

Combination of the T7 Unilateral Erector Spinae Plane Block and T10 Bilateral Retrolaminar Blocks in a Patient with Multiple Rib Fractures on the Right and T10–12 Vertebral Compression Fractures: A Case Report

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Abstract: Multiple vertebral compression and rib fractures in elderly patients with pre-existing chronic obstructive pulmonary disease is a common scenario associated with significant morbidity and mortality. Severe pain prevents normal ventilation and leads to atelectasis, consolidation, and pneumonia. Subsequently, these patients frequently develop respiratory failure and require intubation and critical care. Therefore, adequate analgesia is often a life-saving intervention. Anesthetic management of a 78-year-old kyphotic patient with T6, T7, and T9 rib fractures on the right and T10–12 vertebral compression fractures sustained in an accidental fall is presented. She had inadequate pain control and was unable to take a deep breath or cough. Her respiratory status was deteriorating, with tachypnea and worsening hypoxia, necessitating bi-level positive airway pressure (BiPAP) support. Since thoracic epidural analgesia was contraindicated owing to compressive vertebral fractures and to the pending respiratory failure, we opted for a unilateral erector spinae plane (ESP) block at the T7 level and bilateral retrolaminar (RL) blocks at the T10 level. Following the procedure, the pain was immediately relieved and the patient was able to take deep breaths. Shortly thereafter, her respiratory status improved, with the respiratory rate coming back close to the baseline. The patient was subsequently weaned from BiPAP support and discharged from the intensive care unit. While the combination of ESP and RL blocks is not routinely used in patients with multiple rib and vertebral compression fractures, our report indicates that it may be an excellent alternative for analgesia in situations where thoracic epidural and/or paravertebral blocks are contraindicated and when timely intervention could be potentially life-saving.

Keywords: erector spinae plane block, retrolaminar block, rib fractures, vertebral compression fracture, case report

Introduction

As a result of osteoporosis and degeneration of rib cartilage, people over 65 years of age are highly prone to rib and vertebral compression fractures, often as a consequence of a fall. Moreover, approximately 20% of people in the same age group suffer from chronic obstructive pulmonary disease (COPD).¹ In addition to processes associated with senescence, COPD leads to impaired respiratory gas

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exchange and poor baseline respiratory reserve. Furthermore, severe pain associated with rib and vertebral fractures prevents normal ventilation and may lead to atelectasis, tissue consolidation, and pneumonia. Consequently, these patients frequently develop respiratory failure requiring intubation and intensive care unit (ICU) admission.²

A unique anesthetic management of a respiratory-compromised elderly patient with multiple vertebral compression and unilateral rib fractures is reported. We used a combination of T7 unilateral erector spinae plane (ESP) and T10 bilateral retrolaminar (RL) blocks in the acute setting to mitigate severe pain and avoid imminent respiratory failure.

Case Report

A 78-year-old female with a medical history of hypertension, COPD, abdominal aortic aneurysm, kyphosis, and chronic kidney disease was admitted to the trauma service after a fall caused by sudden dizziness. On admission, the trauma CT scan showed T6, T7, and T9 rib fractures on the right and T10–12 vertebral compression fractures.

The patient stated numerical rating scale (NRS) pain scores of 8/10 at rest, and 10/10 on the slightest movement and deep breaths, despite oral oxycodone, diclofenac, acetaminophen, topical lidocaine patches, and patient-controlled analgesia hydromorphone infusion (0.2 mg IV Q15 min PRN). The pain was particularly severe anteriorly along the right costal margin and on the posterior aspect of the chest close to the midline along the T6–9 levels on the right side and bilaterally along the midline along the T10–12 levels. The patient was unable to move, could not sleep because of raging pain, and was not able to cough or take a deep breath.

On hospital day 3, the patient started to become confused, tachycardic, and tachypneic, with oxygen saturation (O₂ Sat) in the low 90s%, and was transferred to the surgical ICU. The acute pain service was consulted. At that time, the patient was in respiratory distress, with a respiratory rate of 35 breaths/min and O₂ Sat in the high 80s% on bi-level positive airway pressure (BiPAP). In order to prevent hypoventilation, and enable deep breathing, adequate coughing with clearance of secretions, and compliance with chest physiotherapy, an effective analgesia needed to be achieved quickly. The overall goal was to reduce secondary pulmonary complications, including atelectasis, pneumonia, respiratory failure, and the need for respiratory support and/or intubation. Since

thoracic epidural (TE) analgesia was contraindicated owing to compressive vertebral fractures and to the pending respiratory failure, we decided on a unilateral ESP block at the T7 level and bilateral RL blocks at the T10 level.

Ultrasound (US)-guided ESP block was performed at the T7 level on the right and bilateral RL blocks were performed at the T10 level using an in-plane needle technique and a 5–10 MHz linear array probe (L 38; Sonosite, Bothell, WA, USA). The patient was placed in a supine left lateral position with the US probe in the sagittal plane positioned lateral to the midline for each of the blocks.

For the ESP block, we directed the needle deep to the erector spinae muscle and deposited 15 mL of 0.5% ropivacaine as a single injection in the close proximity of the costotransverse foramen. The paravertebral T6–9 level anesthetic spread was confirmed by US imaging and clinically paralleled by almost instantaneous relief of the right hemithorax pain. Bilateral RL blocks were performed with 10 mL of 0.5% ropivacaine injection on each side and produced prompt relief of paramedial back pain along the T10–12 levels. Subsequent testing of the distribution of cutaneous sensory block showed complete loss of cold sensation over the right hemithorax extending from the T5 to T11 level, which was especially dense posterolaterally. In less than 15 minutes, the patient was able to take deep breaths and the respiratory rate returned to close to her baseline. Subsequently, the patient's respiratory status improved, and she was weaned from BiPAP support and discharged from the surgical ICU on the next day, and eventually transferred to a rehabilitation facility on hospital day 6.

Informed consent for publication was obtained from the patient. Institutional approval was not required to publish the case details.

Discussion

The presented case underlines the fact that prompt and adequate analgesia in elderly patients with rib and vertebral fractures is imperative to avoid potentially detrimental pulmonary complications, and can be life-saving in many cases.^{2,3} Early intervention with adequate pain relief improves patients' functional capacity by reducing splinting and improving pulmonary function. In fact, Trauma Anesthesiology Society guidelines recommend prompt and effective multimodal analgesia for rib fractures by combining regional anesthesia techniques with

pharmacotherapy to relieve the pain, optimize pulmonary function, and reduce opioid-related complications.²⁻⁴

The choice of an adequate pain management strategy may pose a challenge, despite the many available options. For instance, oral and systemic non-steroidal anti-inflammatory drugs (NSAIDs) are useful for mild-to-moderate pain, as they do not depress the cardiovascular and central nervous systems. The side effects of NSAIDs include peptic irritation, platelet inhibition, and renal injury. Opioids, on the other hand, are respiratory depressants; they suppress cough and may promote respiratory complications, in addition to interfering with the examination/assessment of other injuries in trauma victims.^{3,4}

An excellent approach to pain management in trauma patients comprises continuous nerve blocks with catheters. The decision regarding continuous peripheral nerve blockade/catheters in trauma patients, who are also frequently receiving antithrombotic prophylactic therapy, must be made on an individual basis, as the benefits and risks (neuraxial or deep peripheral hematoma development) of regional anesthesia must be carefully weighed. In addition, trauma patients often require immediate intervention and multiple perineural catheters to provide optimal long-lasting analgesia. Finally, the most important question when deciding on a single-shot versus an indwelling catheter for continuous peripheral nerve blockade frequently becomes who will follow up the patients. Regarding our patient, concerns around antithrombotic prophylactic therapy, the relatively high acuity of the patient – pending respiratory failure, and the absence of an in-house acute pain service to properly follow up patients with indwelling catheters – led us to the decision to use single-shot RL and ESP nerve blocks.

Considering regional anesthesia, TE analgesia using local anesthetic agents, opioids, or a combination of both has been commonly used to manage pain in patients with rib fractures.³⁻⁵ However, it is technically challenging, with a failure rate of approximately 15%. In patients with multiple injuries, it can mask intra-abdominal injuries and be associated with the loss of bilateral sympathetic tone, causing hypotension. In addition, it can result in cardiovascular collapse and cardiac arrest in an inadequately resuscitated patient.³⁻⁵

Novel regional strategies include several US-guided fascial plane blocks differentially affecting the dorsal, lateral, and anterior cutaneous nerves of the thorax. Examples of these techniques are thoracic paravertebral (PV) block, RL block, serratus plane (SP) block, and the more recently introduced ESP block. These are technically easier to perform than

neuraxial anesthesia and they seem to have significantly fewer serious side effects than epidural analgesia.³⁻⁵

Introduced in 2016, the ESP block is, from a technical standpoint, a relatively simple fascial plane block with an expanding application. It targets the tips of the transverse processes, and the local anesthetic then reaches the paravertebral spaces, providing analgesia of both the dorsal and ventral rami of spinal nerves. The block also produces significant intercostal spread, over five to nine levels, thus exerting effects on the intercostal nerves and their lateral cutaneous branches. The blockade of these nerves is responsible for an extensive and reliable posterolateral and anterior thoracic analgesia. Consistent with this, ESP block demonstrates significant improvement in respiratory function and improved analgesia in patients with multiple rib fractures. Furthermore, an extensive craniocaudal penetration of the local anesthetic, within the thoracolumbar fascia and along the paraspinal muscles, has been well documented. For example, a single injection applied at the T5 level spreads between T2 and T9. The extensive distribution along the thoracolumbar fascia encompassing the dorsal rami of the spinal nerves explains the analgesic benefit in acute trauma patients with vertebral fractures.⁶⁻⁹

RL block is another example of the newer and simpler substitutes for the traditional, and often technically challenging, PV block. The RL block targets the vertebral laminae and spreads to the epidural and neural foraminal spaces over two to five levels. Anatomical studies with the dye injected via an RL block indicate that the main mechanism of action is anesthetic infiltration of the dorsal rami of the spinal nerve, while the ventral rami are less involved. The clinical feasibility, safety, and efficacy of the RL block have been well demonstrated in patients with multiple rib or vertebral compression fractures, especially by using higher volumes of local anesthetic.^{4,6,10-12}

Like other fascial plane blocks, the ESP and RL blocks are technically straightforward to perform, with lower risks of complications compared to EA or PV blocks. In trauma patients with intracranial pathology or potential spinal cord injury, the ESP and/or RL blocks also allow for continued neurological examination, which can be confounded when neuraxial techniques are used. In addition, there are fewer contraindications compared to EA and/or PV blocks, making ESP and/or RL blocks a feasible and effective alternative.^{3,4,7-9,11,12}

As a possible limitation, we need to acknowledge that regional anesthesia techniques may be unavailable in the settings of emergency departments and/or ICUs.^{3,4,8,11}

Another concern may be possible toxicity of ropivacaine; for example, we administered 175 mg. To clarify, the patient's weight was 68 kg and height 172 cm. According to American Society of Anesthesiologists (ASA) guidelines and/or the literature, the maximum single dose (without vasoconstrictor) for ropivacaine is 2–3 mg/kg, not to exceed 225 mg per dose.^{13,14} Thus, we were not very close to potentially toxic levels.

To sum up, we hope that our work will help to further promote ESP and RL blocks in these settings and foster the importance of teamwork and close collaboration among emergency room, trauma, ICU, and anesthesiology services.

Conclusion

The combination of ESP and RL block for patients with acute traumatic vertebral compression and rib fractures provides another regional analgesic option for patients who have previously not been considered as block candidates.¹²

The single-injection ESP and RL blocks can provide adequate pain relief in elderly patients with vertebral compression and unilateral multiple rib fractures, and prevent imminent respiratory failure and avoid intubation until more advanced intensive medical therapy is devised.^{9,10,12}

Author Contributions

All the authors made a significant contribution to the work reported, including the conception (VG, KC, IKL), study design (VG, KC, IKL), acquisition of data (VG, LB, SG), execution (VG, LB, SG), analysis and interpretation (KC, IKL, VG). VG and IKL wrote the manuscript, while KC, SG, and LB critically reviewed and revised the manuscript. All authors made substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data; took part in drafting the article or revising it critically for important intellectual content; agreed to submit to the current journal; gave final approval of the version to be published; and agree to be accountable for all aspects of the work.

Disclosure

The authors report no conflicts of interest in this work.

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