoperative room, 30 min before surgery with a 22-gauge echogenic needle using the same ultrasound machine and linear high frequency probe (Sonosite NanoMaxx Ultrasound System with L25 13-6 MHz probe 38 mm, 7-12 MHz frequency). The anaesthesiologist performing the block was not involved in the preoperative or postoperative assessment of the patient, anaesthesia management, and data collection.

Pregnant females, patients with history of sensitivity to local anesthetic, those with bleeding disorders or on anticoagulant treatment, those with Body mass index (BMI) >35kg/m² and those with any spine or chest wall deformity were excluded from the study.

On the day prior to surgery, a thorough pre-anaesthetic check-up was done, the block procedure was explained in detail to the patient and written, informed, valid consent was obtained. Patients were fasted for 6 hours before surgery. On the day of surgery, wide bore intravenous access was secured on the non-operative arm. Routine monitors including multipara monitor for oxygen saturation (SpO₂), non-invasive blood pressure (NIBP), electrocardiogram (ECG) was attached and the baseline vital parameters recorded. Patients were premedicated with Inj. Glycopyrrolate 4mcg/kg, Inj. Ondansetron 0.08mg/kg and Inj. Midazolam 0.03mg/kg. Oxygen supplementation was provided through venturimask and the block was performed. Group T patients received an ipsilateral paravertebral block at T4 level, in lateral position, under ultrasound guidance with the transducer in axial (transverse) plane. After skin and transducer preparation, the transducer was placed at the level of T4, just lateral to the spinous process. The transverse process of T4 and rib were visualized as a hyperechoic line with acoustic shadow below it. The transducer was then moved caudad into the intercostal space in a wedge-shaped hypoechoic layer demarcated by the hyperechoic lines of pleura below and the superior costotransverse ligament above. 25 ml of 0.25% bupivacaine was injected under ultrasound guidance in small aliquots after negative aspiration (Figure 1).

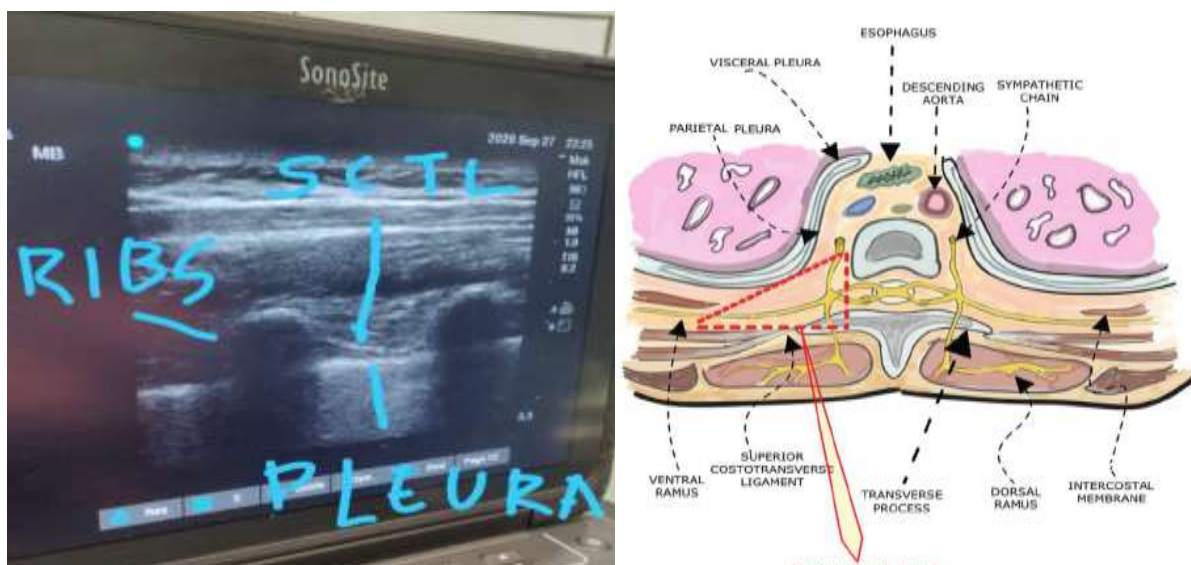


Figure 1:- Ultrasound-guided TPVB SCTL: Superior Costo-Transverse Ligament.

Group P patients received the pectoralis interfascialplane block in supine position, with the transducer in axial (transverse) plane. The probe was placed in a sagittal paramedian fashion inferior to the lateral third of the ipsilateral clavicle medial to the coracoid. Once the pectoralis major muscle and axillary artery is identified, the thoraco-acromial artery is identified between the pectoralis major and pectoralis minor muscle and confirmed with color Doppler. The lateral pectoral nerve is consistently located adjacent to the artery. 5mL of 0.25% bupivacaine was delivered using an in-plane technique via 80 mm echogenic needle adjacent to the artery and into the inter-pectoral plane (PECS I block) to block the lateral and medial pectoral nerves. 20 ml 0.25% bupivacaine was injected in the plane between pectoralis minor and serratus anterior muscle at the level of 3rd rib (PECS II block). The injection was done in aliquots, and negative aspiration done before each injection.

The patients were observed for 30 minutes after the administration of block. The dermatomal spread was checked by pinprick method every 5 mins from T1 to T8 dermatomal level. The vital parameters and side effects if any were noted. General anaesthesia was then induced with Inj. Propofol, in induction dose (till the loss of eyelash reflex) and Inj. Vecuronium 0.1mg/kg to facilitate intubation with appropriate size cuffed endotracheal tube. Anaesthesia was maintained with O₂:N₂O (50:50) with Isoflurane adjusted to an entropy value of 40-60. Fentanyl boluses of 1mcg/kg were given as and when required to maintain entropy between 40-60. Neuromuscular blockade was monitored on peripheral nerve stimulator and vecuronium doses given accordingly. All parameters like heart rate, Blood Pressure, oxygen, SPO₂, end-tidal CO₂ (etCO₂) and entropy were recorded every 5 mins. At the end of surgery, Isoflurane was tapered off and residual neuromuscular blockade was reversed with Inj. Glycopyrrolate 8mcg/kg with Inj. Neostigmine 0.06mg/kg. Patients were extubated after regaining consciousness and return of protective airway reflexes. After recovery from anaesthesia, patients were shifted to post-anaesthetic care unit (PACU) for 4-6 hours. In the PACU, the hemodynamic parameters and complications if any were monitored. Pain intensity was measured using Numerical Rating Scale (NRS) (1-10) at rest and during abduction of the ipsilateral upper limb at 1, 2, 4, 6, 12, 18, and 24 h. Nausea lasting more than 10 minutes and vomiting were treated with Inj. ondansetron 4 mg i.v.

Patient satisfaction for postoperative analgesia was recorded according to a satisfaction score (poor:0, fair:1, good:2, excellent:3). The time for first request of rescue analgesic was noted and analgesia provided by intravenous diclofenac 75 mg diluted in 100ml NS. The total postoperative analgesia requirement in first 24 hours was noted. Patients were administered Inj. Diclofenac sodium 75 mg i.v. at NRS ≥ 4 at rest or on limb movement. The analgesic was administered not less than 8 hours apart and not more than 3 doses were given in 24 hours.

Results:-

Data was statistically analyzed using Statistical Package for Social Sciences (SPSS) version 21.0. Categorical variables were compared using the Chi-square test or Fisher's exact probability test; continuous variables compared using unpaired t-test or Mann-Whitney U test.

The demographic parameters, baseline hemodynamics and duration of surgery were comparable in both groups (Table 1). None of the patients had failure of block or any significant side effects.

Table 1:- Demographic variables, baseline hemodynamic parameters and surgical duration.

Parameter	Group T (n=30)	Group P (n=30)	p
Age	43.56 ± 12.19	47.15 ± 11.55	0.246 ^{NS}
ASA (I:II)	18:12	19:11	0.999 ^{NS}
Surgical duration (min)	133.00 ± 7.35	132.70 ± 7.87	0.879 ^{NS}
HR (/min)	76.00 ± 8.74	76.77 ± 8.76	0.115 ^{NS}
SBP (mm of Hg)	120.93 ± 9.32	120.67 ± 9.32	0.912 ^{NS}
DBP (mm of Hg)	77.63 ± 6.85	76.47 ± 6.07	0.488 ^{NS}

NS: Not Significant, HR: Heart Rate, SBP: Systolic Blood Pressure, DBP: Diastolic Blood Pressure

The dermatomal spread was more extensive in Group P especially cranially to T2 dermatome. In Group P, 21 patients had spread to dermatome T2 whereas only 13 patients from Group T had involvement of T2 dermatome ($p < 0.0001$). For the rest of the dermatomes, both the groups were comparable. All the patients in both groups had involvement of T3 to T5 dermatomes. The T6 dermatome was involved in 26 patients in Group P and 28 patients in Group T.

The mean intraoperative fentanyl supplementation required was 104.17 ± 46.92 mg in Group T and 72.50 ± 27.35 mg in Group P. The difference was statistically significant. ($p = 0.0023$).

NRS at rest was comparable for first and second hour postoperatively. At 4, 12, 16 and 18 hours, the NRS was significantly more in Group T as compared to Group P ($p < 0.0001$). It was comparable in both groups at 24 hours postoperative (Fig. 1).

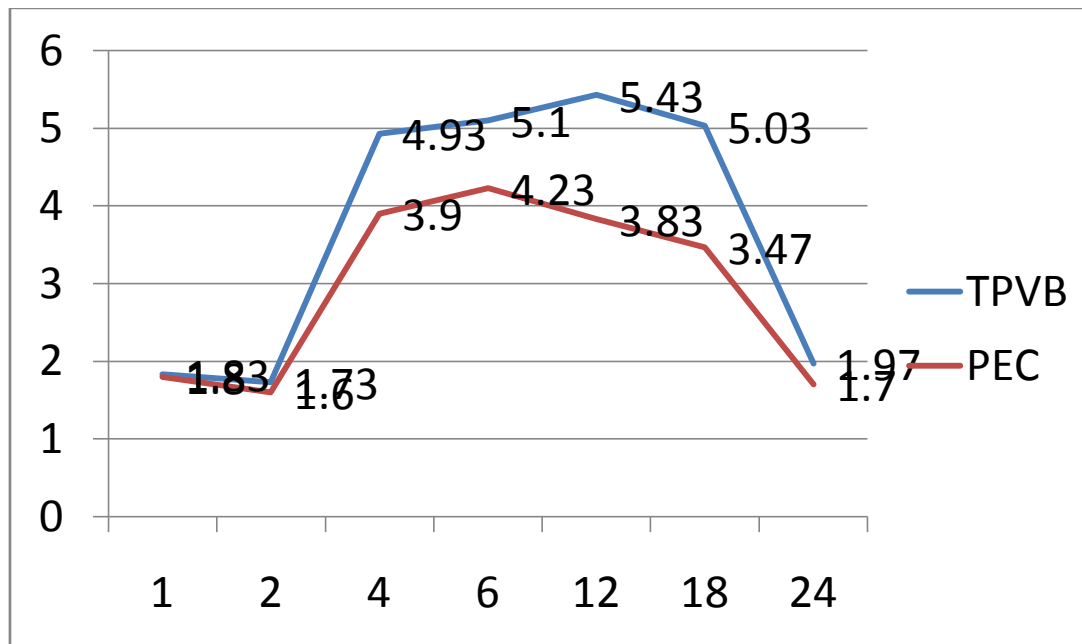


Fig. 1:- Comparison of NRS at rest.

NRS was also noted on limb movement i.e., abduction of the ipsilateral limb. It was significantly more in Group T, as compared to Group P, from 4 hours onwards up to 18 hours postoperatively ($p < 0.001$) (Fig. 2).

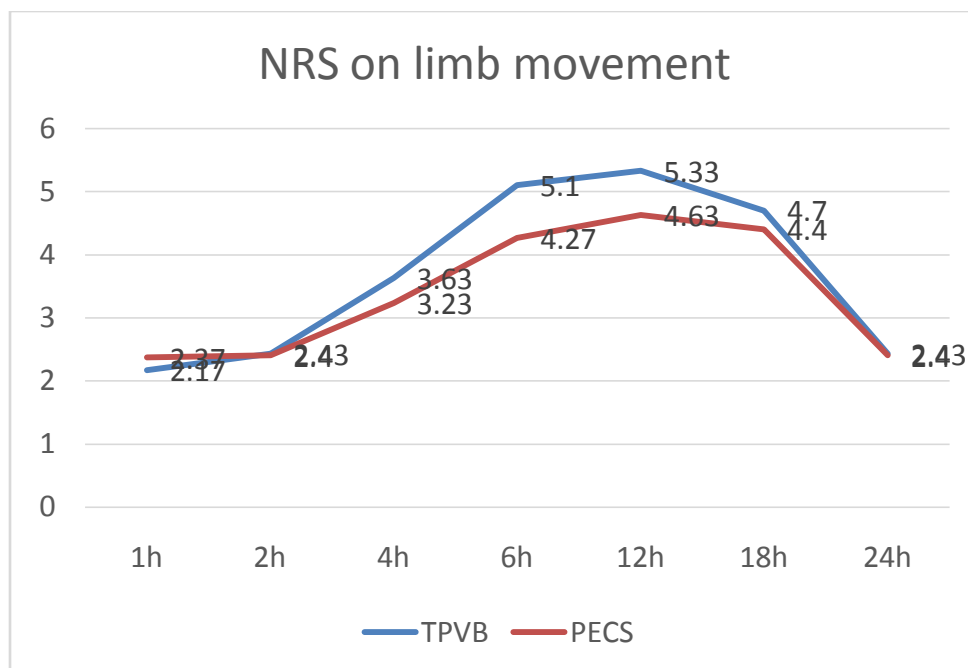


Fig. 2:- Comparison of NRS on limb movement.

The time to rescue analgesia was significantly prolonged and the 24-hour analgesic consumption was significantly less in Group P as compared to Group T. The patient satisfaction score was comparable in both groups (Table 2).

Table 2:- Postoperative block characteristics.

	Group T (n=30)	Group P (n=30)	p value
Time To Rescue Analgesia	234±32.86	320±106.09	0.0001*
24h Analgesic Consumed	217.50±22.88	140± 51.11	0.0001*
Patient Satisfaction	2.27± 0.69	2.37±0.49	0.4762 ^{NS}

*: Significant; NS: Not Significant

Discussion:-

Modified radical mastectomy is the definitive surgical treatment for breast malignancies. It involves axillary dissection and is associated with considerable postoperative pain and restricted shoulder mobility⁽⁴⁾. Acute pain if not addressed adequately, perpetuates into chronic pain and hence the importance of perioperative management of pain by a multimodal approach⁽⁵⁻⁸⁾. Several forms of regional techniques like local anesthetic infiltration, intercostal nerve block, epidural block, and paravertebral block have been used for management of pain after breast surgery. Thoracic epidural analgesia was always considered gold standard technique after breast surgery, followed closely by paravertebral block (PVB) as a potential alternative approach. However, both techniques may be associated with serious complications such as pneumothorax, total spinal anesthesia and inadvertent intravascular injection^(9,10).

Due to the recent application of ultrasound in anesthesia practice, administration of several interfascial plane blocks has been on a rise. Pectoralisinterfascial plane block is a novel block described for breast surgery. Also, ultrasound has significantly reduced the risks associated with thoracic paravertebral block, and it is now increasingly being used for breast surgeries in place of thoracic epidurals⁽⁶⁻¹⁰⁾.

In our study, PECS block was associated with significant spread to T2 dermatome. Similar spread was observed by Blanco et al and Kulhari et al, who demonstrated sensory spread from T3-T5 with TPVB and consistent spread to T2 with PECS block^(4,5). However various factors may be responsible for the differential spread observed, such as speed of injection, amount of drug and position of patient. In our study TPVB was performed in lateral position while PECS block was performed in supine position. We used 25 ml drug in both groups to avoid bias due to different volumes used.

Various studies have shown that TPVB, when combined with general anaesthesia for MRM, is associated with significant pain relief and reduction in opioid consumption. However, TPVB does not block the medial and lateral pectoral nerves as effectively as the long thoracic and thoracodorsal nerves, leading to inadequate analgesia, especially of the axilla and upper limb. In contrast, the PECS block, being an interfascial plane block where the local anaesthetic is deposited directly at the site of nerves, leads to complete block of medial and lateral pectoral nerves along with long thoracic and thoracodorsal nerves. It is therefore associated with better pain relief, both at rest and more importantly on abduction of ipsilateral limb. In our study, the NRS scores at rest as well as on ipsilateral limb abduction were significantly lower in patients receiving the PECS block compared to those receiving TPVB from 4 hour to 18 hours postoperatively. This also led to significantly reduced postoperative analgesic consumption in patients receiving PECS block⁽¹¹⁻¹⁵⁾.

In our study, the patient satisfaction score was comparable in both the groups. This could be attributable to the fact that the patients were administered postoperative analgesic before they experienced severe pain ($\text{NRS} \geq 4$). Also, use of ultrasound could be a factor leading to patient satisfaction in both the groups as due to ultrasound guidance, the patients neither had block failure nor experienced any side effects due to injection of local anaesthetic in aliquots after negative aspiration and also careful observation with Doppler view avoiding intravascular injection of local anaesthetic⁽¹⁵⁾.

Conclusion:-

PECS block is an effective technique of regional anaesthesia for patients undergoing Modified Radical Mastectomy especially for axillary dissection. It provides superior postoperative analgesia with reduced postoperative analgesic requirement, as compared to TPVB.

PECS block leads to better dermatomal spread cranially and is associated with reduced intraoperative opioid consumption.

The side effects and block failures for both the blocks are minimized due to ultrasound guidance, effectively improving the patient satisfaction.

Acknowledgement:-

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