# Ultrasound-Guided Erector Spinae Plane Catheter Provides Analgesia for a Pregnant and a Pediatric Patient

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Analgesia for pregnant and pediatric patients is challenging. Ultrasound-guided erector spinae plane (ESP) block provides safe and effective analgesia for thoracic and abdominal surgery and is a potential alternative to thoracic epidural or paravertebral blocks. In this report, we demonstrated continuous ESP catheters utilized for pain control in a pregnant woman with traumatic multiple fractured ribs and a child undergoing upper abdominal surgery.

**Keywords:** analgesia, erector spinae plane block, multiple rib fractures, abdominal surgery, regional anesthesia

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## Introduction

Erector spinae plane (ESP) block was first reported as an effective treatment for chronic thoracic neuropathic pain and post-surgical pain by Forero et al. in 2016.[1] The ESP block improved pain intensity and reduced analgesic requirement in breast, thoracic, cardiac and abdominal operations.[2-10] Even though the ESP block demonstrated comparable pain control following breast surgery when compared to the thoracic paravertebral block, the procedural time for performing the ESP block was shorter.[10] Additionally, when performed by an experienced operator, the ultrasound-guided ESP block provided a 100% success rate.[2]

Two cases of successful continuous ESP catheter are reported as alternative analgesic regimen for multiple fractured ribs (MFR) after failed thoracic epidural analgesia (TEA) in a third-trimester pregnant and for postsurgical pain control in a 4-year-old boy who underwent open abdominal surgery. Written informed consents from the pregnant patient and the child's mother were obtained for this report.

## Case Report #1

A previously healthy 29-year-old nulliparous woman at 28 weeks of gestation, 75 kg and 164 cm had fractures of left posterior $7^{th}$-$9^{th}$ and anterior $5^{th}$-$7^{th}$ ribs following a motorcycle collision. Bilateral pleural effusion with adjacent compressive atelectasis were noted. Neither pneumothorax nor acute pulmonary embolism was found. She had no other injuries. Two days after injury, acute pain service was consulted due to pain control failure by intravenous morphine and oral paracetamol. Her numeric rating scores (NRS) were 8/10 at rest, and 10/10 during movement over the left hemithorax with rapid shallow breathing and difficulty with deep breathing. Her oxygen saturation decreased to 90% despite receiving supplemental oxygen. The fetus was monitored and confirmed to be safe by an obstetrician.

The TEA was performed by a senior anesthesia resident at T6-T7 interspace using a paramedian approach with an 18-G Tuohy needle (B Braun Perifix® Continuous Epidural Sets). After failed attempts, the epidural space was not able to be identified by a traditional loss-of-resistance technique. The ESP block

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guided by a high frequency linear-array ultrasound probe (Sonosite M-Turbo; SonoSite, Inc., Bothell, WA, USA) was performed by a consultant anesthesiologist. An 18-G Tuohy needle was inserted in-plane in caudal-to-cephalic direction until the needle tip contacted the left T7 transverse process. The ESP, a plane between erector spinae muscle (ESM) and the transverse process, was identified by posterior shifting of the ESM after hydrodissection of five mL normal saline. After correct space confirmation, 20 mL of bupivacaine 0.25% was injected through the needle, the catheter was inserted five cm beyond the needle tip. The catheter was secured and tunneled under the skin.

Within five minutes after completion of the block, the patient's NRS was 3/10 at rest. Her pain intensity was markedly improved to the NRS of 0/10 at rest and 1/10 on coughing within one hour. The area of diminished cold sensation involved the dermatomes T4-T10 on the left side. The ESP catheter was continuously infused with 10 mL/h of bupivacaine 0.125% for four days. The patient reported the NRS of 0-1/10 at rest and with activity. The pain control was gradually transited to oral pain medication. After discontinuation of the analgesic infusion, the pain was manageable, and the patient was discharged home safely.

## Case Report #2

A 4-year-old boy, 13 kg with a stage M neuroblastoma (bone, pleural, lymph nodes metastasis) was scheduled for exploratory laparotomy. His tumor occupied the left suprarenal retroperitoneal region with anterior displacement of stomach and pancreas and lateral displacement of spleen. After chemotherapy, the tumor size decreased from 4.3 cm to 3.5 cm.

General anesthesia was induced with propofol, fentanyl, cisatracurium and was maintained with desflurane in an oxygen-air mixture. An uneventful 4-hour surgery was performed under left subcostal incision. Following the surgery, the child was placed in right lateral decubitus position for an ESP block performed by two experienced pediatric regional anesthesiologists. A 13-6 MHz linear-array transducer (Sonosite M-Turbo; SonoSite, Inc., Bothell, WA, USA) was placed in a longitudinal parasagittal orientation over left T7-T9 transverse processes. Ordered from superficial to deep levels, layers of skin, subcutaneous tissue, trapezius muscle, erector spinae muscle and transverse processes were visualized. A 50-mm needle (Stimuplex A50; B. Braun, Melsungen, Germany) was inserted in-plane craniocaudally to posterior surface of the T8 transverse process. Two mL normal saline 0.9% was injected to visualize posterior shifting of the ESM. After negative aspiration, 10 mL of bupivacaine 0.25% - lidocaine 0.5% with epinephrine 5 μg/mL was incrementally injected into the ESP to expand the plane (Figure 1). After that, an 18-G Tuohy needle was inserted using the same technique. A 20-G catheter was threaded 3 cm beyond the needle's tip (Figure 2), tunneled under the skin and covered with a transparent dressing. Having stable hemodynamics and awakening, the patient was extubated and transferred to post-anesthetic care unit (PACU).

Postoperative pain score was evaluated using CHEOPS (Children's Hospital of Eastern Ontario Pain Scale). When fully awake, the patient had a CHEOPS score of 13. One dose of 0.5 mg morphine was intravenously administered, and his pain deceased to a 7/13 score. Prior to PACU discharge, five mL/h (0.38 mg/kg/h) of bupivacaine 0.1% infusion was started through the ESP catheter. Postoperative pain regimen was 1) 15 mg/kg of rectal acetaminophen every 6 h on postoperative day (POD) 0-1 and then 10 mg/kg of oral acetaminophen every 6 h on POD 2; and 2) 0.5 mg of intravenous morphine every 4 h as needed. During 72-h postoperative period, the patient was comfortable and had CHEOPS score of 4-6/13. He had no breakthrough pain and required no opioids. The catheter was removed on POD 3 without any complications.

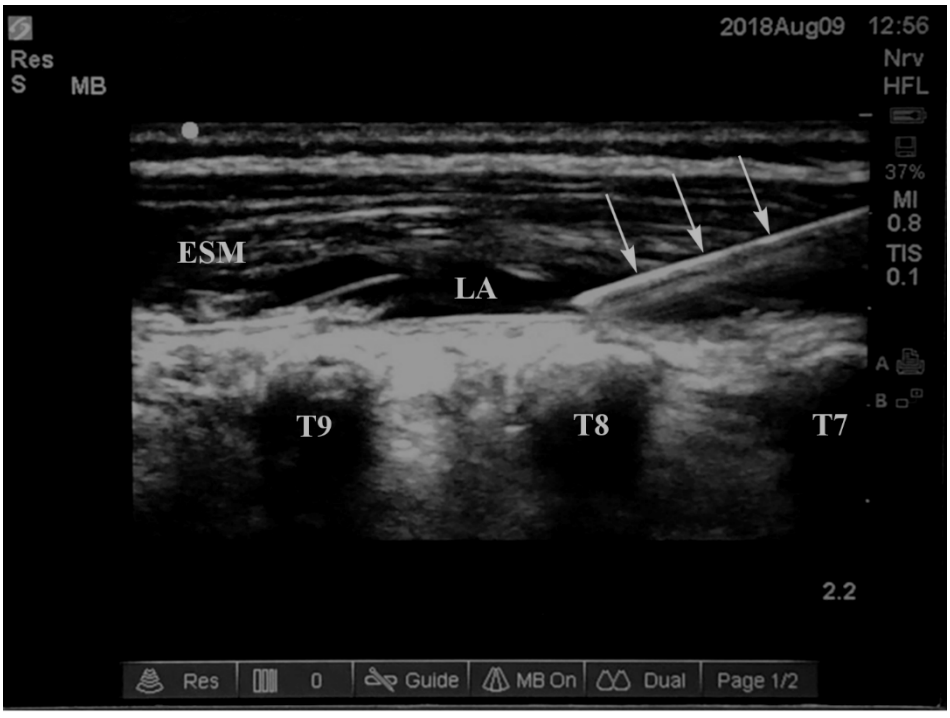



**Figure 1** Ultrasound-guided erector spinae plane (ESP) block at the level of T8 transverse process (TP). The needle (arrows) was inserted craniocaudally to contact the TP. Local anesthetic (LA) was injected within the ESP and the erector spinae muscle (ESM) was posteriorly shifted.

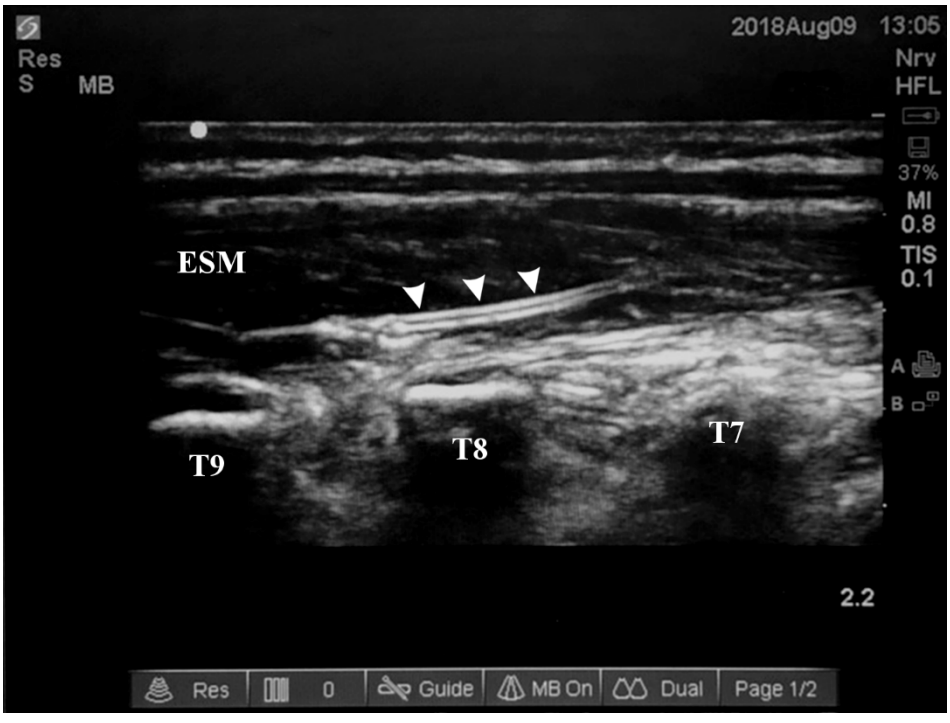



**Figure 2** The catheter (arrowheads) was placed within the erector spinae plane (ESP) between erector spinae muscle (ESM) and transverse process (TP).

## Discussion

This case report shares an experience of ESP catheters in a pregnant woman with MFR and a pediatric abdominal surgery as demonstrated above which provided a safe, effective analgesia, and technical simplicity.

Traumatic MFR results in severe pain and adverse effects to the pulmonary mechanics which is altered during pregnancy. Adequate pain relief by regional anesthetic techniques is advised to prevent maternal hypoxia and respiratory failure which increases risks of morbidity and mortality to the fetus.[11,12] The TEA is a gold standard for pain relief after MFR;[13] however, it is related to technical difficulty, increased complications and notable failure rates.[14] For both anterior and posterior MFR, the ESP block is an attractive regional anesthetic technique and can be an alternative pain control strategy to the TEA or paravertebral block which have reported some minor and major complications.[15]

Optimal postoperative pain management for major abdominal surgery especially in children is challenging. The TEA and paravertebral block have longstanding safety and effectiveness to control pain after abdominal surgery in children.[16,17] Anesthesiologists showed reluctance to perform these blocks due to invasiveness and possible neurological complications. The oblique subcostal transversus abdominis plane (TAP) block is another option.[18] Nevertheless, concerns of visceral pain sparing, excessive local anesthetic (LA) dose and risk of surgical wound contamination leads to hesitation of some anesthesiologists to perform this technique.

The ESM is a group of three muscles consisting spinalis, longissimus, and iliocostalis muscles extending from sacrum and lumbar spinous processes to thoracic and cervical regions.[6] Thoracolumbar fascia covers the ESM and creates a musculofascial plane for LA distribution.[19] An injection of LA into the plane deep to the ESM, blocks multiple levels of dorsal and ventral rami of thoracic spinal nerves by the mechanism of cranio-to-caudal and medial-to-lateral spreading of the LA. Moreover, there is an indirect anterior paravertebral extension across the intertransverse connective tissue.[5] The ESP block at a lower thoracic level may anesthetize rami communicantes that contain sympathetic fibers and result in visceral pain relief.[6] However, a recent anatomical study revealed that only dorsal ramus was stained following the ESP block using dye injection.[20] The ventral ramus and paravertebral space were not involved. The dye extended laterally to lateral cutaneous branches of intercostal nerves when they pierced the intercostal muscles. This may explain an analgesic effect of the ESP block in the lateral chest wall area.

The ESP blocks for MFR were beneficial to reduce pain and assist weaning from mechanical ventilation.[21,22] Consistent with our case, the ESP catheter with continuous administration of LA presented successful pain control following severe MFR. Regarding a pediatric case visceral pain was rescued by a single dose of morphine and regular acetaminophen afterward. Similar to our patient, continuous ESP catheter combined with regular analgesic regimen has also been described to provide adequate post-thoracotomy analgesia.[23] The ESP block also facilitated smooth tracheal extubation and shortened hospital stays.[24,25] Even though the ESP block has shown its clinical benefits, a high dose of LA required during bilateral ESP blocks potentially induces LA toxicity.[26] Therefore, the dosage of LA should be strictly limited to minimum necessary and symptoms of LA toxicity must be closely monitored. Additionally, bilateral quadriceps muscle weakness has been reported after bilateral ESP injections using a 25 ml of LA per side at the T11 spinal level.[26] This is possibly because of a LA spread to the adjacent lumbar plexus.

In summary, this report illustrates the efficacy and safety of the continuous ESP catheter for a pregnant woman with traumatic MFR and a child undergoing open upper abdominal surgery. Further studies are required to elucidate precise technique and mechanism of the ESP.

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