https://doi.org/10.48047/AFJBS.6.2.2024.2878-2885

African Journal of Biological Sciences

Journal homepage: http://www.afjbs.com

Research Paper Open Access

An Overview about Ultrasound Erector Spinae Plane Block For Postoperative Analgesia

Ahmed Abdelkhalik Abdullah Elassar, Lobna Taha El-Dorgham, Osama Aboalfotouh Esmaeel, Mohamed Ahmed El-Morshedi

Anesthesia, Intensive Care and Pain Management Department, Faculty of Medicine, Zagazig University

Corresponding author: Ahmed Abdelkhalik Abdullah Elassar

Email: ahmedabdelkhalik05@gmail.com, ahmed.aam@zu.edu.eg

Article History

Volume 6, Issue 2, Apr-Aug 2024

Received: 5 August 2024

Accepted: 15 August 2024

Published: 15 August 2024

doi: 10.48047/AFJBS.6.2.2024.2878-2885

Abstract: Background: The ESP block is a novel ultrasound-guided interfascial technique serendipitously discovered while treating thoracic neuropathic pain in an adult patient. This interfascial block is hypothesised to target the ventral - and dorsal rami of spinal nerves, as the block is performed in a tissue plane deep to the erector spinae muscle. Local anaesthetic is deposited deep to the erector spinae muscle, yet superficial and lateral to the tips of the transverse processes. Moreover, the ESP is also adjacent to the plane between quadratus lumborum and the erector spinae muscles at low thoracic and lumbar levels, and thus it may have a similar mechanism of action with posterior quadratus lumborum block. The therapeutic effect of the ESP block is attributed to the craniocaudal spread of anaesthetic over multiple vertebral levels within the tissue plane. The ESP block carries a lower risk of clinical complications as the needle is inserted into a tissue plane that is a safe distance from that of the parietal pleura, neuroaxis and major neurovascular structures.

Keywords: *Erector Spinae Plane Block*

Introduction

The ESP block is a novel ultrasound-guided interfascial technique serendipitously discovered while treating thoracic neuropathic pain in an adult patient. The first report of the successful use of this procedure was in 2016; the block was used to manage thoracic neuropathic pain in a patient with metastatic disease of the ribs and rib fractures. This interfascial block is hypothesised to target the ventral - and dorsal rami of spinal nerves, as the block is performed in a tissue plane deep to the erector spinae muscle [(114)]. Local anaesthetic is deposited deep to the erector spinae muscle, yet superficial and lateral to the tips of the transverse processes. **(1)**

Anatomy of Erector Spinae muscle:

It is the main back extensor, it consists of three parts on each side; the iliocostalis, longissimus, and spinalis muscles. It forms the intermediate layer of intrinsic back muscles. Erector spinae provides resistance that help in controlling action of bending forward at the waist, and act as a powerful extensor to promote return to erect position. **(2)**

During full flexion (i.e., when touching hands' fingertips to floor), erector spinae are relaxed and strain is borne entirely by ligaments of back. On reversal of the movement, these muscles are initially inactive, and extension is initiated by hamstring muscles of thighs and gluteus maximus muscles of buttocks. As a result of this peculiarity, lifting a load or moving suddenly from a bent-over position is potentially injurious to muscles and ligaments of back and intervertebral discs. Erector spinae muscles readily go into painful spasms following injury to back structures **(3)**

The anatomy of each part is:

a. Iliocostalis:

The most lateral muscle group of the erector spinae muscle extending from pelvis to neck.

It has 3 portions: lumborum, thoracis, and cervicis.

Its origin is: iliac crests (lumborum portion); inferior 6 ribs (thoracis portion); ribs 3 to 6 (cervicis portion).

Its insertion is in the angles of the ribs (lumborum and thoracis portions); transverse processes of cervical vertebrae C6–C4 (cervicis portion).

Its action is: Extending and laterally flex the vertebral column, maintain erect posture; acting on one side, bend vertebral column to same side.

Its nerve supply is: Spinal nerves (dorsal rami). **(2)**

b. Longissimus

The intermediate tripartite muscle group of the erector spinae muscle, extending by many muscle slips from lumbar region to the skull, mainly passes between transverse processes of the vertebrae. **(2)**

It has 3 parts: thoracis, cervicis, and capitis.

Its origin is: transverse processes of lumbar through cervical vertebrae.

Its insertion is: transverse processes of thoracic or cervical vertebrae and to ribs superior to origin as indicated by name; capitis inserts into mastoid process of the temprol bone

Its action is: thoracis and cervicis parts acting to extend and laterally flex vertebral column; acting on one side causes lateral flexion. Capitis part extends and rotates the head toward same side **(2)**

Its nerve supply is: Spinal nerves (dorsal rami).

c. Spinalis

The most medial muscle column of the erector spinae muscle.

It has 2 parts: thoracis and cervicis.

Cervicis usually rudimentary and poorly defined.

Its origin is: spines of upper lumbar (L1,2) and lower thoracic vertebrae (T11,12) in thoracis part. While the cervicis part form ligamentum nuchae and spine of C7 sometimes T1, 2.

Its insertion is: spines of upper thoracic and cervical vertebrae.

Its action is: Extending vertebral column.

Its nerve supply is: Spinal nerves (dorsal rami) **(2)**

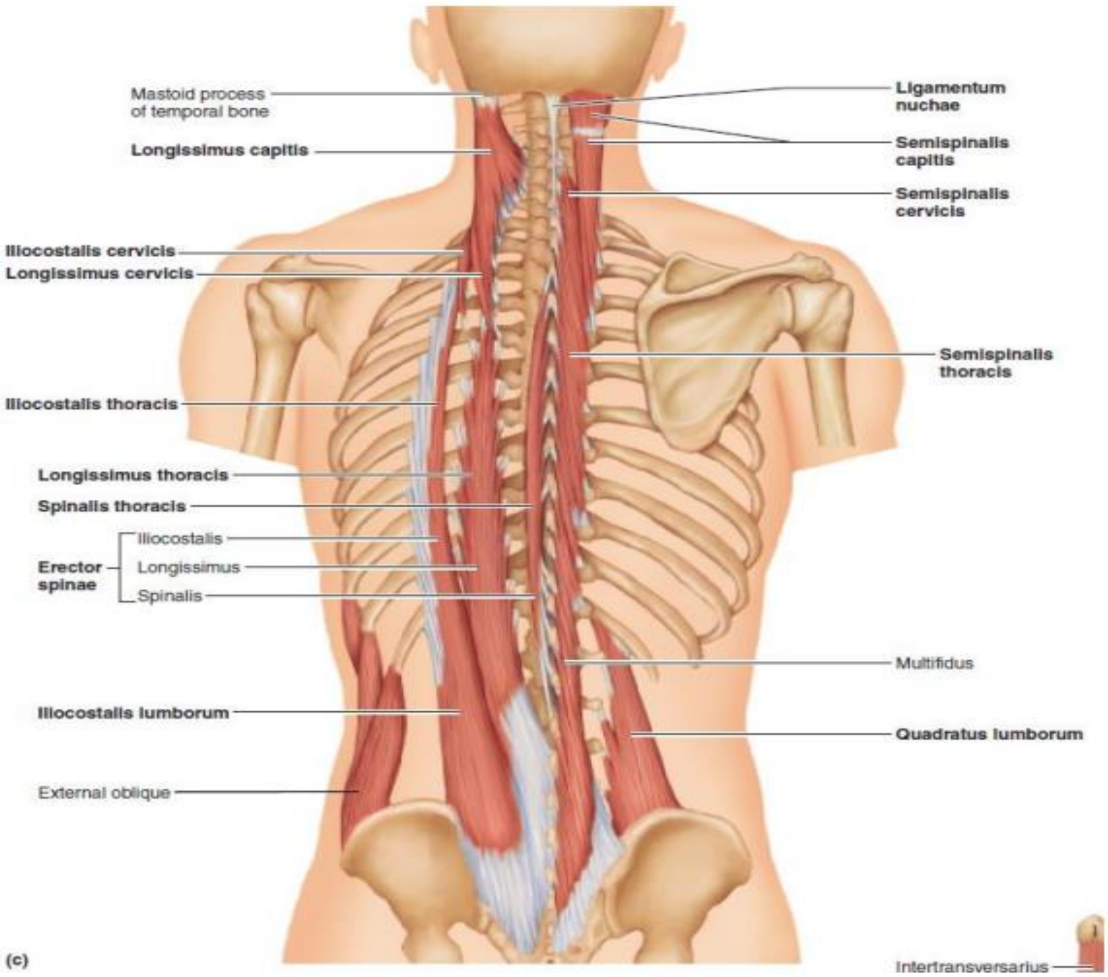


Fig (1): Anatomy 0f erector spinae muscle (2)

Mechanism of action of erector spinae plane block:

There are now three probable mechanisms in place to induce analgesic ESP injection of local anesthesia **(4).**
The first is that local anesthetics enter in advance via fenestrations of the connective tissues that cover neighbouring transverse processes and ribs into the PV and epidural areas that contain vertebral nerves and dorsal and ventral rams. This "intertransverse tissue complex" consists of numerous components, involving not just superior cost-transverse ligament, but also the intertransverse ligaments as well as the cost-arum levator and rotator muscles. The dorsal ram and the accompanying ships cross the barrier and offer at least one route of injecting the injectate into the photovoltaic space from whence it may laterally expand to the intercostal and medial space. This is seen in both fresh and living individuals in magnetic resonance imaging **(5).**
The second, the dorsal rami are blocked as they ascend through the lake of local anesthetic deposited in the ESP **(6).**
Thirdly, since the ESP is sideways to the earth and is superficial to both ribs and intercostal muscles and deep to the serratus anterior muscular plane, it may perhaps reach and treat lateral skin nerve branches laterally inside this plane **(7).**

Moreover, the ESP is also adjacent to the plane between quadratus lumborum and the erector spinae muscles at low thoracic and lumbar levels, and thus it may have a similar mechanism of action with posterior quadratus lumborum block **(8).**

Figure (2): Dermatomal analysis of erector spinae plane block **(8).**

The therapeutic effect of the ESP block is attributed to the craniocaudal spread of anaesthetic over multiple vertebral levels within the tissue plane (**9)**

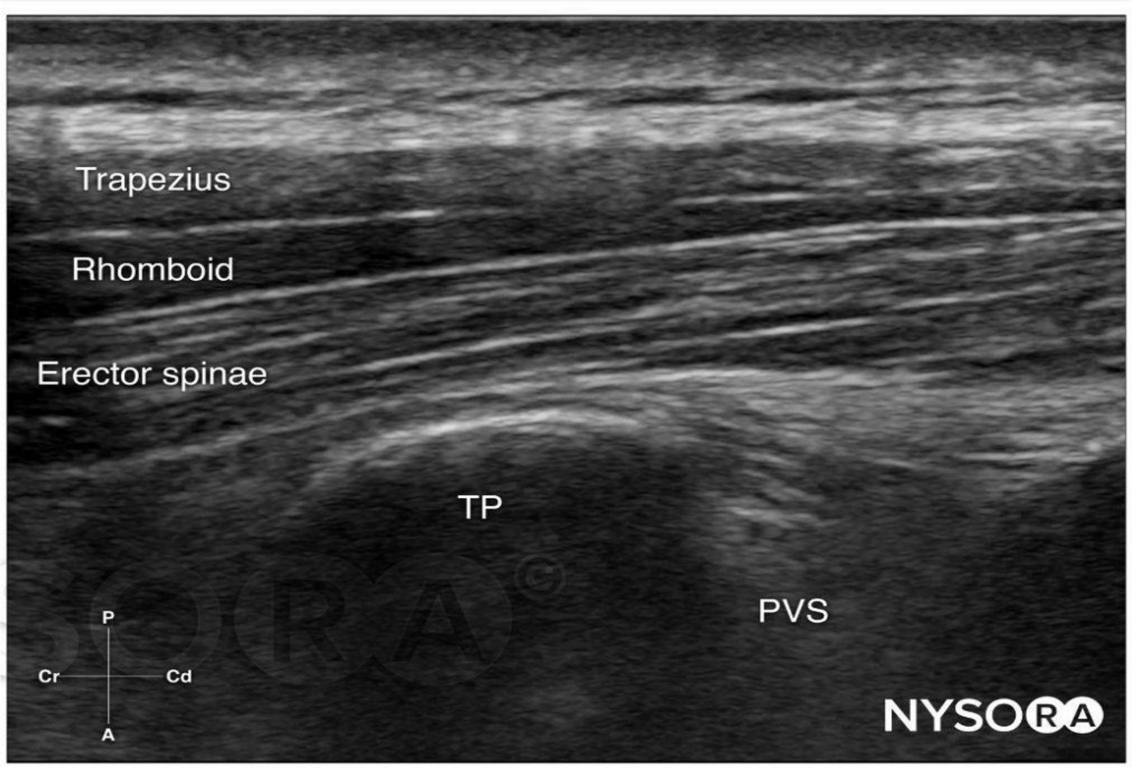
Absorption and diffusion of anaesthetic across intersecting tissue planes also play a role in the extent and quality of the block. Furthermore, the block has been reported to successfully manage acute and chronic pain for truncal procedures as it blocks both visceral and somatic pain **(4)**

There is a hypothesis that the multi-dermatomal sensory block is due to the cranial and caudal spread of the injected local anesthetic. This spread is aided by the thoracolumbar fascia, which extends across the posterior thoracic wall and abdomen **(4)**

the local anesthetic spread extended 3 or 4 levels cranially and caudally from the site of injection. The reported mechanism of action is the diffusion of the injected local anesthetic through the connective tissues and towards the spinal nerve roots. **(10)** A more recent study described the transforaminal and epidural spread of the local anesthetic during ESP block using MRI. The authors noted that ESP block might be advantageous to other thoracic interfascial plane blocks because of this spread and the resultant abdominal visceral analgesia (**11)**

Technique (4):

The ESP block is most often performed between the T5-T7 paraspinal levels, but it can be performed at lower levels as well. The curvilinear ultrasound transducer should be placed in a cephalocaudal orientation over the midline of the back at the desired level. The probe should then slowly be moved laterally until the transverse process is visible. The transverse process requires differentiation from the rib at that level. The transverse process will be more superficial and wider, while the rib will be deeper and thinner. Upon verification of the transverse process, the trapezius muscle, rhomboid major muscle (if performing at T5 level or higher), and erector spinae muscle should be identified superficial to the transverse process. The Tuohy needle should be inserted superior to the ultrasound probe using an in-plane approach in the cephalad to caudal direction. The bevel of the Tuohy needle should point posteriorly and inferiorly, and advance under ultrasound guidance through the trapezius muscle, rhomboid major muscle, and erector spinae muscle and towards the transverse process; once the needle tip is below the erector spinae muscle, a small bolus of local anesthetic should be given through the Tuohy needle. The erector spinae muscle should be visualized, separating from the transverse process. This separation from the transverse process confirms the proper needle position. The local anesthetic should then be injected in 5 ml increments, with aspiration after every 5 ml to prevent intravascular injection. Between 20 and 30 ml of 0.25% bupivacaine or 0.5%, ropivacaine should be used.



TP: Transverse process
PVS: Paravertebral space
Figure (3): Ultrasound guided erector spinae plane block performance **(8).**

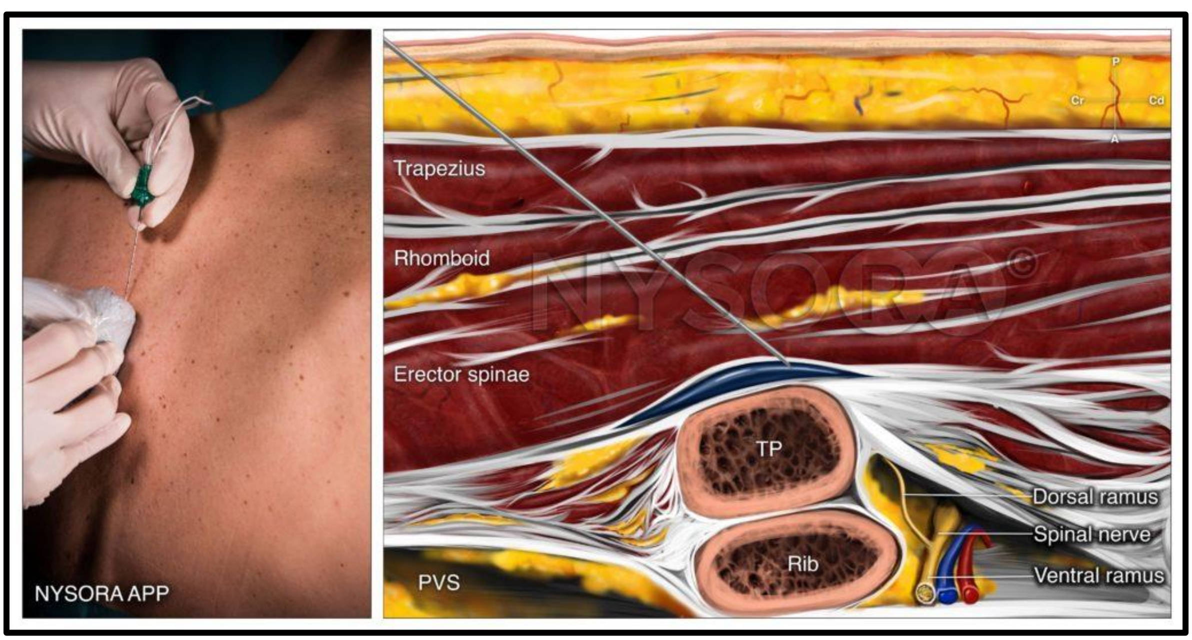


Figure (4): Reverse ultrasound anatomy of an ESP block with needle insertion in-plane from a cranial to caudal direction. The spinal nerve is exiting the paravertebral space with the dorsal ramus branching and traveling posterior to innervate the posterior back muscles. TP, transverse process; PVS, paravertebral space. Cr, cranial, Cd, caudad; A, anterior; P, posterior **(8).**

Indications (12):

The ESP block can be used to deliver regional analgesia for a wide variety of surgical procedures in the anterior, posterior, and lateral thoracic and abdominal areas, as well as for the management of acute and chronic pain syndromes. The vast majority of indications for ESP block have their basis in case reports and anecdotal clinical experience.

Contraindications (12):

Infection at the site of injection in the paraspinal region or patient refusal, are absolute contraindications for performing an ESP block.

Anticoagulation may be a relative contraindication to ESP block, although there are no specific guidelines. The most recent 2018 ASRA consensus statement does not specifically address paraspinal blocks and anticoagulation.

Complications

Complications are very rare because the site of injection is far from the pleura, major blood vessels, and the spinal cord. Infection at the needle insertion site, local anesthetic toxicity/allergy, vascular puncture, pleural puncture, pneumothorax, and failed block are the primary complications. Because of the few published data, more investigations (e.g., randomized controlled trials, RCTs) are needed to verify the safety, complications rates, and efficacy of this strategy. A recent evidence-based study, indeed, identified only four RCTs and their endpoints were heterogeneous. (**13)**

Advantages and disadvantages

The main appeal of the ESP block is the ease of application. With the aid of ultrasound guidance, bony landmarks and anatomical structures are easily identifiable **(14)**

The ease of identification reduces procedure time, as well as the potential for failed blocks. Furthermore, the entire course of the needle and eventual endpoint can be constantly viewed, allowing the practitioner to avoid important anatomical structures in the area **(15)**

The ESP block carries a lower risk of clinical complications as the needle is inserted into a tissue plane that is a safe distance from that of the parietal pleura, neuroaxis and major neurovascular structures **(16)**

Additionally, byallowing the tip of the needle to make contact with the transverse process, it acts as a natural barrier and further provides a guide to the appropriate depth of insertion in children of different sizes, contributing to the safety of the block **(17)**

Since the block has the ability to cover multiple dermatomal levels from a single injection, the block can be performed at a different vertebral level than the level of the surgical site, thereby avoiding wound dressing or surgical incision **(17)**

This block also allows for the use of catheter insertion for intermittent boluses and continuous infusion of regional anaesthesia **(18)**

The ESP block is linked to reduced opioid requirement, as there is ongoing analgesic coverage into the post-operative period Another advantage is that the patient can be positioned in various ways, including prone, lateral decubitus or leaning forward in a seated position and the recently described dry leaf technique (semi-lateral position) **(6)** However, as with most regional blocks, there is a risk of systemic toxicity, for which authors suggest routinely adding epinephrine when introducing large doses of anaesthesia for this block **(18)**

Although there haven't been any reported incidences, put forward a theoretical possibility that the ESP block may negatively affect the spinal biomechanics and further impact stable, non-displaced vertebral fractures brought about by muscular relaxation from the block. Furthermore, the ESP block is not contraindicated for anti-coagulated patients, unlike the epidural block **(18)**

Major hepatic surgery usually requires large abdominal incisions for surgical access with special difficulties in managing postoperative pain, which comprises both visceral and somatic components, the coeliac plexus provides nerve supply to the majority of HPB structures, whereas the intercostal nerves primarily supply the somatic component

Providing sufficient analgesia in these patients is crucial to reduce the potential for respiratory complications and the onset of chronic pain after surgery

Opioid use can worsen postoperative ileus, which is already prevalent in these patients, and the return of gastrointestinal function is related to the dose and duration of opioids administered. Given the increasing frequency of hepatic and pancreatic surgeries, it is important to assess and compare alternative analgesic techniques for this patient population.

Intrathecal morphine (ITM) has been evidenced to provide efficient analgesia in the postoperative period The risks, however, are postoperative nausea and vomiting, pruritus, and of utmost importance, the possibility of delayed respiratory depression

The emergence of innovative regional anesthesia techniques offers the possibility of utilizing lower-risk methods as an alternative to ITM that can provide good-quality analgesia, improve patient outcomes, and produce fewer adverse effects One such technique is the Erector Spinae Plane Block (ESPB), which has been previously described by Forero et al. (2) for control of chronic thoracic pain. This block has been used in diverse acute pain conditions, such as fractured ribs and bariatric surgery Studies propose that administering the block to the lower thoracic level (T7-T9) can offer a combined visceral and somatic analgesia for upper abdominal surgery

Performing ESPB on patients is relatively simple, and it can be carried out with little or no sedation in the preoperative holding area. The in-plane ultrasound-guided technique is the most commonly used method for performing the ESPB. This block involves insertion of a needle in the facial plane between the erector spinae muscles and the thoracic transverse processes where the local anesthetic is administered. The local anesthetic extends in both caudal and cephalic directions blocking the dorsal and ventral rami of the thoracic and abdominal spinal nerves. This results in a sensory block that spans multiple dermatomes of the anterior, posterior, and lateral thoracic and abdominal walls.

References

1. Muñoz, F., Cubillos, J., Bonilla, A. J., and Chin, K. J. (2017): Erector spinae plane block for postoperative analgesia in pediatric oncological thoracic surgery. Canadian Journal of Anesthesia/Journal canadien d'anesthésie, 64, 880-882.
2. Forero M, Adhikary SD, Lopez H, Tsui C, and Chin KJ (2016): The Erector Spinae Plane Block: A Novel Analgesic Technique in Thoracic Neuropathic Pain. Reg Anesth Pain Med. Sep-Oct;41(5):621-7
3. C. Aksu, Y. Gürkan. Ultrasound-guided bilateral erector spinae plane block could provide effective postoperative analgesia in laparoscopic cholecystectomy in paediatric patients. Anaesth Crit Care Pain Med, 2019;38: 87-88
4. Chin K, Adhikary S, Forero M (2019): Erector spinae plane (ESP) block: A new paradigm in regional anesthesia and analgesia. Curr Anesthesiol Rep., 9:271- 80
5. Adhikary, S. D., Bernard, S., Lopez, H., & Chin, K. J. (2018): Erector spinae plane block versus retrolaminar block: a magnetic resonance imaging and anatomical
6. Yang H, Choi Y, Kwon H et al. (2018): Comparison of injectate spread and nerve involvement between retrolaminar and erector spinae plane blocks in the thoracic region: a cadaveric study. Anaesthesia, 73:1244-
7. Aksu, C., Kuş, A., Yörükoğlu, H. U., Tor Kiliç, C., & Gürkan, Y. (2019): The effect of erector spinae plane block on postoperative pain following laparoscopic cholecystectomy: a randomized controlled study. Anestezi Dergisi, 27(1), 9-14.
8. Aksu, C., Kuş, A., Yörükoğlu, H. U., Tor Kiliç, C., & Gürkan, Y. (2019): The effect of erector spinae plane block on postoperative pain following laparoscopic cholecystectomy: a randomized controlled study. Anestezi Dergisi, 27(1), 9-14.
9. López, M. B., Cadórniga, Á. G., González, J. M. L., Suárez, E. D., Carballo, C. L., and Sobrino, F. P. (2018): Erector spinae block. A narrative review. Cent Eur J Clin Res, 1(1), 28-39.

10. Hamilton DL, and Manickam B. (2017): Erector spinae plane block for pain relief in rib fractures. Br J Anaesth. Mar 01;118(3):474-475
11. Schwartzmann A, Peng P, Maciel MA, and Forero M. (2018): Mechanism of the erector spinae plane block: insights from a magnetic resonance imaging study. Can J Anaesth. Oct;65(10):1165-1166
12. Krishnan S, and Cascella M. (2023): Erector Spinae Plane Block. [Updated 2023 Jan 8]. In: StatPearls [Internet]
13. De Cassai A, Bonvicini D, Correale C, Sandei L, Tulgar S, and Tonetti T (2019): Erector spinae plane block: a systematic qualitative review. Minerva Anestesiol. Mar;85(3):308-319
14. Jinn, C. K., and Kariem, E. B. (2021): Mechanisms of action of the erector spinae plane (ESP) block: a narrative review. Canadian Journal of Anesthesia, 68(3), 387-408.
15. El-Boghdadly K, and Pawa A. (2017): The erector spinae plane block: plane and simple. Anaesthesia 72(4):434–8
16. Fusco P, DI Carlo S, Scimia P, Luciani A, Petrucci E, and Marinangeli F. (2017): Could the new ultrasound-guided erector spinae plane block be a valid alternative to paravertebral block in chronic chest pain syndromes? Minerva Anestesiol 83(10):1112–3
17. Ma, Y., Lin, L., Xiao, K., Luo, Z., and Jin, T. (2022): Efficiency and Safety of Erector Spinae Plane Block in Percutaneous Nephrolithotomy: A Meta-Analysis Based on Randomized Controlled Trials. Urology, 168, 64-71.
18. Restrepo-Garces CE, Chin KJ, Suarez P, Diaz A (2017): Bilateral continuous erector spinae plane block contributes to effective postoperative analgesia after major open abdominal surgery: a case report. A A Case Rep. 9:319–21