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CASE REPORT

Is Erector Spinae Plane Block a Good Solution for Managing Pain Associated with Rib Fractures? Reviewing Literature Through Case Series

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ABSTRACT

Rib fractures are a significant cause of morbidity and mortality due to potential respiratory complications. Pain is one of the most critical factors affecting respiratory functions. Therefore, pain management is a crucial component of treatment. The erector spinae plane block, a newly defined technique, has been used for postoperative acute pain control and chronic pain syndromes. Its use has become widespread in rib fractures due to its ability to provide effective analgesia and its safe application under ultrasound guidance. Data is needed to determine if it is the best method compared to other techniques. In this article, we aim to review the literature through our case series.

Keywords: Analgesia, nerve block, pain management, rib fractures

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Introduction

Rib fractures frequently result from blunt thoracic trauma and represent a substantial risk for morbidity and mortality. Insufficient pain management in cases of rib fractures can hinder the effective clearance of pulmonary secretions, disrupt normal respiratory mechanics, decrease tidal volume, contribute to atelectasis, hypoxia, pneumonia, and ultimately result in respiratory failure. Hence, primary goals in managing patients with rib fractures include providing effective analgesia, promoting early mobilization, and offering respiratory support.

A multimodal analgesic approach is commonly utilized, involving systemic administration of nonsteroidal anti-inflammatory drugs (NSAIDs) and opioids, in addition to the use of central and peripheral nerve blocks. Each method presents unique risks. Intravenous opioids may lead to side effects such as sedation, respiratory depression, and hypotension, while regional techniques can potentially result in hypotension, spinal cord injury, hematoma, infection, and local anesthetic toxicity.

Regional anesthesia techniques such as thoracic epidural analgesia (TEA), intercostal nerve block, serratus anterior block, paravertebral block, and erector spinae plane block have been documented in the literature. This case series intends to review existing literature based on our experiences with analgesia employing the erector spinae plane block (ESP) in patients with rib fractures who were admitted to our university hospital between January 2023 and April 2024 and were not deemed suitable for surgical intervention.

Case Report

In our clinic, between January 2023 and April 2024, we treated 13 rib fracture patients referred to thoracic surgery with no surgical treatment plan. These patients were treated with an

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ESP catheter for analgesia. Throughout the treatment period, close monitoring was performed to assess the efficacy of analgesia and to promptly address possible complications.

A consent form was obtained from the patients for data monitoring and recording, and ethics committee approval was not obtained since the purpose of this article was to write a case series. Eight of the patients were male and five were female. All patients were extubated and GCS was 15. Twelve of them needed nasal oxygen (3–5 lt/min). Detailed demographic information, fracture and catheter application levels are given in Table 1 and Table 2.

The ESP block was performed in the operating theatre, after the patient was monitored, in the lateral position with the affected side on top. During positioning, 1–2 mcg/kg fentanyl was administered in necessary patients to increase pain tolerance. The procedure was performed under ultrasound guidance and with full aseptic precautions. The transverse processes and erector spinae muscle group at the level of the lower border of the fracture levels were visualised in the parasagittal plane using a linear probe (7–12 MHz) during block placement. After the needle insertion site was determined, local infiltration was performed using 2 cc %2 prilocaine. An 18 G needle was inserted into the plane and hydrodissection was used to separate the fascial layers between the erector spinae muscle group and the transverse processes. Then, following negative aspiration confirmation, 15 cc of %0.5 bupivacaine and 5 cc of %2 lidocaine were injected. A 20 G block catheter was then inserted at the skin-to-transverse process distance plus 2 cm for each fracture level and firmly secured to the skin. The local anaesthetic content of the pain pump was prepared as 60 cc %0.5 bupivacaine and 40 cc saline. The pain pumps continued local analgesic infusion at a standard dose of 2 ml/h. The patients were followed up in the intensive care unit after pain and sensory examination.

In the first 5 minutes after the block, pain questionnaires of all patients were recorded as VAS 0. Sensory examination revealed sensory block along the applied levels on the relevant side. No complications were observed during the procedure and follow-up in any patient.

Pain levels were assessed using visual analogue scale (VAS), at rest, with movement and cough, both before the procedure and at regular intervals up to 72 hours after the procedure. Pain assessments were performed at 2, 6, 10, 14, 18, 24 and 72 hours after the procedure (Table 3). In addition, patients were closely monitored for additional analgesic needs and potential side effects after the procedure. Monitoring included assessment of complications such as pneumothorax, respiratory depression, nausea, vomiting, haematoma formation and allergic reactions to ensure patient safety and appropriate management of any adverse events.

Catheters were kept for an average of 3 days, ranging from 2 to 5 days. Resting VAS scores before the procedure showed a median value of 6 ranging from 5 to 10, while post-procedure VAS scores showed a median value of 3 ranging from 0 to 5. The VAS scores on movement and with cough were a median of 8 and 7 pre-procedure and 4 and 4 post-procedure, respectively. Five patients required additional analgesics during the follow-up period. One patient experienced pneumonia and received antibiotic treatment as a result. No block-related complications were recorded in any of the patients.

A resting VAS score>4 was accepted as a rescue analgesia criterion. NSAIDs (dexketoprofen 75 mg iv), paracetamol (1 g iv) or tramadol (50 mg iv) were administered to patients with resting VAS score>4. Additional analgesic needs were recorded as in Table 4.

Table 1. Demographic data

					Comorbidity					
Patient	**Gender**	**Age (year)**	**BMI**	**Cigarette**	**HT**	**DM**	**Lung disease**	**Cardiac disease**	**Neurological disease**	**Endocrinological disease**
1	M	40	28.1	+	–	–	–	–	–	–
2	M	74	24.3	–	–	+	–	+	–	–
3	M	57	31.2	–	+	–	–	–	–	–
4	F	68	29.7	–	–	–	–	–	–	–
5	M	66	28.4	+	+	–	–	–	–	–
6	F	74	27..5	–	–	–	+	–	–	–
7	M	66	29.1	–	–	+	–	–	–	–
8	M	65	28.4	+	–	–	–	–	–	–
9	M	67	28.7	+	+	+	–	–	–	–
10	M	49	24.2	+	–	–	–	–	–	–
11	F	67	37.8	–	+	–	–	–	+	+
12	F	58	33.3	–	+	–	+	–	–	–
13	F	69	36	–	–	–	–	–	–	–

BMI: Body mass index; HT: Hypertension; DM: Diabetes mellitus; M: Male; F: Female

Table 2. Rib fracture and block catheter side / level information

Patient	Etiology	Rib fractures side and levels		Other fractures	ESP block catheter				SpO$_2$ %	
		Right	Left		Implemented party	Implemented level	Implementation period (day)	Duration of hospitalisation	Pre-procedure	Post-procedure
1	IVTA	1–2–3–5	–	Left fibula	Right	T8	2	6	94	96
2	NVTA	–	3–4–5–6–7	–	Left	T8	3	3	93	97
3	NVTA	–	4–5–6–7	–	Left	T8	3	3	93	96
4	IVTA	4–5–6–7	–	–	Right	T8	3	4	94	97
5	NVTA	–	4–5–6–7–8	–	Left	T9	3	3	95	97
6	NVTA	4–5	–	–	Right	T7	3	4	95	97
7	Fall from height	4–5–6–7		–	Right	T8	3	4	93	96
8	IVTA	–	2–3–4–5–6–7	–	Left	T8	3	3	92	96
9	Fall from height	4–5–6–7–8	–	–	Right	T8	4	5	95	97
10	Fall from height	1–2	–	–	Right	T5	5	5	96	97
11	Fall from height	4–5–6–7–9	3–4–5–6	–	Bilateral	T5	4	6	94	96
12	NVTA	–	7–9	–	Left	T6	3	4	93	95
13	Fall from height	2–6–7	2–3–4–5–6	–	Bilateral	T4	3	5	88	93

ESP: Erector spinae plane; SpO$_2$: Oxygen saturation; IVTA: In-vehicle traffic accident; NVTA: Non-vehicle traffic accident; T: Thoracal

Discussion

The erector spinae plane block was initially introduced by Forero et al.[1] in 2016 for treating rib-associated neuropathic pain in two patients. This technique is classified as an interfascial nerve block. Since its inception, it has gained recognition as a viable alternative for providing analgesia in abdominal, thoracic, breast, and orthopedic surgeries. While the precise mechanism of action is not yet fully elucidated, it is hypothesized that the dispersion of the local anesthetic induces a blockage of the lateral cutaneous and intercostal nerves, extending potentially into the paravertebral space.

In a study by Schwartzmann et al.[2] in 2018, utilizing contrast-enhanced MRI imaging, it was demonstrated that following the injection of 30 ml of local anesthetic (comprising 29.7 ml bupivacaine and .3 ml gadolinium) at the left T10 level, the contrast agent diffused craniocaudally from T5 to T12 on the left side. This diffusion exhibited distribution into the transforaminal, epidural, and paravertebral spaces, with additional intercostal spread from T6 to T12 on the left side. These findings indicate that the visceral and somatic analgesic effects associated with the erector spinae plane block are likely attributable to its transforaminal and epidural dispersal.

The ESP block is typically carried out in a parasagittal plane under ultrasound guidance, with the patient positioned either sitting or in a lateral decubitus position. While it is frequently conducted at the T5-T7 levels, it is adaptable for use at various levels as needed. A one-time injection of 20–30 ml of local anesthetic is a common approach, although an alternative method involves the insertion of a catheter for continuous infusion to sustain analgesic effects over a prolonged period.[3]

In a study conducted by El-Sherbiny et al.,[4] a comparison was made between TEA and ESP block for managing rib fractures resulting from chest trauma. The research found that both TEA and ESP were effective in providing analgesia, showcasing no substantial statistical variance in analgesic efficacy, opioid consumption, or the need for additional analgesic interventions between the two groups. However, TEA was correlated with a more pronounced reduction in heart rate and blood pressure when juxtaposed with ESP. Additionally, there was a significant difference in mean arterial pressure observed between the TEA and ESP groups.

In a study conducted by Elawamy et al.,[5] a comparison was made between paravertebral block and erector spinae plane block in the management of rib fractures. The results indicated that both techniques were successful in reducing pain scores and opioid consumption, with no substantial statistical variance observed between the two groups.

Table 3. VAS score (1–10) (rest / movement / coughing)

Patient	Pre-procedure	Post-procedure									
		0. hours	2. hours	6. hours	10. hours	14. hours	18. hours	24. hours	36. hours	48. hours	72. hours
1	5 / 10 / 7	3 / 2 / 5	3 / 4 / 4	2 / 4 / 3	3 / 3 / 4	3 / 4 / 4	1 / 3 / 3	1 / 2 / 3	1 / 2 / 2	1 / 2 / 2	1 / 2 / 2
2	5 / 7 / 7	2 / 3 / 3	2 / 3 / 3	2 / 5 / 5	0 / 4 / 4	0 / 3 / 3	0 / 3 / 3	0 / 3 / 3	0 / 3 / 3	0 / 3 / 3	0 / 3 / 3
3	5 / 7 / 7	1 / 3 / 2	2 / 4 / 4	2 / 4 / 4	3 / 4 / 4	1 / 2 / 2	1 / 2 / 2	1 / 2 / 2	1 / 2 / 2	1 / 2 / 2	1 / 2 / 2
4	6 / 8 / 8	3 / 4 / 4	3 / 4 / 4	2 / 3 / 3	1 / 2 / 2	1 / 2 / 2	1 / 2 / 2	1 / 2 / 2	1 / 2 / 2	1 / 2 / 2	1 / 2 / 2
5	6 / 7 / 7	3 / 4 / 4	2 / 3 / 3	2 / 3 / 3	0 / 1 / 2	0 / 1 / 2	0 / 1 / 2	0 / 1 / 2	0 / 1 / 2	0 / 1 / 2	0 / 2 / 2
6	6 / 7 / 7	3 / 4 / 4	2 / 3 / 3	2 / 4 / 4	1 / 4 / 4	1 / 3 / 3	1 / 3 / 3	1 / 2 / 2	1 / 2 / 2	1 / 2 / 2	1 / 2 / 2
7	6 / 10 / 10	3 / 4 / 4	3 / 4 / 4	2 / 4 / 4	2 / 3 / 3	1 / 3 / 3	1 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0
8	6 / 8 / 8	0 / 5 / 5	0 / 5 / 7	0 / 6 / 7	0 / 7 / 6	0 / 7 / 6	0 / 6 / 7	0 / 6 / 7	0 / 7 / 7	0 / 5 / 5	0 / 3 / 4
9	5 / 7 / 7	3 / 5 / 5	3 / 6 / 6	2 / 6 / 6	0 / 5 / 7	0 / 4 / 6	0 / 4 / 6	0 / 3 / 6	0 / 3 / 4	0 / 2 / 2	0 / 2 / 2
10	9 / 10 / 10	5 / 5 / 5	5 / 5 / 6	4 / 6 / 6	4 / 4 / 5	4 / 4 / 5	4 / 7 / 8	7 / 5 / 9	6 / 7 / 9	6 / 7 / 9	6 / 7 / 9
11	10 / 10 / 10	3 / 4 / 4	2 / 5 / 5	2 / 5 / 5	2 / 4 / 5	2 / 3 / 4	2 / 3 / 4	1 / 2 / 4	1 / 3 / 4	1 / 3 / 4	2 / 3 / 4
12	8 / 9 / 9	3 / 3 / 5	3 / 3 / 3	3 / 3 /3	3 / 3 / 3	5 / 5 / 5	5 / 5 / 6	4 / 4 / 6	3 / 3 / 5	3 / 3 / 5	3 / 3 / 5
13	7 / 8 / 6	3 / 3 / 4	3 / 4 / 4	3 / 5 / 4	4 / 4 / 4	3 / 4 / 4	3 / 3 / 4	4 / 5 / 5	3 / 4 / 4	3 / 4 / 4	3 / 4 / 4

VAS: Visual analogue scale

Table 4. Need for additional analgesic

Patient	Pre-procedure	Post-procedure									
		0. hours	2. hours	6. hours	10. hours	14. hours	18. hours	24. hours	36. hours	48. hours	72. hours
1	Fentanyl inf 0.5 mcg/kg/h	–	–	–	–	–	–	–	–	–	–
2	Fentanyl inf 1 mcg/kg/h	–	–	–	–	–	–	–	–	–	–
3	Paracetamol 4×1 gr iv Dexketoprofen 75 mg 1×1 iv	–	–	–	–	–	–	–	–	–	–
4	Fentanyl inf 0.5 mcg/kg/h	–	–	–	–	–	–	–	–	–	–
5	Fentanyl inf 0.5 mcg/kg/h	–	–	–	–	–	–	–	–	–	–
6	Fentanyl inf 0.5 mcg/kg/h	–	–	–	–	–	–	–	–	–	–
7	Fentanyl inf 0.5 mcg/kg/h	–	–	–	–	–	–	–	–	–	–
8	Paracetamol 4×1 gr iv Tramadol 4×50 mg iv	–	–	–	–	–	–	–	–	–	–
9	Fentanyl inf 0.5 mcg/kg/dk	–	D	–	–	–	–	–	–	–	–
10	Fentanyl inf 0.5 mcg/kg/h	–	D-T	P	T	P	T	D-P	T-P	P-T-P-T	D-P-T-P-T
11	Fentanyl inf 1 mcg/kg/h	–	D	–	–	–	–	–	–	–	–
12	Fentanyl inf 0.5 mcg/kg/h	–	–	–	–	D	P	T	–	–	–
13	Fentanyl inf 0.5 mcg/kg/h	–	–	–	P	–	–	–	–	–	–

D: Dextketoprofen 75 mg 1×1; P: Paracetamol 1 gr iv; T: Tramadol 50 mg iv

In a study by El Malla et al.[6] comparing serratus anterior plane block and erector spinae plane block for rib fractures, it was noted that ESP block exhibited a significant improvement in pain scores and a notable decrease in total opioid consumption compared to the serratus anterior plane block group. However, despite these findings, the study did not identify a statistically significant difference between the two groups in terms of their effectiveness for pain management.

Based on a thorough review encompassing 37 studies involving 802 patients, it was reported that the utilization of ESP blocks for rib fractures yielded positive outcomes. These included enhancements in pain management and respiratory parameters, a commendable safety profile, decreased opioid utilization, and a reduction in opioid-related side effects such as nausea and vomiting. Noteworthy is the absence of major complications like hypotension, local anesthetic toxicity, dural puncture, or pneumothorax. In rare instances, minor issues such as block failure, infection, or hematoma occurred but did not necessitate additional interventions.[7]

The ESP block has been recognized as one of the seven "Plan A blocks" in the shift from a paradigm of "many blocks for a few patients" to "a few blocks for the majority." This classification is attributed to various factors that make ESP stand out as a favorable choice. These include its capacity to provide comparable analgesia to established techniques, reduced reliance on practitioner experience for successful block administration, a favorable complication profile, few contraindications, and a versatile application range. These attributes collectively contribute to ESP's role as a recommended primary choice in the evolving approach to regional anesthesia strategies.[8]

The outcomes from our study are consistent with the established body of literature regarding the effectiveness of ESP blocks in providing analgesia for rib fractures, reducing opioid consumption, and exhibiting low rates of complications. Across all patients in our study, post-procedure VAS scores decreased by 50% compared to pre-procedure levels, with no requirement for opioid analgesics during the follow-up period. Nonsteroidal anti-inflammatory drugs proved adequate for pain management in five patients when their VAS scores exceeded 4, and only one patient necessitated a pain pump renewal after 72 hours. Importantly, no adverse events related to the procedure were observed in any of the patients, underscoring the safety and efficacy of ESP blocks in this context.

Conclusion

While the data available in the literature exhibit variability in outcomes and the scarcity of prospective studies hinders definitive conclusions on the superiority of ESP blocks for treating rib fractures, our study adds valuable insights. Our findings support the viability of ESP as a feasible and effective analgesic modality for rib fractures, demonstrating comparable efficacy to established methods with an enhanced safety profile. Although further research is warranted for a comprehensive evaluation, our results contribute positively to the existing body of evidence, emphasizing the potential of ESP blocks as a beneficial approach in pain management for rib fractures.

Disclosures

Informed Consent: Written informed consent was obtained from all patients.

Authorship Contributions: Concept – H.G., Ç.Y.G., B.G.E., Ö.Ö.A., Y.K., G.K.; Design – H.G., Ç.Y.G., B.G.E., Ö.Ö.A., Y.K., G.K.; Supervision – H.G., Ç.Y.G., B.G.E., Ö.Ö.A., Y.K., G.K.; Fundings – H.G.; Materials – H.G.; Data collection &/or processing – H.G., B.G.E., Ö.Ö.A.; Analysis and/or interpretation – H.G., Ç.Y.G.; Literature search – H.G.; Writing – H.G., Ç.Y.G.; Critical review – H.G., Ç.Y.G., B.G.E., Ö.Ö.A., Y.K., G.K.

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