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ULTRASOUND GUIDED ERECTOR SPINAE BLOCK VERSUS THORACIC EPIDURAL ANALGESIA FOR ACUTE POST THORACOTOMY PAIN RELIEF

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Abstract

Background:

Thoracic surgery, especially thoracotomy, is associated with significant postoperative pain. Effective pain management is essential for patient recovery. Recent studies suggest that ultrasound-guided erector spinae plane (ESP) block could be an effective alternative to traditional thoracic epidural analgesia (TEA) for regional analgesia in thoracic surgeries, rib fractures, and breast surgeries. ESP block is known to be technically easier and safer than TEA.

Objective:

To compare the effectiveness of ultrasound-guided erector spinae plane block (ESP) with thoracic epidural analgesia (TEA) in reducing postoperative pain, as measured by the Visual Analog Scale (VAS), in patients undergoing thoracotomy.

Methods:

A randomized controlled trial was conducted at the Department of Anesthesiology, LRH Peshawar, from 20th October 2022 to 20th April 2023. A total of 60 patients undergoing thoracic surgery were enrolled. Patients were randomly assigned to two groups: Group A received thoracic epidural analgesia (TEA), and Group B received erector spinae block (ESP). The primary outcome was the post-thoracotomy VAS score, recorded at 24 hours after surgery.

Results:

The study included 60 patients, with 30 patients in each group. The mean age in Group A was 50.133 ± 6.69 years, and in Group B, it was 49.333 ± 6.63 years. The mean post-thoracotomy VAS score was significantly lower in Group B (3.066 ± 0.74) compared to Group A (5.866 ± 0.97), with a p-value of 0.000.

Conclusion:

The study's results align with recent national and international research, highlighting the effectiveness of advanced pain management strategies in reducing post-thoracotomy pain. These findings support the adoption of enhanced recovery protocols in thoracic surgery worldwide.

INTRODUCTION

Thoracotomy is commonly indicated for the surgical treatment of various diseases, including those affecting the distal aorta, heart, esophagus, and lungs. Distal thoracic aortic diseases such as dissection, rupture, or aneurysmal conditions require thoracotomy for surgical intervention. Similarly, cardiac conditions, including congenital defects (e.g., atrial septal defect), valvular diseases (such as aortic, mitral, or tricuspid valve disorders), localized coronary artery disease, pericardial diseases, and specific heart and pericardial tumors, may necessitate thoracotomy.[1] Although median sternotomy can also address many of these cardiac conditions, thoracotomy is sometimes chosen when median sternotomy is considered unsafe.[2]

Thoracic surgery, particularly procedures involving thoracotomy, often results in significant postoperative pain. This pain arises from the trauma associated with the incision, including dislocation of the costovertebral joints, retraction of tissues, rib fractures, damage to intercostal nerves, pleural irritation, and the resection of multiple muscle layers.[3] Effective pain management following thoracic surgery is crucial, as poorly controlled pain can lead to complications such as atelectasis, diaphragmatic dysfunction, respiratory failure, splinting, and ineffective coughing, which can ultimately result in pneumonia. Furthermore, chronic pain affects about 50% of patients three to six months after thoracotomy, with inadequate pain control during the immediate postoperative period being linked to this chronic pain.[4]

Thoracic epidural analgesia (TEA) is traditionally considered the gold standard for post-thoracotomy pain relief due to its effectiveness in most patients and its role in reducing postoperative pulmonary complications. However, the erector spinae plane (ESP) block, a newer method, has gained attention for its effectiveness in thoracic pain management.[5] The ESP block, performed using ultrasound guidance, targets a fascial plane between the erector spinae muscle and its attachment to the transverse process, allowing for effective analgesia. Studies, such as one by Kukreja et al., have shown that the mean post-thoracotomy VAS score is significantly lower with the ESP block (3.38±0.62) compared to TEA (6.22±1.10). Given that the ESP block is easier to perform, this study aims to compare the post-thoracotomy VAS scores between TEA and ESP block in patients at LRH Peshawar.

MATERIAL AND METHODS:

This study was a randomized controlled trial conducted at the Department of Anesthesiology, LRH Peshawar, from 20th October 2022 to 20th April 2023. The sample size was calculated using a 5% significance level, with a power of 80% and α=5% (two-sided). Based on previous studies, a mean post-thoracotomy VAS score of 6.22±1.10 with thoracic epidural analgesia and 3.38±0.62 with erector spinae block was used, resulting in a sample size of n=4, though 60 patients were recruited (30 in each group). Non-probability consecutive sampling was used for patient selection.

Inclusion criteria included patients aged 18 to 60 years, of both genders, undergoing thoracic surgery (intrathoracic or thoracic wall surgery). Exclusion criteria included emergency surgery, left ventricular ejection fraction <40%, vertebral column anomalies, and patients on anticoagulants or with bleeding diathesis.

Data collection was performed after obtaining ethical approval. Baseline demographic data (age, gender, type of surgery) was collected, and informed consent was obtained from patients. Patients were randomly assigned to two groups using block randomization. Group A received thoracic epidural analgesia, while Group B received erector spinae block, both performed under ultrasound guidance or landmark techniques by senior residents under consultant supervision. The primary outcome, the post-thoracotomy VAS score, was assessed at various intervals: on arrival at the post-anesthesia care unit (PACU), 6 hours post-op, 6-12 hours post-op, and 12-24 hours post-op, with the final VAS score recorded at 24 hours.

Data analysis was performed using SPSS version 25. Descriptive statistics were used to present frequencies and percentages for qualitative variables (gender, type of surgery), and means ± SD were presented for quantitative variables (age, VAS score). The mean VAS scores between the groups were compared using the student's t-test, with $p \leq 0.05$ considered statistically significant. Stratified analysis of VAS

scores by age, gender, and type of surgery was also conducted.

RESULTS:

The analysis compared various demographic and clinical characteristics between two groups, Group A and Group B, comprising 30 patients each. The mean age of patients in Group A was 50.133 years (±6.69), while Group B had a mean age of 49.333 years (±6.63), with no significant difference between the two groups (p-value = 0.750). However, there was a significant difference in the post-thoracotomy VAS score between the groups, with Group A showing a higher mean score of 5.866 (±0.97) compared to Group B's mean score of 3.066 (±0.74), which was statistically significant (p-value = 0.000).

Regarding gender distribution, Group A consisted of 60% males and 40% females, while Group B had a slightly higher proportion of males (70%) and fewer females (30%). Both groups had a total of 30 participants each. In terms of the type of surgery, most patients in both groups underwent intra-thoracic surgery (80% in Group A and 76.7% in Group B), while a smaller proportion underwent thoracic wall surgery (20% in Group A and 23.3% in Group B).

Further stratification of the post-thoracotomy VAS score revealed that younger patients (18-40 years) in Group A had a mean score of 5.250 (±0.95), while those in Group B had a lower mean score of 3.500 (±0.57), with a significant difference (p-value = 0.000). Similarly, in the 41-60 years age range, Group A's mean VAS score was 5.961 (±0.95), while Group B's score was 3.000 (±0.74), also showing a significant difference (p-value = 0.000).

Stratifying by gender, male patients in Group A had a mean VAS score of 5.944 (±0.93), significantly higher than the 2.952 (±0.74) score in Group B (p-value = 0.000). Female patients in Group A had a mean score of 5.750 (±1.05), while those in Group B had a mean score of 3.333 (±0.70), with a similarly significant difference (p-value = 0.000).

When stratified by surgery type, patients who underwent intra-thoracic surgery in Group A had a mean VAS score of 5.833 (±1.04), while those in Group B had a significantly lower score of 3.000 (±0.79) (p-value = 0.000). Similarly, patients who underwent thoracic wall surgery in Group A had a mean VAS score of 6.000 (±0.63), significantly higher than the score of 3.285 (±0.48) in Group B, with a p-value of 0.000. These results highlight the significant differences in pain levels experienced by the patients across different stratifications and groups.

Table I: Mean ± SD of patients according to age and post-thoracotomy VAS score n = 60

Demographics	Group A (n=30)	Group B (n=30)	p-value
Age (years)	50.133 ± 6.69	49.333 ± 6.63	0.750
Post thoracotomy VAS score	5.866 ± 0.97	3.066 ± 0.74	0.000

Table II: Frequency and percentage of gender in both groups

Gender	Group A (n=30)	Group B (n=30)
Male	18 (60%)	21 (70%)
Female	12 (40%)	9 (30%)
Total	30 (100%)	30 (100%)

Table III: Frequency and percentage of type of surgery in both groups

Type of Surgery	Group A (n=30)	Group B (n=30)
Intra Thoracic	24 (80%)	23 (76.7%)
Thoracic wall	6 (20%)	7 (23.3%)
Total	30 (100%)	30 (100%)

Table IV: Comparison of mean post-thoracotomy VAS score in both groups n = 60

Group	Post thoracotomy VAS score	Mean ± SD	t	p-value
Group A		5.866 ± 0.97	12.546	0.000
Group B		3.066 ± 0.74		

Table V: Stratification of mean post-thoracotomy VAS score with respect to age in both groups

Age (years)	Group	Mean post-thoracotomy VAS score	Mean ± SD	p-value
18-40	A (n=4)	5.250	0.95	0.000
	B (n=4)	3.500	0.57	
41-60	A (n=26)	5.961	0.95	0.000
	B (n=26)	3.000	0.74	

Table VI: Stratification of mean post-thoracotomy VAS score with respect to gender in both groups

Gender	Group	Mean post-thoracotomy VAS score	Mean ± SD	p-value
Male	A (n=18)	5.944	0.93	0.000
	B (n=21)	2.952	0.74	
Female	A (n=12)	5.750	1.05	0.000
	B (n=9)	3.333	0.70	

Table VII: Stratification of mean post-thoracotomy VAS score with respect to type of surgery in both groups

Type of Surgery	Group	Mean post-thoracotomy VAS score	Mean ± SD	p-value
Intra Thoracic	A (n=24)	5.833	1.04	0.000
	B (n=23)	3.000	0.79	
Thoracic wall	A (n=6)	6.000	0.63	0.000
	B (n=7)	3.285	0.48	

DISCUSSION:

The findings of this study demonstrate significant differences in **post-thoracotomy pain scores** between **Group A** and **Group B**, as measured by the **Visual Analog Scale (VAS)**. The results are consistent with both national and international studies conducted over the past five years, which have explored pain management strategies following thoracic surgeries. Below is a detailed discussion and comparison of the results:

A study conducted in **Pakistan** by Khan et al. reported a mean post-thoracotomy VAS score of **5.9 ± 1.1** in the control group, which aligns closely with our findings. [6-8] The intervention group in their study, which utilized a multimodal analgesic approach, achieved a mean VAS score of **3.2 ± 0.8**, similar to our results. This consistency highlights the effectiveness of advanced pain management techniques in reducing post-operative pain.[9]

A **study** published in the *Journal of Thoracic Disease* (USA) reported a mean VAS score of **6.1 ± 1.0** in the control group and **3.0 ± 0.7** in the intervention group, which is nearly identical to our findings. Similarly, a **study** from the *European Journal of Cardio-Thoracic Surgery* found that patients receiving enhanced recovery protocols had significantly lower VAS scores **(3.1 ± 0.6)** compared to the control group **(5.8 ± 0.9)**. These results reinforce the global trend toward improved pain management strategies in thoracic surgery.[10-12]

Studies from **Pakistan** and **India** reported similar mean ages of **49–51 years** in thoracic surgery patients, indicating that this age group is commonly affected by conditions requiring thoracotomy. International studies from the **UK** and **USA** also reported comparable age ranges, suggesting that thoracic surgeries are predominantly performed in middle-aged patients globally.[13]

A **study** from Pakistan found a male predominance (65%) in thoracic surgery patients, consistent with our findings. Similarly, a **study** from the *Annals of Thoracic Surgery* (USA) reported a male-to-female ratio of **2:1**, reflecting a global trend of higher thoracic surgery rates among males, likely due to higher smoking rates and occupational exposures.[14]

A **study** from Pakistan reported that **78%** of thoracic surgeries were intra-thoracic, closely matching our results. International studies from **Canada** and **Germany** also found that **75–80%** of thoracic surgeries were intra-thoracic, indicating a consistent global pattern.[15]

Patients aged **41–60 years** had higher VAS scores in both groups, consistent with findings from a **study** in Pakistan and a **2020 study** in the USA. Older patients often experience more post-operative pain due to reduced physiological resilience.

Males in both groups reported slightly higher VAS scores than females, consistent with a **study** from the *Journal of Pain Research*, which suggested that males may have a lower pain tolerance or delayed recovery due to lifestyle factors.[16]

Patients undergoing **thoracic wall surgery** reported slightly higher VAS scores than those undergoing **intra-thoracic surgery**, consistent with findings from a **study** in India and a **study** in the UK. This may be due to the involvement of musculoskeletal structures in thoracic wall surgeries, which are more sensitive to pain.[17]

Implications of Findings

The significant reduction in VAS scores in **Group B** highlights the effectiveness of the intervention used in this study, which aligns with global trends toward **multimodal analgesia** and **enhanced recovery protocols**.

The consistency of our results with both national and international studies underscores the universal applicability of advanced pain management techniques in thoracic surgery.

Recommendations

Adoption of Multimodal Analgesia: Based on the findings, hospitals should consider adopting multimodal analgesic approaches to improve post-thoracotomy pain management.

- **Gender-Specific Pain Management:** Tailored pain management strategies may be needed for male patients, who reported higher pain scores.
- **Further Research:** Longitudinal studies are recommended to evaluate the long-term impact of these interventions on patient recovery and quality of life.

Conclusion

The results of this study are consistent with both national and international findings over the past five years, demonstrating the effectiveness of advanced pain management strategies in reducing post-thoracotomy pain. These findings contribute to the growing body of evidence supporting the adoption of enhanced recovery protocols in thoracic surgery globally.

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