

## CASE REPORT

# Opioid-free Analgesia for Posterior Spinal Fusion Surgery Using Erector Spinae Plane (ESP) Blocks in a Multimodal Anesthetic Regimen

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**Study Design.** A case report.

**Objective.** The aim of this study was to report the use of erector spinae plane (ESP) blocks as part of an opioid-free multimodal anesthetic regimen and its impact on postoperative pain and opioid requirements following spine surgery.

**Summary of Background Data.** Posterior spinal fusion surgery is highly painful and usually requires significant amounts of opioids for adequate perioperative analgesia; this is commonly associated with adverse effects, including opioid-induced hyperalgesia, nausea, and ileus. The ESP block is a novel ultrasound-guided regional anesthetic technique involving local anesthetic injection into the musculofascial plane between erector spinae muscle and transverse processes. This safe and simple technique blocks dorsal rami of spinal nerves and can thus provide opioid-sparing analgesia for spine surgery.

**Methods.** A 35-year-old woman with a previous T3-pelvis fusion for neuromuscular scoliosis underwent revision surgery involving T2–T8 decompression and fusion. She refused the use of perioperative opioids due to intolerable adverse effects during previous surgeries. Analgesia was provided by preoperative bilateral ESP blocks at T4 with 20 mL 0.25% bupivacaine and epinephrine 5 µg/mL on each side, and intraoperative infusion of ketamine and dexmedetomidine. Oral acetaminophen 1 g 6-hourly was administered postoperatively, together with baclofen 10 mg 8-hourly to treat muscle spasms.

**Results.** The patient had adequate analgesia without use of any opioids during her anesthetic or hospital stay.

**Conclusion.** A multimodal intraoperative anesthetic regimen incorporating ESP blocks was able to eliminate the need for postoperative opioid analgesia following posterior spinal fusion surgery. This case report serves as proof-of-concept that this regimen may significantly improve pain trajectories and reduce opioid use in this patient population.

**Key words:** bupivacaine, dexmedetomidine, erector spinae plane block, fusion, general anesthesia, ketamine, local anesthesia, multimodal analgesia, opioid-free anesthesia, opioids, osteotomy, remifentanyl, scoliosis, spine surgery.

**Level of Evidence:** 4

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Opioids are the mainstay of perioperative analgesia in posterior spinal fusion; however, drawbacks include opioid-induced hyperalgesia,<sup>1</sup> and adverse effects such as nausea, gastrointestinal dysmotility, respiratory depression, and risk of opioid habituation.<sup>2</sup> We report a case of posterior spinal fusion in which a multimodal anesthetic regimen was successfully used to provide opioid-free perioperative analgesia. A key component was the novel ultrasound-guided erector spinae plane (ESP) block, which anesthetizes ventral and dorsal rami of spinal nerves (Figure 1).<sup>3,4</sup> This case highlights the benefit that this regimen may have on postoperative pain following spine surgery.

## CASE REPORT

A 35-year-old woman with cerebral palsy underwent a T3-pelvis posterior fusion for scoliosis correction. Five months postoperatively, she developed acute leg numbness and weakness. Magnetic resonance imaging (MRI) revealed a T3 fracture, proximal junction kyphosis, and canal stenosis (Figure 2A–F). At preoperative assessment for revision surgery, the patient reported unpleasant experiences with opioids during multiple childhood surgeries, and particularly her recent spinal surgery, which was complicated by severe and prolonged postoperative ileus attributed to

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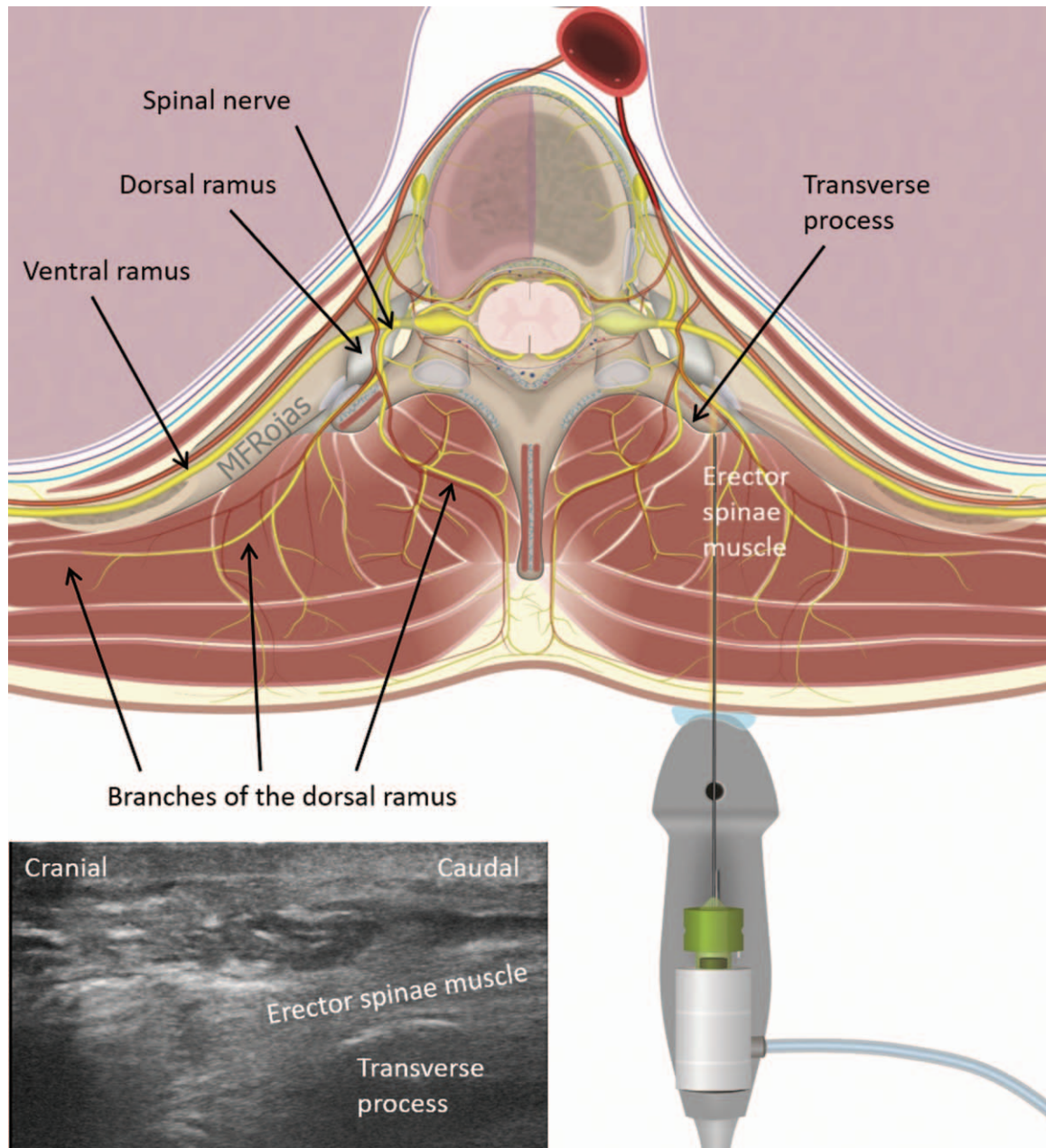
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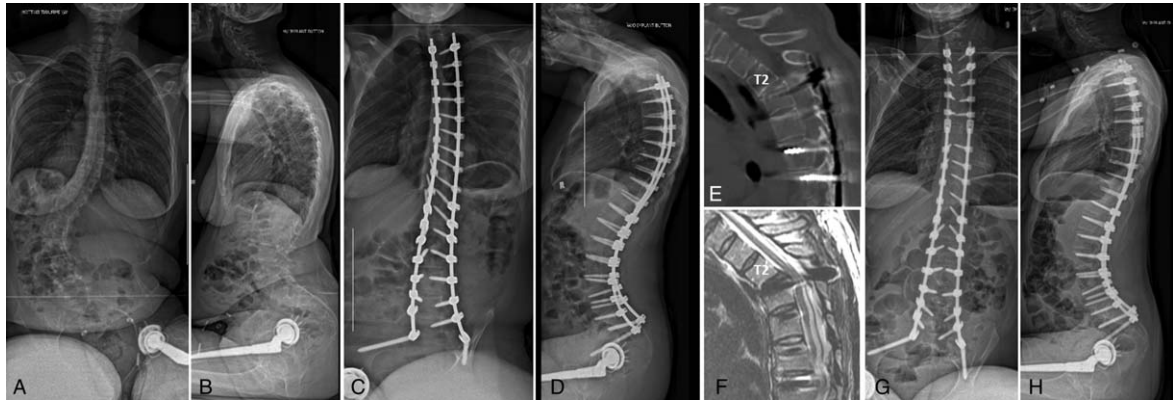


**Figure 1.** Graphic illustration of the ESP block. A linear-array ultrasound transducer is placed in a parasagittal orientation 2–3 cm lateral to midline to visualize the tip of the targeted transverse process and the overlying erector spinae muscle (inset image). Local anesthetic is injected between erector spinae muscle and the tips of the transverse processes. This anesthetizes the dorsal rami of the spinal nerves and their branches that innervate the paraspinal muscles and bony vertebrae (Image adapted and used with permission from Maria Fernanda Rojas Gomez).

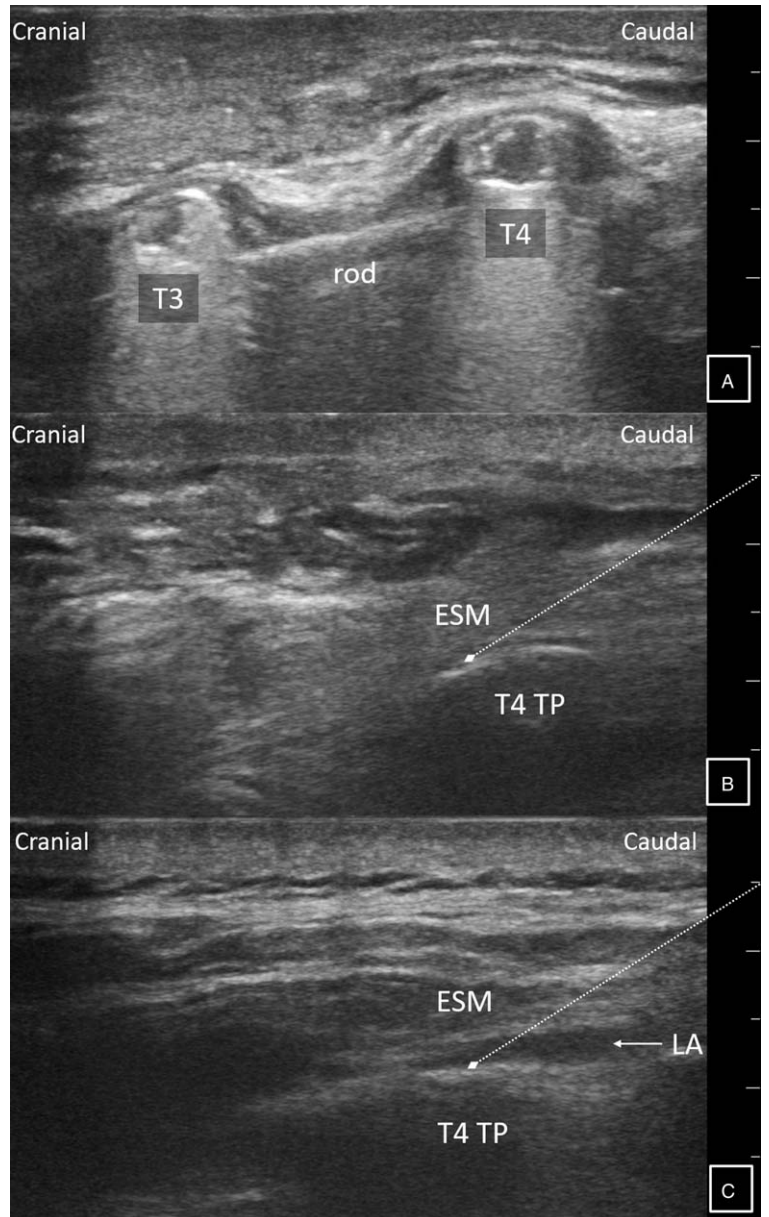
hydromorphone. She described intolerances to multiple analgesics, including gabapentin, morphine, oxycodone, and hydromorphone. She was adamant on receiving only acetaminophen for analgesia and refused to consider any perioperative opioid therapy.

An opioid-free anesthetic was therefore designed to minimize, and ideally eliminate, the need for postoperative opioid analgesia. Before induction of general anesthesia, bilateral ultrasound-guided ESP blocks were performed at the T4 level (the approximate midpoint of the proposed revision). A 22-gauge needle was inserted under ultrasound

guidance through erector spinae muscle to contact the tip of the T4 transverse process (Figure 3A–C). Twenty milliliters of 0.25% bupivacaine with 5  $\mu$ g/mL epinephrine was injected into the musculofascial plane between erector spinae muscle and transverse processes. This was repeated on the opposite side. General anesthesia was induced with intravenous midazolam 2 mg, propofol 200 mg, lidocaine 100 mg, rocuronium 50 mg, and esmolol 25 mg. Intravenous dexamethasone 8 mg was given for analgesia<sup>5</sup> and antiemetic prophylaxis. Anesthesia was maintained with intravenous ketamine (0.5 mg/kg loading dose, 0.5 mg/kg/h



**Figure 2.** Anteroposterior (A) and lateral (B) upright seated radiographs of the patient illustrating her neuromuscular scoliosis before T3 to pelvis instrumentation and deformity correction. Anteroposterior (C) and lateral (D) radiographs 3 months later demonstrate a corrected deformity with some kyphosis at the proximal end of the construct. The patient returned at 5 months with increasing weakness and numbness of her lower extremities. Sagittal reconstructed CT scan (E) and MRI (F) demonstrate a compression fracture of T3 with junctional kyphosis and cord compression at the level of T2-T3. Revision decompression and proximal extension of the construct to T2 with posterior column osteotomies at T2-T3 and T4-T5 were performed as seen on the 1-week postrevision anteroposterior (G) and lateral (H) upright seated radiographs.



**Figure 3.** (A) Ultrasound visualization of pedicle screws and rod at T3 and T4 in a parasagittal plane, medial to the tips of the transverse processes. (B) The ultrasound transducer is shifted slightly laterally to visualize the tip of the T4 transverse process (TP) and the overlying erector spinae muscle (ESM). A 22-gauge needle (trajectory illustrated by dotted line) is inserted in a caudal-to-cranial direction to gently contact the TP. (C) Injection of local anesthetic (LA) into the musculofascial plane between TP and ESM produces a characteristic linear spread pattern of dark fluid that separates ESM from the TPs.

infusion), dexmedetomidine (0.5 mcg/kg loading dose, 0.2 mcg/kg/h infusion), and propofol 100 µg/kg/min. No additional analgesics were administered intraoperatively. The spine was exposed from T2 to T8 and the existing rods were cut at T7 and removed. Pedicle screws were placed at T2, a laminotomy decompression performed at T2-T3, and posterior column osteotomies performed at T2-3 and T4-5 to correct the kyphosis. New proximal rods were connected end-to-end to the original rods and local bone graft was placed around the osteotomy sites (Figure 2G, H). No significant abnormalities were detected on somatosensory and motor-evoked potential monitoring during surgery. Ketamine and dexmedetomidine infusions were stopped once wound closure commenced, and the patient was extubated awake 45 minutes later. She complained of chest wall pain secondary to prone positioning and this was treated with intravenous ketorolac 15 mg. She reported no pain from the surgical site itself.

Postoperatively, the patient received oral acetaminophen 1 g 6-hourly, which maintained resting and dynamic pain scores at 0 to 1/10 and 2 to 3/10, respectively. On postoperative day (POD) 2, she complained of muscle spasms in her upper back, which were effectively treated with the addition of baclofen 10 mg 8-hourly. Acetaminophen was only administered as needed by POD5 (1-2 doses/day) and she did not require opioids at any time until her discharge on POD11.

## DISCUSSION

The ESP block has been successfully used for lumbosacral spine surgery<sup>4</sup>; however, this is the first report of its use in major revision surgery of the thoracic spine. A single injection blocks spinal nerves at multiple levels, thanks to extensive cranial-caudal local anesthetic spread in the musculofascial plane deep to erector spinae muscle.<sup>3</sup> As demonstrated here, ESP blocks are feasible following previous instrumentation; the injection site is lateral to the area of fusion and the expected pattern of spread under erector spinae muscle can be directly visualized (Figure 3). Furthermore, the needle remains distant from the neuraxis, pleura, and major vessels or nerves. This makes it a simple and safe procedure with minimal adverse effects as long as maximum recommended local anesthetic doses are not exceeded. It is thus advantageous over more invasive techniques such as epidural analgesia.<sup>6</sup>

The other important elements of the anesthetic regimen included avoiding intraoperative use of potent opioids and pre-emptive analgesic administration of dexamethasone,<sup>4</sup> dexmedetomidine, and ketamine. Opioid-induced hyperalgesia, particularly following the use of remifentanyl, may contribute to postoperative pain.<sup>1,7</sup> Both dexmedetomidine and dexamethasone prolong the analgesic duration of nerve conduction blockade.<sup>8,9</sup> The N-methyl-D-aspartate receptor-blocking properties of ketamine, and the alpha-2 adrenoreceptor agonist action of dexmedetomidine influence pain processing in dorsal horn neurons and may prevent windup and central sensitization.<sup>10</sup> The

use of these agents can thus enable opioid-sparing in spine surgery.<sup>11-13</sup>

## CONCLUSION

The combination of intraoperative conduction blockade with ESP blocks, modulation of nociceptive processing in the dorsal horn, and avoiding opioid-induced hyperalgesia may explain the prolonged duration of effective analgesia observed in this case. The potential of this multimodal anesthetic approach to significantly improve postoperative analgesia following spinal fusion surgery and reduce both acute as well as chronic opioid use<sup>2</sup> warrants further investigation.

## ➤ Key Points

- ❑ The ultrasound-guided erector spinae plane (ESP) block is a novel, safe, and simple technique that anesthetizes dorsal rami of spinal nerves and can thus provide effective perioperative analgesia in spine surgery.
- ❑ The site of injection superficial to the tips of the transverse processes makes the ESP block a simple and safe technique without risk for neuraxial or pleural injury, and one that is feasible even in the presence of previous spinal instrumentation.
- ❑ The use of ketamine and dexmedetomidine infusions not only contributes to intraoperative analgesia but also modulates nociceptive processing in the dorsal horn, preventing central sensitization and improving postoperative analgesia.
- ❑ Minimizing or eliminating the use of potent opioids during surgery reduces the risk of opioid-induced hyperalgesia.
- ❑ A pre-emptive, multimodal, intraoperative anesthetic regimen combining intraoperative conduction blockade, modulation of nociceptive processing in the dorsal horn, and avoidance of opioid-induced hyperalgesia may significantly reduce the need for postoperative opioid analgesia following posterior spinal fusion surgery.

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