



Educational case report

Erector spinae plane (ESP) block in the management of post thoracotomy pain syndrome: A case series

Mauricio Forero^a, Manikandan Rajarathinam^a, Sanjib Adhikary^b, Ki Jinn Chin^{c,*}^a Department of Anesthesia, McMaster University, Hamilton, Ontario, Canada^b Department of Anesthesia, Penn State Hershey Medical Center, Hershey, PA, USA^c Department of Anesthesia, University of Toronto, Toronto, Ontario, Canada

HIGHLIGHTS

- Erector spinae plane block is a new ultrasound-guided paraspinal analgesic technique.
- ESP blocks were performed in 7 patients with post thoracotomy pain syndrome.
- All 7 patients had immediate and profound analgesia following the block.
- Four patients had pain relief lasting more than 2 weeks.
- ESP block is a simple procedure that facilitates management of chronic thoracic pain.

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ABSTRACT

Background and aims: Post thoracotomy pain syndrome (PTPS) remains a common complication of thoracic surgery with significant impact on patients' quality of life. Management usually involves a multidisciplinary approach that includes oral and topical analgesics, performing appropriate interventional techniques, and coordinating additional care such as physiotherapy, psychotherapy and rehabilitation. A variety of interventional procedures have been described to treat PTPS that is inadequately managed with systemic or topical analgesics. Most of these procedures are technically complex and are associated with risks and complications due to the proximity of the targets to neuraxial structures and pleura. The ultrasound-guided erector spinae plane (ESP) block is a novel technique for thoracic analgesia that promises to be a relatively simple and safe alternative to more complex and invasive techniques of neural blockade. We have explored the application of the ESP block in the management of PTPS and report our preliminary experience to illustrate its therapeutic potential.

Methods: The ESP block was performed in a pain clinic setting in a cohort of 7 patients with PTPS following thoracic surgery with lobectomy or pneumonectomy for lung cancer. The blocks were performed with ultrasound guidance by injecting 20–30 mL of ropivacaine, with or without steroid, into a fascial plane between the deep surface of erector spinae muscle and the transverse processes of the thoracic vertebrae. This paraspinal tissue plane is distant from the pleura and the neuraxis, thus minimizing the risk of complications associated with injury to these structures. The patients were followed up by telephone one week after each block and reviewed in the clinic 4–6 weeks later to evaluate the analgesic response as well as the need for further injections and modification to the overall analgesic plan.

Results: All the patients had excellent immediate pain relief following each ESP block, and 4 out of the 7 patients experienced prolonged analgesic benefit lasting 2 weeks or more. The ESP blocks were combined with optimization of multimodal analgesia, resulting in significant improvement in the pain experience in all patients. No complications related to the blocks were seen.

Conclusion: The results observed in this case series indicate that the ESP block may be a valuable therapeutic option in the management of PTPS. Its immediate analgesic efficacy provides patients with temporary symptomatic relief while other aspects of chronic pain management are optimized, and it may also often confer prolonged analgesia.

Implications: The relative simplicity and safety of the ESP block offer advantages over other interventional procedures for thoracic pain; there are few contraindications, the risk of serious complications (apart from local anesthetic systemic toxicity) is minimal, and it can be performed in an outpatient clinic

* Corresponding author at: Department of Anesthesia, University of Toronto, Toronto Western Hospital, McL 2-405, 399 Bathurst St, Toronto, Ontario, Canada M5T 2S8.

E-mail addresses: maofoeroman@hotmail.com (M. Forero), drmani.ab8@gmail.com (M. Rajarathinam), sadhikary1@pennstatehealth.psu.edu (S. Adhikary), gasgenie@gmail.com (K.J. Chin).

setting. This, combined with the immediate and profound analgesia that follows the block, makes it an attractive option in the management of intractable chronic thoracic pain. The ESP block may also be applied to management of acute pain management following thoracotomy or thoracic trauma (e.g. rib fractures), with similar analgesic benefits expected. Further studies to validate our observations are warranted.

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1. Introduction

Post thoracotomy pain syndrome (PTPS) afflicts approximately 25–47% of patients following thoracotomy or video-assisted thoracoscopic surgery (VATS) [1–5]. Pain intensity is moderate-to-severe in more than a quarter of these patients, particularly with activity; and the majority experience impairment of sleep, activities of daily living and overall quality of life as a result [2,3]. Initial management usually comprises NSAIDs, opioids, neuropathic medications and topical local anesthetics [6,7]. A variety of interventional procedures have been described for treatment of refractory pain, including intercostal nerve blocks, thoracic paravertebral blocks, epidural steroid injections, thoracic sympathetic blocks, pulsed radiofrequency ablation of the dorsal ganglion, and spinal cord stimulation [7–11]. The erector spinae plane (ESP) block is a newly-described technique for treating thoracic pain, and has several advantages that make it an attractive alternative to these more invasive procedures [12]. We describe our experience with the ESP block in a cohort of 7 patients with PTPS to illustrate its therapeutic potential.

2. Methods

Written informed consent was obtained from all the patients in this report. All patients had undergone thoracic surgery for lung cancer and recurrence was ruled out at the time of their presentation. The ESP block was performed in all patients at a thoracic level congruent with the distribution of their thoracic pain. All blocks were performed in a pain clinic setting by the primary author (M.F) using the following technique. With the patient seated, a scout ultrasound scan using a high-frequency (12–5 MHz) linear transducer (NextGen LOGIQe, GE Healthcare, Wauwatosa, WI) was performed to identify and mark the targeted thoracic spine level by counting ribs from above. The skin was sterilized with a 2% chlorhexidine in 70% alcohol solution and the transducer was placed in a transverse orientation to identify the spinous process, lamina, and transverse process (Fig. 1A). The tip of the transverse process was centered on the ultrasound screen, and the transducer was rotated 90 degrees into a longitudinal orientation to obtain a parasagittal view (Fig. 1B). Depending on the level imaged, 2 or 3 hypoechoic muscle layers were identified overlying the tip of the transverse processes. From T1 to T5 the erector spinae, rhomboid major and trapezius muscles are visible posterior and superficial to the transverse processes. The rhomboid major muscle has its lower border at the T5 or T6 level, and thus only the erector spinae and trapezius muscles are visible at more caudad levels. An 8-cm 22-gauge block needle (EchoStim; Benlan Inc., Canada) was inserted in-plane to the ultrasound beam in a cephalad-to-caudad direction to place the needle tip between the posterior fascia of erector spinae and the tip of the targeted transverse process. Correct tip position was confirmed by injection of 0.5 mL of 0.5% ropivacaine and visualization of linear fluid spread deep to the erector spinae muscle (Fig. 1B); following which a total of 20–30 mL of 0.5% ropivacaine was injected, taking care not to exceed the maximum recommended dose of 2 mg/kg of ropivacaine. Pulse oximetry and non-invasive blood pressure monitoring were instituted in all

patients from the beginning of the procedure until at least 15 min after block completion. All the patients were assessed for pain relief 30 min after the injection before being discharged from the pain clinic. Patients were followed up by telephone one week later and a second clinic visit was scheduled approximately 1 month later for further management, with further telephone and clinic followup as indicated.

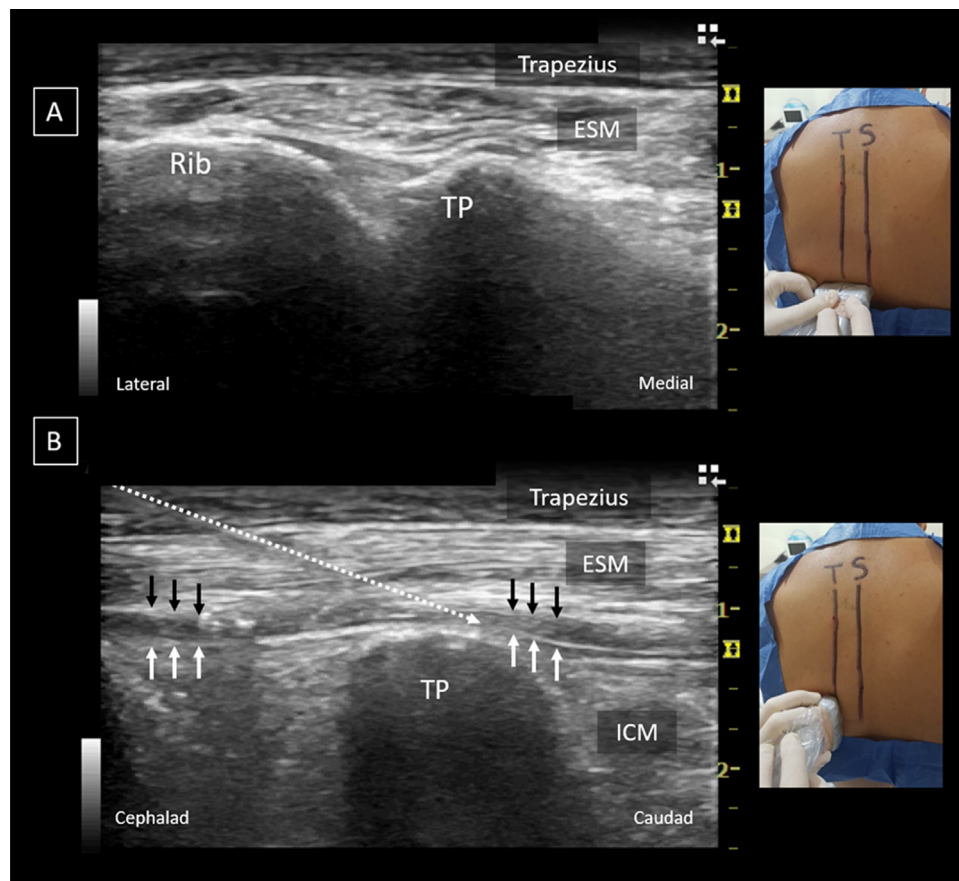
3. Reports

3.1. Case 1

A 58-year-old man presented with PTPS 2½ months following thoracotomy for a right upper lobectomy. The pain was moderate-to-severe (6–8/10) intensity on a numerical rating scale (NRS) and described as constant aching, throbbing pain over the right anterior and lateral hemithorax which was aggravated by any movement of his upper body. This was refractory to management with oxycodone 10 mg nightly, naproxen 375 mg 8-hourly, and pregabalin 75 mg nightly. Examination revealed significant hyperalgesia and diminished pinprick sensation but no allodynia around the thoracotomy scar at the level of T8–T9. A right ESP block was performed at the T9 level with 30 mL of 0.5% ropivacaine. Thirty minutes later, the patient reported >50% pain relief (NRS 3/10) with a significant improvement in the range of movement of his upper body. There was also sensory loss to pinprick from T2 to T10 over the posterior and lateral aspects of the right hemithorax, extending to the mid clavicular line on the anterior aspect. At clinic followup 5 weeks later, he reported that there had been a further reduction in pain intensity to 1–2/10 for the first 2 weeks followed by a gradual increase to 3–5/10 over the next 3 weeks. The ESP block was repeated at T9 with 30 mL of 0.5% ropivacaine and he again experienced immediate reduction in pain to 2/10 in intensity. On telephone followup 4 weeks later, his pain continued to be controlled at 3/10 in intensity. He returned to the clinic for two further ESP blocks at 4 and 6-week intervals respectively and each time obtained immediate relief of his thoracic pain and significant continued analgesia for at least 4 weeks afterwards.

3.2. Case 2

An 81-year-old woman presented with PTPS 10 months after repeat thoracotomy for right lower lobectomy and decortication of recurrent lung cancer. The pain was severe (8/10 NRS intensity) and described as constant aching over the entire posterior hemithorax with intermittent tingling around the surgical scar at the T8–T9 level. She was unwilling to take systemic analgesics and requested interventional therapy instead. A right ESP block was performed at the T8 level with 25 mL of 0.5% ropivacaine. Within 20 min, she reported complete resolution of her pain associated with diminished cold sensation over the entire right hemithorax between T4 and T8 dermatomes. At clinic followup 4 weeks later, she reported that her thoracic pain had recurred but was satisfactorily controlled at a NRS intensity of 2–3/10 and she declined further treatment.



Sonoanatomy and technique of the erector spinae plane (ESP) block.

Fig. 1. Sonoanatomy and technique of the erector spinae plane (ESP) block. (A) The probe is placed lateral to the spinous processes (line S) to obtain a transverse view of tip of transverse process (TP) and rib with overlying trapezius and erector spinae muscle (ESM). (B) The probe is rotated into a longitudinal orientation to obtain a parasagittal view of the tips of the TPs (line T), and the block needle (dotted arrow) is advanced in a cephalo-caudad direction to contact the TP. Correct needle tip position is signaled by linear spread of local anesthetic (solid arrows) deep to ESM and superficial to the TP and intercostal muscle (ICM).

3.3. Case 3

A 64-year-old man presented with PTPS 6 months after undergoing right pneumonectomy. He had severe pain (8/10 NRS intensity) over the anterior and posterior right hemithorax and described it as constant tightness with intermittent tingling, paresthesiae, and electric shock-like sensations around the thoracotomy scar at the T8–T9 level. Despite controlled-release oxycodone 40 mg twice-daily and immediate-release oxycodone 6-hourly, he experienced significant limitation of daily activities and difficulty eating due to the pain, with consequent weight loss. A right ESP block with 25 mL of 0.5% ropivacaine and 40 mg of methylprednisolone was performed at the level of T8. Following the injection, he experienced complete resolution of his pain to 0/10 NRS intensity. At clinic follow-up 1 month later he reported that the pain relief had lasted for 2 weeks, allowing improved sleep and reduction in the use of breakthrough opioid. A second ESP block was performed with 20 mL of 0.5% ropivacaine which again produced significant analgesia lasting 2 weeks.

3.4. Case 4

A 77-year-old man weighing 72 kg presented with PTPS 5 months after a robotic left lower lobectomy. He described severe pain (9/10 NRS intensity) inferior to the left subcostal margin and extending over the left hemithorax from the xiphisternum all the

way to the posterior midline. The pain was constant, pressure-like, and burning in nature with episodic sharp pain and intermittent tingling, paresthesiae, and electric shock-like sensations in the affected area. He had failed a trial of pregabalin due to side-effects of mental sluggishness and was taking hydromorphone 4 mg 4-hourly with marginal relief. On examination, the pain was noted to be worst at the level of T12 posteriorly and along the left subcostal margin in the anterolateral thorax. There was erythema associated with allodynia and hyperalgesia in the site of pain but no sign of infection. An ESP block was performed at the level of T12 with 30 mL of 0.5% ropivacaine. Thirty minutes later his pain had decreased from 9/10 to 2/10 in NRS intensity. At clinic follow-up 2 weeks later, he reported that the pain relief had lasted for only 2 h before recurring at its previous intensity. However the quality of pain had changed, with a decrease in the pressure-like and sharp pains. A second ESP block was performed at T12 with 30 mL of 0.5% ropivacaine, following which he again experienced reduction in pain intensity from 10/10 to 2/10. At telephone followup 2 weeks later, he reported that the analgesia had lasted for 24 h this time. He no longer had episodes of sharp pain but still complained of hyperalgesia and allodynia. At a third clinic visit 4 weeks after the second injection the ESP block was repeated and again provided 24 h of analgesia. He was subsequently managed on a multimodal regimen with oral gabapentin and a topical compound application of lidocaine, amitriptyline and gabapentin until his demise 4 weeks later.

3.5. Case 5

A 66-year-old woman presented with PTPS 1 year following robotic left upper lobe segmentectomy. She had moderate-to-severe pain (4–8/10 NRS intensity) described as a constant burning pain in the area posterior to the surgical scar at the T7–T8 level, together with intermittent electric shock-like sensations predominantly in the anterior, lateral, and posterior aspects of the left hemithorax just above the costal margin. On examination there was significant allodynia and hyperalgesia in this area, as well as significant ache and tenderness over the left scapula and a port site at the T6 level. She was only taking acetaminophen 500 mg twice-daily. An ESP block was performed at the level of T7 with 20 mL of 0.5% ropivacaine. Thirty minutes later, she reported almost complete resolution of the thoracic pain and hyperalgesia. Pregabalin 75 mg twice-daily was added to her analgesic regimen and she was discharged from the clinic. At telephone followup 1 week later, she reported that analgesia had lasted 2 days before returning to its original intensity. However there was subsequent improvement to tolerable levels with pregabalin therapy and she declined further intervention and followup.

3.6. Case 6

A 67-year-old woman presented with PTPS 2 months following left pneumonectomy. She described severe sharp, stabbing and shooting pain of 9/10 NRS intensity in the left anterolateral thorax at the level of T8, despite treatment with hydromorphone 2–4 mg 4-hourly, pregabalin 25 mg twice-daily, and amitriptyline 10 mg nightly. A left ESP block was performed at the T8 level with 20 mL of 0.5% ropivacaine. Thirty minutes later, she reported that her pain intensity had significantly declined from 9/10 to 0/10 in the lateral chest wall and from 9/10 to 4/10 in the anterior chest wall. At telephone followup 1 week later, she reported that the effects of the block lasted for 4 h before recurring at its original intensity. She elected to continue with her current analgesic regimen and declined further followup and intervention.

3.7. Case 7

A 55-year-old man presented with PTPS 8 months after right thoracotomy and upper lobectomy. He described severe aching, shooting and burning pain in the right anterolateral hemithorax with an NRS intensity of 7/10 at rest and 10/10 with activity. The pain interfered significantly with work and activities of daily living despite treatment with gabapentin 1200 mg 8-hourly, extended-release hydromorphone 12 mg 8-hourly and immediate-release hydromorphone 2 mg 6-hourly. On examination, he had severe allodynia in the anterior chest wall between T4 to T8 dermatomal levels, and extending from the mid-axillary line to the sternum. A right ESP block was performed at the T5 level with 35 mL of 0.375% ropivacaine and 80 mg methylprednisolone. Twenty minutes after injection, he reported significant (75%) reduction in the intensity of dynamic pain to 2/10, which was accompanied by a remarkable absence of allodynia. At followup one week later, the improvement in his resting and dynamic pain remained at 50% of baseline intensity (3–4/10 and 5/10 respectively). A right ESP block at T5 was repeated with 25 mL of 0.375% ropivacaine, which again produced almost complete analgesia. At the second followup four weeks later, the patient described experiencing an 80% improvement in pain for approximately two and a half weeks, tapering subsequently to a 40–50% improvement. A third ESP block at T5 was performed with 20 mL of 0.25% ropivacaine and 80 mg methylprednisolone. At followup 7 weeks later, the patient reported that he had had significant pain relief lasting more than 4 weeks. He had been able to resume working, and had also significantly reduced his opioid

requirements to 9 mg of extended-release hydromorphone 12-hourly and two tablets of oxycodone 5 mg-acetaminophen 325 mg daily. His gabapentin dose had been reduced to 400 mg 8-hourly and with the addition of nortriptyline 10 mg twice-daily as well as the series of ESP blocks, he reported that the severity of his allodynia was reduced by 70% from baseline 3 months ago.

4. Discussion

PTPS remains a significant long-term complication of thoracic surgery despite the use of minimally invasive thoracic surgical approaches and optimal acute pain management in the perioperative period [13,14]. The pathogenesis of PTPS is believed to be neuropathic in most cases but there may also be non-neuropathic elements, such as myofascial pain [8]. Once local infection, cancer recurrence, or surgical complications have been ruled out, patients are usually managed with oral analgesics and referred to a pain specialist for severe or refractory pain. Pain management is tailored to the individual patient but typically involves a multidisciplinary approach that includes optimizing multimodal systemic analgesics, performing interventional techniques, and coordinating additional care like physiotherapy, psychotherapy and rehabilitation [7]. The interventional procedures may range in complexity from simple trigger point injections to intercostal nerve, thoracic paravertebral and epidural blocks, or even dorsal root ganglion ablation or spinal cord stimulation depending on patient characteristics, severity of pain and the experience of the pain physician [15–17]. Most of these procedures are relatively invasive, technically complex, often require specialized equipment such as fluoroscopy, and cannot be readily performed in an office setting.

In contrast, the ultrasound-guided ESP block is a simple technique involving local anesthetic injection into a paraspinous tissue plane distant from the pleura and neuraxis, thus minimizing the risk of complications associated with injury to these structures. The key landmarks of the tips of the transverse process and erector spinae muscle are easily visualized on ultrasound, as is the end-point of injectate spread deep (anterior) to erector spinae muscle. Local anesthetic spreads readily in this tissue plane and a single injection of 20–30 mL in adults produces predictable and extensive cephalo-caudal spread and anesthesia of several dermatomes [18]. Cadaveric investigation has shown that the injectate involves both the ventral and dorsal rami of spinal nerves, producing sensory blockade over the posterior as well as anterolateral thorax [12]. This confers an advantage over the serratus plane block, which has also recently been described for treatment of post-thoracotomy [19] and post-mastectomy pain [20] but does not cover the posterolateral chest wall. Furthermore, the ESP block may potentially provide sympathetic block and contribute to visceral analgesia [21]. It must be noted however that while the ESP block is technically feasible in an office or clinic-based setting, IV access, monitoring of ECG, non-invasive blood pressure, and pulse oximetry, as well as availability of 20% lipid emulsion (Intralipid), are recommended to manage the risk of local anesthetic systemic toxicity.

All patients in this series experienced significant improvement in their thoracic pain immediately following the ESP block. In 4 out of the 7 patients, the pain relief outlasted the expected duration of conduction blockade. This is not an uncommon phenomenon in chronic pain and is attributed to interruption of the vicious pain cycle and the elimination of maintenance of central sensitization [22–24]. In the other 3 patients, all of whom primarily had features of severe neuropathic pain, the analgesia was relatively short-lived. Nevertheless, this is comparable to the results obtained with more invasive procedures [9,10], and the ESP block may still be valuable in providing temporary relief while other aspects of analgesic management are optimized, including

opioid weaning. Apart from repeating the ESP block at regular intervals, other potential strategies to prolong therapeutic benefit include continuous local anesthetic infusion through an indwelling catheter [25] and adding steroids to the injectate solution. Steroid injections are well-established in chronic pain management, and they can potentially contribute to analgesia through a combination of anti-inflammatory effects, suppression of ectopic discharges from damaged nerves, and modulation of conduction in normal nerves [26]. Patients 3 and 7 in this series received an ESP block with ropivacaine plus methylprednisolone and this may have contributed to the observed analgesic duration of 2 and 4 weeks respectively. Another possible mechanism underlying the efficacy of the ESP block in chronic pain is the anti-nociceptive effect of systemically absorbed local anesthetic. This has been characterized best for lidocaine, and is attributed to both peripheral effects on sodium channels, as well as central effects mediated by its anti-inflammatory properties and possibly glycinergic inhibition of nociception by its N-ethylglycine metabolite [27,28]. To date however such effects have not been described specifically for ropivacaine.

5. Conclusion

In conclusion, we believe the efficacy and simplicity of the ESP block as demonstrated in this case series make it a promising addition to the pain physician's armamentarium in managing PTPS. Its immediate analgesic efficacy provides patients with temporary symptomatic relief while other aspects of chronic pain management are optimized, and our experience indicates that the ESP block may also often confer prolonged analgesia in and of itself. Further studies to validate our observations are warranted.

6. Implications

The ESP block offers several advantages over other interventional procedures. By virtue of the fact that injection is performed in a musculofascial plane away from the neuraxis, there are few contraindications and the risk of serious complications (apart from local anesthetic systemic toxicity) is minimal. It is relatively simple to perform, does not require the use of ionizing radiation, and can therefore be performed in an outpatient clinic setting. This, combined with the immediate and profound analgesia that follows the block, makes it an attractive first-line option in the management of intractable chronic thoracic pain, regardless of etiology. The ESP block may also be applied to management of acute pain management following thoracotomy [25] or thoracic trauma (e.g. rib fractures) [29], with similar analgesic benefits expected.

Ethical issues

Written informed consent for inclusion in this case series was obtained from all patients. Local institutional ethics board approval is not required for case reports or case series and thus was not obtained.

Conflict of interest

None.

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