



# Erector spinae plane catheter for pain management of multiple rib fractures: Anecdotal records of cases with blunt chest trauma

*Çoklu kosta kırıklarında ağrı tedavisi için erektör spinae plan kateteri: Künt göğüs travması olan olguların anekdot kayıtları*

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## Summary

Yüksek enerjili göğüs duvarı travmaları sıklıkla yüksek morbidite ve mortalite ile ilişkili olan çoklu kosta kırıklarına yol açar. Çoklu kosta kırığı olan hastalardaki akciğer komplikasyonları, pulmoner kontüzyon alanlarında yetersiz gaz değişimi ve şiddetli ağrı nedeniyle solunum mekaniğinin bozulması sonucu ortaya çıkar. Bu nedenle analjezi, kosta kırıklarının tedavisinde bir anahtar rol oynar. Erektör spinae plan (ESP) bloğu yeni tanımlanan bir tekniktir ve posterior kosta kırıklarında acil servislerde de kullanılmaya başlanmıştır. ESP blokları, ilgili bölgenin nispeten yüzeysel olması ve majör vasküler yapılardan uzak olması nedeniyle yoğun bakım ünitesinde antikoagülan tedavi alan hastalarda da uygulanabilir. Bu yazıda, ESP bloklarından anlamlı olarak fayda gören çoklu kosta kırığı olan 3 olgunun anekdot kayıtları sunulmuştur. Bu raporda, tek taraflı enjeksiyon sonrasında duysal bloğun bilateral yayılımı, ESP bloğunun mekanik ventilatörden ayrılma üzerine etkisi ve ESP kateteri takıldıktan sonra arteryel kan gazı analizindeki belirgin düzelleme vurgulanmaktadır.

Keywords: Ağrı yönetimi; analjezi; bölgesel anestezi; kosta kırığı; sinir bloğu; ultrasonografi.

## Özet

High-energy chest wall traumas usually lead to multiple rib fractures associated with high morbidity and mortality. Pulmonary morbidity in patients with multiple rib fractures results from the impaired gas exchange from the pulmonary contusion areas and compromised breathing mechanics as a result of severe pain. Thus, analgesia plays a key role in the management of rib fractures. Erector spinae plane (ESP) block is a newly described technique and it has come into use in emergency departments for posterior rib fractures. ESP blocks can be administered in patients under anticoagulant therapy in the intensive care unit because the relevant area is located relatively superficial and far from the major vascular structures. In this report, anecdotal records of three patients with multiple rib fractures who had real benefits from ESP blocks are presented. This report highlights the bilateral extent of the sensory block after unilateral injection, the effect of ESP blocks on weaning from mechanical ventilation, and dramatic improvement in arterial blood gases analysis following ESP catheter insertion.

Anahtar sözcükler: Pain management; analgesia; regional anesthesia; rib fractures; nerve block; ultrasonography.

## Introduction

High-energy chest wall traumas usually lead to multiple rib fractures associated with high morbidity and mortality. Chest injury scoring is a useful method to predict patients under risk of complications, and it was proposed that a chest injury score  $\geq 20$  necessitated critical care.<sup>[1]</sup> Pulmonary morbidity in patients with multiple rib fractures results from impaired gas exchange from the pulmonary contusion areas and compromised breathing mechanics as a result of se-

vere pain. Thus, analgesia is the cornerstone of rib fractures management.<sup>[2]</sup> Regional blocks provide excellent analgesia when systemic pharmacologic treatment is inadequate. Given that the only available literature is a few case reports, erector spinae plane (ESP) block is thought to be a promising technique for effective analgesia in multiple rib fractures.

In this report, anecdotal records of three patients with multiple rib fractures who had real benefits from ESP blocks are presented.

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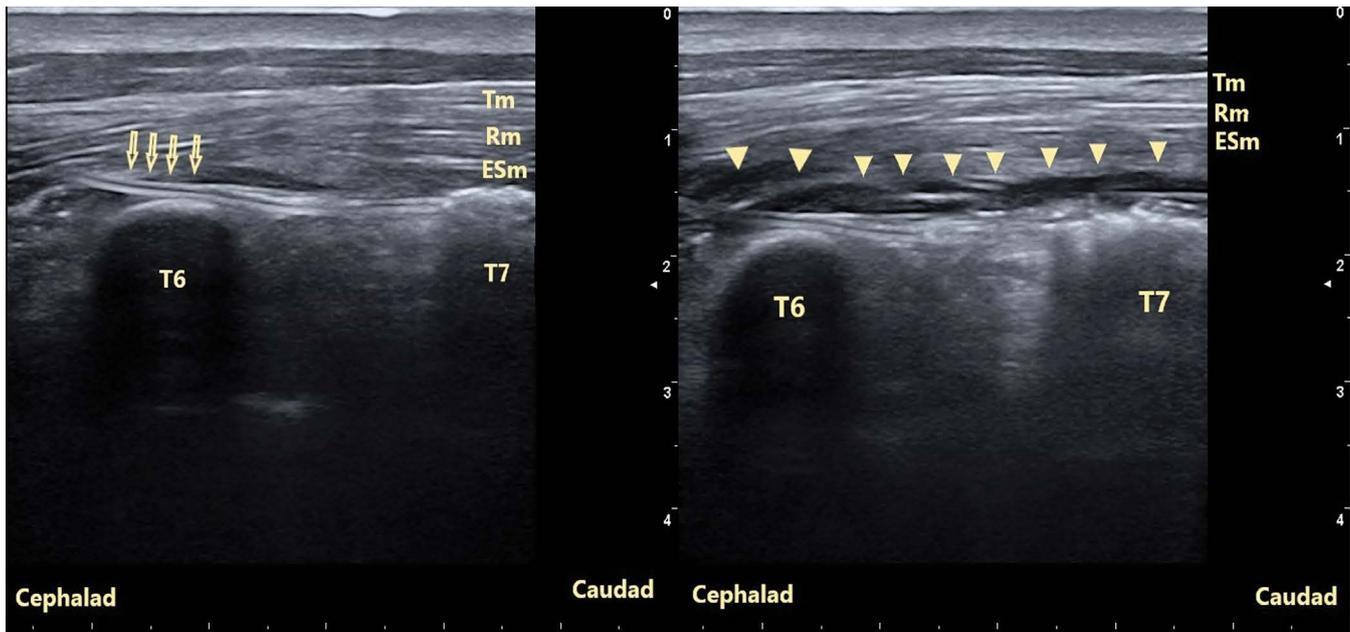
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**Figure 1.** Sonogram of the ESP catheter.

Left: Arrows indicating the placement of ESP catheter; Right: Triangles indicating hydro dissection of ESP following local anaesthetic injection; Tm: Trapezius muscle; Rm: Rhomboides major muscle; ESm: Erector spinae muscle.

## Case Reports

### Case 1 – Dramatic improvement in blood gas analysis following ESP catheter insertion

A 45-year-old male patient (70 kg, 1.75 m) with a chronic pulmonary disease was admitted to hospital after falling from a standing height. Computed tomography (CT) of the thorax revealed adjacent posterior rib fractures from 4 to 12 on the left side (9 ribs were fractured), each fracture was at a single place on the rib. There was no hemo/pneumothorax, so no thorax drainage tube was inserted. The chest injury score was 39, then the patient was transferred to the intensive care unit (ICU) for close follow-up. The patient was not intubated, and 6 mL/min oxygen was administered via a face mask for mild hypoxia. On the second day of ICU stay, arterial blood gas (ABG) analysis showed a moderate hypoxia (pH: 7.47, pCO<sub>2</sub>: 29 mm Hg, pO<sub>2</sub>: 50 mm Hg), and the patient was having difficulty in breathing due to severe pain in his chest while intravenous tramadol (30 mg/h) was being infused. With the patient in the sitting position, an ultrasound-guided (Esaote® MyLab30, Italy) catheter-through-needle 18-G 80-mm Tuohy needle, 20-G catheter (Perifix®, Braun®, Germany) was placed to the ESP at the level of T6 and T7 for intermittent bolus local anesthetic injections, and then the first dose of 30 mL of 0.25% bupivacaine was injected through the catheter (Fig. 1). The pain intensity decreased significantly 10 minutes after the ESP block

intervention. He was totally pain-free while breathing at the 2<sup>nd</sup> hour of the ESP block. The dose of tramadol infusion was tapered off after 2 hours. The arterial blood gas (ABG) analysis (with 4 mL/min oxygen) at the 2<sup>nd</sup> hour showed a marked improvement (pH: 7.45, pCO<sub>2</sub>: 36 mm Hg, pO<sub>2</sub>: 83 mm Hg). The sensory block with pinprick at the 2<sup>nd</sup> hour showed an involvement between T2 and L1 levels on the left dorsal and the ventral dermatomes. Pain intensity was never rated more than 3 points on the Numeric Rating Scale (NRS) while coughing and there was no additional analgesic requirement in the following 36 hours. A second local anesthetic bolus on demand was administered at the 36<sup>th</sup> hour of the catheter insertion. The patient was discharged from the ICU to the thoracic surgery ward on the 4<sup>th</sup> day of the follow-up in the ICU.

### Case 2 – Weaning from a mechanical ventilator and maintaining spontaneous ventilation

A 49-year-old male multi-trauma patient (80 kg, 1.80 m) was admitted to hospital unconscious following a traffic accident. Whole-body computed tomography imaging revealed a left frontoparietal subarachnoid hemorrhage and edema (not requiring surgery), liver injury, left proximal humerus fracture, left pneumothorax (requiring thorax tube), and bilateral hemothorax. On the left side, there were fractures in adjacent ribs from the 3<sup>rd</sup> to the 11<sup>th</sup> (9 ribs) at the

collum costae level, and from the 3<sup>rd</sup> to the 6<sup>th</sup> ribs there were consecutive fractures at the angulus costae level (representing flail chest). On the right side, there was a scapula fracture, and fractures on adjacent ribs from the 6<sup>th</sup> to the 10<sup>th</sup> (5 ribs) at the collum costae level. The patient was intubated in the emergency department and underwent surgery for a liver laceration and humerus fracture. Following surgery, he was transferred to the ICU for follow-up (chest injury score 49). The patient was sedated deeply and mechanically ventilated for 15 days and then successfully weaned the mechanical ventilator after he regained consciousness. Following extubation, while intravenous (IV) tramadol 30 mg/h and fentanyl 50 µg/h was being infused, the patient rated his pain score as 6-7 points on an NRS, which prevented deep breathing and effective coughing. Then, with the patient in the sitting position, using the in-plane technique, a unilateral (left side) ultrasound-guided catheter-through-needle (19-G 100-mm facet tip needle, 20-G catheter, PlexoLong Sono®, Pajunk®, Germany) was placed in the fascial plane beneath the erector spinae muscle at T5 level for pain management, and 0.25% bupivacaine 30 mL was injected. The NRS score decreased to 2 points after 1 hour following the catheter insertion. The dose of opioid analgesic infusion was reduced and then discontinued entirely after 1 hour. He stated that the pain intensity was decreased significantly on both right and left sides. However, we were not able to assess the anesthesia level on the dermatomes evidently due to hemi-paresthesia on the right side because of the brain injury. The second demand-dose was administered through the ESP catheter 24 hours after the first block. The catheter was removed 4 days following the insertion. The patient was discharged from the ICU to the thoracic surgery ward on the 27<sup>th</sup> day of follow-up.

### Case 3 – Bilateral spread of local anesthetic following a single-shot ESP block

A 34-year-old male patient (86 kg, 1.76 m) was admitted to the emergency department following a traffic accident. Computed tomography showed splenic subcapsular hematoma (not requiring surgery), left side posterior rib fractures from the 6<sup>th</sup> to the 10<sup>th</sup> ribs (5 ribs), pulmonary contusion, and left hemothorax (requiring thorax tube). Additionally, he had a tibia shaft fracture and patella fracture on the right

leg. His right leg was splinted to undergo surgery later, and a left thorax drainage tube was inserted for the hemothorax in the emergency department. He was then transferred to the ICU for close follow-up because of dyspnea (chest injury score 20). On admission to the ICU, the patient expressed difficulty in breathing due to severe pain. The patient initially rated his pain as 8-9 on NRS. Tramadol 100 mg IV was administered, and then the decision was made to perform a unilateral ESP block. With the patient in the sitting position, using an in-plane technique, a left-side single-shot ESP block at T7 level (100 mm, SonoPlex STIM®, Pajunk®, Germany) with 30 mL of 0.25% bupivacaine was performed. The patient rated pain as 3 points on the NRS one hour after the block, and 1 point two hours after the ESP block. At the 2<sup>nd</sup> hour of the ESP block injection, the sensory block with pinprick showed involvement between T1 and L1 on the left dorsal and the ventral dermatomes. Additionally, dorsal dermatomes between T4 and T10 were also anesthetized on the right side. No other analgesics were necessary during the following 24 hours. At the 24<sup>th</sup> hour of the ESP block, the sensory evaluation with pinprick revealed that the involvement of left-side ventral and dorsal dermatomes between T1 and L1 persisted; however, the involvement of the right-side dorsal dermatomes had regressed to the level of T6 and T7. The pain intensity on NRS was rated as 2 points. On the following day, he was discharged to the orthopedics ward for treatment of the fractures in the right leg.

### Discussion

Reduced respiratory effort and ineffective coughing due to severe pain from rib fractures can lead to secondary pulmonary complications including atelectasis and pneumonia because of the decrease in vital capacity and reduction in clearance of secretions. The incidence of pneumonia following rib fractures has been reported as 31%, and mortality rate among patients admitted to the ICU can reach 33%.<sup>[3,4]</sup> Therefore, in order to reduce possible secondary complications, it is essential to provide adequate analgesia in the management of rib fractures. Regional analgesia techniques can be used for effective pain relief when systemic analgesics are inadequate.

Conventional regional anesthesia methods used for pain management in rib fractures such as epidural,

paravertebral, intercostal, and intrapleural blocks are shown to be similarly effective, and each has specific advantages and disadvantages.<sup>[2]</sup> New plane blocks – the serratus anterior plane block and the ESP block – have been used as good alternatives to traditional techniques in rib fractures.<sup>[5–8]</sup> Recently described ESP blocks gained popularity and have been used for various indications.<sup>[9–13]</sup> ESP blocks have come into use in emergency departments for posterior rib fractures because they are not limited by technical difficulties and have a good safety profile.<sup>[14–16]</sup>

In addition, because ESP blocks are relatively superficial blocks and are located far from the major vascular structures, they can be administered in patients under anticoagulant therapy in the intensive care unit. Also, ESP blocks were performed without any bleeding and hematoma formation in the three cases presented in this report while they were receiving enoxaparin. It is recommended that effective analgesic control should be achieved as soon as possible in patients with multiple rib fractures.<sup>[5,17]</sup> However, the ESP block in Case 2 was performed in a weaning period, which is relatively delayed in terms of timing, because the weaning time from mechanical ventilation was unpredictable on admission to the ICU, especially due to the head trauma. ESP blocks have been reported to help weaning from mechanical ventilation.<sup>[18]</sup> In Case 2, after effective regional analgesia with ESP block, systemic opioids were immediately tapered off and the patient was able to maintain spontaneous breathing. Case 1 also showed significant improvement in respiratory pattern and ABG after the ESP block.

In cadaver dissections and MR studies, ESP injections have been shown to spread craniocaudally, infiltrating the dorsal and ventral ramus of the spinal nerves, as well as to the paravertebral area, epidural area, and even the opposite side.<sup>[19–22]</sup> Thus, ESP can provide ventral and dorsal dermatomal somatic analgesia, as well as visceral analgesia.<sup>[23]</sup> A case report showed the clinical provision of anesthesia of a level T9 ESP block in contralateral ventral dermatomes.<sup>[24]</sup> In the present report, it was stated by the patient (Case-2) that unilateral ESP block provided bilateral analgesia even though dermatomal assessment could not be performed due to the patient's paraparesis. However, it cannot be ruled out that unilateral

hemi-paresthesia may lead to a false perception of having bilateral analgesia when pain relief is provided in the non-deficit area. In Case 3, the ipsilateral ESP block from level-T7 could be clearly evaluated by dermatomal mapping by contralateral dorsal dermatomal sensorial block. All patients were discharged from the ICU without re-admission.

In conclusion, ESP blocks in multiple rib fractures are effective methods for pain relief providing marked improvement in respiratory parameters and ABG analysis. Contralateral spread of local anesthetic can cause unilateral ESP block resulting in bilateral dermatomal anesthesia.

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