Section: Anaesthesia

Original Research Article

STUDY OF EFFICIENCY AND SAFETY PROFILES OF ANAESTHE-SIA IN MULTIPLE RIB FRACTURES BY USING THORACIC EPI-DURAL AND ERECTOR SPINAL PLANE BLOCK

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ABSTRACT

Background: Emergency rib fracture pain can be treated with "Erector Spinae Plane Block (ESPB)". It anaesthetizes the posterior, anterior, and lateral chest walls, including the damaged ribs and periosteum, by injecting a local anaesthetic into the erector spinal plane. ESPB is more ergonomic than "serratus anterior plane block (SAPB)" in cases of numerous rib fractures with "intercostal chest drain (ICD)" in situ. **Aims and Objectives:** The purpose of this study is to evaluate the efficacy and safety of thoracic epidural and erector spinal plane blocks for the treatment of numerous rib fractures. **Materials and Methods:** From December 2022 to July 2023, Medical college Hospital's trauma unit undertook this prospective, randomised, double-blinded trial. Two equal groups got ordinary bupivacaine 0.5% and dexamethasone: the paravertebral injection group and the erector spine injection group. Before ultrasound-guided operations, patients were evaluated and examined. VAS measured pain alleviation. Pre-surgery cardiovascular stability and pain management comprised intravenous paracetamol and morphine. An independent physician without block technique knowledge collected data. **Result:** The Thoracic Epidural and Erector Spinal Plane Block for rib fractures had similar demographic and clinical characteristics in a study. Neither rib fracture size nor location differed statistically. The trauma mechanism did not differ between the two groups. TPVB relieved coughing pain more than rescue analgesics. TPVB increased the risk of hypotension, emphasising the need to monitor and consider each technique's effects. **Conclusion:** In conclusion, Thoracic Epidural and Erector Spinal Plane Block relieve rib fracture pain. ESPB reduces unwanted effects and the procedure selection requires physician judgement.

INTRODUCTION

Due to considerable mortality as well as morbidity rates of up to 33%, "multiple rib fractures (MRFs)" caused by high-velocity blunt thoracic trauma necessitate "intensive care unit (ICU)" admission. Being unable to cough and poorly controlled thoracic cage pain increases the risk of pneumonia, severe atelectasis, and pulmonary secretion retention. In the "emergency room (ED)", rib fracture patients frequently present. Rib fracture pain may limit pulmonary function and lead to hypoxemia or pneumonia, which could require mechanical ventilation. The patient's ability to inhale deeply, avoid intubation, and efficiently clear mucus will help to decrease respiratory conditions if their rib fracture pain is adequately relieved.[1,2]

Regional anaesthesia is one component of a multimodal approach that is necessary for the best pain control after a rib fracture. Since conventional RA methods are not easily accessible in the emergency department, patients receive multiple administrations of narcotic analgesics to manage their pain. Due to many side effects, including respiratory depression, opioids have their own disadvantages.[3]

The use of neuraxial and para-neuraxial blocks is restricted and prohibited by hemodynamic instability, coagulopathy, patients using anticoagulants, and placement. Additionally, in critically ill intubated patients, nerve damage, and epidural hematoma may go unnoticed. Additionally, damage to the spine or the nervous system prevents these blocks from being used. Erector spinal plane block (ESPB) which is ultrasound (US) guided is an inter-fascial plane block that enables catheter implantation and local anaesthetic infusion in the

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plane superficial to the transverse processes as well as deep to the spine's erector spinal muscle.[4,5]

In order to manage the pain associated with rib fractures, Truitt et al. introduced facial plane blocks, whereby "local anaesthesia (LA)" was infiltrated superficially into the rear ribs using tunnelled catheters. Since then, a variety of RA methods have been created that involves injecting the local anaesthetic solution guided by ultrasound from the thoracic spinal lamina through the sternum facial planes to anaesthetize different areas of the thorax.[6] Erector spinae plane block, serratus anterior plane block, rhomboid intercostal and sub serratus (RISS) block, and erector spine plane block are three facial plane blocks that may be employed to manage rib fracture pain.[5]

Contrary to lumbar epidural injections, which spread more cephalically, local anaesthesia given at the level of the thoracic epidural had been demonstrated to dissipate at a 2:1 cauda-cephalic ratio blocking fewer dermatomes above the area of injection. Despite the fact that it is generally agreed that a sensory block with no more than four dermatomes would be sufficient for VATS, some patients might need expanded sensory levels. The amount of the medicine and the location of the injection are key factors in deciding how widely an epidural may spread.[5] The epidural zone is a smaller region than the ESP and is encircled by the spinal column. When local anaesthesia is injected in the myofascial planes deep to the erector spinal muscle and superficial to the upper half of the transverse process, the posterior, anterior, and lat-eral thoracic walls of the thorax are likely to expe-rience sensory block at multiple dermatomal levels.[6] The analgesic effect seems to be the result of LA's diffusion into the paravertebral region, where it works on the ventral and dorsal rami of the tho-racic spinal neurons in addition to the rami com-municants that feed the sympathetic neural chain. The ESP plane is larger than the epidural space thanks to the erector spinal muscle's ability to cross the entire length of the thoracolumbar spine.[7]

The erector spinal plane, which is located among the posterior part of the spinal transverse processes and the anterior part of the spinal erector spinal muscles, is the area that the ESPB is intended to treat. The dorsal part of the spinal cord is anaesthe-tized after LA is injected into the erector spinal plane, which delivers anaesthesia to the posterior chest wall. The ventral ramus and intercostal nerves are anaesthetized as a result of LA spreading anteriorly as well. This provides analgesia to a significant section of the anterior and lateral chest wall as well as the broken ribs and periosteum through the anterior and lateral branches of the intercostal nerves.[8]

Fractures of the ribs have been treated with serratus anterior and erector spinae plane blocks, with varying degrees of analgesia. Serratus anterior plane block is problematic to administer in patients having multiple fractures in the rib with intercostal chest drain (ICD) in situ due to awkward ergonomics. As opposed to SAPB, ESPB offers better ergo-nomics for blocking in emergency situations.[8]

MATERIALS AND METHODS

Research Design

This interventional, prospective, randomized, dou-ble-blinded study was conducted at the trauma unit of the Hospital, from December 2022 to July 2023. Patients were randomly allocated into 2 equal groups: group 1 Paravertebral injection group: patients received pain relief by paraverte-bral injection of plain bupivacaine 0.5% and dex-amethasone.

Erector Spinae injection group 2 patients received thoracic erector spinae injection of plain bupiva-caine 0.5% and dexamethasone. The study con-sidered the history of the patients, did the physical examination and reviewed the investigations. An intravenous channel was made using an 18-gauge cannula. Systematic assessment, history gathering, physical examination, and standard investigations were performed on the patients. The participants learned how to report discomfort using "Visual Analogue Scales (VAS)". Cardiovascular stability and surgical needs were addressed before ultra-sound-guided PVB or ESPB surgeries. Paracetamol was given intravenously. In cases of severe pain, intravenous morphine was given. An independent physician evaluated and collected data without knowing the block method.

Inclusion and Exclusion Criteria

Inclusion

- Patients who have had several rib fractures on one side.
- Patients with a VAS pain score of 7 or higher.
- Patients without a broken sternum or broken ribs on both sides.
- Patients who are able to express themselves clearly.

Exclusion

- Patients that are unable to express emotions properly.
- Patients who have suffered a broken sternum or two broken ribs on each side.
- Patients have pain ratings of 7 or higher on the VAS visual analogue scale.
- Individuals who already have a spinal deform-ity.
- Patients experiencing injection-site sepsis.
- Coagulopathy sufferers.
- Patients who were already allergic to the study's local anaesthetic were excluded.
- Patients who have suffered serious trauma to areas other than the chest (such as a fractured spine or pelvis, a severe head or spinal cord in-jury, or a ruptured organ in the abdomen).

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Statistical Analysis

The statistical analysis included a power analysis, which compared a sample size of 100 patients with an alpha error level of 0.05 and a research power of 90%. SPSS version 24 analysed the data and performed many statistical tests. Tests like chi-square or Fisher's exact were used for qualitative variables. Quantitative data were analysed using parametric or nonparametric tests. For nonparametric pre/post-treatment comparisons, Wilcoxon's signed rank test was used. Kaplan-Meier analysis determined the meantime until analgesic delivery. Statistical significance is shown by the p-value be-low 0.05.

RESULTS

The table 1 illustrates the demographic and clinical features of two cohorts in a research study, wherein one cohort received "Thoracic Epidural and the other cohort received ESPB as an intervention for rib fractures. The groups exhibited comparable gender distributions, ages, weights, heights, and BMIs, suggesting a well-balanced representation. No statistically significant differences were seen in terms of the size or location of rib fractures among the groups. The data indicate that both "thoracic paravertebral block (Paravertebral injection group)" and "thoracic epidural block (TESB)" treatments were utilized on a wide range of patient profiles. In general, the study appears to have successfully accounted for these variables, facilitating a targeted evaluation of the respective outcomes of the two techniques in the treatment of rib fractures.

Table 1: Patients' Characteristics of both study groups

Characteristic	Paravertebral injection group (n = 51)		Erector Spinae injection group (n=49)		p-value
Gender: No (%)					
Male	44	86.27%	46	93.87%	
Female	7	13.72	3	6.12%	
Age group (years)	34.60±11.49		35.33±11.44		0.715
Weight (kg)	77.29 ±8.91		75.25 ± 8.25		0.519
Height (cm)	169.50 ±7.10		169.48± 7.49		0.845
BMI (kg/m2)	24.09 ±2.13		24.01 ±1.53		0.364
Side: Right Left	 30 21	 58.82% 41.17%	 25 24	 51.02% 48.97%	0.679
Site of the fracture: Anterior Posterior Lateral	 20 16 15	 39.21% 31.37% 29.41%	 11 20 18	 22.44% 40.81% 36.73%	0.812
Number of fractured ribs	4.69 ±1.25		4.39 ±1.09		0.336

Table 2 presents a comparison of the trauma mechanism between the group receiving Thoracic Epidural and the group receiving Erector Spinal Plane Block in the conducted study. The presented table provides information regarding the frequency and proportion of patients within each category who encountered various mechanisms of trauma. Within the Paravertebral injection group group, it was observed that 58.82% of patients encountered trauma as a result of traffic accidents, while 29.41% suffered "falls from height (FFH)". Additionally, 5.88% of patients reported trauma caused by direct strikes, and an equal percentage of 5.88% attributed their injuries to animal hits. Within the Erector Spinae injection group, the observed proportions were as follows: road accidents accounted for 57.14%, FFH accounted for 30.61%, direct blows accounted for 12.24%, and there were no reported instances (0.0%) of animal impacts. The obtained p-value of 0.439 indicates that there is insufficient evidence to support the pre
sence of statistically significant variations in the mechanisms of trauma between the two groups.

Table 2: Mechanism of trauma in Paravertebral injection group vs.Erector Spinae injection group groups

Mechanism of trauma	Group 1 (Paravertebral injection) (n = 51)		Group 2 (Erector Spinae injection) (n=49)		Group 3 (Paravertebral injection) (n = 51)		P value
	No.	%	No.	%	No.	%	
Traffic accident	30	58.82%	28	57.14%	58	58.0%	
FFH	15	29.41%	15	30.61%	30	30.0%	
Direct blow	3	5.88%	6	12.24%	9	9.0%	
Animal hit	3	5.88%	0	0.0%	3	3.0%	.439

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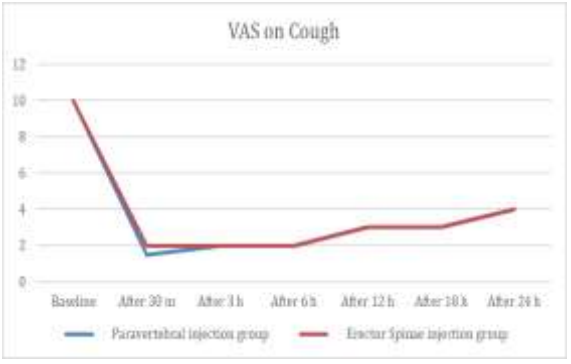
The study conducted a comparison of rescue analgesic use between patients who underwent the Thoracic Epidural and the Erector Spinal Plane Block as presented in Table 3. The period until initial res-cue analgesia was not statistically different be-tween the two cohorts. "Thoracic paravertebral block (Paravertebral injection group)" patients re-ported pain alleviation at 18.89 hours, while Erec-tor Spinae injection group patients reported pain relief at 16.78 hours. Paravertebral injection group and Erector Spinae injection group groups received a median of 5.89 mg and 6.88 mg of rescue morphine, respectively. Rescue morphine was needed by 54.90% of Paravertebral injection group pa-tients and 53.06% of Erector Spinae injection group patients. This study found no statistically significant changes in the need for additional pain management between the two groups, indicating that both therapies controlled pain similarly.

Table 3: Patients required rescue post analgesia

	Group 1 Paravertebral injection group (n = 51)	Group 2 Erector Spinae injection group (n=49)	P value
Time to first rescue analgesia (hours) mean (Std. Error)	18.89	16.78	0.199
Total dose of rescue morphine (mg) Median (Range)	5.89	6.88	0.189
No. of patients who required rescue morphine (%)	28 (54.90%)	26 (53.06%)	0.418

The comparison of pain intensity, as measured on the Visual Analog Scale (VAS), at rest and during cough is presented in Table 4. This comparison is made between patients who received Thoracic Epidural and the Erector Spinal Plane Block. Many VAS ratings were recorded after surgery. Both groups initially had comparable discomfort during rest (8.0) and coughing (10.0). After 30 minutes, the Paravertebral injection group had a significantly lower VAS score during cough (1.5) than the Erector Spinae injection group group (2.0) (p-value = 0.042*). However, pain levels during rest and coughing were not statistically different across groups. Thoracic paravertebral block (Paraverte-bral injection group) may reduce coughing pain slightly better in the hours after therapy. Both methods handle pain similarly for the rest of the observation.



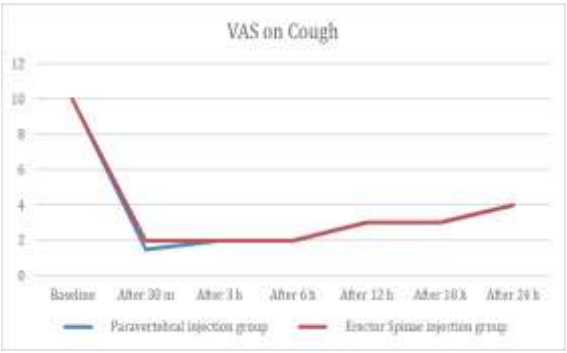


Figure 1: VAS at rest and during Cough in Paravertebral injection group vs.Erector Spinae injection group groups

Table 4 compares difficulties in Paravertebral injection group and Erector Spinae injection group patients. 15.68% of Paravertebral injection group patients reported hypotension, but no Erector Spinae injection group patients did. In this study, Paravertebral injection group patients had a greater risk of hypotension (p-value = 0.022*). Bradycardia and vascular puncture were similar across groups. Paravertebral injection group had 7.84% bradycardia, but Erector Spinae injection group had none. However, the observed difference between the two groups was not statistically significant (p-value 0.489). Thoracic Epidural (Paravertebral injection group) had 11.76% vascular puncture. Compared to Erector Spinal Plane Block, which had no vascular puncture, this difference was not statistically significant (p-value = 0.229). This study highlights the importance of rigorous surveillance and thoughtful examination of the potential repercussions of each strategy in actual application.

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Table 4: Complications of both the techniques

Complication	Group 1 Paravertebral injection group (n = 51)		Group 2 Erector Spinae injection group(n =49)		P value
	No.	%	No.	%	
Hypotension	8	15.68%	0	0.00%	0.022*
Bradycardia	4	7.84%	0	0.00%	0.489
Vascular puncture	6	11.76%	0	0.00%	0.229

DISCUSSION

Mostly 11.8% of all patients experiencing trauma gets rib fractures, which are most frequently caused by blunt thoracic trauma. In order to improve pulmonary hygiene and ward off pneumonia and atelectasis, adequate pain relief is essential.[5,6] The treatment of pain following severe thoracic trauma makes use of the erector spine plane block, which is on of the most unique multiple thoracic ultrasound-guided procedures, in particular, be-cause it can offer analgesic effects to both the an-terior as well as posterior hemithorax. In a study of individuals with numerous rib fractures, the analgesic safety and efficacy were compared between ultrasound-guided thoracic paravertebral block and ultrasound-guided erector spinae plane block.[7] According to the study's findings, thoracic erector spinae plane blocks guided by ultrasound were equally as efficient as thoracic paravertebral blocks at relieving pain for individuals with unilaterally multiple rib fractures. These blocks also had a similar period of analgesic effect, reduced opioid intake, and steady hemodynamic profiles. The thoracic erector spinae plane block, however, offered the benefit of a decreased incidence of side effects.[8,9]

Following repeated fractures of the ribs, regional anaesthetic frequently aids in enhancing pain and respiratory function. Due to its relative ease and alleged safety, the erector spine plane block has taken over as the preferred technique in our institution. The retrospective cohort study's goal was to ascertain how well it affected analgesic and pulmonary outcomes. Erector spinae plane blocks, in the aftermath of rib fracture, were linked to better inspiratory capacity and analgesic results without causing hemodynamic instability. When other regional analgesic methods are not practical, we suggest that they be taken into consideration as a potential substitute.[10]

A 73-year-old man who is diagnosed with left 4th–11th rib fractures was presented in a case report. His discomfort and spirometry incentive enhanced as a consequence of the continuous erector spine plane catheter that was initially used to treat him. Sadly, he continued to deteriorate, and only the insertion of a T6-T7 epidural infusion and catheter of bupivacaine could save him from impending respiratory failure. The case study demonstrates that a continuous erector spinae plane block may be a beneficial regional anaesthesia strategy in the treatment of rib fractures due to its capacity to improve pain management and increase incentive spirometry volumes. The fact that the patient's condition continued to deteriorate despite receiving a thoracic epidural to prevent respiratory failure further raises the possibility that its usefulness may have some limitations.[11]

Fractures of rib are a frequent after of trauma of chest and are linked to high morbidity. The erector spinae nerve block (ESB) has been proposed as an alternative first-line regional treatment for rib fractures because of its ease of administration and minimal risk of sequelae. The study's objective was to review the existing literature on this subject with an emphasis on pain and respiratory effects. Current research on the use of ESB in the treatment of rib fractures offers a favourable qualitative assessment of effectiveness and safety. Almost everyone experienced improvements in their respiratory and pain measures. The enhanced safety profile of ESB was the review's notable result. Even in cases when coagulopathy and anticoagulation were present, the ESB was not linked to problems that required medical attention.[12]

Multiple rib fractures from blunt chest wall trauma are common, and painful, and may affect the mechanics of the ventilator. Analgesia plays a significant role in the management of rib fractures. Opioids are helpful, but when used as the only medication, they may be so potent that they cause respiratory depression, particularly among elderly people. Constant epidural injection of local anaesthetic has the best kind of analgesic effect for a serious chest wall injury. A complete analgesia effect is provided, enabling inhalation and coughing with-out the danger of respiratory depression. According to the study, thoracic epidural analgesia is more effective than intercostal blocks at relieving rib fracture pain. At all study times, patients receiving epidural analgesia had considerably less pain levels.[13]

A retrospective evaluation of systemic patient-controlled and thoracic epidural analgesia practices in patients with thoracic trauma was performed. Retrospective evaluations were done on patients who had numerous rib fractures from thoracic trauma and had been brought to the intensive care unit. 50 patients who are meeting the following criteria had their data collected: 3 or more fractures of rib, PCA with fentanyl started intravenously, or thoracic epidural analgesia with fentanyl and bupivacaine. The study found that thoracic epidural analgesia is preferable because it offers more effective analgesia and shortens the length of stay in the intensive care unit for patients with more than three fractured ribs who require intensive care.[14]

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An innovative ultrasound-guided procedure called the erector spine plane block has been recently developed for the treatment of rib fracture discomfort in the emergency room. This analgesic block has been used to treat chronic thoracic pain and post-operative pain, and it is often administered by critical care or anaesthesia experts. A potential treatment option for rib fracture pain in the emergency room is erector spinae plane block. For treating acute pain brought on by multiple rib fractures, emergency physicians can use the safe and efficient erector spinae plane block in emergency room settings.[15]

CONCLUSION

The study has concluded that "paravertebral block (PVB)" and ultrasound-guided "erector spinae plane block (ESPB)" are equally effective at relieving pain in patients with unilateral multiple rib fractures. They both keep blood pressure and heart rate constant while effectively reducing pain and the need for opioids. On the other hand, ESPB has fewer side effects overall. The decision between PVB and ESPB is left up to the discretion of the treating physician, who may base their decision on his or her own clinical experiences and preferences. Both approaches are practical and useful for treating pain in this patient population. A catheter was not inserted, and rather than continuous infusions, the patient received injections at irregular intervals. For the best results, it is best to use a catheter that stays put for a continuous section. Booster dosages were required later because of the use of dexamethasone as an adjuvant with local anaesthetics. Direct comparison may not be optimal due to differences in methodology and sample size limits. Additionally, those with addiction were not excluded from the study.

REFERENCES

1. Adhikary, S. D., Pruett, A., Forero, M., & Thiruvenkatarajan, V. (2018). Erector spinae plane block as an alternative to epidural analgesia for post-operative analgesia following video-assisted thoracoscopic surgery: A case study and a literature review on the spread of local anaesthetic in the erector spinae plane. Indian Journal of Anaesthesia, 62(1), 75-78. https://doi.org/10.4103/ija.IJA_693_17
2. Kumar, G., Bhoi, S. K., Sinha, T. P., & Paul, S. (2021). Erector spinae plane block for multiple rib fracture done by an Emergency Physician: A case series. Australasian Journal of Ultrasound in Medicine, 24(1), 58-62. https://doi.org/10.1002/ajum.12225
3. Diwan, S. M., Adhye, B., Nair, A., & Sancheti, P. (2022). Comparison of thoracic epidural and thoracic erector spinae plane block for pain relief of posterolateral rib fractures—A retrospective cohort study. Ain-Shams Journal of Anesthesiology, 14(1), 1-6. https://doi.org/10.1 186/s42077-022-00287-2
4. Kumar, G., Bhoi, S. K., Sinha, T. P., & Paul, S. (2021). Erector spinae plane block for multiple rib fracture done by an Emergency Physician: A case series. Australasian Journal of Ultrasound in Medicine, 24(1), 58-62. https://doi.org/10.1002/ajum.12225
5. Steinthorsdottir KJ, Wildgaard L, Hansen HJ, Petersen RH, Wildgaard K. Regional analgesia for video-assisted thoracic surgery: A systematic review. Eur J Cardiothorac Surg. 2014;45:959–66.
6. Chin KJ, Adhikary S, Sarwani N, Forero M. The analgesic efficacy of pre-operative bilateral erector spinae plane (ESP) blocks in patients having ventral hernia repair. Anaesthesia. 2017;72:452–60.
7. Hamilton DL, Manickam B. Erector spinae plane block for pain relief in rib fractures. Br J Anaesth. 2017;118:474–5.
8. Forero M, Adhikary SD, Lopez H, Tsui C, Chin KJ. The erector spinae plane block: A Novel analgesic technique in thoracic neuropathic pain. Reg Anesth Pain Med. 2016;41: 62 1–7.
9. Elawamy A, Morsy MR, Ahmed MAY. Comparison of Thoracic Erector Spinae Plane Block With Thoracic Paravertebral Block for Pain Management in Patients With Unilateral Multiple Fractured Ribs. Pain Physician. 2022 Sep;25(6):483-490. PMID: 36122257.
10. Adhikary SD, Liu WM, Fuller E, Cruz-Eng H, Chin KJ. The effect of erector spinae plane block on respiratory and analgesic outcomes in multiple rib fractures: a retrospective cohort study. Anaesthesia. 2019 May;74(5):585-593. doi: 10.1111/anae.14579. Epub 2019 Feb 10. PMID: 30740657.
11. Coblentz, I. J., & Ilfeld, B. M. (2023). Thoracic Epidural as a Rescue Analgesic in a Patient with a Continuous Erector Spinae Plane Block for Rib Fractures: A Case Report. The American Journal of Case Reports, 24, e938875-1. https://doi.org/10.12659/AJCR.938875
12. Jiang M, Peri V, Ou Yang B, Chang J, Hacking D. Erector Spinae Plane Block as an Analgesic Intervention in Acute Rib Fractures: A Scoping Review. Local Reg Anesth. 2023 Jun 12;16:81-90. doi: 10.2147/LRA.S414056. PMID: 37334278; PMCID: PMC10275321.
13. Hashemzadeh S, Hashemzadeh K, Hosseinzadeh H, Aligholipour Maleki R, Golzari SE. Comparison thoracic epidural and intercostal block to improve ventilation parameters and reduce pain in patients with multiple rib fractures. J Cardiovasc Thorac Res. 2011;3(3):87-91. doi: 10.5681/jcvtr.2011.019. Epub 2011 Aug 20. Erratum in: J Cardiovasc Thorac Res. 2014;6(1):75. Golzari, Samad [corrected to Golzari, Samad E J]. PMID: 24250961; PMC ID: PMC3825332.
14. Topçu I, Ekici Z, Sakarya M. Toraks travmali hastalarda intravenöz hasta kontrollü analjezi ile torakal epidural hasta kontrollü analjezinin klinik etkinliğinin karşilaştirilmasi [Comparison of clinical effectiveness of thoracic epidural and intravenous patient-controlled analgesia for the treatment of rib fractures pain in intensive care unit]. Ulus Travma Acil Cerrahi Derg. 2007 Jul;13(3):205-10. Turkish. PMID: 17978895.
15. Kumar, G., Bhoi, S. K., Sinha, T. P., & Paul, S. (2021). Erector spinae plane block for multiple rib fracture done by an Emergency Physician: A case series. Australasian Journal of Ultrasound in Medicine, 24(1), 58-62. https://doi.org/10.1002/ajum.12225.

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