JOURNAL OF NEUROSURGERY:
Case Lessons

J Neurosurg Case Lessons 3(18): CASE21633, 2022
DOI: 10.3171/CASE21633

Ultrasound-guided bilateral erector spinae plane nerve blocks: a novel application for the management of acute postoperative pain in awake spine surgery. Illustrative case

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BACKGROUND Postoperative pain management is a limiting factor for early ambulation and discharge following spine fusion surgery. Awake spinal surgery, when combined with minimally invasive transforaminal lumbar interbody fusion, is associated with enhanced recovery in well-selected patients. Some neurosurgeons have recently aimed to further improve outcomes by utilizing erector spinae plane block catheters, allowing for a continuous infusion of local anesthetic to improve the management of acute postoperative pain following minimally invasive transforaminal lumbar interbody fusion.

OBSERVATIONS A patient who underwent a minimally invasive transforaminal lumbar interbody fusion with perioperatively placed erector spinae plane catheters at the T12 level ambulated 30 minutes after surgery and was discharged the same day (length of stay, 4.6 hours). The total amount of narcotics administered during the hospital stay was 127.5 morphine milligram equivalents.

LESSONS The placement of bilateral erector spine plane nerve block catheters at the T12 level with an ambulatory infusion pump may help to improve acute postoperative pain management for patients undergoing lumbar spinal fusion.

https://thejns.org/doi/abs/10.3171/CASE21633

KEYWORDS TLIF; ERAS; regional anesthesia; awake; spine; postoperative pain

Postoperative pain control remains a significant challenge for patients undergoing lumbar spinal fusion procedures. Typically pain control has been the limiting factor for early ambulation and discharge following spine fusion surgery. In recent years there have been improvements in postoperative pain control and recovery time due to increased use of minimally invasive (MI) surgical techniques and a multidisciplinary focus on enhanced recovery after surgery. Awake spine surgery is a novel technique utilizing only local or regional anesthetics. MI techniques are used to enhance recovery by attempting to reduce the total anesthetic dose administered to patients. Advancements in regional anesthesia now allow for the possibility to perform fusion operations in an outpatient setting, applying MI transforaminal lumbar interbody fusion (TLIF) techniques. Numerous authors have cited the use of thoracolumbar interfascial plane (TLIP) blocks with liposomal bupivacaine aimed at decreasing perioperative pain and enhancing early recovery in patients undergoing spine surgery.[1–4] To further improve outcomes, some neurosurgeons have advocated for the use of bilateral erector spinae plane (ESP) block catheters, allowing for a continuous infusion of local anesthetic to improve the management of acute postoperative pain following MI-TLIF.

Wang and Grossman[5] first reported blocking the posterior rami of the spinal nerves for awake MI-TLIF using a TLIP block with liposomal bupivacaine. One potential limitation of this method is the added cost of liposomal bupivacaine as well as the variable pharmacokinetics given the drug is eluded from the liposome. The ESP block first described in 2016 was used as a regional block for treatment of thoracic neuropathic pain.[6] Since then it has shown to be effective as a block for a variety of surgeries.[7] The purpose of this article is to describe the novel use of a bilateral continuous ESP block for awake MI-TLIF.

Illustrative Case

History

A 57-year-old male presented to our clinic reporting long-term, gradual worsening of bilateral low back pain and radiating posterior

ABBREVIATIONS ESP = erector spinae plane; MI = minimally invasive; NRS = numeric rating scale; PACU = postanesthesia care unit; TLIF = transforaminal lumbar interbody fusion; TLIP = thoracolumbar interfascial plane.

INCLUDE WHEN CITING Published May 2, 2022; DOI: 10.3171/CASE21633.
SUBMITTED December 7 2021. **ACCEPTED** March 9 2022.

leg pain with associated numbness and burning paresthesia. Pain symptoms were bilateral but more severe on the left side. The patient rated his back pain at a constant 5/10 and his leg pain at a constant 6/10 on a numeric rating scale (NRS).[8] Symptoms were exacerbated by prolonged standing, walking, or physical activity. Pain improved by sitting, forward flexion, or lying down. The patient had previously failed extensive conservative treatment with physical therapy, lifestyle modifications, nonsteroidal anti-inflammatory drugs, and lumbar injections that provided diagnostic but no durable relief of his pain. The patient was having trouble with exercise and daily activity, including his job duties as a surgical physician assistant. The patient also had a previous vocal cord injury after a motorcycle crash and preferred an alternative to general anesthesia.

Physical Examination

On physical examination the patient was noted to have 4/5 left extensor hallucis longus strength compared to 5/5 on the right but was otherwise intact in strength and sensation to the bilateral lower extremities. Patellar and Achilles reflexes were 2+ bilaterally. The patient experienced increases in back and leg pain symptoms with lumbar extension that improved with lumbar flexion.

Imaging

Preoperative imaging studies included magnetic resonance imaging (MRI) of the lumbar spine without contrast and 4-view radiographs of the lumbar spine. The imaging revealed Meyerding grade 1 spondylolisthesis and bilateral L5 pars defects. There was associated L5 S1 degenerative disc disease with loss of disc space height, disc protrusion, and facet arthropathy contributing to left greater than right foraminal stenosis. There was instability appreciated at the L5–S1 level on flexion-extension radiographs.

ESP Block Procedure

Patients undergoing an awake MI-TLIF surgery receive bilateral T12 ESP nerve block catheters in preoperative holding before surgery (Fig. 1). The T12 level is targeted so there is no interference with the surgical site. Over a short period of time after installation and initiation of infusion, the drug then spreads, potentiated by muscular contraction,[9] along the ESP to the lumbar region.

In all cases, including that described here, this portion of the procedure is performed by the anesthesia block team. The patient was placed in prone position then prepped and draped in the usual sterile fashion. A high-frequency linear array transducer (SonoSite SII Ultrasound System, FujiFilm Sonosite) was placed 3 cm from the midline in the thoracolumbar region. The ribs were counted to identify the T12 level in the longitudinal plane. A local anesthetic (1% lidocaine with epinephrine) was administered to the skin and soft tissues. An 18-gauge Touhy needle with catheter (Contiplex Tuohy Continuous Nerve Block Set, B. Braun Medical Inc.) was directed utilizing ultrasound beam to the caudal aspect of the T12 transverse process (Fig. 2). Correct needle tip position was confirmed using hydro-dissection with 2 mL of preservative-free saline to visualize linear fluid spread under the erector spinae muscle complex. The steps were then repeated on the contralateral side. After confirmation of proper placement with ultrasound, the ESP catheters were then loaded with 20 mL of 0.2% ropivacaine bilaterally.

Surgical Procedure

The patient underwent a left L5–S1 MI-TLIF with posterior instrumentation using neuronavigation for pedicle screw placement. A description of this awake MI-TLIF procedure is described previously in the literature.[4] Prior to surgery the patient had bilateral T12 ESP nerve block catheters placed using ultrasound guidance as described above. He then received a spinal block for surgical anesthesia. The patient was taken to the operating room and a left-sided facetectomy was performed. The disc space was prepared and then a dual expandable cage was inserted into the disc space and expanded per manufacturer specifications. Bilateral L5 and S1 pedicle screws along with connecting rods were placed percutaneously. Intraoperative fluoroscopic images demonstrated appropriate placement of instrumentation with reduction of the patient's spondylolisthesis and restoration of disc space height. The patient remained awake and conversant throughout the entire duration of the operation. The patient did not require a surgical drain or Foley catheter.

Immediate Postoperative Course

Following surgery, the patient was transferred to the postanesthesia care unit (PACU). His ESP catheters were then connected to an ambulatory infusion pump (InfuBlock; InfuSystem). Once connected, a continuous infusion of 0.2% ropivacaine at 8 mL/hour was administered for 72 hours after surgery. The patient-controlled anesthesia feature of the pump was programmed to allow for a 5 mL bolus with a 60-minute lockout per hour and a maximum administration limit of 13 mL/hour.

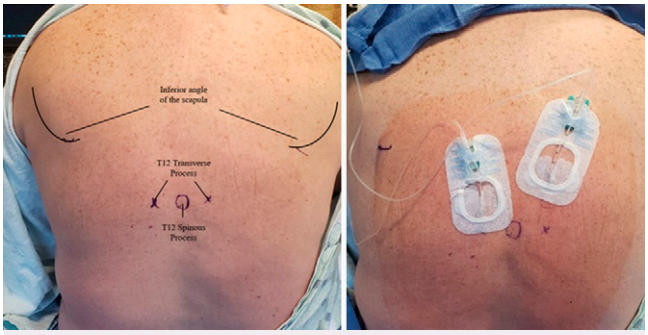

FIG. 1. Left: Image of injection site with the inferior angle of the scapula, T12 spinous process, and left and right T12 transverse processes labeled. **Right:** Catheters after placement and fixation of the appropriate drapes.

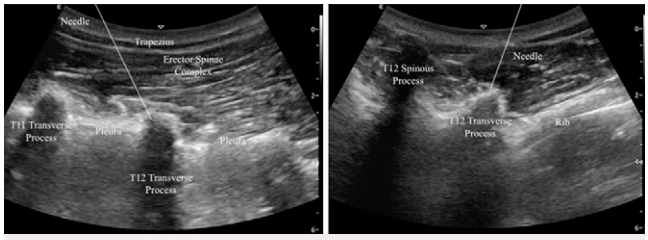

FIG. 2. Bilateral ESP block technique in the sagittal orientation (**left**) and coronal orientation (**right**). The ultrasound probe is placed in the parasagittal orientation over the posterior aspect of the T12 transverse process. The needle with catheter is inserted to the caudal aspect of the T12 transverse process. Correct needle tip position is confirmed by hydro-dissection to visualize linear fluid spread under the erector spinae complex.

The patient was able to mobilize within 30 minutes of surgery. During postoperative physical therapy he was able to transfer from bed and ambulate without the use of assistive devices. On the day of surgery, the patient received a total of 127.5 morphine milligram equivalents for pain management. The patient was able to be discharged from the surgery center the same day as surgery. The time in PACU and total length of stay for this case were 2.6 and 4.6 hours, respectively. He was discharged home with prescriptions for hydrocodone-acetaminophen (7.5/325 mg), methocarbamol (750 mg), and lorazepam (0.5 mg). ESP blocks and ambulatory infusion pump were left in-place at discharge and instructions were provided for use until and removal on postoperative day 3.

Postoperative Follow-Up

The patient was seen in clinic 2.5 weeks after surgery for a postoperative follow-up appointment. At that time, the patient noted complete resolution of his preoperative radicular pain symptoms. He had significant improvement of his low back pain symptoms and rated his pain at a 1 to 2 out of 10 on NRS. He had transitioned to over-the-counter acetaminophen for daytime pain control and was taking only an occasional dose of hydrocodone-acetaminophen at night. The patient was able to return to his job seeing patients in clinic 2 weeks after surgery. When the patient returned for his 6.5-week follow-up he rated his pain at 0/10 on NRS, was participating in outpatient physical therapy, and had completely discontinued pain medications. At 3 months he had completed outpatient physical therapy. Radiographic images demonstrated the implants were intact and appropriately placed at the L5–S1 level without signs of loosening, fracture, or subsidence. The patient was then cleared for return to all normal activities and exercise.

Discussion

Observations

Spine surgery is a target for cost reduction within the US healthcare system. As a result of socioeconomic forces, there is a growing interest to perform spine surgery in the ambulatory setting with the goal of faster recovery and reduced cost.[10] In addition to the use of other multimodal strategies, here we present a novel use for ultrasound-guided bilateral ESP for awake MI-TLIF procedures. This technique is safe and reproducible in selected patients and has the capability to reduce early postoperative pain and dependence on narcotics for acute pain control following lumbar spine surgery.

Bilateral TLIP blocks[11,12] were initially described for lumbar laminectomy and have been documented in relatively small series. They have since gained greater use in the setting of MI-TLIF when combined with liposomal bupivacaine.[4,5,13,14] A TLIP block involves an injection of a local anesthetic into the fascial plane between the multifidus and longissimus muscles, usually at the level of surgery to block the dorsal rami of the thoracolumbar nerves. As an adjunct to traditional regional anesthesia techniques, we describe the potential for utilizing an ESP block in the thoracic region to treat acute postoperative pain following lumbar spine surgery. The ESP block allows for direct administration of local anesthetic to the dorsal rami of spinal nerves which can be accomplished using an ambulatory infusion pump.

In 2016, Forero et al.[6] described the use of an ESP block for treating chronic thoracic pain at the level of T5 transverse process. These blocks have been found to be useful for numerous indications and are now used to combat multiple types of acute and chronic pain following thoracotomy, mastectomy, rib fracture, laparoscopic abdominal surgery, and gynecological surgery.[15] In a case report, Almeida et al.[9] described ESP blocks at T8 after an L2–S1 spine fusion in the setting of a general anesthetic. To our knowledge this is the first description of an ultrasound guided bilateral T12 ESP block used for awake MI-TLIF.

The proposed mechanism of action is that ESP block administration results in spread of the local anesthetic along the intertransverse ligament that blocks the dorsal rami and its branches of lumbar spinal nerves as they exit to the foramen. Chin et al.[16] demonstrated that an injection of 20 mL of dye at T7 produced spread extending to C7–T2 cranially and L2–L3 caudally in fresh cadavers. The spread of the anesthetic is potentiated by muscular contraction in the thoracolumbar spine. Although it was not confirmed using tracing techniques, we believe that the administered anesthetic likely travels to the surgical level despite the block being placed in the thoracic region.

Determining the level for placement of these blocks is important. By placing the ESP blocks at the T12 level we believe that the risk for hematoma or bacterial colonization and infection related to catheter placement is limited because the catheter is not within the surgical site. In the setting of spinal instrumentation, we believe that it is ill advised to place a catheter within the surgical bed for the administration of the local anesthetic due to the risk of infection. Since the adoption of the ESP block technique for use in MI-TLIF procedures we have noted no instances of postoperative wound infection in over 80 cases that have been completed.

Lessons

Based on our use of this technique so far, the authors believe that the bilateral ESP blocks described here for continuous infusion in the erector spinae plane is a promising technique to address acute postoperative pain following surgery. Although the case described here is in an awake patient, this technique likely has application in patients undergoing traditional general anesthetics as well. Similar trends that incorporate postoperative ambulatory infusion pumps to address acute postoperative pain for shoulder, hip, and knee surgery are also evident.[17] Based on the increased adoption of these techniques it seems logical to apply this technology to lumbar fusion surgery.

The case described here shows how placement of bilateral ESP nerve block catheters may contribute to improving postoperative pain control for patients undergoing lumbar spinal fusion. The authors believe that incorporation of ESP catheters into a larger multimodal approach for acute postoperative pain management, could contribute to an increased likelihood of a same-day discharge following MI-TLIF. This treatment has become a valuable part of the multimodal approach used for pain management after spine surgery in our institution. The authors feel that placement of bilateral T12 erector spinae plane nerve blocks has enhanced our ability to perform outpatient procedures as well as other traditional lumbar fusion. Future research including well designed clinical trials should be conducted to understand how using multimodal pain control and enhanced recovery after surgery can be continuously adapted to further improve patient outcomes.

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Disclosures

Dr. Braxton reported personal consulting fees from Accelus, Aesculap, Boston Scientific, and Medtronic outside the submitted work. No other disclosures were reported.

Author Contributions

Conception and design: Heinze, Braxton, Spears, Acquisition of data: Heinze, Brena, Spears, Analysis and interpretation of data: Heinze, Braxton, Spears, Drafting the article: Heinze, Braxton, Brena, Spears, Critically revising the article: Heinze, Braxton, Brena, Reviewed submitted version of manuscript: all authors, Approved the final version of the manuscript on behalf of all authors: Heinze, Administrative/ technical/material support: Heinze, Conrad, Study supervision: Heinze, Acute pain management specialist: Conrad.

Supplemental Information

Previous Presentations

Part of this work was presented as an ePoster at the 2021 Society for Minimally Invasive Spine Surgery (SMISS) conference in Las Vegas, Nevada, October 28–30, 2021.

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