Open Access

Original Article

Comparison of Analgesic Efficacy of Ultrasound-Guided Erector Spinae Plane Block with Local Anesthetic Infiltration Wound Site in Patients Undergoing Posterolateral Thoracotomy

Syed Majid Waseem, Zulfiqar Haider, Abdullah, Muhammad Saeed, Abdul Khaliq, Muhammad Ammar Amjad

Department of Anesthesia, Combined Military Hospital Multan/National University of Medical Sciences (NUMS) Pakistan

ABSTRACT

Objective: To compare the effects of preoperative ultrasound-guided Erector spinae plane block with local anesthetic wound site infiltration on postoperative pain score and opioid consumption in patients undergoing posterolateral thoracotomy.
Study Design: Quasi-experimental study.
Place and Duration of Study: Department of Anesthesia and Pain Management Combined Military Hospital, Multan Pakistan from Dec 2022 to May 2023.
Methodology: Sixty adult patients undergoing posterolateral thoracotomy were allocated randomly in two Groups, Erector spinae plane block Group X (n=30) and wound infiltration Group Y (n=30). In the ultrasound-guided Erector spinae plane block Group, Erector spinae plane block was performed with 0.5% Bupivacaine 20 ml at the level of thoracic vertebrae 5. In contrast, in the Wound Infiltration Group, 20 ml of 0.5% Bupivacaine was injected along the line of the surgical incision and also at the site of chest tube placement postoperatively. The postoperative opioid consumption and mean pain score at 01 hours, 06 hours, 12 hours, and at 24 hourS were assessed.
Results: Compared with the wound site infiltration Group, the mean Pain scores at 1 hour, 06 hours, 12 hours, and 24 hours were significantly less in the ESPB Group (p<0.001). Moreover, postoperative opioid consumption in the Erector spinae plane block Group was also significantly reduced postoperatively.
Conclusion: Compared to wound infiltration with local anesthetics, Ultrasound-guided erector spinae block could significantly reduce the postoperative pain score opioid consumption and reduce the incidence of opioids induced complications in patients undergoing thoracotomy.

Keywords: Local Anesthetics, Opioids, Postoperative Pain, Thoracotomy, Ultrasound.

How to Cite This Article: *Waseem SM, Haider Z, Abdullah, Saeed M, Khaliq A, Amjad MA. Comparison of Analgesic Efficacy of Ultrasound-Guided Erector Spinae Plane Block with Local Anesthetic Infiltration Wound Site in Patients Undergoing Posterolateral Thoracotomy. Pak Armed Forces Med J 2025; 75(1): 94-98. DOI: https://doi.org/10.51253/pafmj.v75i1.11026*

INTRODUCTION

Perioperative pain management is one the greatest challenges one can face during practice and plays a vital role in obtaining better outcomes of the surgery. Better postoperative pain management prevents the development of chronic postsurgical pain syndrome.[1] The incidence of postoperative pain after thoracic surgeries ranges from 20% to 60%.[2] Acute post-thoracotomy pain is of moderate to severe type, resulting from rib resections, rib retractions, and chest tube insertions.[3] Different modalities are being used to treat postoperative pain in patients undergoing thoracotomies, which include systemic analgesics including NASAID'S, opioids, locoregional anesthesia techniques, intercostal nerve blocks, paravertebral nerve blocks, thoracic epidural, and above all, multimodal analgesia.[4] Each technique has its risks and benefits. Nowadays, regional anesthetic techniques are most commonly practiced due to their cumbersome advantages over other modalities. Inadequate postoperative pain management results in unwanted local and systemic manifestations, which include hemodynamic variations, life-threatening arrhythmias, stasis of bronchial secretions, atelectasis, pneumonia, and delayed wound healing.[5]

In recent literature, locoregional techniques are much more efficacious than systemic analgesics because of opioids induced complications, which include respiratory depression, nausea, vomiting, and constipation.[6] Ultrasound-guided erector spinae plane (ESP) block is an interfacial plan technique.[7] When compared with other neuraxial techniques or peripheral nerve blocks, the ultrasound-guided erector spinae plane block is much easier to perform and has fewer complications.[8] In an ultrasound-guided erector spinae plane block, local anesthetic is injected deep into the erector spinae muscle and superficial to the tip of the transverse process of a thoracic vertebra in the myofascial plan.[9] The local anesthetic-induced sensory block at multiple dermatomal levels across the posterior, anterior, and lateral thoracic wall is

Correspondence: Dr Syed Majid Waseem, Department of Anesthesia, Combined Military Hospital, Multan Pakistan
Received: 10 Oct 2023; revision received: 14 Jul 2024; accepted: 23 Jul 2024

probably due to craniocaudal movement of local anesthetics and, ultimately, diffusion of local anesthetics into paravertebral space. Wound infiltration with local anesthetics is very simple, traditional, an effective analgesic technique and has been practiced for a long.[10]

This study aimed to determine the efficacy of Ultrasound-guided erector spinae plane block when compared with local anesthetic infiltration technique to reduce post-thoracotomy pain and ultimately reduce perioperative morbidity and mortality.

METHODOLOGY

The quasi-experimental study was carried out, from December 2022 to May 2023, in the Department of Anesthesia and Pain Management Combined Military Hospital, Multan. WHO sample size calculator was used for sample size calculation with the absolute population proportions in patients who developed chronic pain after thoracotomy in Group ESPB and Group LAI were 0.20 and 0.60, respectively.[11] Calculated sample size (n) was 30 in each Group.

Inclusion Criteria: All the patients of either gender aged 20 to 60 years of age with ASA II & III required right and left posterolateral thoracotomy were included.

Exclusion Criteria: The patients with a history of coagulopathies, known allergy or sensitivity to local anesthetic (Bupivacaine), BMI >35 kg/m2, and ASA IV were excluded.

After approval from the Institutional Review Board (ERC No. 81/2023 dated 10 May 2023) and written informed consent, 60 patients 20 to 60 years of age requiring posterolateral thoracotomy were included in the study. The technique used was non-probability consecutive sampling.

Patients were divided into two Groups using a computer-generated method. Group X (ESPB) received an ultrasound-guided erector spinae plane block on the side of the thoracotomy, and Group Y (LAI) received local anesthetic preparation into the surgical incision site and at the site of chest tube insertion by the infiltration method. All patients underwent general endotracheal anesthesia and were pre-medicated with IV metoclopramide 10 mg and dexamethasone 4 mg 30 minutes before induction. All patients were induced with injection of Nalbuphine 0.1 mg/kg and Propofol 2-2.5 mg/kg intravenously and maintained with inhaled anesthetics (Isoflurane) in 50 % oxygen with air. The airway was maintained with a double-lumen endotracheal tube, and mechanical ventilation was continued in continuous mandatory ventilation (CMV) mode (Figure).

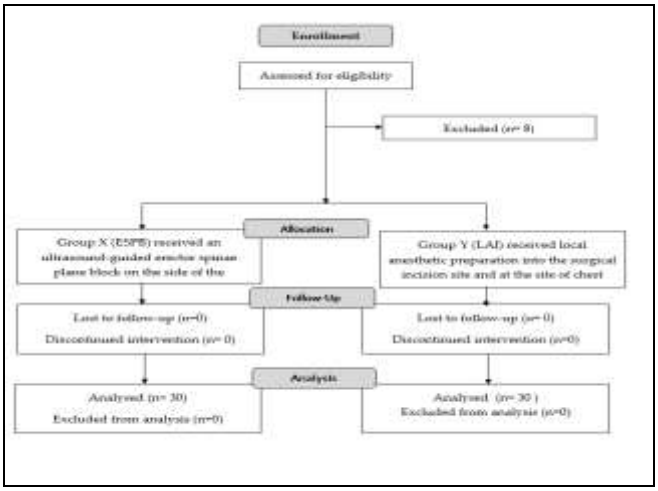

Figure: Patient Flow Diagram (n=60)

Group X (ESPB) patients received an Ultrasound erector spinae plan block immediately after completion of the surgical procedure with 20ml of 0.5% Bupivacaine on the side of the thoracotomy. At the same time, Group Y (LAI) patients received a similar dose of local anesthetic wound infiltration after the completion of the surgical procedure. The patient was placed in a lateral decubitus position, and a high-frequency linear ultrasound transducer was placed in a longitudinal orientation 3cm lateral to the transverse process of T5. Then, three muscular layers were identified superficial to the hyperechoic transverse process shadow, as follows: trapezius, rhomboid major, and erector spinae. Under Ultrasound guidance, a 10 cm 22gauge block needle was inserted in a plane in caused to cephalad direction until the tip was laid in the surface of the transverse process. Correct needle tip position was confirmed by the spread of linear fluid that separated the erector spinae from the transverse process. The 20ml of 0.5% Bupivacaine was injected deep into the erector spinae muscle. All the patients recovered from general anesthesia and were assessed for pain in the recovery area as soon they became conscious, at 1 hour, at 06 hours,12, and 24 hours inwards. Pain score was assessed by a numerical rating scale (NRS) ranging from 0-10. A score of 0 was taken as no pain, a score of 1-3 was considered as minimal pain, 4–7 was considered moderate pain, and 8-10 was severe pain and was treated with rescue analgesia. Average NRS

for 24 hours was calculated for individual patients and then used in statistical analysis. Moderate to severe pain was treated with an injection of Nalbuphine 2.5 mg IV PRN, and the total rescue dose consumed in 24 hours was calculated. The mean pain score and mean nalbuphine dose consumed in 24 hours were calculated in both Groups. Patients were also monitored for any procedure (ESPB & LAI) related complications.

Statistical Package for Social Sciences (SPSS) version 23.0 was used for the data analysis. Descriptive statistics were done for age, weight, gender, and ASA level. Median and IQR were calculated for the pain score (NRS) in both Groups. Mann-Whitney U test was applied to compare the mean ranks of the numerical pain scale. Mean±SD were calculated for quantitative variables. The *p*-value of less than or equal to 0.05 was considered statistically significant.

RESULTS

A total of 60 patients were included in the study and divided into two Groups. Both Groups had 30 patients in each. The mean age in Group X(ESPB) and Group Y (LAI) was 44.27±10.21 and 42.50±10.56 years, respectively. The mean weight in Groups X and Y were 71.83±9.10 and 71.47±6.92 kg. In Group X, 18 patients were ASA-II, and 12 were ASA-III; similarly, in Group Y, 16 patients were ASA-II, and 14 were ASA-III, respectively. In Group X, male to female ratio of patients was 21 (n=30) and 9 (n=30); similarly, in Group Y was 19 (n=30) and 11(n=30). Median (IQR) in Group X was at 01 hours 3(1), 06 hours 2(1),12 hours 4(1), and 24 hours 3(1), and similarly in Group Y, were at 01 hours 4(2), 06 hours 4.5 (1),12 hours 6 (2) and 24 hours 7 (1). The mean rescue analgesia dose required in Group X in 24 hours was 4.25±1.75 mg, and in Group Y was 10.91±4.22 mg of injection Nalbuphine (*p*-value <0.005).

Table-I: Patient Demographic Data (n=60)

Parameters	Group X (ESPB) (n=30)	Group Y (LAI) (n=30)
Age		
(Mean+SD)	44.27±10.21	42.50±10.56
Weight		
(Mean+SD)	71.83 ± 9.10	71.47±6.92
ASA Status		
ASA II	18 (60%)	16(53.34%)
ASA III	12 (40%)	14(46.66%)
Gender		
Male	21(70%)	19(63.34%)
Female	09(30%)	11(36.66%)

When we compared both Groups, there was a statistically significant difference between the two Groups.

There was a statistically significant reduction in analgesic consumption in Group X as compared to Group Y (*p*-value <0.001).

Table-II: Distribution of Pain Score (n=60)

Outcome Variables	Group X (Median, IQR) (n=30)	Group Y (Median, IQR) (n=30)	*p*-value
Median(IQR) for Pain Score			
(NRS) at 01 Hour	3(3-2)	4(5-3)	<0.001
Median(IQR) for pain Score			
(NRS) at 06 Hour	2 (3-2)	4.5 (5-4)	<0.001
Median(IQR) for pain Score			
(NRS) at 12 Hour	4(4-3)	6(7-5)	<0.001
Median(IQR) for pain Score			
(NRS) at 24 Hour	3(4-3)	7(8-7)	<0.001

Table- III: Rescue Analgesia Required in the Study Groups (n=60)

Outcome Variables	Group X (Mean±SD) (n = 30)	Group Y (Mean±SD) (n=30)	*p*-value
Rescue Analgesia Required (mg)	4.25±1.75	10.91±4.22	<0.001

DISCUSSION

Pain after thoracotomy is very severe and persists for a longer period of time due to wider surgical incision; if it is not treated well, it can lead to serious postoperative complications.[12] In order to prevent post-thoracotomy pain, longer and continuous analgesia techniques must be applied. In our study, USG, USG-guided erector spinae block proved to have a better quality of analgesia than local anesthetic infiltration at surgical incision sites with fewer postoperative rescue analgesic requirements. Local anesthetic infiltration at the surgical incision site is a traditional and most commonly practiced post-operative analgesia method, which has been widely performed due to procedural simplicity. In contrast, ultrasound-guided erector spinae block is a novel technique that requires an expert hand and good knowledge of ultrasonography.

Our results have been comparable with different studies as mentioned in the literature, as Qiang Wang *et al*., compared the analgesic efficacy of Ultrasound-guided erector spinae block with local anesthetic infiltration in 60 patients undergoing esophagectomies. Compared to wound site infiltration, the intra-

operative and postoperative opioid consumption and pain scores were significantly less immediately after the surgery in patients undergoing Ultrasound-guided erector spinae block.[13]

In another study conducted by Lomate P *et al*., 60 patients were enrolled, and 56 patients were analyzed. It showed that the mean duration of analgesia was prolonged (16.8±2.14 hours) in the erector spinae Group when compared with the wound site infiltration Group (6.93±2.15 hours), which was statistically significant. The visual analog score, number of rescue analgesics required, and total consumption of tramadol in 24 hours were also significantly less in the erector spinae Group.[14] Abo Zeid *et al*., compared single-shot paravertebral block with local anesthetic infiltration in thoracoscopic surgery; when comparing both techniques, the para-vertebral block had analgesic superiority to the local anesthetic infiltration of the surgical site in terms of postoperative pain reduction and improvement in respiratory functions.[15]

Erector spinae block is comparable with thoracic epidural, paravertebral block, intercostal nerve block, and intrapleural analgesia. Nagaraja *et al*., showed that erector spinae block had a comparable pain score with thoracic epidural analgesia and proved to be an effective alternative to thoracic epidural in perioperative pain management and fast-tracking.[16] Durey *et al*., showed that erector spinae block was associated with less postoperative pain at 24 hours than paravertebral block after VATS or RATS in patients undergoing lung cancer surgery.[17] In a systemic review by Luo *et al*., showed low-quality evidence that erector spinae plane block exhibits superior analgesia compared to no block in children undergoing surgeries.[18]

In our study, we found that Erector spinae block is comparable to local anesthetic infiltration for short-term analgesia, i.e., less than 24 hours, but not comparable for long-term analgesia, i.e., more than 24 hours; erector spinae block could also provide superior analgesia for longer duration especially till 24 hours after surgery. There were fewer opioid requirements in the erector spinae Group when compared to the local anesthetic Group. No complications were observed in the erector spinae Group. However, erector spinae block-associated complications are failure to achieve the desired level of block, vascular injury, pneumothorax, and nerve injuries.

ACKNOWLEDGMENTS

Staff of the anesthesia department for their complete support in patient management and data collection.

LIMITATIONS OF STUDY

In our study, pain score observation was limited to 24 hours post-operatively, and the sample size was small. Furthermore, Ultrasound-guided erector spinae block is skill-dependent, time-consuming, and has more financial impact as compared to the simple, traditional, and quick local anesthetic wound infiltration. Our results are comparable to many studies, but some studies also have different results from this observation.

CONCLUSION

Compared to wound infiltration with local anesthetics, Ultrasound-guided erector spinae block could significantly reduce the postoperative pain score and opioid consumption and reduce the incidence of opioids induced complications in patients undergoing thoracotomy.

Conflict of Interest: None.

Funding Source: None.

Authors Contribution

Following authors have made substantial contributions to the manuscript as under:

SMW & ZH: Conception, study design, drafting the manuscript, approval of the final version to be published.

A & MS: Data acquisition, data analysis, data interpretation, critical review, approval of the final version to be published.

AK & MAA: Conception, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

REFERENCES

1. Thapa P, Euasobhon P. Chronic postsurgical pain: current evidence for prevention and management. Korean J Pain 2018; 31(3): 155-173. https://doi.org/10.3344/kjp.2018.31.3.155
2. Kristensen AD, Pedersen TA, Hjortdal VE, Jensen TS, Nikolajsen L. Chronic pain in adults after thoracotomy in childhood or youth. Br J Anaesth 2010; 104(1): 75-79. https://doi.org/10.1093/bja/aep317
3. Kelsheimer B, Williams C, Kelsheimer C. New Emerging Modalities to Treat Post-Thoracotomy Pain Syndrome: A Review. Mo Med 2019; 116(1): 41-44.
4. Mijatovic D, Bhalla T, Farid I. Post-thoracotomy analgesia. Saudi J Anaesth 2021; 15(3): 341-347. https://doi.org/10.4103/sja.SJA_743_20
5. Joshi GP, Ogunnaike BO. Consequences of inadequate postoperative pain relief and chronic persistent postoperative pain. Anesthesiol Clin North Am 2005; 23(1): 21-36. https://doi.org/10.1016/j.atc.2004.11.013
6. Paul AK, Smith CM, Rahmatullah M, Nissapatorn V, Wilairatana P, Spetea M, et al. Opioid Analgesia and Opioid-Induced Adverse Effects: A Review. Pharmaceuticals 2021; 14(11): 1091. https://doi.org/10.3390/ph14111091

7. Pirsaharkhiz N, Comolli K, Fujiwara W. Utility of erector spinae plane block in thoracic surgery. J Cardiothorac Surg 2020; 15: 91. https://doi.org/10.1186/s13019-020-01118-x
8. Hu Y, Li M, Li J, Lyu Q, Jiang R, Du Y, et al. Effects of ultrasound-guided erector spinae plane block on the immune function and postoperative recovery of patients undergoing radical mastectomy. Gland Surg 2021; 10(10): 2901-2909. https://doi.org/10.21037/gs-21-603
9. Chin KJ, El-Boghdadly K. Mechanisms of action of the erector spinae plane (ESP) block: a narrative review. Can J Anaesth 2021; 68(3): 387-408. https://doi.org/10.1007/s12630-020-01875-2
10. Hong JH, Park JH, Shim JW. Comparison of Craniocaudal Spread of Lumbar Erector Spinae Plane Block with Two Volumes of Local Anesthetics. Pain Physician 2023; 26(3): 265-272.
11. Stamenkovic DM, Bezmarevic M, Bojic S, Unic-Stojanovic D, Stojkovic D, Slavkovic DZ, et al. Updates on Wound Infiltration Use for Postoperative Pain Managem: A Narrative Review. J Clin Med 2021; 10(20): 4659. https://doi.org/10.3390/jcm10204659
12. Gerner P. Postthoracotomy pain management problems. Anesthesiol Clin 2008; 26(2): 355-367. https://doi.org/10.1016/j.anclin.2008.01.007
13. Wang Q, Zhang G, Wei S, He Z, Sun L, Zheng H, et al. Comparison of the effects of ultrasound-guided erector spinae plane block and wound infiltration on perioperative opioid consumption and postoperative pain in thoracotomy. J Coll Physicians Surg Pak 2019; 12(29): 1138-1143. https://doi.org/10.29271/jcpsp.2019.12.1138
14. Lomate P, Jadhav VR, Yadav A. Comparison of the efficacy of erector spinae plane block and peritubal infiltration of levobupivacaine for postoperative analgesia following percutaneous nephrolithotomy. J Anaesthesiol Clin Pharmacol 2021; 37(4): 574-579. https://doi.org/10.4103/joacp.JOACP_430_19
15. Abo-Zeid MA, Elgamal MM, Hewidy AA, Moawad AA, Adel Elmaddawy AE. Ultrasound-guided multilevel paravertebral block versus local anesthesia for medical thoracoscopy. Saudi J Anaesth 2017; 11(4): 442–448. https://doi.org/10.4103/sja.SJA_292_17
16. Nagaraja PS, Ragavendran S, Singh NG, Asai O, Bhavya G, Manjunath N, et al. Comparison of continuous thoracic epidural analgesia with bilateral erector spinae plane block for perioperative pain management in cardiac surgery. Ann Card Anaesth 2018; 21(3): 323-327. https://doi.org/10.4103/aca.ACA_16_18
17. Durey B, Djerada Z, Boujibar F, Besnier E, Montagne F, Baste J-M, et al. Erector Spinae Plane Block versus Paravertebral Block after Thoracic Surgery for Lung Cancer: A Propensity Score Study. Cancers 2023; 15(8): 2306. https://doi.org/10.3390/cancers15082306
18. Luo R, Tong X, Yan W, Liu H, Yang L, Zuo Y, et al. Effects of erector spinae plane block on postoperative pain in children undergoing surgery: A systematic review and meta-analysis of randomized controlled trials. Paediatr Anaesth 2021; 31(10): 1046-1055. https://doi.org/10.1111/pan.14255