Focused Review: Efficacy of the Rector Spinae Plane Block

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Abstract
Since the original publication on the erector spinae plane (ESP) block in 2016, the technique of the ESP block has evolved significantly in the last few years. This review highlights recent developments in the technique for administering the ESP block and proposes directions for future research. Continuous efforts are being aimed at improving understanding regarding the administration of the ESP block. Current reports suggest that the ESP block provides effective analgesia in thoracic and abdominal sites in patients of all ages. However, no cohort studies or randomized controlled trials were performed in 2016 and 2017. The ESP block is an effective analgesic tool in a wide range of sites. However, we are uncertain how effective the ESP block is compared to other types of regional anesthesia. Therefore, more research on ESP blocks is required.

Keywords
Peripheral Nerve Block, Erector Spinae Plane, Thoracic and Abdominal Analgesic Tool

1. Introduction
The erector spinae plane (ESP) block was first described by Forero et al. [1]. Currently, the ESP block is performed as one of the pain management procedures for patients of all generation (newborns, infant, children, adolescents and adults) undergoing abdominal and thoracic surgeries [1]-[6].

In spite of the many publications on ESP blocks, there are still unclear aspects of the technique such as the spread of local anesthetic and mechanisms of action.

2. Anatomy of the Thoracolumbar Fascia (Figure 1)
To understand the ESP block better, we must first understand the anatomy of
the region, particularly, the thoracolumbar fascia [7].

At the upper thoracic site, the spinal nerve splits into the dorsal and ventral
rami at their exit from the intervertebral foramen’ exist. The dorsal ramus runs posteriorly through the costotransverse foramina and ascends into the erector spinae muscle. The thoracic dorsal ramus then divides into lateral and medical branches. The medial branch continues to ascend through the rhomboid major and trapezius muscles to superficial location before ending in a posterior cutaneous branch. The lateral cutaneous branch arises from the intercostal nerve next to the angle of the rib and this branch then ascends to a superficial location. The ventral ramus runs laterally, becoming the intercostal nerve, into a plane between the internal and innermost intercostal muscle on the inner aspect of the rib.

3. Nomenclature (Figure 2)

The first publication on the ESP block reports 2 different approaches (ESP 1 block and ESP 2 block) [1].

The ESP 1 block: Local anesthetic is injected into the interfascial plane between the rhomboid major and the erector spinae muscles.

The ESP 2 block: Local anesthetic is injected into the interfascial plane between the erector spinae muscle and the underlying transverse process.

Forero et al. currently recommended the ESP 2 block over the ESP 1 block. We could not perform the ESP 1 block at lower levels, because the rhomboid muscle has its inferior border at T6. The ESP 2 block below was expressed the ESP block.

4. Techniques of ESP Block

Although the first publication suggested the patient must be in a sitting position, the ESP block is currently performed in all position [1] [2] [3] [8]. A high-frequency linear ultrasound transducer is placed against the target vertebral level and moved in a cranio-caudal direction 3 cm lateral to the spinous process. The erector spinae muscle is then identified and a needle is advanced through the interfascial plane between the erector spinae and the underlying transverse process, following which the local anesthetic is administered into the space.

Although most studies mainly report on injections targeted at the transverse process, this method can miss the erector spinae sheath and prevent the spread of local anesthetic [9]. Compared to the transverse process, the sagittal process is clearer to spread of local anesthetic [10].

5. Comparison of ESP Block with Retrolaminar Block

ESP blocks and retrolaminar blocks are very similar peripheral nerve blocks in terms of anatomical target, spread of local anesthetic and analgesic effect [11] [12]. The anatomical site in ESP blocks is the transverse process, whereas in retrolaminar blocks, it is the lamina. In other words, only the insertion sites are different.
Figure 2. Nomenclature of ESP 1 and ESP 2 (referred to Atlas of Human Anatomy 6th Edition).
6. Spread of ESP Block

The spread of local anesthetic in the ESP block has been investigated in several ways such as by using computed tomography (CT) imaging of cadavers, fluoroscopy, chest radiography, and CT imaging of actual patients [1] [13] [14] [15] [16] [17] [18].

These investigations show that local anesthetics in the ESP block spread to the upper and lower sides of the interfascial plane between the erector spine muscle and the underlying transverse process. Additionally, the local anesthetic spreads beyond the transverse process to reach the costotransverse junctions, after which it permeates the paravertebral space (Figure 3).

7. Analgesia (Table 1)

Considering the spread of local anesthetic in the ESP block, it is possible for it to block wider spinal nerves. Therefore, since the first publication, the ESP block has been reported as an effective analgesic for several types of pain and has been used mainly in thoracic surgery. It has also been used in abdominal surgery, nephrectomy, hernia surgery, and hip surgery, among others. Additionally, the ESP block has been used not only for acute pain management but also for chronic pain management.

Figure 3. Sagittal view in ESP 2 block.
Table 1. Indications and spread of local anesthetic in ESP 2 block.

<table>
<thead>
<tr>
<th>Level</th>
<th>Pain</th>
<th>Volume-level⁻¹ [ml]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper Thoracic</td>
<td>Chronic shoulder pain</td>
<td>3.1 (2.5 - 6.6)</td>
</tr>
<tr>
<td></td>
<td>Mastectomy</td>
<td></td>
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<tr>
<td></td>
<td>Video assisted thoracoscopy</td>
<td></td>
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<tr>
<td></td>
<td>Open thoracic surgery</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Chronic thoracic pain</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pneumothorax surgery</td>
<td></td>
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<tr>
<td></td>
<td>Abdominoplasty</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bariatric surgery</td>
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</tr>
<tr>
<td></td>
<td>Ventral hernia repair</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Open cystoprostatectomy</td>
<td>3.7 (2.5 - 6)</td>
</tr>
<tr>
<td></td>
<td>Nephrectomy</td>
<td></td>
</tr>
<tr>
<td>Lower Thoracic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lumbar</td>
<td>Hip surgery</td>
<td>6.0</td>
</tr>
</tbody>
</table>

We do not know the appropriate local anesthetic concentration and volume to be used for ESP block. Considering the past case report, the concentration of the local anesthetic concentration of ropivacaine was 0.5%, that of revobupivacaine was 0.25% and 0.375% while bupivacaine concentration were 0.25% and 0.5%. Additionally, spread of local anesthetic in upper thoracic surgery (3.1 ml·level⁻¹) was more extensive lower thoracic (3.7 ml·level⁻¹) and lumbar surgery (6.0 ml·level⁻¹) [1]-[32]. These data are small and vary widely. By a case, a single bolus of 30 ml in the ESP block was of 9 dermatomes [29].

Further, it is difficult to objectify the duration of analgesia after the ESP block. Most case reports show that additional analgesic after the ESP block is not required [2] [19]. In future, we propose a clear description as for the duration of analgesia after the ESP block.

Several methods (intermittent bolus, continuous infusion and patient controlled analgesia) of continuous infusion in ESP blocks have been reported [3] [15] [18] [19]. It is still uncertain which one is the best due to the small size of the studies.

8. Complication

Complications of ESP block have never been reported in 2016 and 2017. Pneumothorax after ESP was reported in 2018 [33]. In the future, complications such as arterial puncture and hematoma except pneumothorax should be considered.

9. Discussion

Since the original publication on the ESP block in 2016, this technique has been reported as an effective analgesic for several types of pain. Considering the spread of local anesthetic in the ESP block, it is clearly an effective analgesic for the management of several types of pain.

Local anesthetic concentration was used more than 0.25% of long-acting local anesthetic and volume was about 3.0 ml·level⁻¹. Duration of analgesia after the ESP is still unknown. Therefore, continuous ESP block may be required for ma-
In this review, with the exception of a few case reports, there were no RCTs and no observational or other comparative studies. Future research should compare the ESP block to the paravertebral or other nerve blocks. Additionally, the rare of complications and efficacy of analgesic for the ESP block should be investigated.

10. Conclusion

Since the original publication on the erector spinae plane (ESP) block in 2016, the report of the ESP block has evolved significantly in the last few years. Currently, it is understood that the ESP block is an effective analgesic for thoracic and abdominal sites in all ages. However, there were no cohort studies or randomized controlled trials in 2016 and 2017. Future research on ESP block is required.

Conflict of Interest

There are no conflicts of interest.

References


Block for the Management of Chronic Pain. *Anaesthesia Critical Care & Pain Medicine*.


