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A Comparison Of Continuous Paravertebral Block Versus Thoracic Epidural For Patients Undergoing Lateral Thoracotomy

[1]Dr. S Arun Raj, [2]Dr. G Manikandan, [3]Dr. K Madhan Balaji
[1,2,3]Assistant Professor,
Department Of Anaesthesiology Government Medical College& Hospital, Thiruvarur, Tamil Nadu, India

***Corresponding Author:**
Dr. G Manikandan
Assistant Professor, Department Of Anaesthesiology Government Medical College& Hospital, Thiruvarur, Tamil Nadu, India

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Abstract

Background: Lateral Thoracotomy is a surgical procedure most commonly used for Pulmonary Resection surgeries, Cardiac Procedures, Mediastinal masses, Oesophageal pathologies, Ipsilateral lung surgeries, VATS Procedures, Ipsilateral foreign body removal, and diaphragmatic hernia repairs. Conventionally Thoracic Epidural Analgesia is used for Perioperative Pain relief in Lateral Thoracotomy which is Difficult to Perform and provides Excellent Analgesia, Bilateral Sensory, Motor & Autonomic Block and Dynamic Pulmonary Functions are suboptimal. Paravertebral block is a regional anaesthetic technique where local anaesthetic is injected into the Paravertebral space adjacent to the vertebrae to block the spinal nerves as they emerge from the intervertebral foramen.

Aim Of The Study: To compare continuous paravertebral block versus thoracic epidural for patients undergoing lateral thoracotomy. To study the dynamic lung function from both techniques.

Methods: After taking written informed consent from each patient the selected 70 patients were randomly assigned to two groups by computer-generated lots and labeled as GROUP-E (THORACIC EPIDURAL) – 35 and GROUP-P (PARAVERTEBRAL BLOCK) – 35. In Group E-18-G epidural catheter was placed at T5-T6 interspace through an 18-G Touhy epidural needle using the midline/paramedian approach and a saline loss of resistance technique under complete asepsis. The epidural catheter was inserted in a cephalic direction with only 5cm of the epidural catheter left in the epidural space T4-T5. In Group P-18-G epidural needle was inserted 2.5cm lateral to the spinous process of the T5 or T6 vertebra perpendicular to the skin and then advanced until contacting the corresponding transverse process. Then the needle was re-angled inferiorly and advanced 1-1.5cm deeper than the depth of bone contact until loss of resistance to saline was appreciated. General Anaesthesia was Induced and Controlled Ventilation was instituted in a similar method in Both groups. VAS score was noted 4th hourly till 24 hours. Analgesia was considered adequate when the VAS score ranges from 0 to 4. Intraoperatively Patient's heart rate and blood pressure were noted every 15 minutes till extubation and postoperatively 4th hour to 24 hours.

Results: There was no significant difference noted in Gender, Age, Weight, and Preop PEFR. The variation in SBP and DBP were found to be statistically significant with p values 0.0014 ($p<0.05$) and 0.0001 ($p<0.05$) in Group E. The variation in HR and SpO2 was not statistically significant. The mean postoperative PEFR in patients in Group E ranged from 281.71 to 258.57 and in patients in Group P ranged from 311.14 to 294.29 and there was a statistically significant difference between the two groups with subjects in Group E experiencing lesser PEFR than subjects in Group P. There was no additional requirement for rescue analgesia in the postoperative period for both Group P and Group E.

Conclusion: Paravertebral is Easier to Perform, Provides Equal Analgesia quality both Intraoperatively and Immediate Postoperative period and Dynamic Lung Function is well preserved than Epidural analgesia.

Keywords: Thoracic Epidural, Paravertebral Block, Thoracotomy, PEFR

Introduction

Paravertebral block is a regional anaesthetic technique where local anaesthetic is injected into the Paravertebral space adjacent to the vertebrae to block the spinal nerves as they emerge from the intervertebral foramen. [1] This will produce unilateral somatic and sympathetic nerve blockade which, in turn, suppress the neuroendocrine stress response in patients undergoing major thoracic and abdominal surgeries. This technique is available as single shot or continuous infusion technique or patient controlled analgesia. Bilateral block can also be given to patients undergtoing bilateral thoracotomies, thoracoscopic surgeries and abdominal vascular surgeries.[2] It is superior to epidural block and intercostal nerve blocks in terms of safety and efficacy. Performed by nerve stimulator guided, ultrasound guided technique, landmark guided technique.Paravertebral block advantages over Thoracic epidural are less failure rate, easier to perform, less neurological adverse effects, reduced hematoma risk, no urinary retention, less incidence of hypotension, improved pulmonary function and lesser pulmonary complications. [3] Contraindications to thoracic epidural (e.g.sepsis, deranged coagulation profile) do not preclude thoracic paravertebral block. Thoracic epidural which was considered as gold standard technique for thoracotomy surgeries previously, not only provides excellent but also causes bilateral sensory, motor and autonomic blockade, this provides better hemodynamics in intraoperative and postoperative period and also provides better post op analgesia which, in turn, provides better respiratory functions but Dynamic Pulmonary Functions are suboptimal. [4]Thoracic epidural technique is difficult compared to lumbar epidural technique due to steeply aligned spinous process, less epidural fat,varying ligamentum flavum position and less adherent dura. This technique is available as single shot or continuous infusion technique or patient controlled analgesia. With the advent of thoracic paravertebral block and thoracic epidural, post thoracotomy pain can be alleviated and outcome improved. Continuous infusion technique provides constant pain relief and also better patient compliance.[5]

Methodology: This study is a Prospective Randomized Trial conducted at Government Thiruvarur medical college during the period August 2021 to July 2022. The sample size was calculated using the VAS score. After getting approval from our institution's ethical committee, this study was conducted among 70 patients belonging to ASA grades I and II who undergoes elective thoracotomy surgery under general anesthesia. The age distribution was selected between 20-65 years. All patients have undergone thorough preoperative examinations. The procedure was explained to the patient in their language and consent was obtained. All patients underwent examinations like height, weight, vitals like blood pressure, and heart rate, and basic investigations like complete blood count, renal function tests, chest X-ray, and ECG. All major systems were examined and an airway examination was also done. The visual analog scale was explained to all the patients with pictorial representation. Patients between 20-65 years of age, both gender, ASA-I and II, BMI<30, Posted for elective anterolateral thoracotomy surgeries were included in this study. Surgery requiring Post op Ventilation, Emergency surgeries, Spinal/thoracic wall deformity, Coagulopathy, and Local site infection were excluded from this study. After taking written informed consent from each patient the selected 70 patients were assigned to two groups by computer-generated lots and labeled as **GROUP-E (THORACIC EPIDURAL) – 35 GROUP-P (PARAVERTEBRAL BLOCK) – 35**. Since only the patient is blinded to the group allocation, this study is single-blinded. All the patients were kept nil per oral for 6 hrs. After shifting the patient to the operation theatre peripheral IV line was secured and IV fluid was started. Standard monitors like Pulse Oximetry, Invasive Blood Pressure (IBP), and

Volume 5, Issue 6; November-December 2022; Page No 620-627

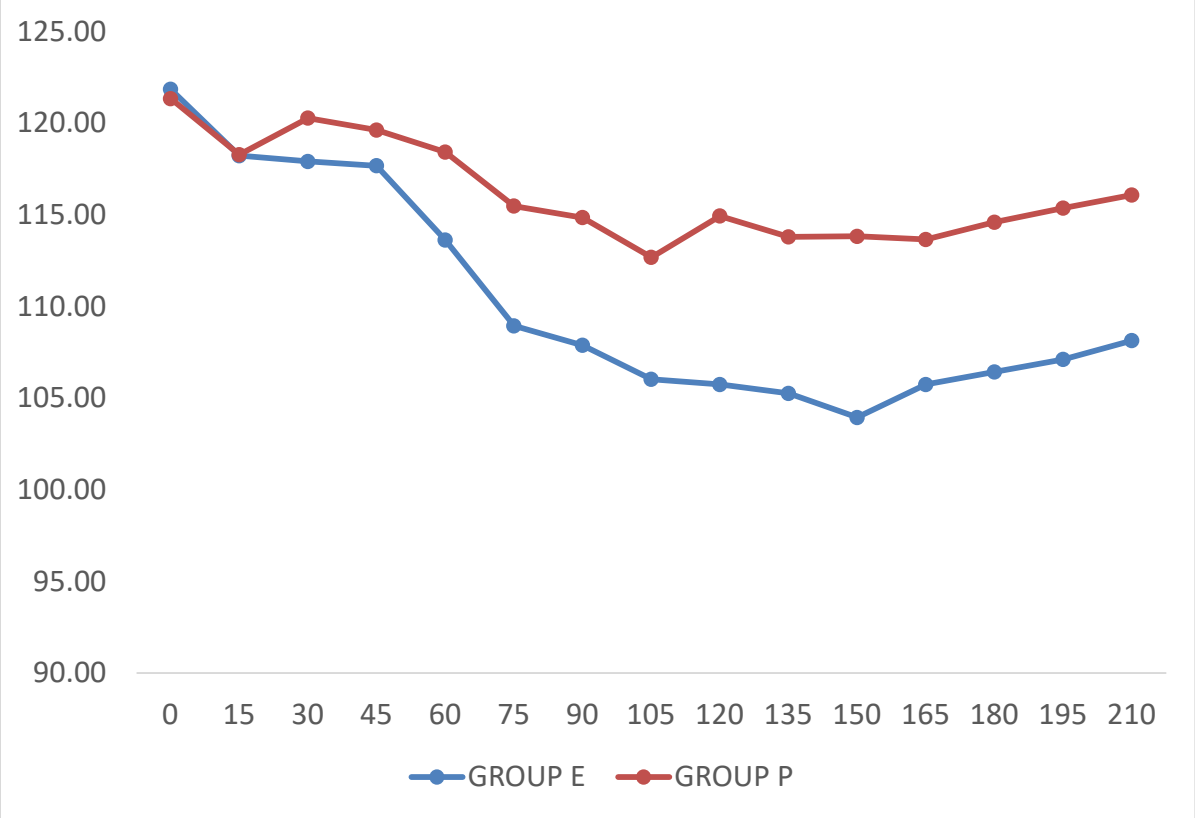
Electrocardiogram (ECG) were connected. The baseline values were recorded. The patient was premedicated with an injection of glycopyrrolate 0.01mg/kg intravenous. In **Group E**-18-G epidural catheter was placed at T5-T6 interspace through an 18-G Touhy epidural needle using the midline/paramedian approach and a saline loss of resistance technique under complete asepsis. The epidural catheter was inserted in a cephalic direction with only 5cm of the epidural catheter left in the epidural space aimed at T4-T5. In **Group P**- the 18-G epidural needle was inserted 2.5cm lateral to the spinous process of the T5 or T6 vertebra perpendicular to the skin and then advanced until contacting the corresponding transverse process. Then the needle was re-angled inferiorly and advanced 1-1.5cm deeper than the depth of bone contact until loss of resistance to saline was appreciated. The space was expanded using 10 ml of normal saline. Then an 18-G epidural catheter was introduced through the Touhy needle and inserted 2cm beyond the tip of the needle into the paravertebral space. General Anaesthesia was Induced and Controlled Ventilation was instituted in a similar method in Both groups. In group E, 10ml of 0.25% Bupivacaine was administered through the Epidural catheter. In group P, 10ml of 0.25% Bupivacaine was administered through the Paravertebral catheter. The intraoperative Opioid used was Inj. Fentanyl Citrate IV, Titrated to Hemodynamic Parameters, and total Dose are recorded. After an assessment of Pain (VAS) score 20mins after extubation Continuous Infusion of Bupivacaine 0.125% is set up for Post-op Analgesia for the First 24 hours. Hemodynamic Parameters and Oxygenation status are continuously Monitored with an Invasive Blood Pressure Monitor and Pulse oximetry. After the surgery is over, patients were turned supine and the volatile agents were cut off and ventilation was assisted. Once the patients had recovered adequately from the neuromuscular blockade, they were reversed with inj. Glycopyrrolate 10mcg/kg/min and inj. Neostigmine 40mcg/kg. After adequate oral suctioning, the patient was extubated. All the patients were kept in postoperative intensive care units. Intraoperatively Patient's heart rate and blood pressure were noted every 15 minutes till extubation and postoperatively 4th hour to 24 hours. Technique performance rating score was also noted for each procedure. Postoperatively VAS score was noted 4th hour till 24 hours. Analgesia was considered adequate when the VAS score ranges from 0 to 4. And inj. Tramadol was given for rescue analgesia. All the data were initially entered into Microsoft Excel 2010 and then the spreadsheets were used for statistical analysis using SPSS version 20.0. For all the statistical tests of significance, a p-value of <0.05 was considered to reject the null hypothesis.

Results:

The sex distribution of study subjects in both groups was similar and only a minor difference was observed. The minor difference in sex between the two groups was not statistically significant (p>0.05) and hence both groups were comparable. The Age distribution of study subjects in both groups was similar and only a minor difference was observed. The minor difference in Age between the two groups was not statistically significant (p>0.05) and hence both groups were comparable. The Weight distribution of study subjects in both groups was similar and only a minor difference was observed. The minor difference in Weight between the two groups was not statistically significant (p>0.05) and hence both groups were comparable. The PEFR distribution of study subjects in both groups was similar. There was a statistically significant difference between the mean SBP between the 2 groups in the per-operative period except in the first 30 minutes of surgery with subjects in the epidural group experiencing lesser systolic blood pressure (fall in SBP) than subjects in the paravertebral group as suggested by the student 't-test. Variation in SBP: In factorial repeated measures ANOVA, there was a statistically significant variation in mean systolic blood pressure over time as p<0.05. However, this variation in SBP happened to be minimal in subjects who received paravertebral block in comparison to a statistically significant drop in SBP among subjects who received epidural block and this difference in variation of SBP between the 2 groups was statistically Significant.

Volume 5, Issue 6; November-December 2022; Page No 620-627

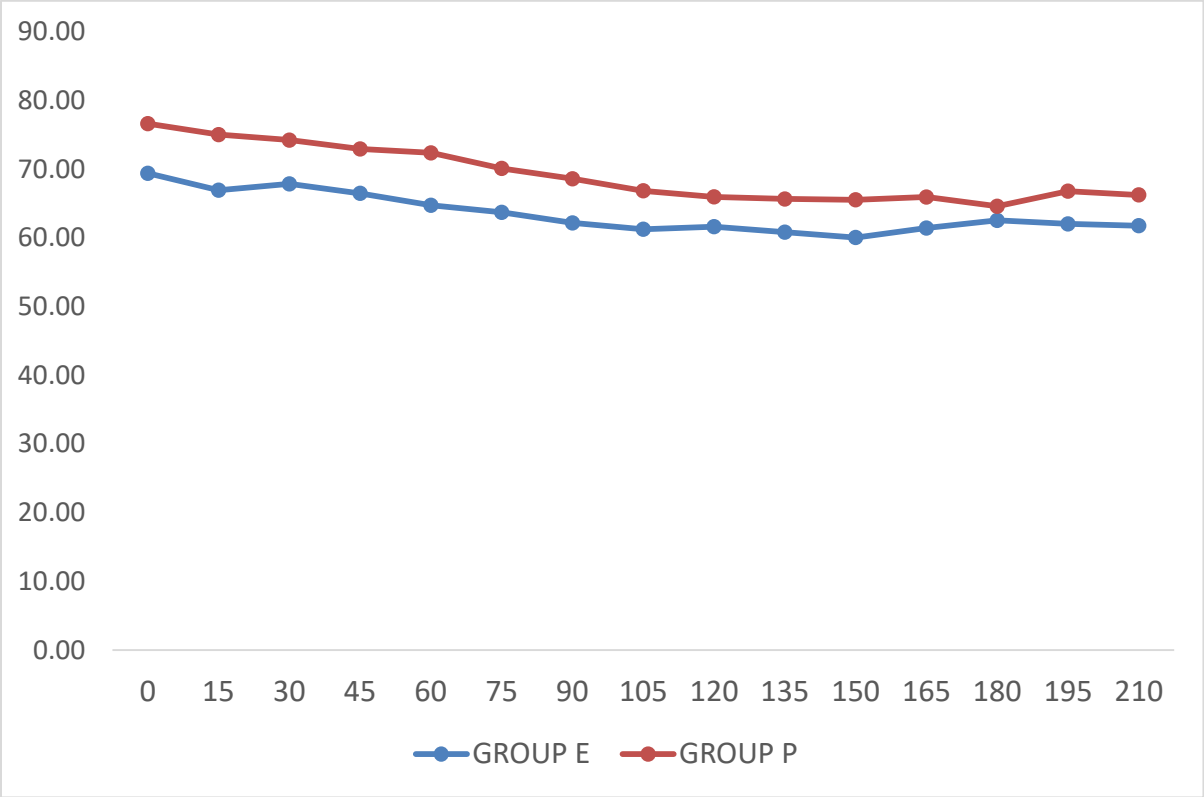
Diagram 1: Intraoperative Mean Systolic Blood Pressure in mmHg



There was a statistically significant difference between the mean DBP between the 2 groups in the per-operative period with subjects in the epidural group experiencing lesser diastolic blood pressure (fall in DBP) than subjects in the paravertebral group as suggested by the student 't-test. Variation in DBP: In factorial repeated measures ANOVA, there was a statistically significant variation in mean diastolic blood pressure over time as $p<0.05$. However, this variation in DBP happened to be minimal in subjects who received paravertebral block in comparison to the statistically significant drop in DBP among subjects who received epidural block and this difference in variation of DBP between the 2 groups was statistically significant.

Volume 5, Issue 6; November-December 2022; Page No 620-627

Diagram 2: Intraoperative Mean diastolic Blood Pressure in mmHg

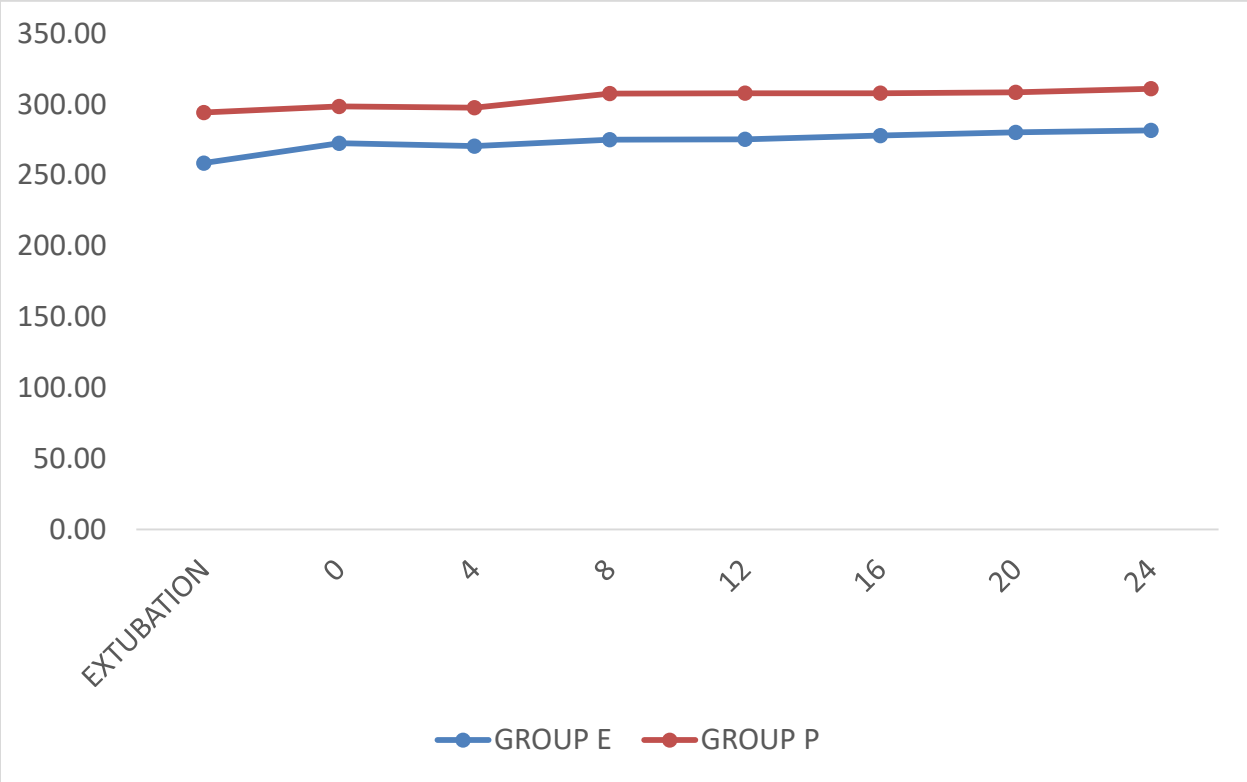


There was a statistically significant difference between the mean HR between the 2 groups in the per-operative period with subjects in the epidural group experiencing lesser heart rate (fall in HR) than subjects in the paravertebral group as suggested by the student's t-test. Variation in HR: In factorial repeated measures ANOVA, there was no statistically significant variation in mean heart rate over time as $p>0.05$. There was no statistically significant difference between the mean SpO2 between the 2 groups throughout the per-operative period as suggested by the student's t-test. There was a statistically significant difference between the mean Technique performance rating score between the 2 groups in the perioperative period, stating that technique is easier to be performed in the paravertebral group than the epidural group as suggested by the student 't-test with p value<0.05 for landmark identification, identification of target space and catheter insertion. There was no statistically significant difference between the mean VAS between the 2 groups in the postoperative period. There was no statistically significant difference between the mean SpO2 between the 2 groups throughout the postoperative period as suggested by the student's t-test. There was a statistically significant difference between the mean HR between the 2 groups in the postoperative period with subjects in the epidural group experiencing lesser heart rate (fall in HR) than subjects in the paravertebral group as suggested by the student's t-test.

There was a statistically significant difference between the mean DBP between the 2 groups in the postoperative period with subjects in the paravertebral group experiencing lesser diastolic blood pressure (fall in DBP) than subjects in the epidural group. There was a statistically significant difference between the mean RR between the 2 groups in the postoperative period with subjects in the paravertebral group experiencing increased respiratory rate than subjects in the epidural group. There was a statistically significant difference between the mean PEFR between the 2 groups in the postoperative period with subjects in the epidural group experiencing lesser PEFR than subjects in the paravertebral group.

Volume 5, Issue 6; November-December 2022; Page No 620-627

Diagram 3: Postoperative Mean Peak flow rate in liters per minute



Discussion:

The findings of the present study suggest that the use of continuous paravertebral block in patients undergoing Lateral thoracotomy is associated with good hemodynamic stability than continuous thoracic epidural, good intraoperative and postoperative analgesia similar to that of a continuous epidural. It also provided adequate analgesia without impairing dynamic lung functions compared to the continuous thoracic epidural. Compared to the continuous thoracic epidural technique, the continuous paravertebral block is easier to perform. [6]The patients in the paravertebral group experienced higher heart rates than patients in the epidural group which is statistically significant over time but this difference in change in heart rate between the two groups was not significant. In this study, there was no significant change concerning heart rate between the 2 groups. This correlates with *Drevon Det.al*. The patients in the epidural group experienced a significant drop in Intraoperative systolic blood pressure than the patients in the paravertebral group who had a minimal drop in blood pressure which is statistically significant.The patients in the epidural group experienced a significant drop in Intraoperative diastolic blood pressure than the patients in the paravertebral group who had a minimal drop in diastolic blood pressure which is statistically significant.[7] The significant incidence of hypotension in an epidural group compared to the thoracic paravertebral group correlates with the study of *Elmore B,et al.* This signifies that there is hemodynamic stability in the paravertebral block.The postoperative visual analog scale score between the two groups showed no significant difference with a p-value of 0. out of 354.Thus analgesia provided by paravertebral block is similar to that of analgesia provided by thoracic epidural which was previously considered the only gold standard technique for postop analgesia in thoracotomy surgeries. This study showed that continuous paravertebral block can also provide equal and adequate analgesia comparable to the thoracic epidural.[8] correlation with our study in which there is no significant difference in postoperative VAS scores between the two groups(p=0.736). The postoperative mean blood pressure, mean heart rate, mean respiratory rate and mean oxygen saturation between the continuous paravertebral and continuous thoracic epidural was

Volume 5, Issue 6; November-December 2022; Page No 620-627

found to be statistically insignificant over time and also between the two groups since the variation between them was minimal and the P>0.05. This signifies that the postoperative maintenance of hemodynamics was comparable in both groups. [9]The postoperative mean PEFR which indirectly predicts dynamic lung functions were found to be statistically significant as suggested by the student 't' test but over time it was found to be statistically insignificant. This signifies that Dynamic lung functions are well preserved in a continuous paravertebral group than continuous epidural group postoperatively which enables the patient to ambulate early, provide effective cough and reduce postop pulmonary complications. [10] This result correlates with Licker M et al. Eur J Cardiothorac Surg 2010 Feb, who studied 44 patients with TEB(n=19) and PVB(n=25) and found that there was no significant difference between the two groups concerning VAS, FEV1and PEFR. In contrast, adverse effects and duration of catheterization were statistically significantly lower in Group PVB (p=0.001 and p<0.001) [11] Licker M et al.., observed in their studies that there is no significant difference in pulmonary function tests after thoracotomy between patients receiving epidural and paravertebral analgesia this in contrast with our study that there is a significant decrease in postoperative dynamic lung functions (PEFR) between the two groups showing P value 0.003. [12] But McCormick F, et al who conducted a prospective randomized study observed that Paravertebral analgesia was better in terms of respiratory function than Epidural analgesia which is in correlation with our study.[13] From this study in both groups, the postoperative opioid requirement was minimal and hence the analgesic effect in both groups was comparable. There were no complications found in both the techniques in the postoperative period with better respiratory outcomes in the paravertebral group.[14,15]

Conclusion: Continuous Paravertebral block provides adequate analgesia without impairing the Dynamic lung functions postoperatively when compared to continuous Thoracic epidural for patients undergoing lateral thoracotomy. Paravertebral catheterization can be performed easily and in a short span perioperatively when compared with a Thoracic epidural. Therefore, continuous Paravertebral block might be the preferred method over Thoracic epidural.

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Volume 5, Issue 6; November-December 2022; Page No 620-627

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Volume 5, Issue 6; November-December 2022; Page No 620-627