

## The “new kid” on the fascial plane block: erector spinae block – a narrative review

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The erector spinae plane (ESP) block is a novel and versatile regional technique that involves the injection of local anaesthetic (LA) deep into the erector spinae muscle (ESM). LA is injected under ultrasound guidance at a site adjacent to the vertebral transverse processes and spreads along both the erector spinae fascial plane and the paravertebral fascial plane. The ESP block covers both visceral and somatic nociceptors and may be administered for the management of both acute and chronic pain for paediatric and adult patients. The procedure is simple to perform and the risk of complications is low with no major structures in close proximity to the injection site. ESP blocks are used for a wide range of applications and can be administered at the vertebral levels craniocaudally from cervical (C6) to lumbar (L4). Analgesic efficacy can be targeted by manipulating the LA agent used, the volume and concentration as well as the vertebral level(s) of insertion. LA spread may be titrated according to indication with a median of 3.4 ml injected volume offering analgesic coverage over one dermatome with distribution between two to five vertebral levels. The ESP block is an effective alternative when epidural blocks are contraindicated as well as for patients with coagulopathy. The ESP block is an innovative regional technique and should be considered in the analgesic management of polytrauma patients in South Africa. This narrative review aims to highlight the versatility and ease of application of the ESP block.

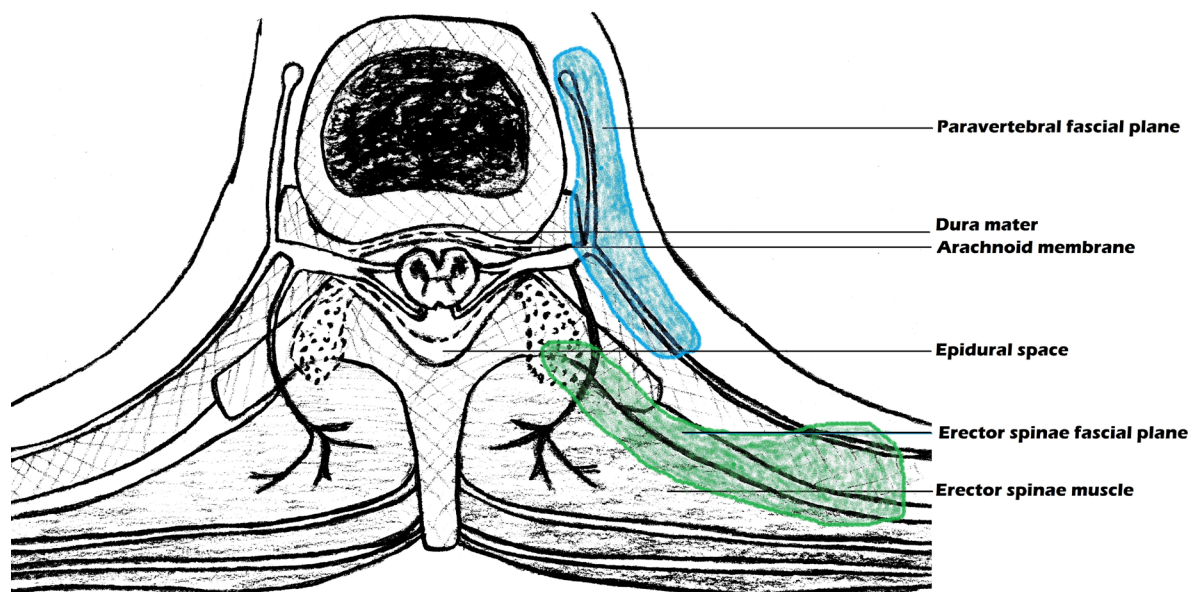
**Keywords:** erector spinae plane block, regional anaesthesia, interfascial plane block, chronic pain, acute pain

### Introduction

The erector spinae plane (ESP) block was initially described in 2016 making it one of the “newest kids on the block” in terms of regional anaesthesia.<sup>1</sup> The ESP block technique was demonstrated in the management of chronic and acute analgesia of the thoracic dermatomes.<sup>1</sup> Specifically, it was first used in the treatment of patients suffering from chronic thoracic neuropathic pain and patients undergoing thoracoscopic surgery.<sup>1-3</sup> Subse-

quently, the technique was expanded craniocaudally along the interfascial plane with equivalent analgesic efficacy for cervical, thoracic and lumbar dermatomes.<sup>2,3</sup> The novel ESP block challenges many of the older techniques with its profound versatility, simplicity and wide range of applications.<sup>3</sup>

This narrative review outlines the technique and clinical application of the ESP block, highlighting the simplicity and versatility thereof. Specific focus is placed on the advantages of the ESP



**Figure 1:** A schematic drawing to illustrate a cross section of the spinal cord with relevant anatomy. Local anaesthetic injected deep into the erector spinae muscle traverses the erector spinae fascial plane (green) and spreads through the epidural sinuses to enter the paravertebral fascial plane (blue)

Creator: Dr Z Maharaj  
Source: self-illustrated

block over older alternative regional techniques and its potential use in patients with coagulopathies or polytrauma patients, which are commonly seen in the South African setting.

### Mechanism of analgesic efficacy and distribution

The mechanism of action proposes the spread of an injected local anaesthetic (LA) below the erector spinae muscle along this fascial plane and with subsequent infiltration of the paravertebral space. Current literature describes LA spread from the erector spinae plane through the epidural sinuses to the paravertebral space (Figure 1), leading to both a visceral and a somatic nociceptive blockade.<sup>2,3</sup>

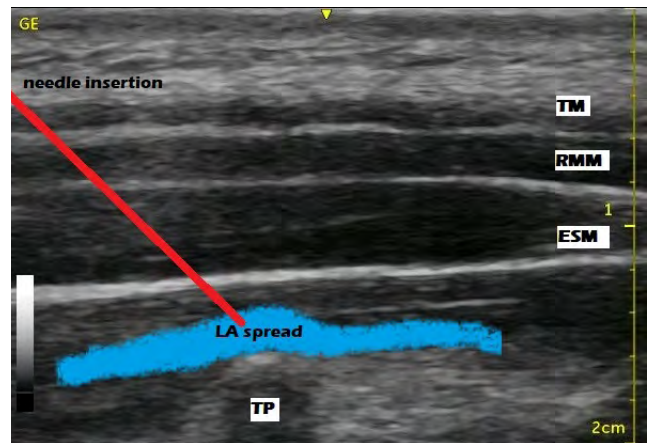
Radiological and anatomical investigations on cadavers have demonstrated that the ESP block takes effect on dorsal and ventral rami of the spinal nerves as these exit the vertebral canal (Figure 1) resulting in a block covering both visceral and somatic nociceptive pathways.<sup>2,3</sup> LA diffuses anteriorly to the ventral and dorsal rami, and across intertransverse connective tissue to enter the paravertebral space. Diffusion may also allow penetration into the epidural space.<sup>2</sup>

Therefore, the ESP block is an interfascial plane block involving the injection of LA deep into the erector spinae muscle (ESM) complex at a site adjacent to the vertebral transverse processes. Both single-shot techniques and continuous infusion with catheter insertion have been described.<sup>3,4</sup> The analgesic effect correlates to the spread of LA along the interfascial tissue planes with a median of 3.4 ml injected volume offering analgesic coverage over one dermatome.<sup>4</sup> Large volumes of diluted LA solutions are often used for maximum distribution of the analgesic effect.<sup>2,4</sup> The proposed spread of LA anterior to the paravertebral and epidural space provides both visceral and somatic analgesia with distribution between two to five vertebral levels.<sup>4,5</sup>

Consequently, specific vertebral level(s) can be targeted and the volume of LA injected can be customised, respectively, according to specific patient or procedure requirements.<sup>2,4,5</sup>

### Technique

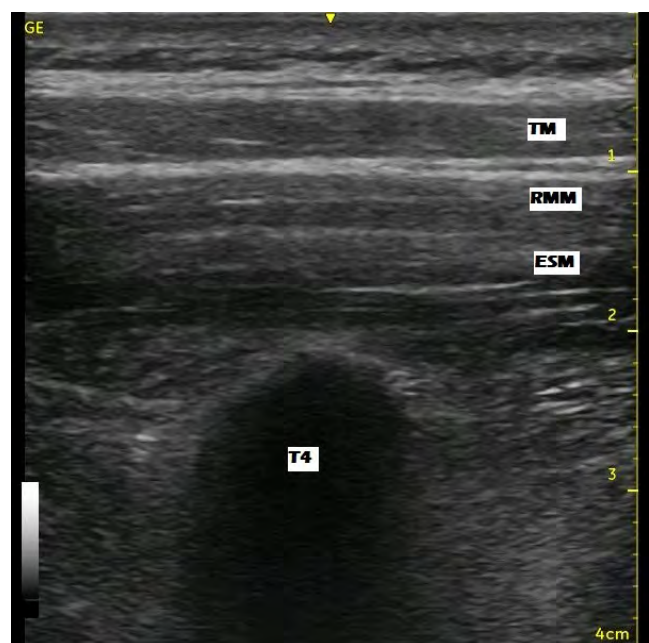
The ESP block is performed by the ultrasound-guided injection of LA deep into the ESM complex at a site adjacent to the vertebral transverse processes.<sup>1,3</sup> The ESM complex is formed by the spinalis, longissimus and iliocostalis muscles, and attach to the transverse processes of the vertebral bones.<sup>3</sup> The block may be performed while the patient is positioned sitting up, lying lateral or prone.<sup>2,3</sup> The patient may either be awake or under general anaesthesia, with the latter technique advisable for paediatric patients.<sup>3,4</sup> The needle is visualised after in-plane insertion and aimed in the direction of the transverse process (TP).<sup>1,3</sup> The vertebral TP is located approximately 2 cm lateral to the spinous process.<sup>3</sup> The ultrasound probe is positioned to visualise the targeted TP in the parasagittal orientation to administer in-plane injection of LA deep into the respective muscle layers.<sup>1,6</sup> The LA is injected in the fascial plane, deep into the ESM complex, at the tip of the transverse process of the vertebra (Figure 1 and



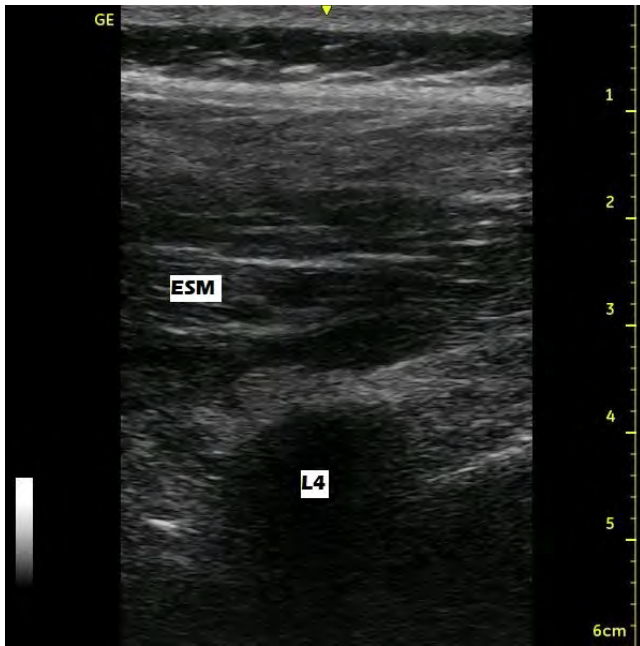
**Figure 2:** Ultrasound image at C6 vertebral level using a linear probe depicting the C6 transverse process (TP) and overlying muscle layers as well as the needle path (red) and area of local anaesthetic spread (blue) of the erector spinae plane block  
 TM – trapezius muscle, RMM – rhomboid major, ESM – erector spinal muscle  
 Creator: Dr K Morley-Jepson, Dr Z Maharaj  
 Source: Ultrasound machine: GE Healthcare, venue 40

Figure 2).<sup>6</sup> The correct needle placement is confirmed when the injection of LA results in the separation of the ESM complex from the TP.<sup>1,3</sup>

The ideal ultrasound probe depends on the vertebral level. A high-frequency linear transducer is used for thoracic level blocks and a curvilinear transducer is used for lumbar level blocks.<sup>6</sup> The trapezius, rhomboid major and erector spinae muscles are the three muscles identified for cervical and thoracic level blocks (Figure 3).<sup>7</sup> Two muscle layers are visualised for lower thoracic and lumbar ESP blocks as the rhomboid major muscle disappears at the level of the seventh thoracic vertebra (T7).<sup>7</sup> The trapezius muscle overlaps and continues as the latissimus dorsi



**Figure 3:** Ultrasound image at T4 vertebral level using a linear probe depicting the T4 transverse process (T4) and overlying muscle layers  
 TM – trapezius muscle, RMM – rhomboid major, ESM – erector spinal muscle  
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 Source: Ultrasound machine: GE Healthcare, venue 40



**Figure 4:** Ultrasound image at L4 vertebral level using a linear probe, depicting the L4 transverse process (L4) and overlying muscle layers ESM – erector spinal muscle  
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 Source: Ultrasound machine: GE Healthcare, venue 40

muscle extends to the lumbar region.<sup>7</sup> Only one muscle layer representing the ESM is visible in the lumbar region (Figure 4).

### Clinical applications

#### Chronic pain

The ESP block may be administered as either a single shot or a catheter infusion for the management of chronic pain.<sup>3</sup> The ESP block remains an effective analgesic in the treatment of neuropathic pain related to chest wall malignancies.<sup>1</sup> The use of an ESP block has also been demonstrated in the management of chronic thoracic<sup>2,5</sup> and lower limb<sup>8</sup> pain from herpes zoster neuralgia. Reports have demonstrated the efficacy of ESP blocks in the treatment of tension headaches and postdural puncture headaches (PDPHs).<sup>9</sup> De Haan et al.<sup>9</sup> demonstrated the use of bilateral ESP blocks at the level of the fourth thoracic vertebra (T4) in the successful management of a PDPH following the placement of a lumbar epidural. Although inserted at T4, the proposed target was anaesthetic spread to cervical spinal levels, specifically the trigeminocervical complex, which is implicated in the pathophysiology of PDPH.<sup>9</sup> Similarly, Hernandez et al.<sup>10</sup> demonstrated the treatment of both primary and secondary headaches with bilateral T4 ESP blocks.

**Table 1:** Comparison between erector spinae plane (ESP) blocks and older, alternative regional blocks

Dermatomal region (Vertebral level)	Types of surgery	Alternative regional block	Advantages (☑) and disadvantages (☒)	
			Alternative block	ESP block
<b>Cervical</b> (C6,7) <sup>11,13,17</sup>	C-spine surgery	Cervical epidural	☑ Epidural C/1*	☒ Phrenic nerve paralysis (single case report)
		<b>Cardiothoracic</b> (T4–6) <sup>2,3,32</sup>	Thoracic epidural	☑ Epidural C/1*
	Thoracotomy, mini-thoracotomy	TPVB	☑ Difficult technique, failure rate up to 10%	☒ Poorer analgesic efficacy
		Breast surgery	☑ Risk injury to cervical chain, vagus, superior and recurrent laryngeal nerves	☑ Superior analgesic efficacy
			☑ Brainstem effects with accidental injection in vertebral artery; seizures, coma, death	
			☑ Epidural C/1*	
	Breast surgery	Intercostal nerve block	☑ Poor analgesic distribution	☑ Superior analgesic efficacy
		PECS 1, PECS 2	☑ LA spread distorts surgical anatomy	☑ Poorer analgesic efficacy
<b>Lower abdominal</b> (T8–10) <sup>9,18</sup>	Gastrointestinal, hepatobiliary, lower inguinal, gynaecological, obstetric	TAP block	☑ LA spread may affect electrocautery	☑ Superior analgesic efficacy
			☑ Ineffective analgesia with central obesity	
		QLB	☑ Difficult technique with central obesity	
<b>Lumbar</b> (L3/4) <sup>2,16</sup>	Lumbar spine	Epidural nerve block	☑ Epidural C/1*	
		MTP block	☑ Difficult technique	☒ Poorer analgesic efficacy

TPVB – thoracic paravertebral plane block, PECS – pectoralis and serratus plane nerve blocks, TAP – transverse abdominis plane, QLB – quadratus lumborum block, MTP – modified-thoracolumbar interfascial plane

\*Epidural C/1: uncorrected hypovolaemia, increased intracranial pressure, uncorrected coagulopathy



## Acute pain

The wide range of applications in the management of acute pain highlights the versatility of the ESP block. The application of ESP blocks craniocaudally has been reported from the level of the sixth cervical vertebra (C6) down to the fourth lumbar vertebra (L4) for upper limb amputation and hip surgery, respectively.<sup>11-13</sup>

The remarkable versatility of the ESP block is highlighted by the analgesic efficacy comparable to previously-used, older regional techniques (Table I).

## Thoraco-abdominal level ESP block

### Cardiothoracic

A systematic review and meta-analysis by Huang et al.,<sup>14</sup> which included 1 018 patients, assessed the use of ESP blocks in the management of postoperative pain for breast and thoracic surgery. The ESP blocks demonstrated significantly reduced 24-hour postoperative opioid consumption ( $p = 0.002$ ) as well as lower pain scores at rest or movement ( $p = 0.01$ ) compared to those who received no block.<sup>14</sup> The ESP block also demonstrated analgesic efficacy comparable to the thoracic paravertebral block (TPVB) with no significant differences for any outcomes reported on.<sup>14</sup>

Post-thoracotomy pain syndrome is a common experience for patients undergoing thoracic surgery and has debilitating consequences associated with inadequate analgesic efficacy.<sup>15</sup> Despite the advantages of the minimally invasive surgical technique, video-assisted thoracoscopic surgery (VATS) with mini-thoracotomy is painful with stimulation of both visceral and somatic nociceptive nerve fibres.<sup>15</sup> The ESP block at the level of the fifth thoracic vertebra (T5) in patients undergoing mini-thoracotomy was evaluated for postoperative analgesic efficacy.<sup>15,16</sup> Reports have shown that patients undergoing a mini-thoracotomy who receive ESP blocks have lower postoperative pain scores compared to both those who receive intercostal nerve blocks ( $p < 0.05$ )<sup>16</sup> and those who receive no regional block ( $p = 0.005$ ),<sup>15</sup> respectively. However, it was demonstrated that the TPVB had the greatest analgesic efficacy compared to both intercostal nerve blocks and ESP blocks for a mini-thoracotomy.<sup>17</sup> Turhan et al.<sup>17</sup> reported lower 24-hour pain scores ( $p = 0.017$ ) and lower overall perioperative morphine consumption ( $p = 0.017$ ) for mini-thoracotomy patients who received TPVB blocks compared to patients who received intercostal nerve or ESP blocks.

### Abdominal surgery

Analgesic coverage for the vast range of abdominal surgeries can be provided by ESP blocks due to its efficacy in blocking both somatic and visceral nociception.<sup>26</sup> Abdominal surgeries encompass several specialities, including colorectal surgery, gynaecological procedures, hepatobiliary laparoscopies and urological procedures.<sup>23</sup> Most often, the level for abdominal surgery is T6–T10. However, this can be modified depending on the indication.<sup>3</sup> Boules et al.<sup>18</sup> compared the use of ESP blocks to the use of transversus abdominis plane (TAP) blocks for

analgesia post-caesarean section. The ESP block demonstrated greater analgesic efficacy and longer duration of analgesia than the TAP blocks.<sup>18</sup> Additionally, the TAP block may be associated with technical difficulty such as difficult needle insertion and placement in patients with higher BMIs, a common consideration within the obstetric population.<sup>18</sup>

Kwon et al.<sup>19</sup> published a randomised control trial (RCT) in May 2020 specifically aimed to determine whether it can be confirmed that the ESP block does provide visceral analgesia. The RCT was conducted on patients presenting for laparoscopic cholecystectomy. All of the patients received bilateral rectus sheath blocks (RSB) to provide somatic analgesia. The intervention group then also received bilateral ESP blocks. The study noted that the intra-operative remifentanyl consumption and the postoperative fentanyl requirement was significantly reduced in the intervention group compared to the group who received only the bilateral RSB.<sup>19</sup>

## Orthopaedic surgery

### Spinal surgery

The ESP block may form part of the analgesic plan for all levels of spinal surgery. To date it is most well documented for its use at lumbar vertebral levels, however, usage in thoracic and cervical spine surgery is gaining popularity. A systematic review including 15 studies assessed the efficacy of ESP blocks for lumbar spine surgery.<sup>20</sup> Rizkalla et al.<sup>20</sup> reported significantly decreased postoperative pain scores as well as consumption of pain medication for patients undergoing lumbar spine surgery who received ESP blocks. However, studies demonstrated that modified-thoracolumbar interfascial plane blocks have an increased analgesic efficacy compared to ESP blocks for lumbar spine surgery.<sup>21,22</sup> A case report by Goyal et al.<sup>23</sup> described the effective use of a C7 ESP block for cervical spine surgery involving C5–C7 instrumentation. Pain was well-controlled for the 48 hours postoperatively, with no rescue analgesia being required.<sup>23</sup>

### Upper and lower limb surgery

There is limited published data on the use of ESP blocks for upper and lower limb surgery. Cervical level dermatomal distribution may be targeted indirectly, as reported by several cases of ESP block insertions between levels T2–T5, demonstrating effective analgesia for shoulder and proximal humerus procedures.<sup>10,11,24</sup> ESP blocks at T4 demonstrated diaphragm sparing blockade for upper limb surgery.<sup>24</sup> The analgesic efficacy of lumbar ESP blocks for hip and proximal femur surgery is comparable to quadratus lumborum blocks (QLB).<sup>25</sup> Further investigations may be necessary before the ESP block is regarded as a reliable alternative compared to older, well-described regional techniques for orthopaedic limb procedures.<sup>10,11,24-26</sup>

## Advantages of ESP blocks: why should it be used?

The incidence of complications is almost negligible for ESP blocks, and very few technique-specific contraindications have been reported.<sup>2</sup> The published literature on ESP block

complications includes pneumothorax, phrenic nerve palsy and inadvertent motor blockade; however, these are single incident case reports with a high risk of bias.<sup>2</sup> The site of LA administration of the ESP block must be emphasised as there are no major structures in close proximity.<sup>2</sup> Complications from epidural nerve blocks and TPVB can occur with accidental injection into the subarachnoid, subdural or epidural space, which may potentially result in high spinal, phrenic nerve palsy and epidural haematoma.<sup>27</sup> Inadvertent injection of LA into the spinal cord itself is a devastating complication that may result in quadriplegia.<sup>28</sup> ESP blocks may be safely performed in cases where paravertebral or epidural blocks are contraindicated due to thrombocytopenia, antiplatelet or anticoagulant treatments, or coagulopathy.<sup>2</sup>

South Africa is considered to have some of the worst trauma statistics in the world. Injury-related mortality rates are six times, and road traffic injuries double the global rate.<sup>29</sup> The three leading causes of trauma-related mortality in South Africa are head injuries (32.6%), polytrauma (29.7%) and chest injuries (27.4%).<sup>30</sup> ESP blocks are particularly useful in the management of trauma patients who may present with raised intracranial pressure, hypovolaemia and trauma-induced coagulopathy.<sup>2</sup> All of which are factors which limit the use of neuraxial anaesthetic techniques. Cardiovascular compromise accounts for 63% of perioperative mortality in high-risk patients and 30% in low-risk patients.<sup>28</sup> ESP blocks have been used successfully in the primary anaesthetic management in patients with severe cardiovascular instability as well as those with a high risk of intolerance for general anaesthesia as the block does not affect haemodynamics in the way that is seen with neuraxial techniques.

## Conclusion

The ESP block is an innovative and versatile tool for regional anaesthesia with a wide range of applications. It is easy to perform with a low risk of complications and contraindications, and should be considered as an alternative to older, regional techniques. In the South African setting, with high rates of trauma, the ESP block is particularly useful for polytrauma patients who may present with raised intracranial pressure, hypovolaemia and trauma-induced coagulopathy. It is an incredibly valuable technique in the management of acute and chronic pain. The "new kid" on the interfascial plane block is a valuable addition to regional anaesthetics and new research opportunities exist to examine the yet undiscovered applications of the versatile ESP block.

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