Erector Spinae muscle block for Analgesia among Postmastectomy Operations

Sara Heikal Mohamed Yousif, Hassan Mohamed Ali Magid, Hala Ibrahim Zanfaly, Asmaa Mohamed Galal

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

Email: sarahaikl@zu.edu.eg, Saraheikal.oper@gmail.com

Article History: Received 10th June, Accepted 5th July, published online 10th July 2023

Abstract

Background: Patients with breast carcinoma treated with Modified Radical Mastectomy (MRM), is associated with appreciable acute postoperative pain and limited shoulder mobility. Postoperative pain is a risk factor in developing chronic Postmastectomy pain. About 40% of women have severe acute postoperative pain after breast cancer surgery, whereas 50% develop chronic postmastectomy pain and have a poor quality of life. Pain following mastectomy was first documented in the 1970s, yet postmastectomy pain syndrome (PMPS) remains poorly defined .Though pain associated with mastectomy is implied, PMPS has also been applied to chronic neuropathic pain following other surgical procedures of the breast, such as lumpectomy in breast-conserving surgery. Regional anesthesia and pain management have experienced advances in recent years, especially with the advent of fascial plane blocks. The erector spinae plane block is one of the newest techniques to be described. In the past two years, publications referring to ESP block have increased significantly. The objective of this review is to give brief overview about ESP block. Ultrasound-guided ESP block could be a choice with better outcome in patients undergoing elective mastectomy as regards lower frequency of hypotension, better efficiency and patient satisfaction.

Keywords: Erector Spinae muscle block, Postmastectomy

DOI: 10.53555/ecb/2023.12.Si12.292

Introduction

Patients with breast carcinoma treated with Modified Radical Mastectomy (MRM), is associated with appreciable acute postoperative pain and limited shoulder mobility. Postoperative pain is a risk factor in developing chronic Postmastectomy pain. About 40% of women have severe acute postoperative pain after breast cancer surgery, whereas 50% develop chronic postmastectomy pain and have a poor quality of life **(1)**.
Pain following mastectomy was first documented in the 1970s, yet postmastectomy pain syndrome (PMPS) remains poorly defined .Though pain associated with mastectomy is implied, PMPS has also been applied to chronic neuropathic pain following other surgical procedures of the breast, such as lumpectomy in breast-conserving surgery**(2).**

PMPS is characterized by persistent pain affecting the anterior thorax, axilla, and/or medial upper arm following mastectomy or lumpectomy. Time of onset, however, is not identified, and thus, PMPS has subsequently been misclassified as having a duration of more than 3 months. The International Association for the Study of Pain (IASP) notes that a 6-month time point is preferred for research. Furthermore, varying definitions of PMPS have been used for the purpose of different studies **(3).**

This lack of definition is apparent given the differing inclusion/exclusion criteria in PMPS research, and consequently, the findings of one study may not always be applicable to another **(4).**

Epidemiology:

PMPS affects approximately 30% of patients who undergo surgical treatment for breast cancer, though this value ranges from 25 to 60%. Numerous risk factors for the development of PMPS have been proposed. In particular, the type of surgery can greatly affect the rate of PMPS, as more invasive procedures in the breast area have a greater probability of disrupting sensory nerves. Mastectomy and axillary lymph node dissection are associated with severe nerve damage, while breast conservation surgery and sentinel lymph node biopsy are less likely to result in neuropathic pain **(5**).

Clinical Relevance:

Neuropathic pain associated with PMPS most commonly affects the axilla and arm, followed by the chest wall/breast region. The onset of pain is most likely to occur after surgery, though there may also be a new onset of symptoms following adjuvant therapy such as chemotherapy or radiation therapy. PMPS pain has been characterized by burning, painful cold, or electrical shock sensations, as well as numbness, tingling, or pins and needles sensations. Hypoesthesia and mechanical allodynia may also be present **(6**).

Numerous studies have reported on the debilitating nature of chronic pain following breast cancer surgery. PMPS exerts a significantly negative impact on the overall quality of life, even in instances in which the severity of chronic pain is mild **(7).**

Pain may result in limited range of motion of the upper extremity, subsequently affecting the patient's ability to carry out activities of daily living. For a significant number of patients, severe pain may also impair occupational function. Furthermore, PMPS not only affects the patient's physical health but also takes a significant toll on mental and emotional health. Multiple studies have documented a strong association between PMPS and mood disorders, including anxiety and depression (**8).**

Pathophysiology:

PMPS is a debilitating complication of breast cancer surgery, characterized by chronic neuropathic pain localized to the axilla, medial upper arm, breast, and/or chest wall. The underlying pathophysiology is likely multifactorial, though exact mechanisms have yet to be elucidated **(9).**

At present, neuralgia of the intercostobrachial nerve is implicated as the most common cause of PMPS. Damage to the intercostobrachial nerve is associated with various mechanisms of injury during axillary dissection, including stretching or compression during retraction and frank transection **(10).**

The beneficial analgesic effect of regional blocks is well known, the other potentially beneficial effects include decreased need for opioids, decreased postoperative nausea vomiting, fewer pulmonary complications, and decreased duration of post anesthesia care unit stay. Regional anesthesia may reduce cancer progression by attenuation of the surgical stress response, and by direct protective action of local anesthetics on cancer cell migration. **(11).**

The most commonly and time trusted blocks for providing analgesia for breast surgeries, are the paravertebral blocks and the thoracic epidural. The recently introduced pectoral nerve blocks (PECS blocks) and modified PEC block, have showed promising results with excellent intraoperative analgesia and comfortable postoperative patients **(12).**

The use of regional blocks can not only help to minimize pain, but also improves the pulmonary function and reduce narcotic requirement during the perioperative period **(13)**. It was showed that thoracic epidural analgesia is the gold standard technique after breast surgery but the adequacy of thoracic and axillary blockade during lymph node dissection is still a problem

Interventional techniques such as high thoracic epidural anaesthesia, cervical epidural anaesthesia, and thoracic paravertebral block have all been utilised to manage postoperative pain in the past. However, because to the close closeness of the pleura and the central neuraxial system, these procedures are extremely difficult**(14)**.

1) **Pectoralis block:**

The advance in the knowledge of sensitive innervation of the breast and the widespread use of ultrasound have led to the development of new types of interfascial plane blocks, such as the pectoral nerve blocks (PECS blocks), that can be added to general anesthesia to improve perioperative pain management and control in breast cancer surgery. PECS blocks' combination acts by blocking the long thoracic and thoracodorsal nerves in addition to the lateral branches of the intercostal nerves. The latter innervate the mammary gland and the skin from the 2nd to 6th thoracic dermatomes; as a consequence, PECS blocks prove to be useful in both breast-conserving surgery (BCS) and mastectomy with or without axillary lymphadenectomy **(15)**.

2) **Paravertebral Block (TPVB):**

Several different techniques exist for TPVB. It can be performed with the patient in the sitting, lateral, or prone position. The sitting position allows easy identification of landmarks, and the patients are often more comfortable. The classical technique, which is most commonly used, involves eliciting loss of resistance. At the appropriate dermatome under aseptic precautions, the needle (22-gauge, 8–10-cm short beveled spinal needle, or a Tuohy needle if a catheter is to be placed) is inserted 2.5–3 cm lateral to the most cephalad aspect of the spinous process and advanced perpendicular to the skin in all planes to contact the transverse process of the vertebra below at a variable depth (2–4 cm) depending on the build of the individual. If bone is not encountered at this depth, it is possible that the needle tip is lying between adjacent transverse processes. It is imperative to locate the transverse process before advancing the needle any further to prevent inadvertent deep insertion and possible pleural puncture. This is accomplished by withdrawing the needle to the subcutaneous plane and redirecting it cephalad and caudad to the same depth until bone is encountered. If bone is still not encountered, the needle is advanced a further centimeter and the above process repeated until the transverse process is tip traverses the thin superior costotransverse ligament, usually within 1–1.5 cm from the superior edge of the transverse process **(16)**

Thoracic epidural anesthesia (TEA) and thoracic paravertebral block (TPVB) represent the main techniques to manage postoperative analgesia in breast surgery. However, although these techniques allow excellent control of pain, they are not always easy to perform and their clinical effectiveness is limited by the presence of several contraindications, as well as the possible occurrence of systemic side effects or procedural complications **(17).**

3) **Erector Spinae muscle block**

Anatomy of Erector Spinae muscle

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. (**18)**

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 **(19)**

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). (**20)**

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. **(21).**

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 **(22)**
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) **(22).**

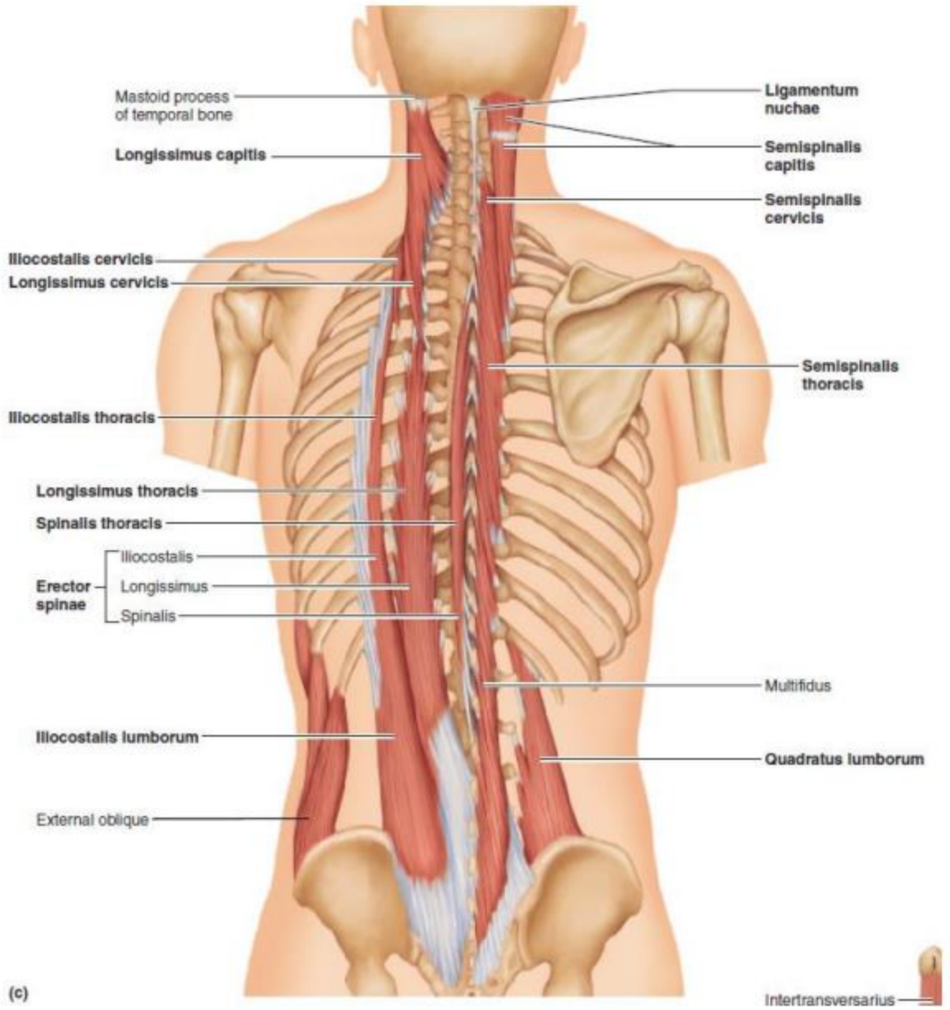

Fig (1): Anatomy 0f erector spinae muscle (23)

The mechanism of action

The mechanism of action can be detected by the spread of injectate, according to cadaveric study of dye injection either by dissection or 3D CT reconstruction studies or MRI scanning **(22).**

According to (**24)** (cadaveric study on 20 cadavers), When 20 ml of dye injected into the plane deep to erector spinae muscle at the level of T5, it shows extensive spread deep and superficial to the erector spinae muscle involving many segmental levels and lateral spread often to the lateral attachments of iliocostalis part.
The majority of the dye spread was cephalad to T6 and lateral into the plane deep to erector spinae muscle. In contrast, anterior spread of the dye into the paravertebral or intercostal spaces to involve the origin of the ventral or dorsal rami in the paravertebral space did not occur (**23).**
ESP block, targeting the dorsal and ventral rami of spinal nerve roots in the plane between erector spinae and intercostal muscles to anesthetize the anterior and posterior chest wall, axilla and medial aspect of upper arm. But due to limitation of data on its efficacy in breast surgeries, is a major drawback. In a case reported by Veiga M, ESP block was given in a patient undergoing radical mastectomy. Block was given before induction of anesthesia in a 40 year old woman. Opioid sparing effect was seen intraoperatively. During hospitalization, the patient reported no pain, without resorting to rescue analgesia **(22).**

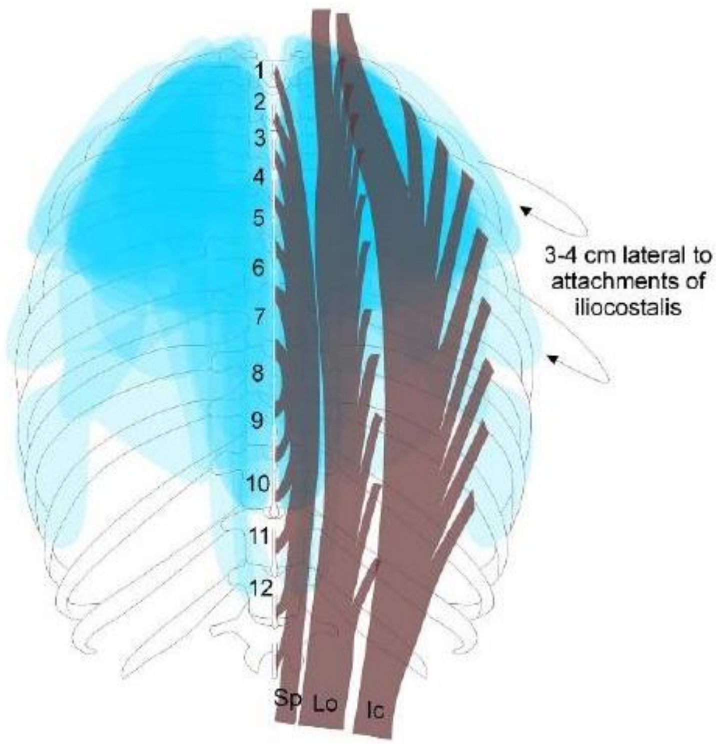

Figure 2:Dye spread by blue colour **(25).**

<u>Indications</u>
Erector Spinae plane block is a novel block that is recently described for:
A) Post-operative pain for various thoraco-abdominal surgeries
as:

1. Breast surgery
2. laparoscopic abdominal surgeries (cholecystectomy –Reux en y-sleeve gastrostomy)
3. Nephrectomy
4. Ventral hernia repair
5. video-assisted thoracoscopic
6. Thoracotomy.
7. Surgeries in Posterior Thoracic Wall
8. Spine fusion (**26)**

B) And for chest wall neuropathic pain as :

1. Herpetic and Post-herpetic neuralgia
2. Rib fracture
3. Bone malignancy **(26).**

contraindications

As any regional nerve block:

1- Patient refusal &un-cooperation.
2- Infection at site of injection.
3- Bleeding disorder.
4- Local anesthetic allergy. (**26)**

Advantages:

1. Ease of learning and performing.
2. Can be done in awake or anaesthetized patient.
3. Being far from sympathetic outflow, there is minimal risk for hemodynamic derangement and urine retention in comparison with thoracic epidural block.
4. As an opioid sparing analgesic technique there is less nausea, vomiting, urine retention and opioid related ileus **(22).**

Complications:

Possible complication in form of:

1. Pain at site of injection.
2. Local anesthetic systemic toxicity (LAST): As an inter-facial block which require relatively large volume of local anesthetic.
3. Local anesthetic allergy.
4. Failure of Block.
5. Pneumothorax also has been reported **(23).**

Approach and technique

Preparation:

Informed consent should be obtained from the patient and IV access be established.

Standard non-invasive monitoring should be applied including NIBP, pulse oximetry, and ECG should always be used and the block is performed in an area where full resuscitation facilities and a trained assistant are available. Full aseptic precautions should be taken when preparing for the block **(21).**

Positioning:

If awake, the patient should be seated with the neck and back flexed. If performed under sedation or general anaesthesia, the patient is turned to the lateral position with the operation side up.

Equipment:

High-frequency ultrasound probe Active Array L12-4 (8–13MHz) of an ultrasound machine, and a 22 gauge, 50 mm echogenic needle (Stimuplex D; B Braun, Germany) for performing the block **(27).**

Technique:

There are two ways to detect the level:

The first; vertebrae are counted from cephalad to caudal direction till T5 spinous process reached as the first palpable spinous process is C7. And the second counting the ribs up from 12th rib.

Linear ultrasound probe should be placed vertically 3 cm lateral to the T5 spinous process. Then three muscles should be identified superficial to the hyperechoic transverse process shadow as the following: trapezius, rhomboid major, and erector spinae. The needle can be introduced from superior to inferior direction in-plane until the tip lay deep or superficial to erector spinae muscle (the needle tip contacts the tip of the transverse process in case of deep to muscle), 0.5: 1 mL of non-active fluid is injected to confirm correct needle tip position by visualizing the spread a total of 20 mL of 0.25% bupivacaine is injected next **(22).**

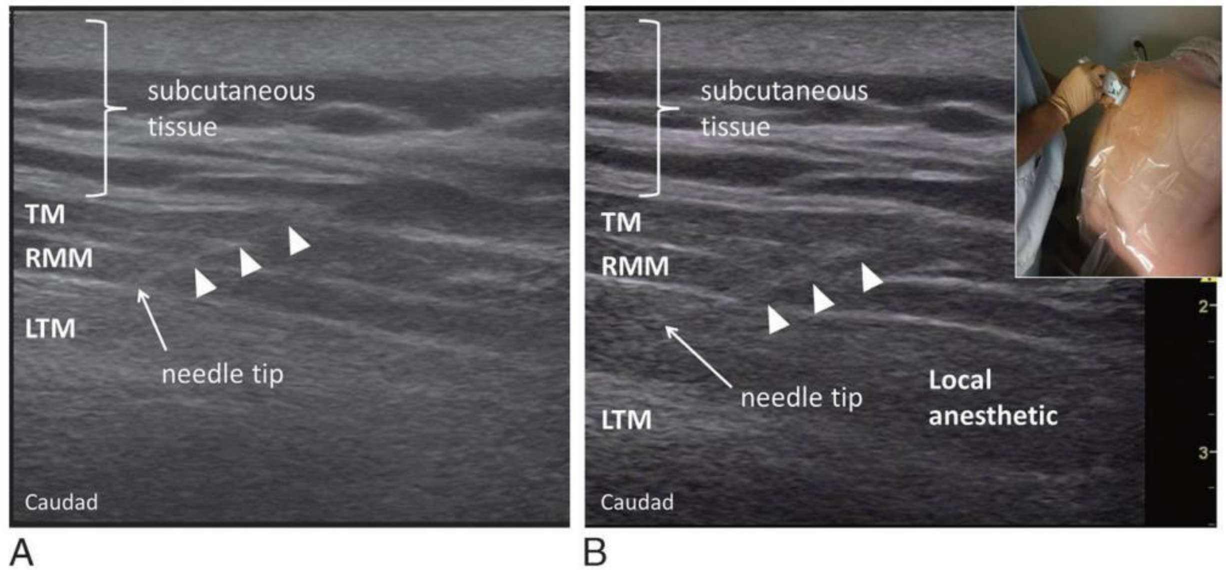

Fig (3): injection superfacial to erector spinae muscle
A- Needle positioning
B- Spread superfacial to the muscle (28).

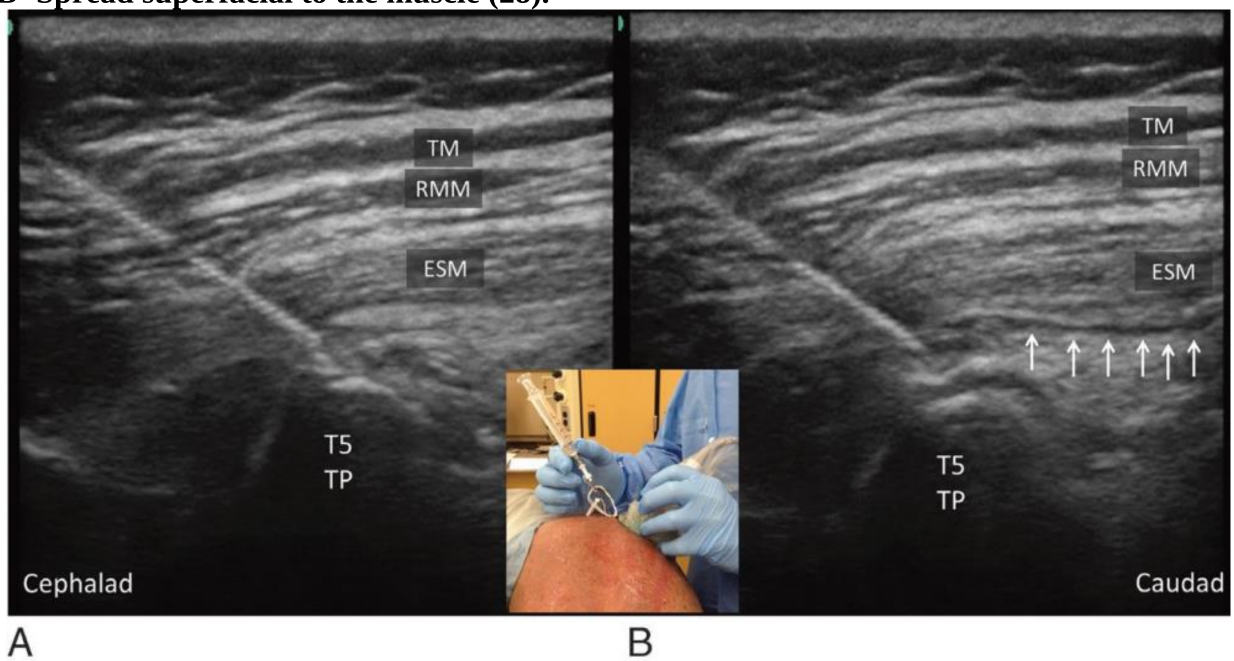

Fig (4): injection deep to erector spinae muscle
A- Needle positioning
B- Spread deep to the muscle (28).

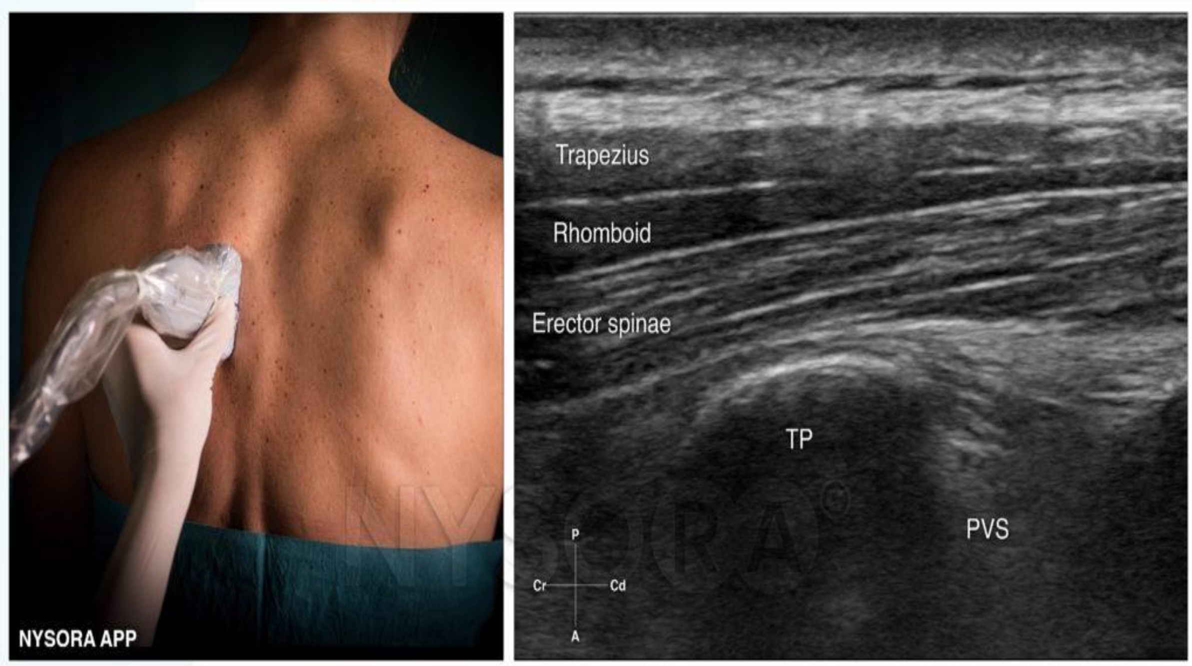

Figure (5): Administration of US- guided ESP block **(28).**

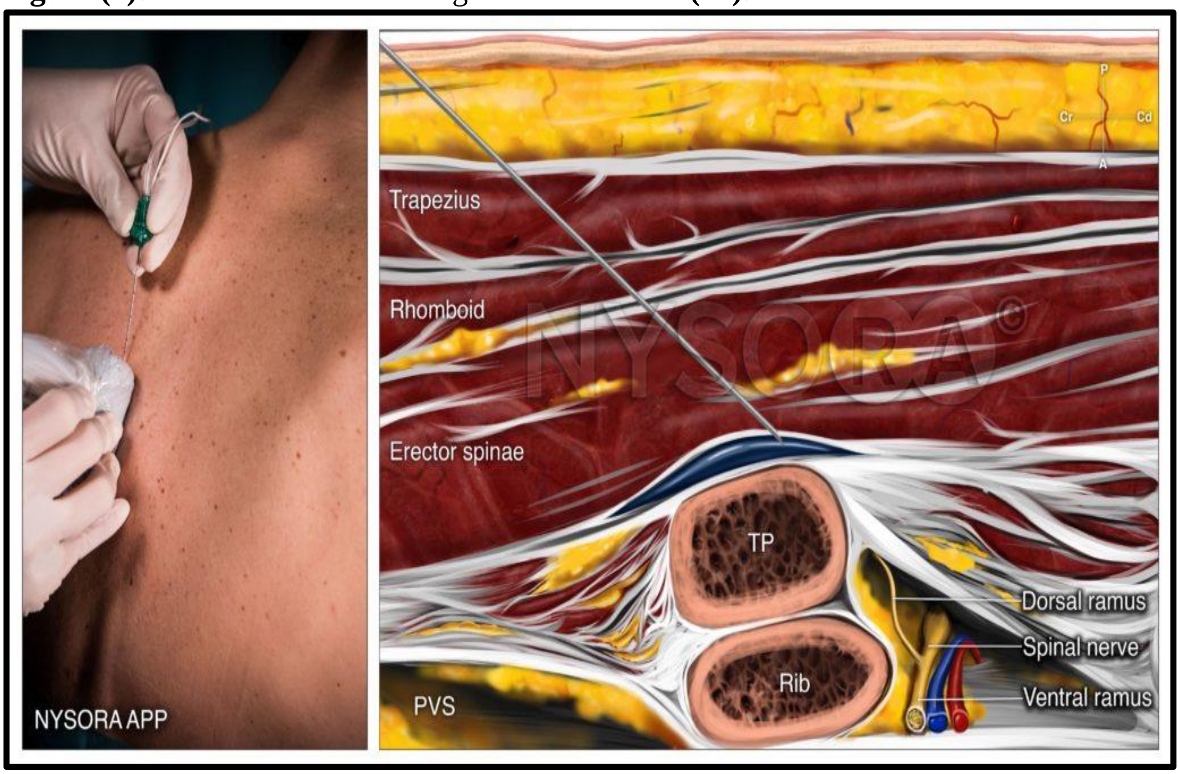

Figure (6): Reverse ultrasound anatomy of an ESP block with needle insertion in-plane from a cranial to caudal direction. The spinal nerve is exiting the paravertebral space with the dorsal ramus branching and traveling posterior to innervate the posterior back muscles. TP, transverse process; PVS, paravertebral space. Cr, cranial, Cd, caudad; A, anterior; P, posterior **(28).**

The erector spinae plane block is one of the newest techniques to be described. In the past two years, publications referring to ESP block have increased significantly. The objective of this review is to give brief overview about ESP block. Ultrasound-guided ESP block could be a choice with better outcome in patients undergoing elective mastectomy as regards lower frequency of hypotension, better efficiency and patient satisfaction.

References

1. American Institute for Cancer Research [Internet] How diet, nutrition and physical activity affect breast cancer risk. World Cancer Research Fund International; [[Accessed March 31, 2020]]. Available from: https://www.wcrf.org/dietandcancer/breast-cancer. [Google Scholar]
2. Elzohry AAM, Abd Elhamed MF, Mahran MH. Post Mastectomy Pain Is No Longer Nightmare. Journal of Family Medicine. 2018;1:1. [Google Scholar]
3. Gartner R, Jensen MB, Nielsen J, Ewertz M, Kroman N, Kehlet H. Prevalence of and factors associated with persistent pain following breast cancer surgery. JAMA. 2009;302:1985–92. [PubMed] [Google Scholar]
4. Abdel Dayem OT, Saeid MM, Ismail OM, El Badrawy AM, Abdel Ghaffar NA. Ultrasound guided stellate ganglion block in postmastectomy pain syndrome: a comparison of ketamine versus morphine as adjuvant to bupivacaine. Journal of Anesthesiology. 2014;2014 doi: 10.1155/2014/792569 . [Google Scholar]
5. Wood KM. Intercostobrachial nerve entrapment syndrome. South Med J. 1978;71:662–3. [PubMed] [Google Scholar]
6. Granek I, Ashikari R, Foley K, editors The post-mastectomy pain syndrome: clinical and anatomical correlates. Proc Am Soc Clin Oncol. 1984;3:122. [Google Scholar]
7. Jung BF, Ahrendt GM, Oaklander AL, Dworkin RH. Neuropathic pain following breast cancer surgery: proposed classification and research update. Pain. 2003;104:1–13. [PubMed] [Google Scholar]
8. Waltho D, Rockwell G. Post-breast surgery pain syndrome: establishing a consensus for the definition of post-mastectomy pain syndrome to provide a standardized clinical and research approach - a review of the literature and discussion. Can J Surg. 2016;59:342–50. [PMC free article] [PubMed] [Google Scholar]
9. Couceiro TC, Menezes TC, Valenca MM. Post-mastectomy pain syndrome: the magnitude of the problem. Rev Bras Anestesiol. 2009;59:358–65. [PubMed] [Google Scholar]
10. Kaur N, Jain A. Postmastectomy chronic pain in breast cancer survivors: An update on definition, pathogenesis, risk Factors, treatment and prevention. Clin Oncol. 2017;2:1300. [Google Scholar]
11. International Association for the Study of Pain (IASP) Classification of chronic pain. Descriptions of chronic pain syndromes and definitions of pain terms. Prepared by the International Association for the Study of Pain, Subcommittee on Taxonomy. Pain Suppl. 1986;3:S1–226.
12. Li J, Lam D, King H, Credaroli E, Harmon E, Vadivelu N. Novel Regional Anesthesia for Outpatient Surgery. Curr Pain Headache Rep. 2019 Aug 01;23(10):69. [PubMed]
13. Loizou E, Mayhew DJ, Martlew V, Murthy BVS. Implications of deranged activated partial thromboplastin time for anaesthesia and surgery. Anaesthesia. 2018 Dec;73(12):1557-1563. [PubMed]
14. Doo AR, Shin YS, Choi JW, Yoo S, Kang S, Son JS. Failed dural puncture during needle-through-needle combined spinal-epidural anesthesia: a case series. J Pain Res. 2019;12:1615-1619. [PMC free article] [PubMed]
15. Battista C, Krishnan S. Pectoralis Nerve Block. [Updated 2023 Jul 25]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2024 Jan-.
16. Richardson J. Fin-de-siecle renaissance of Paravertebral analgesia. Pain Rev. 1997;4:159–71.
17. Eason MJ, Wyatt R. Paravertebral thoracic block-a reappraisal. Anaesthesia. 1979;34:638–642.
18. Forero M, Adhikary SD, Lopez H, Tsui C, Chin KJ. The Erector Spinae Plane Block: A Novel Analgesic Technique in Thoracic Neuropathic Pain. Reg Anesth Pain Med. 2016 Sep-Oct;41(5):621-7. [PubMed]
19. Yoshizaki M, Murata H, Ogami-Takamura K, Hara T. Bilateral erector spinae plane block using a programmed intermittent bolus technique for pain management after Nuss procedure. J Clin Anesth. 2019 Nov;57:51-52. [PubMed]
20. Raft J, Chin KJ, Belanger ME, Clairoux A, Richebé P, Brulotte V. Continuous Erector Spinae Plane Block for thoracotomy analgesia after epidural failure. J Clin Anesth. 2019 May;54:132-133. [PubMed]
21. Kim E, Kwon W, Oh S, Bang S. The Erector Spinae Plane Block for Postoperative Analgesia after Percutaneous Nephrolithotomy. Chin Med J (Engl). 2018 Aug 05;131(15):1877-1878. [PMC free article] [PubMed]
22. Chin KJ, Adhikary S, Sarwani N, Forero M. The analgesic efficacy of pre-operative bilateral erector spinae plane (ESP) blocks in patients having ventral hernia repair. Anaesthesia. 2017 Apr;72(4):452-460. [PubMed]
23. Chin KJ, Lewis S. Opioid-free Analgesia for Posterior Spinal Fusion Surgery Using Erector Spinae Plane (ESP) Blocks in a Multimodal Anesthetic Regimen. Spine (Phila Pa 1976). 2019 Mar 15;44(6):E379-E383. [PubMed]
24. Hamilton DL, Manickam B. Erector spinae plane block for pain relief in rib fractures. Br J Anaesth. 2017 Mar 01;118(3):474-475. [PubMed]

25. Schwartzmann A, Peng P, Maciel MA, Forero M. Mechanism of the erector spinae plane block: insights from a magnetic resonance imaging study. Can J Anaesth. 2018 Oct;65(10):1165-1166. [PubMed]

26. De Cassai A, Bonvicini D, Correale C, Sandei L, Tulgar S, Tonetti T. Erector spinae plane block: a systematic qualitative review. Minerva Anestesiol. 2019 Mar;85(3):308-319. [PubMed]

27. Forero M, Rajarathinam M, Adhikary SD, Chin KJ. Erector spinae plane block for the management of chronic shoulder pain: a case report. Can J Anaesth. 2018 Mar;65(3):288-293. [PubMed]

28. Bugada D, Zarcone AG, Manini M, Lorini LF. Continuous Erector Spinae Block at lumbar level (L4) for prolonged postoperative analgesia after hip surgery. J Clin Anesth. 2019 Feb;52:24-25