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Motor Blockade After Erector Spinae Plane Block for Lumbar Spinal Surgery: A Case Report

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Background: Regional anesthetic techniques, including the erector spinae plane block (ESPB), decrease pain scores while reducing opioid consumption. Given their high safety profile and analgesic efficacy, ESPBs offer an alternative to neuraxial anesthetic techniques for perioperative analgesia.

Case Report: Transient unilateral dense L3 motor weakness occurred as a complication of the ESPB performed intraoperatively for an L2-L5 laminectomy and L2-L3 discectomy at the L3 level. The motor weakness was concerning for spinal cord injury and confounded the postoperative neurologic examination.

Conclusions: Lesson learnt from this case suggests the lumbar ESPB should be performed preoperatively in awake patients to avoid confounding physical exam findings in the postoperative anesthesia care unit; this also reduces the need for further emergent imaging and workup. During a lumbar ESPB, a local anesthetic should be deposited at the tip of the transverse process, and not breach the intertransversarii muscle and ligament to favor the dorsal spread and sparing of ventral rami motor fibers.

Key words: Erector spinae plane block, ultrasound, regional anesthesia, spine surgery

BACKGROUND

Targeted multimodal pain strategies are essential components of enhanced recovery after surgery pathways (1). Peripheral nerve blocks decrease opioid requirements and improve patient satisfaction (2). They are less costly and invasive than epidural analgesia, and do not usually require significant in-hospital monitoring beyond the time of placement (3). The erector spinae plane block (ESPB) is a novel technique gaining popularity for thoracic, abdominal, and lumbar spine surgeries. ESPBs are viewed favorably given their presumed safety profile and technical feasibility. Complications are rare with this block, with an estimated risk of 2 complications per 10,000 procedures (4-7). Motor and sensory deficits can be mistaken for an acute hematoma, spinal cord, or nerve root injury. In this case report, we describe transient unilateral dense L3 motor weakness as a complication of the ESPB performed for postoperative pain control for lumbar spine laminectomy and discectomy.

CASE

A 66-year-old man, American Society of Anesthesiologists physical status classification score of 3, with a past medical history of coronary artery disease, hypertension, and lumbar stenosis with neurogenic claudication presented for L2-L5 laminectomy and L2-L3 discectomy under general anesthesia. Informed consent was obtained for a bilateral single injection ESPB at the L3 level. Following an uncomplicated induction of general anesthesia, the patient was positioned prone and sterilely prepped. A Fujifilm Sonosite PX Ultrasound System (Fujifilm Sonosite Inc, Bothell, Washington) was used and an L15-4 high-frequency linear transducer was placed in a transverse orientation over the lumbar

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region. The right L3 transverse process (TP) was isolated by counting the lumbar vertebra on ultrasound over midline and then sliding the probe right lateral to L3. The erector spinae muscle group and right L3 TP were identified. A 21-G 100-mm nonstimulating Pajunk needle (Pajunk Medical Systems, Tucker, GA) was advanced in an in-plane approach lateral to medial until the needle tip made contact with the osseous tip of the L3 TP. A solution of 15 mL of sterile 0.5% ropivacaine without additives was administered in 3 mL to 5 mL aliquots with negative aspirations of blood with real-time visualization of local anesthetic deposition. The same process was performed on the contralateral side.

The surgical procedure was performed via a midline vertical skin incision over L2-L5. The patient remained hemodynamically stable throughout the operation (mean arterial pressure maintained > 65 mm Hg throughout), with an estimated blood loss of 500 mL. In the postoperative anesthesia care unit (PACU), the patient was noted to have a dense sensory and motor deficit over the right thigh in an L3 distribution with complete loss of knee extension on the right. Importantly, the patient did not exhibit saddle paresthesia, bladder, and bowel dysfunction, or incisional tenderness. The surgical and anesthesia staff discussed the finding, which was probably due to the local anesthetic reaching the nerve root; however, other causes had to be ruled out, hence emergent imaging was recommended. A lumbar spine magnetic resonance imaging (MRI) was ordered emergently in the PACU. The MRI was negative for spinal cord or nerve root compression, ischemia, infarction, or evidence of unrecognized surgical manipulation. The motor and sensory deficits were presumed secondary to the ESPB in the absence of pertinent imaging findings, and no lumbar drain was placed. He remained hemodynamically stable in the postoperative period with routine supportive care, and neurological assessments were performed every 4 hours. By 16 hours post-block, on postoperative day one, he had recovered full right lower extremity sensation and motor function. He was later discharged neurologically intact without deficits. Per institutional guidelines, Institutional Review Board approval was not required for the generation of this case report; however, written Health Insurance Portability and Accountability Act authorization was obtained from the patient.

DISCUSSION

Regional anesthesia plays an essential role in multimodal pain management. ESPB, a novel block proposed in 2016 for neuropathic pain (8), is now increasingly performed in thoracic, abdominal, and spine surgeries for acute postoperative analgesia (9). In a 2021 meta-analysis of 12 randomized control trials involving 828 patients, Ma et al (10) evaluated the utility of the ESPB in spine surgery as compared to no regional anesthesia. They found that patients with the ESPB had lower postoperative pain scores, decreased opioid consumption in the first day following surgery, reduced need for rescue analgesics, and decreased postoperative nausea and vomiting. When compared with neuraxial procedures, ESPBs have a lower risk profile due to less proximity to vital neuraxial structures and pleura.

The procedure is typically performed under ultrasound guidance. Local anesthetic is injected within the erector spinae plane at the lateral tip of the vertebral TP. The anesthetic then spreads cranially and caudally acting on the dorsal rami in multiple dermatomes providing analgesia (8-10). When the local anesthetic tracks ventrally onto the ventral rami, motor impairment can occur. At present, the extent of sufficient local anesthetic spread to ventral spinal roots is unknown. Tulgar et al (11) assessed 182 patients undergoing ESPBs at a single institution. They reported an instance of bilateral quadriceps muscle weakness for 14 hours after the bilateral ESPB at the T9 level following completion of a laparoscopic hysterectomy. Similarly, White et al (12) described bilateral weakness in hip flexion and knee extension for 16 hours after the ESPB performed bilaterally at T11 prior to a thoracoabdominal aneurysm repair. In this case, the patient underwent spinal drain placement and blood pressure augmentation to mean arterial pressure > 80 mm Hg until etiology of motor loss was correlated with the ESPB and spinal cord ischemia ruled out. Our current case follows a similar timeframe as these prior reports, with symptom resolution within 16 hours; however, the motor deficit was unilateral and did not require further intervention to alleviate symptoms. Furthermore, our report was a more localized symptomatology and at the level of the L3 injection, rather than the extensive off-target spread as seen in the prior reports of thoracic ESPBs.

Discrepancies in reported benefits and efficacy of the ESPB is most likely due to variations in the local anesthetic deposition. In the lumbar region, Harbell et al (13) injected 20 mL of 0.166% methylene blue dye between the distal end of L4 TP and erector spinae muscle bilaterally, and found cephalocaudal spread from L3-L5 in all specimens. Interestingly, they found no dye anteriorly into the dorsal root ganglion, ventral rami, or paravertebral space. This contrasted with a prior anatomical study (14) in which the injection was approximately midway between the lamina and the tip of the TP where the spread was noted anterior to the psoas muscle reaching the third and fourth lumbar spinal nerves in 17% of cadavers.

We propose that this difference in spread pattern observed both clinically and cadaverically is due to technical differences and interprovider variability. Ideally, needle placement should be posterior to the intertransversarii muscle and ligament. This key muscle lies between the TPs and acts as a roof to the neuroforamina (Fig. 2B). Needle placement medial and posterior to the tip of the TP favors injection onto the sensory fibers of the dorsal ramus. In Fig. 1, we demonstrate these pertinent anatomical landmarks with a recommended needle placement and trajectory.

During our injection, it is likely that the needle landed on the tip of the L3 TP, but had slipped off the bone violating the deep layer of the thoracolumbar fascia and intertransversarii muscle and ligament by a few millimeters. At this location, a local anesthetic is administered closer to the nerve root emerging from the neuroforamina. This spread explains the dense motor block observed. Ensuring local anesthetic injection at the lateral tip of the TPs posterior to the intertransversarii muscle minimizes this spread to the spinal roots and favors spread to the dorsal rami (Fig. 2A). If the ESPB and motor exam were completed preoperatively in

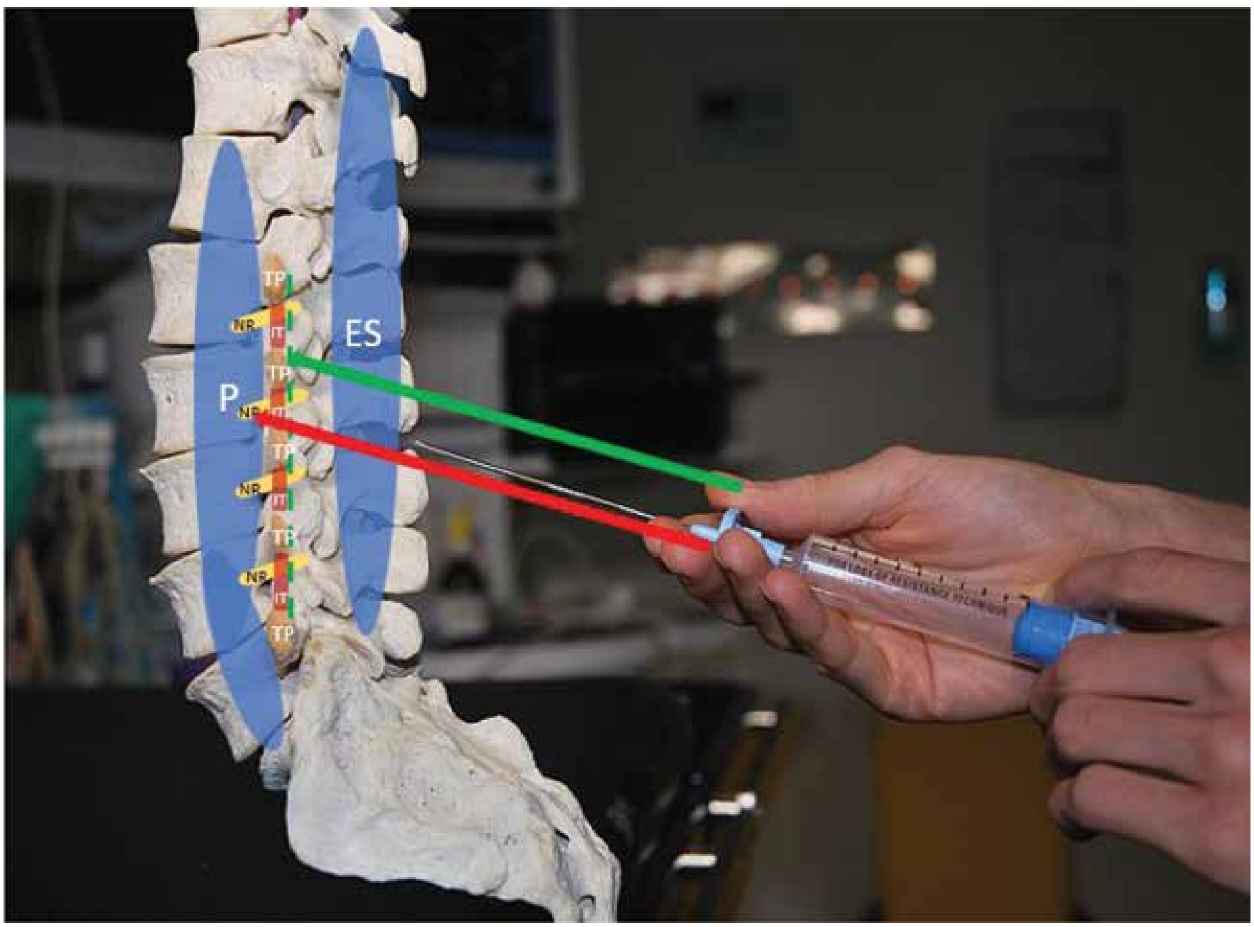

Fig. 1. A depiction of proposed correct needle trajectory (green) and the incorrect needle trajectory (red) of a lumbar ESPB. The green dashed line indicates the line of safety and the maximum point of needle insertion to avoid depositing local anesthetic anterior to the intertransversalis muscle and ligament near nerve roots.
ES - erector spinae muscle group, TP - transverse process, NR - nerve root, IT - intertransversalis muscle and ligament, P - psoas muscle

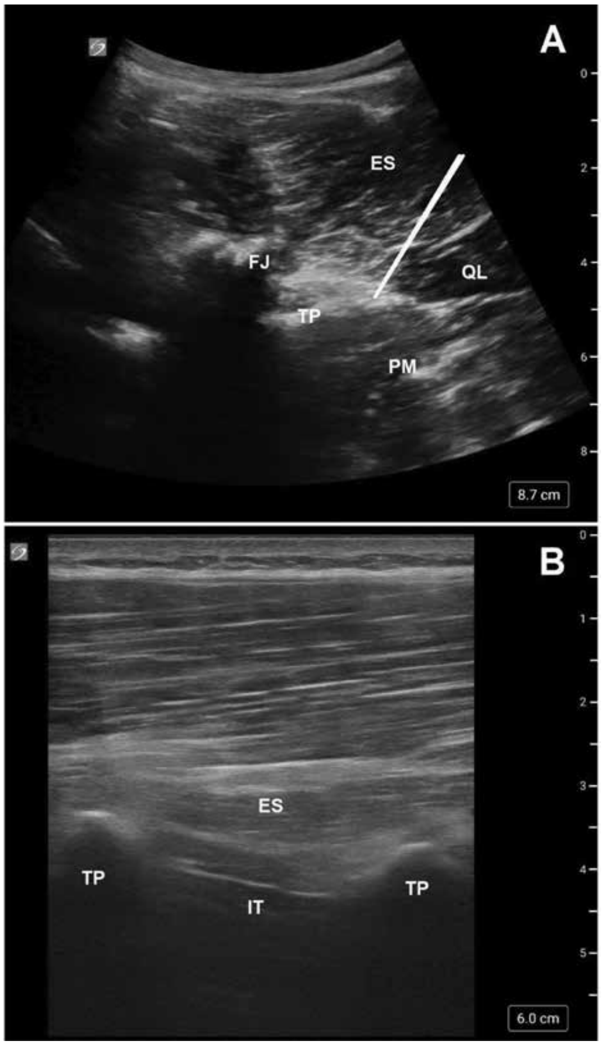

Fig. 2. A) Ultrasound image and landmarks of a lumbar ESPB in axial orientation with proposed ideal needle (white) placement on lateral tip of TP; ultrasound indicator is medial. B) Ultrasound image and landmarks of a lumbar ESPB in sagittal orientation; indicator is cephalad.
ES - erector spinae muscle group, PM - psoas muscle, QL - quadratus lumborum muscle, FJ - facet joint, TP - transverse process, IT - intertransversalis muscle and ligament.

our case prior to surgical manipulation, the need for diagnostic imaging postoperatively could potentially have been avoided.

The type and concentration of local anesthetic utilized in the lumbar ESPB was influenced by prior literature and institutional practices. Most studies and reports of lumbar ESPBs (15,16) utilize either bupivacaine or ropivacaine in concentrations ranging from 0.25% to 0.5%. A prior meta-analysis (10) assessing 24-hour postoperative pain scores found no significant difference in outcomes when utilizing bupivacaine or ropivacaine. Given this prior data, in combination with less cardiovascular and central nervous system toxicity, ropivacaine was selected. While accounting for weight-based dosing for the patient, 15 mL of 0.5% ropivacaine for each ESPB was utilized to provide maximum block duration. As the incision overlaid L2-L5, the 15 mL volume was likely to provide enough craniocaudal spread in the ESP, as evidenced by injectate spread in prior cadaveric studies (13,14). In light of the complication, we suggest that a lower concentration of local anesthetic be utilized for this block, for 2 reasons: 1) in the event of a complication, such as the motor blockade encountered in this report, a motor block from a lower concentration injectate is likely to resolve faster than the higher concentration injectate, and 2) a higher volume of injectate can be utilized to facilitate a greater extent of spread in the ESP while avoiding toxic local anesthetic doses. Ultimately, the volume of local anesthetic utilized should be tailored to each patient based on the extent of the incision and desired area of coverage. With the dense but narrow motor blockade band observed in this report, it is likely that even if a smaller volume of injectate or lower concentration of ropivacaine had been utilized, needle violation of the intertransversarii muscle and ligament and deposition of local anesthetic near the L3 nerve root would have resulted in a similar outcome.

CONCLUSIONS

In summary, this case highlights the rarely reported outcome of motor weakness following the ESPB. Neurological weakness is an undesirable complication of ESPBs. This finding is especially worrisome after spinal surgery where loss of motor function can indicate spinal cord or nerve root compression, ischemia, or injury. Such findings in the postoperative period often require immediate investigation, urgent imaging, and possible interventions, including surgical reexploration. Our case, taken together with others, supports performing ESPBs preoperatively with a dilute local anesthetic solution where a comprehensive neurologic exam can be performed immediately after the block, and again prior to induction of anesthesia. From a technical perspective, the block should be targeted to the tip of the TP, posterior to the intertransversarii muscle and ligament. This favors the dorsal spread targeting sensory fibers, and spares the motor components traveling with the ventral rami. Ultimately, shared decision-making between patients, anesthesiologists, and surgeons should be undertaken to weigh the aforementioned benefits of a lumbar ESPB against potential side effects as described.

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