



Role Of Presurgical Erector Spinae Plane Block Versus Paravertebral Block In Pain Control And Hemodynamic Stability After Modified Radical Mastectomy-A Prospective Randomized Trial

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Abstract

Background:

Pain is defined as “unpleasant sensory or emotional experience associated with actual or potential tissue damage” by IASP (International Association for Study of Pain). Pain prevention is an important part of anaesthesiology. Modified radical mastectomy (MRM) is a common surgical procedure, accounting for 31% of all breast cancer surgery cases performed. A variety of regional anesthetic blocks are used following thoracic surgery, including Thoracic Epidural Block (TEB), thoracic Paravertebral Block (PVB), intercostal block and intra- or extra pleural block. Each of these blocks has its own specific advantages and disadvantages.

Aim Of The Study:

To compare the effect of Para vertebral block with Erector spinae plane block post mastectomy acute pain control using time to request for first analgesic total intraoperative fentanyl consumption and total post operative opioid consumption.

Methodology:

A Prospective randomized trial conducted in the department of anaesthesia, GOVERNMENT THIRUVARUR MEDICAL COLLEGE. The patients who were posted for modified radical mastectomy was approached as study subjects. GROUP I included those to receive Thoracic Paravertebral Block (TPVB). GROUP II included those to receive Erector Spinae Plane Block (ESPB). Patients in group I received thoracic Paravertebral block and those in group II received Erector spinae plane block. Both these blocks were performed before induction of general anaesthesia using ultrasound guidance. Each patient received 20 ml of 0.25% bupivacaine.

Results:

Intra operative fentanyl consumption is comparatively lesser in GROUP II (135.96 µg) than GROUP I (141.3 µg). Complications were lesser in group II than group I. There were 16 cases who had no complications in group II compared to 8 cases in group I which about 66% vs 33% with (p 0.026). Other parameters in this study, like Time to request for analgesic request, post operative tramadol consumption for 24 hours, hemodynamics and VAS score were comparable between the two groups and statistically not significant.

Conclusion:

Ultrasound guided both Thoracic Para Vertebral Block and Erector Spinae Plane Block were equally effective in postoperative pain control after modified radical mastectomy. Erector Spinae Plane Block could be considered as a safe and effective alternate than Thoracic Para Vertebral Block as it is a simple and easier technique with clear sonoanatomy and lesser complications

Keywords: Erector Spinae Plane Block, Paravertebral Block, Thoracic Epidural, Modified Radical Mastectomy

Introduction

Pain is defined as “unpleasant sensory or emotional experience associated with actual or potential tissue damage” by IASP (International Association for Study of Pain). Pain prevention is an important part of anaesthesiology.

Surgeries like modified radical mastectomy are associated with severe postoperative pain and distress. The multifactorial origin of pain following breast surgeries includes pain from the surgical incision and dynamic pain such as during coughing /straining or mobilizing. But significant post-operative pain *mostly* occurs from the incision site. Therefore, a multimodal approach to post-operative analgesia is required so as to block pain transmission.

Modified radical mastectomy (MRM) is a common surgical procedure, accounting for 31% of all breast cancer surgery cases performed. Post-mastectomy pain managed by opioids alone often leads to side effects such as nausea and vomiting. Inadequate control of pain may later develop into chronic pain syndrome (paraesthesias, phantom breast pain and intercostobrachial neuralgia) in 25%–40% of the patients.

A variety of regional anesthetic blocks are used following thoracic surgery, including Thoracic Epidural Block (TEB), thoracic Paravertebral Block (PVB), intercostal block and intra- or extra pleural block. Each of these blocks has its own specific advantages and disadvantages.

TEB in combination with the administration of opioids has been widely regarded as the gold standard for thoracic analgesia. However, this technique requires highly trained medical staff, not only for the insertion and removal of the epidural catheter, but also for the management of the continuous infusion of the pain medication. The risks associated with TEB include accidental dural puncture, inadvertent high block, local anesthetic toxicity and total spinal anesthesia (inadvertent spinal injection of an epidural dose of local anesthetic leading to depression of the cervical spinal cord and the brainstem due to the effects of the local anesthetic

on these tissues). Additional side effects such as hypotension, neuraxial hematoma, vomiting and urinary retention have also been reported following TEB. Furthermore, an epidural puncture is specifically contraindicated in patients who have local infection or a history of previous spinal surgery, or in patients who have coagulation disorders or who are on concurrent anticoagulant or antiplatelet therapy.

PVB is a technique which involves injection of local anesthetic into the paravertebral space to block nerves after they exit the spinal cord. PVB is a unilateral technique, and hence, respiratory and sympathetic functions are preserved on the contralateral side. This feature may be associated with fewer pulmonary complications and less hypotension and urinary retention. The major potential complications associated with PVB are total spinal block, Pneumothorax and neuronal injury.

Erector spinae plane block is a relatively new interfascial block that has been proven to block somatic and visceral nerves to provide analgesia. It was first introduced by Forero et al in 2016 as a mode of analgesia in patients with thoracic neuropathic pain. The site of action is the thoracic spinal nerves through the blockade of the ventral and the dorsal rami. The indications for the block then extended from thoracic surgeries to upper abdominal surgeries. It is a safe technique which is simple to perform. The block is given under ultrasound guidance.

The nerve block usage is increasing in popularity as it decreases pain as estimated by visual analogue scores/numerical rating pain scores postoperatively and decreases the need for postoperative narcotic analgesic usage thereby reducing opioid induced side effects like postoperative respiratory depression, nausea, vomiting, NSAID induced gastritis etc. Nerve blocks also shorten Post-Anaesthesia Care Unit stay time, and also increases patient satisfaction. They also cause less interference with the physiology of our body as they act by interrupting the nociceptive impulse transmission through the peripheral nerves.

Post mastectomy analgesia consists of many regional techniques. Paravertebral block (PVB) is the most

effective studied technique, but due to its anatomic proximity to pleura and central neuraxial system, it is a challenging one. Erector spinae plane block (ESPB) has been used successfully for post operative analgesia in breast surgeries. The use of ultrasound guidance for performance of these specialized nerve blocks increases the success rate, reduces block performance times, improves quality of block, reduces the local anaesthetic doses needed and reduces the chances of complications. It was decided to compare Paravertebral block with Erector spinae plane block using ultrasound guidance for postoperative pain relief in modified radical mastectomy surgeries. It is hypothesized that ESPB could provide effective post mastectomy pain control; hence, it could replace other regional techniques. Also, it is effective, safe and simple. Hence in this study, it was aimed to compare to compare the analgesic effect of ESPB with TPVB using ultrasound guidance for post operative pain relief in modified radical mastectomy in the form opioid consumption, duration of analgesia, hemodynamic profile and complications.

Objectives Of The Study:

Primary Objective:

To compare the effect of Para vertebral block with Erector spinae plane block in post mastectomy acute pain control using time to request for first analgesic total intraoperative fentanyl consumption and total post operative opioid consumption

Secondary Objective:

To compare hemodynamics during intra operative period and post operative up to 6hrs and complications.

Methodology:

After obtaining institutional ethical committee approval this Prospective randomized trial was conducted in the department of anaesthesia, Thiruvavur medical college. The patients who were posted for modified radical mastectomy was approached as study subjects. Patients posted for unilateral modified radical mastectomy, Age between 20-70 years and ASA class I, II and III breast cancer patients with node positive but metastasis negative were included in this study. Severe respiratory or cardiac disorders, hepatic or renal insufficiency,

coagulopathy, local infection at the injection site, spine or chest wall deformities. allergy to any of the study drugs and opioid addiction/psychiatric illness/uncooperative patients were excluded from this study. Study was conducted during the period from December 2021 to November 2022. Sample size was calculated using openepi.com keeping alpha error as 5% confidence interval as 95% and power as 80%. Sample size was estimated using existing mean difference from previous literature. El Ghamrya et al mean of time to first analgesic request group I 6.35 and SD of 0.27 vs group II 6.58 and SD 0.33 was used. The sample size achieved was 27 per group.

GROUP I included those to receive Thoracic Paravertebral Block (TPVB).

GROUP II included those to receive Erector Spinae Plane Block (ESPB).

Sample was randomized by closed envelope method. 54 plain covers each with a single sheet written P for Thoracic paravertebral block in 27 sheets, E for Erector spinae plane block in 27 sheets were prepared and kept in the operation theatre. The covers were mixed thoroughly. Before start of the surgery for an eligible patient, a theatre staff picked up a cover of her choice. If that cover contains a sheet written P in it, then the case was included in paravertebral block Group(I). If that cover contains a sheet written E in it, then that case was included in the Erector spinae plane block group (II). This procedure was continued till all the 54 covers were used thereby enrolling 27 cases in each group.

Statistical Analysis were made from Unpaired 't' test – to compare the continuous parametric data between two independent groups. Chi-square test – to compare the frequency/proportions between the groups with sample and P value of < 0.05 will be taken as significant.

During the preoperative visit, the patients were explained about the purpose of the study and about the possible complications that can occur and written informed consent was obtained.

All the patients were kept in starvation for 8 h before surgery and after securing 18-gauge cannula premedication iv metoclopramide and iv ranitidine was given in the morning of surgery. In the operation theatre, intravenous fluids were started. After establishing standard anaesthesia monitoring,

baseline measurements such as heart rate (HR), ECG, non-invasive blood pressure and peripheral oxygen saturation were recorded

Patients in group I received thoracic Paravertebral block and those in group II received Erector spinae plane block. Both these blocks were performed before induction of general anaesthesia using ultrasound guidance. Each patient received 20 ml of 0.25% bupivacaine

GROUP I: Thoracic Paravertebral Block (TPVB) were performed at level T5 with patients in sitting position. A high-frequency linear transducer probe connected to an ultrasound (US) machine was positioned in a para-median sagittal plane, approximately 2–2.5 cm lateral to the spinous process at the ipsilateral side of surgery location. The skin was sterilised and the US probe covered with a sterile cap. A 22-gauge, 50 mm blunt insulated nerve block needle was introduced in an in-plane direction. After perforating the costotransverse ligament and confirming negative aspiration of blood, the drug was injected. Anterior movement of the pleura indicated appropriate spread of local anaesthesia (LA) in the paravertebral space.

GROUP II: The Erector Spinae Plane Block (ESPB) were performed at level T5 with patients in sitting position. A high-frequency linear transducer probe was positioned in a para-median sagittal plane approximately 3 cm lateral to the spinous process at the ipsilateral side of surgery. Following the same sterilisation procedure, the needle was introduced in an in-plane direction. The transverse process of the vertebrae, trapezius muscle, rhomboid major and erector spinae muscle was visualised, and the drug was injected between T5 tip of the transverse process and erector spinae muscle after confirming negative

aspiration of blood. The LA spread lifted the erector spinae muscle off the bony shadow of the transverse process.

The success of the block and extension of sensory loss from T2-T9 was evaluated using the pinprick test 20 min after the injection of drugs. The block was considered as failed if the loss of sensation was not attained within 30 min. All patients were provided with standardized general anaesthesia after the block. At the end of surgery, patient was reversed with IV neostigmine 50 mcg/kg and glycopyrrolate 10 mcg/kg. The patient was extubated, and transferred to post anaesthetic care unit (PACU). Post operatively patient haemodynamics and complications were noted. Complications such as nausea or vomiting arises it was treated with injection ondansetron 8mg i.v and if not controlled then injection dexamethasone 8mg i.v was given. If patient had complaints of breathlessness, then patient was shifted for chest X-ray and if pneumothorax was found then Inter Costal drain (ICD) was made available to treat this complication.

Parameters monitored were Total intraoperative fentanyl consumption, Time to request for first analgesic, Heart rate (HR), Mean Arterial Pressure (MAP), Total post operative tramadol consumption, Visual Analog Scale (VAS) and Complications.

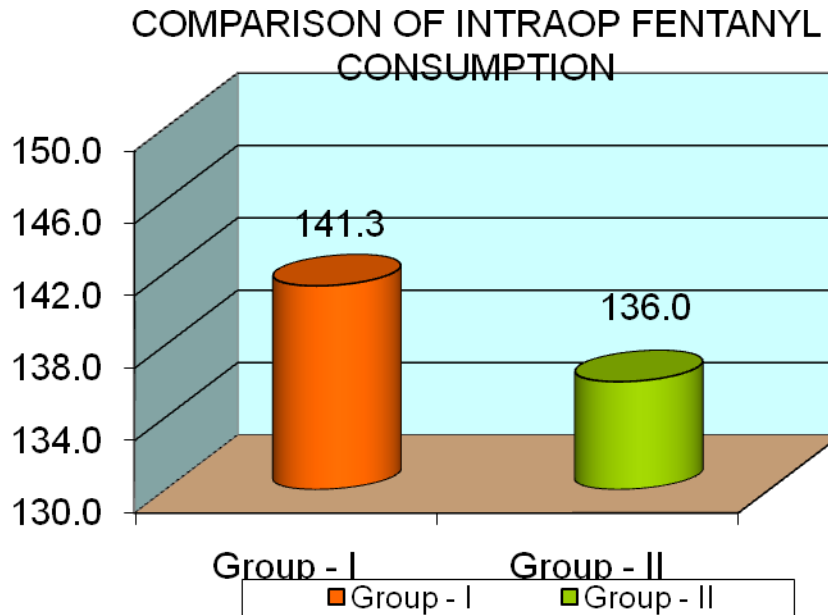
Results:

More than 50% of the cases were in the age group of > 50 in both groups. There was no significant difference in mean age.

Mean Intra operative fentanyl consumption was comparatively high in group I (141.3 µg), then in group II (135.96 µg). This difference was statistically significant.

Intra-operative fentanyl consumption (µg)	Group - I	Group – II
Mean	141.259	135.963
SD	6.298	7.94
P' value	0.009	

Minimum consumption	130	120
Maximum consumption	155	150



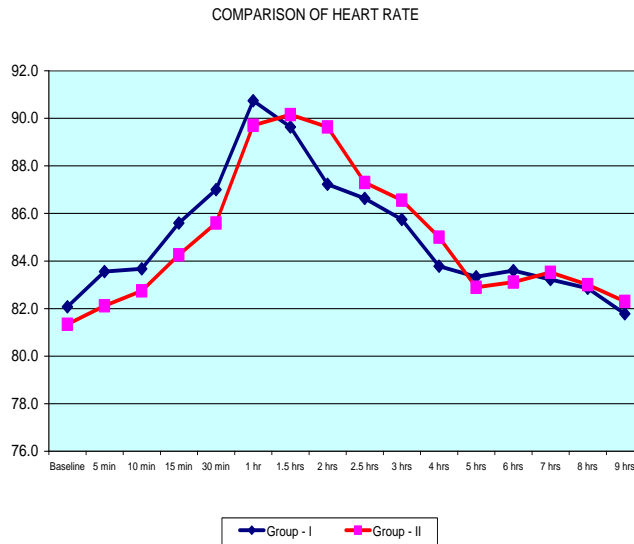
Mean post operative Tramadol consumption was 155.5 in group I and 133.33 in group II. There was no significant difference between both groups. (P value 0.1).

Mean time of analgesic request in group I was 6.43 and 6.58 in group II. There was no significant analgesic request time between two groups.

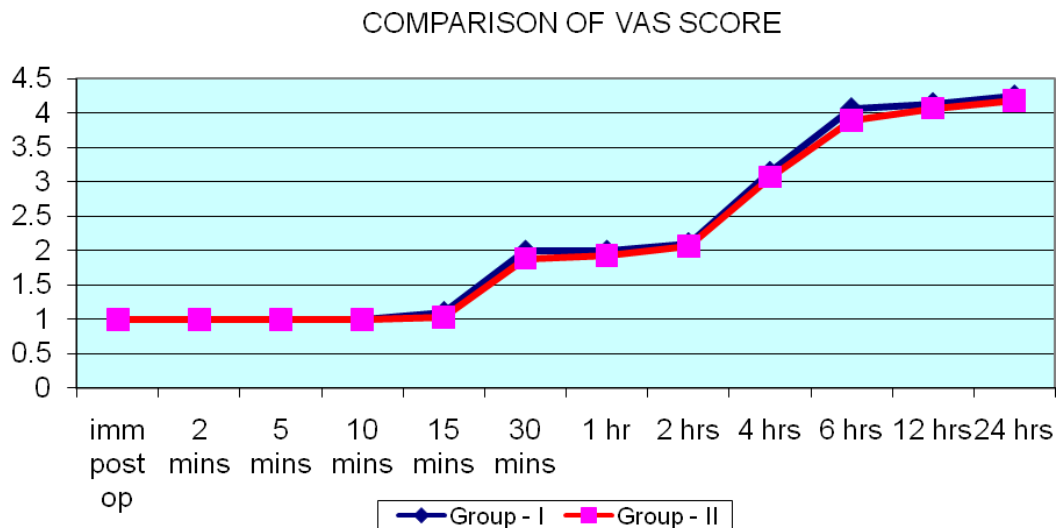
Complications were lesser in group II when compared with group I There were 16 cases who had **no complications** in group II compared to 8 cases in group I which about 66% vs 33%. This was significant between the groups (P 0.026).

Complications	Group - I	Group - II
Nausea	12	8
Vomiting	7	3
Pneumothorax	0	0
No complications	8	16
P' value	0.026	

On comparison of heart rate between the groups, there was no significant difference



On comparison of VAS score between the groups, there was no significant difference.



Discussion:

This study was a prospective randomized trial. A total of 54 patients who underwent Modified Radical Mastectomy (MRM) were included in this study and aimed to compare ultrasound guided Thoracic Paravertebral block and Erector spinae plane block (ESPB) in pain control and haemodynamic stability up to 6 hours postoperatively. Each patient received 20ml of 0.25% bupivacaine in two specialized nerve blocks GROUP I (TPVB) and GROUP II (ESPB).

Sample size was calculated using openepi.com keeping alpha error as 5% confidence interval as 95% and power as 80%. Sample size was estimated using existing mean difference from previous literature. **El Ghamrya et al** mean of time to first analgesic request group I 6.35 and SD of 0.27 vs group II 6.58 and SD 0.33 was used. The sample size achieved was 27 per group. GROUP I included those to receive TPVB and GROUP II included those to receive ESPB.

Mean Intra operative fentanyl consumption was comparatively lesser in group II (135.96 μ g) than group I (141.3 μ g). This difference was statistically significant. **Zhao et al** in 2020 found that intraoperative sufentanyl consumption was decreased in ESPB group compared to PVB group who received 30ml 0.4% ropivacaine before induction in VATS surgery. **El Ghamrya et al** conducted a prospective double blinded randomised trial in 2019 among 70 adult female participants to compare the effect of Erector Spinae Plane Block (ESPB) and Thoracic Para Vertebral Block (TPVB) on pain control after modified radical mastectomy. There was no significant difference observed between both groups in the intra-operative fentanyl consumption (p value 0.11).

Complications were lesser in group II when compared with group I. There were 16 cases who had **no complications** in group II compared to 8 cases in group I which about 66% vs 33%. This was significant between the groups (P 0.026). **Huang et al** in 2016 revealed, ESPB had improved analgesic efficacy in breast and thoracic surgery patients on comparison to non-block care. ESPB had reduced the rate of postoperative nausea and vomiting (OR 0.48; $p = 0.01$; $I^2 = 0\%$).

Fang et al in 2019 to study the post operative analgesic effect of single-dose ultrasound-guided erector spinae plane block, administered preoperatively with thoracic paravertebral block. There was no significant difference in the post-operative incidence of cough, nausea and vomiting. In 2017, **Cassi et al** explained about the benefits of peripheral nerve block in conferring anaesthesia and analgesia for breast surgery mainly Thoracic Paravertebral block (TPVB). His study has shown a, decreased rate of postoperative nausea and vomiting, and an overall decrease in length of hospital stay was achieved.

In this study other parameters like, time for analgesic request, post operative tramadol consumption for 24

hours were nil significance. Intra operatively and post operatively both groups were hemodynamically stable. VAS score was also found nil significance. **Moustafa et al** in 2020 conducted a randomised comparative study design comprising of 102 patients comparing analgesic efficacy of ESPB and TPVB in post modified radical mastectomy patients. Hemodynamic profile, time to first analgesic usage and morphine consumption postoperatively were insignificant between the groups.

US-guided Thoracic Para Vertebral Block (TPVB) is an excellent analgesic technique for breast surgery because not only does it decrease pain, but also decreases Post Operative Nausea and Vomiting (PONV) and length of hospital stay. However, the learning curve of US guided TPVB is rather steep requiring a higher degree of skill.

Compared with the epidural zone, the erector spinae plane is not a limited area surrounded by the spinal column. Local anaesthetic instilled in the myofascial plane deep to the erector spinae muscle and superficial to the tip of the transverse process is likely to provide sensory block at multidermatomal levels across the posterior, lateral, and anterior thoracic wall. The analgesic effect seems to be due to the diffusion of LA into the paravertebral space, acting at both the dorsal and ventral rami of the thoracic spinal nerves, in addition to its effect at the rami communicans that supply the sympathetic chain.

The ESP plane is larger than the epidural space as the erector spinae muscle runs along the length of the thoracolumbar spine, thus providing extensive craniocaudal spread. The ESP-block has a clear and simple sonoanatomy, it is easy to perform, not time-consuming, and generally well tolerated by the patients. The major limitation of this study was that patients knew they were receiving some intervention to decrease their pain.

There are no structures at risk of needle injury in immediate vicinity, making it comparatively simpler, safer with lesser expertise, and no procedural

complications as compared to epidural and paravertebral blocks. It eliminates risk of hypotension of epidural analgesia, epidural spread and vascular puncture of paravertebral block, their procedural complications due to vicinity to spinal cord and pleura, respectively, as well as pneumothorax associated with intercostal nerve block and interpleural block.

Conclusion:

In this prospective randomized trial on comparing the effect of Thoracic Para Vertebral Block (TPVB) with Erector Spinae Plane Block (ESPB) in post mastectomy acute pain control using ultrasound the Mean Intra operative fentanyl consumption was comparatively lesser in Erector Spinae Plane Block than Thoracic Para Vertebral Block. Complications were lesser in Erector Spinae Plane Block when compared with Thoracic Para Vertebral Block. Other parameters like time to request for analgesia, post operative tramadol consumption for 24 hours, hemodynamics and VAS score were comparable. Ultrasound guided both Thoracic Para Vertebral Block and Erector Spinae Plane Block were equally effective in postoperative pain control after modified radical mastectomy. Erector Spinae Plane Block could be considered as a safe and effective alternate than Thoracic Para Vertebral Block as it is a simple and easier technique with clear sonoanatomy and lesser complications.

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