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Efficacy and Safety of Pectoral Nerve Blocks in Modified Radical Mastectomy

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Abstract:

Breast cancer is the most common malignancies among women, accounting for 25%–32% of all female cancers Worldwide. Surgical resection of the primary tumour with axillary dissection is one of the main modalities of breast cancer treatment. The most common modality for anaesthesia is general anaesthesia with or without regional blocksIt has been reported that 40% of the females complain from moderate-to-severe pain in the immediate post-operative period after breast cancer surgery. Pectoral nerve (Pecs) block is an effective analgesic tool for the anterolateral chest. In particular, the Pecs block can provide more effective analgesia for breast cancer surgery.

Keywords: pectoral nerve (Pecs) block, chest wall block, breast cancer surgery(BCS), perioperative pain management.

Introduction:

Acute post-surgical pain leads to delayed discharge from post-operative recovery area, impairs pulmonary and immune functions, increases risk of thromboembolism, myocardial infarction and may lead to increased length of hospital stay**(1).** It is also an important factor leading to the development of chronic persistent postoperative pain in almost half of the patients**(2 ,3).** Chronic pain after BCS refers to chronic neuropathic pain condition in and around the area of surgery lasting beyond 3 months after surgery when all other causes of pain such as recurrence have been ruled out **(4).**

Pecs block and serratus plane blocks are newer ultrasound guided regional anesthesia techniques of the thorax .The increasing use of ultrasonography to identify tissue layers and, particularly, fascial layers has led to the development of several newer interfascial injection techniques for analgesia of the chest and abdominal wall**(5).**

Several studies have shown that chronic pain after breast cancer surgery is a common problem, with incidence ranging from 25% to 60%. The incidence significantly decreases in women over the age of 70 **(6).**

Hence, an effective perioperative pain management of patients undergoing breast surgery is essential. Regional blocks have been considered as one of the modalities for effective perioperative pain control. They have an opioid-sparing effect, and allow early mobilisation and early discharge from hospital. With the advent of ultrasound, newer interventions such as fascial plane blocks –pectoral nerve blocks have been reported for perioperative analgesia in breast surgeries**(7).**

Anatomy Relevant To Pectoral Nerve Blocks:

NERVE SUPPLY OF THE BREAST

Sensory innervation of the breast It is mainly derived from the anterolateral and anteromedial branches of thoracic intercostal nerves T2-T6. Supraclavicular nerves from the lower fibers of the cervical plexus also provide innervation to the upper and lateral portions of the breast. Sensation to the nipple is derived largely from the lateral cutaneous branch of T4**(8).**

The lateral pectoral nerve:

Lateral pectoral nerve (LPN) arises from the lateral cord of the brachial plexus. Its origin is C5, C6, and C7 spinal nerves **(Fig.1).** It is the larger of the two pectoral nerves. The lateral pectoral nerve primarily supplies the PMM , some lateral pectoral nerve fibers pass innervate the Pmm. It has fibers that innervate the acromioclavicular joint, periosteum of the clavicle and anterior articular capsule of the shoulder joint and costoclavicular ligaments **(9).**

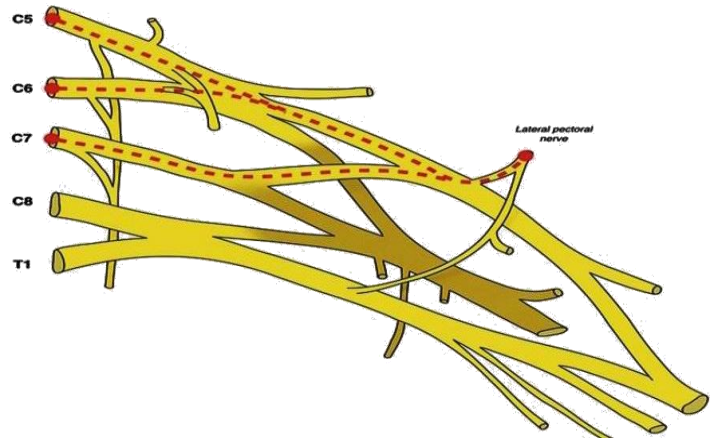

Figure 1:lateral pectoral nerve**(10).**

The medial pectoral nerve:

The medial pectoral nerve (MPN) arises from C8–T1 spinal nerves **(Fig.2).** it supply the Pmm muscle. Its also costal head and gives sensory innervation to the ventral aspect of the arm and the chest wall near the axilla**(9)**

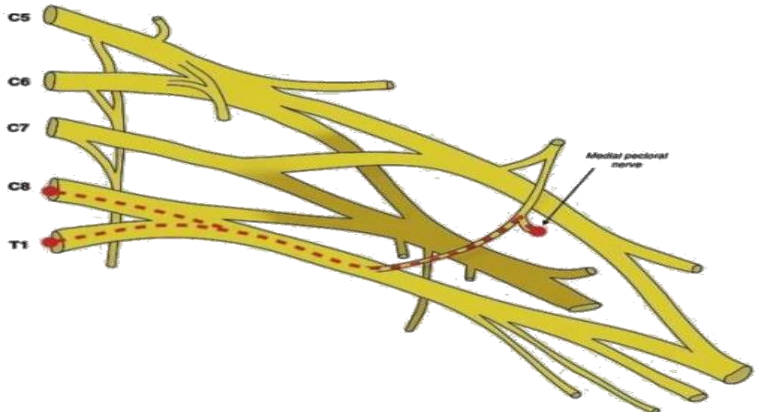

Figure 2: medial pectoral nerve**(10).**

Multimodal analgesia (ie, using different types of analgesics for pain management) is important for all postoperative analgesic plans, which usually incorporate the World Health Organisation analgesic ladder **(11).**

Nociceptive pain responds best to opioids, NSAIDs, para- aminophenol agents and regional anesthesia techniques**(12).**

Although opioids can be used for perioperative analgesia with adequate pain management , they have a wide range of adverse effects like respiratory depression, nausea and vomiting, sedation, and constipation. Other pharmacological agents like gabapentinoids (gabapentin and pregabalin) can be used as adjuvants to reduce the opioid dose. However, they come with their own adverse effects including dizziness, somnolence, fatigue, and ataxia. Local anaesthetic and regional anaesthetic and analgesic techniques should be considered wherever possible because they can reduce the amount of opiate required **(1).**

REGIONAL ANAESTHETIC OR ANALGESIC TECHNIQUES FOR BREAST SURGERY

Thoracic Epidural

Thoracic epidurals were considered to be the criterion standard in providing analgesia following breast surgery for a long time before being overtaken by other relatively easier techniques.An epidural catheter is typically inserted at the level of the interspace between the fifth and sixth thoracic vertebrae. Local anesthetic solution is then introduced in the epidural space to achieve blockade of nerve roots from the second to the eighth thoracic segments thus covering the axillary area along with the chest wall. However thoracic epidurals are not routinely used as their use may delay patient discharge, there is a high failure rate, placement can be challenging in the high thoracic level, and, as always, there are absolute and relative contraindications to epidural insertion as well as the possible complications **(13).**

Paravertebral Block

Paravertebral blocks have largely replaced thoracic epidurals as a regional technique to provide analgesia for breast surgery. The injection of local anesthetic solution in the paravertebral space results in a unilateral sensory, motor, and sympathetic block. A paravertebral block performed at the level of the fourth to fifth thoracic vertebrae should cover the dermatomal extent of the entire breast. The block can be performed either as a single-shot technique or a catheter technique. Depending on the local anesthetic used, a single shot can provide around 8 to 12 hours of good analgesia.

A specific advantage of unilateral paravertebral block is that, it produces less intense sympathetic block compared to epidural block, thus avoiding side effects like hypotension and bradycardia.Complications of paravertebral blocks are much decreased using ultrasound including hypotension, vascular puncture, plural puncture and rarely pneumothorax**(14).**

Serratus Anterior Plane Block

The serratus anterior plane block is another regional anesthetic technique described by Blanco et al .It involves in-line needling and placement of local anesthetic solution either superficial or deep to the serratus anterior muscle at the level of the midaxillary line at the level of the fifth rib, under ultrasound guidance **(15).**

The Pecs I block is a fascial plane block described by Blanco in 2011 and used to provide analgesia for breast surgery.The block is commonly performed using an in-line needling technique under ultrasound guidance to identify the plane between the pectoralis major and minor muscles .The nerves that are targeted are the lateral and medial pectoral nerves. **(16).**

The Pecs II block was described by Blanco et al in 2012 It involves ultrasound-guided injection of local anesthetic solution with the first injection, between the pectoralis major and minor muscles, and a second injection between the pectoralis minor and the serratus anterior muscle **(17).**

INDICATION FOR Pecs BLOCK (18).

Pecs I BLOCK is indicated in the following:.

- Surgery limited to pectoralis major e.g. unilateral surgery such as insertion of breast expanders and submuscular prostheses, portacaths and implantable cardiac defibrillators/pacemakers,
- anterior thoracotomies and shoulder.
- surgery involving the deltopectoral groove.

Pecs II BLOCK is indicated in the following:.

Similar to Pecs I with some additions:

- tumour resections.
- mastectomies.
- sentinel node biopsies.
- axillary clearances.

- Patient refusal or infection at the site of injection are absolute contraindications to performing a Pecs block.

- Anticoagulation may be a relative contraindication to Pecs block I and II, although there are no specific guidelines (**19)**.

Technique of pectoral nerve block:

For Pecs I block, after cleaning the infraclavicular and axillary regions, the probe is positioned under the lateral third of the clavicle. The following structures should be identified (subcutaneous tissue, pectoralis major muscle, pectoralis minor muscle, axillary artery, axillary vein, and pleura) from superficial to deep, and in between PMM and Pmm, there are thoracoacromial artery and the lateral pectoral nerve **(Fig.3)**. The skin puncture point is infiltrated with 2% lignocaine, and then the block is performed by using a 22-gauge block needle. The needle is advanced to the tissue plane between the PMM and Pmm, and 10 mL of 0.25% bupivacaine is deposited with frequent aspiration **(20)**.

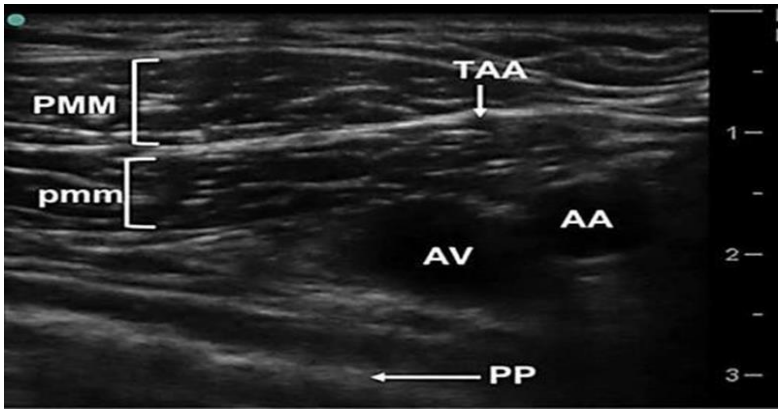

Figure 3: Ultrasound visualization for pectoral nerve block I. The pectoralis major muscle (PMM), pectoralis minor muscle (pmm), thoracoacromial artery (TAA), axillary artery (AA), axillary vein (AV), and parietal pleura (PP) are identified **(`21).**

For the Pecs II block, the target is to reach the level of 2 nd, 3 rd, and 4th ribs at which the lateral border of the Pmm is present. The probe is positioned under the lateral third of the clavicle, then moved laterally and distally until the third rib and the lateral border of the Pmm is visualized **(Fig.4)**. At the 3rd rib, another muscle,

the serratus anterior muscle, and covering 2nd, 3rd, and 4th ribs, also parietal pleura is visualized deep to this muscle between the ribs **(Fig.5).** The skin puncture point will be infiltrated with 2% lignocaine. The needle is advanced, in-plane, medially to laterally; 20 ml of 0.25% bupivacaine will be deposited with frequent aspiration at the level of the third rib between Pmm and the SAM **(22)**.

Figure 4: Image showing external probe position during pectoral nerve block II**(21).**

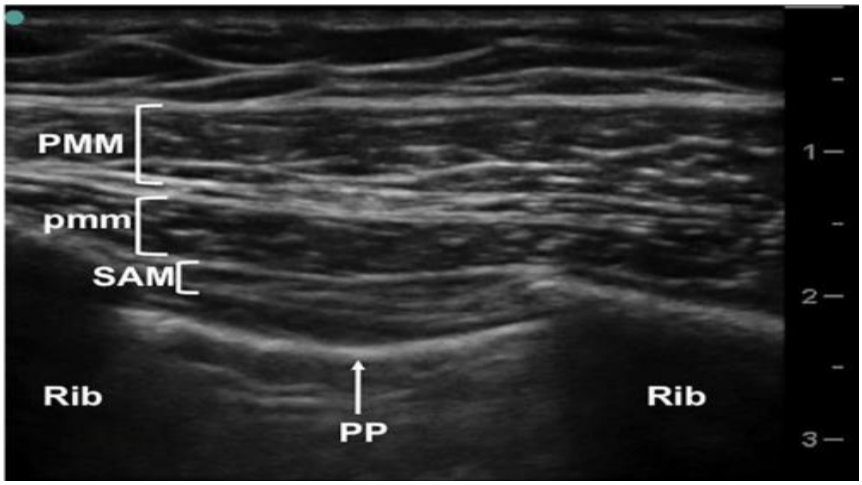

Figure 5: Ultrasound visualization for pectoral nerve block II. The pectoralis major muscle (PMM), pectoralis minor muscle (pmm), and serratus anterior muscle (SAM), and the parietal pleura (PP) is identified between the ribs **(23)**.

Advantages of pectoral nerve block:

1.It differs from thoracic epidural and paravertebral blocks as it is not associated with sympathetic block.

2.It is seems to be simple, easy to learn and fast acting block, also it can be done before or after induction of general anesthesia **(24)**.

Disadvantages of pectoral nerve block:

1**.**Accidental intravascular injection due to local anesthetic injection into pectoral branch of the thoracoacromial artery but can be avoided by proper visualization of anatomy especially the thoracoacromial artery **(19)**.

2.In the Pecs II block, pleural puncture is possible although the pleura is located deep to the SAM,

but it is not far from the desired injection site, and so careful needle visualization should be done **(10).**

Many types of regional nerve blocks have been used during anesthesia for modified radical mastectomy. Thoracic paravertebral, thoracic epidural, intercostal nerve, and interscalene brachial plexus blocks have been used for anesthesia and abirritation during modified radical mastectomy, but their applications are limited by the complicated nature of the procedures and severe complications. **(25)**

PECS block is a thoracic wall block that has gained popularity in postoperative analgesia for mastectomy and lateral chest wall surgeries.

PECS block, especially PECS II block, is a safe and effective option for analgesia in modified radical mastectomy. Compared with GA alone, PECS block combined with GA was more advantageous in reducing intraoperative opioid consumption, postoperative opioid consumption, postoperative early pain, incidence of PONV, and the need for postoperative rescue analgesia. **(20)**

PECS I block by itself may have analgesic effect and cannot effectively reduce the consumption of opioids, it can reduce postoperative chronic pain.

The PECS II block includes the PECS I block, and also entails blocking the intercostal nerve, thoracic nerve, and intercostal brachial nerve, which reduces the sensations on the skin of the thoracic wall and the armpit and achieves a greater range of analgesia. **(26)**

This is one of the first meta-analyses to examine the clinical analgesic efficacy of Pecs block in patients undergoing breast cancer surgery. Our meta-analysis showed that the use of Pecs block significantly reduced VAS pain scores up to 24hours postoperatively. In addition, breast cancer patients receiving Pecs block had significantly less intraoperative and postoperative opioid consumption. The analgesic effect of Pecs block was also demonstrated by a longer time to the first request for analgesia. There was no statistically significant difference in PONV and complications related to Pecs block.

Surgery is the first choice of treatment for breast cancer, and regional anesthesia may potentially reduce the post-mastectomy pain syndrome. It has been implicated that regional anesthesia could reduce tumor recurrence and metastases after mastectomy. **(26)**

In recent years, a less invasive and more effective Pecs block has become popular for perioperative pain control in patients undergoing breast cancer surgery **(16,22).**

The lower VAS pain scores resulted in reduced chronic pain, better sleep, higher patient satisfaction, and less hospital readmission**(4).**

Although conventional opioid analgesics remain the mainstay of postoperative pain management, their use may be limited by potentially harmful effects**(27,28).**Steyaert and colleagues demonstrated that patients who needed opioids in the immediate postoperative period were associated with the presence of chronic pain after mastectomy with axillary lymph node dissection **(29).**Therefore, a multimodal approach to improve postoperative analgesia must be utilized, including local infiltration, regional anesthesia, and nonopioid analgesics **(27,28).**

In conclusion, adding Pecs block to GA procedures leads to lower VAS pain scores, more significant opioid sparing, and longer time to first analgesic request in patients undergoing breast cancer surgery compared with GA procedures alone.

References:

1.Joshi GP and Ogunnaike BO: Consequences of inadequate postoperative pain relief and chronic persistent postoperative pain. Anesthesiol Clin North Am 2005; 23 (1):21-36.

2.Poleshuck EL, Katz J, Andrus CH, Hogan LA, Jung BF, Kulick DI, et al.Risk factors for chronic pain following breast cancer surgery: A prospective study. J Pain. 2006; 7:626–34.

3.Gartner R, Jensen MB, Nielsen J, Ewertz M,Kroman N, and Kehlet H. Prevalence of andfactors associated with persistent pain following breast cancer surgery. JAMA. 2009;302:1985–92.radical mastectomy. Pain and Therapy, 12(5), 1165-1178.

4.Hassn AM, Zanfaly HE and Biomy TA: Pre-emptive analgesia of ultrasound-guided pectoral nerve block II with dexmedetomidine-bupivacaine for controlling chronic pain after modified radical mastectomy. Res Opin Anesth Intensive Care. 2016; 3(1): 6-13.

5.Ahmed H Othman, MD, Ahmad M Abd El-Rahman, MD, and Fatma Adel El Sherif, MD. Efficacy and Safety of Ketamine Added to Local Anesthetic in Modified Pectoral Block for Management of Postoperative Pain in Patients Undergoing Modified Radical Mastectomy. Pain Physician 2016; 19:485-494 • ISSN 1533-3159.

6.Andersen KG and Kehlet H: Persistent pain after breast cancer treatment: a critical review of risk factors and strategies for prevention. J Pain 2011; 12:725–46.

7.Garg R, Bhan S, Vig S. Newer regional analgesia interventions (fascial plane blocks) for breast surgeries: Review of literature. Indian J Anaesth. 2018 Apr;62(4):254-262. doi: 10.4103/ija.IJA_46_18. PMID: 29720750; PMCID: PMC5907430.

8.Pandya S, Sonali MD, Moore RG and Richard G: Breast development and anatomy. Clinical obstetrics and gynecology, 2011; 54(1): 91-95.

9.Blanco R, Fajardo M, Parras Maldonado T. Ultrasound description of Pecs II (modified Pecs I): a novel approach to breast surgery. Rev Esp Anestesiol Reanim. Nov;59(9):470-5. doi: 10.1016/j.redar.2012.07.003. Epub 2012 Aug 29. PMID: 22939099.

10.Porzionato A, Macchi V, Stecco C, Loukas M, Tubbs RS and De Caro R: Surgical anatomy of the pectoral nerves and the pectoral musculature. Clin Anat. 2012; 25:559–75.

11.Smith WH and Nielsen AL: Postoperative hyperalgesia: its clinical importance and relevance. Anesthesiology 2006; 104(3):601-7.

12.Taylor DR: Improving outcomes in acute pain management: Optimizing patient selection. Medscape Neurol Neurosurg 2004; 6(2)1-8.

13.Freise H, Van Aken HK. Risks and benefits of thoracic epidural anaesthesia. Br J Anaesth. 2011;107(6):859-868.

14.Pace MM, Sharma B, Anderson-Dam J, Fleischmann K, Warren L, Stefanovich P. Ultrasound-guided thoracic paravertebral blockade: a retrospective study of the incidence of complications. Anesth Analg. 2016;122(4):1186-1191.

15.Blanco R, Parras T, McDonnell JG, Prats-Galino A. Serratus plane block: A novel ultrasound-guided thoracic wall nerve block. Anaesthesia. 2013;68:1107–13. doi: 10.1111/anae.12344.

16.Blanco R. The 'pecs block'. a novel technique for providing analgesia after breast surgery. Anaesthesia. 2011 Sep;66(9):847-8. doi: 10.1111/j.1365-2044.06838.x. PMID: 21831090.

17.Blanco R, Fajardo M, Parras Maldonado T. Ultrasound description of Pecs II (modified Pecs I): a novel approach to breast surgery. Rev Esp Anestesiol Reanim. Nov;59(9):470-5. doi: 10.1016/j.redar.2012.07.003. Epub 2012 Aug 29. PMID: 22939099.

18.Purcell N, Wu D.Novel use of the PECS II block for upper limb fistula surgery. Anaesthesia. Nov2014;69(11):1294.

19.Kim DH, Kim S, Kim CS, Lee S, Lee IG and Kim HJ: Efficacy of pectoral nerve block type II for breast-conserving surgery and sentinel lymph node biopsy: A prospective randomized controlled study. Pain Res

Manag 2018; 20: 1-8.

20.Zhao J, Han F, Yang Y, Li H and Li Z: Pectoral nerve block in anesthesia for modified radical mastectomy: A meta-analysis based on randomized controlled trials. Medicine (Baltimore) 2019; 98(18): 1-8.

21.Bolin ED, Harvey NR and Wilson SH: Regional anesthesia for breast surgery: techniques and benefits. Curr Anesthesiol Rep 2015; 5: 217-24.

22.Kamiya Y, Hasegawa M, Yoshida T, Takamatsu M and Koyama Y: Impact of pectoral nerve block on postoperative pain and quality of recovery in patients undergoing breast cancer surgery: A randomized controlled trial. Eur J Anaesthesiol 2018; 35(3):215-23.

23.Pérez MF, Miguel JG and de la Torre PA: A new approach to pectoralis block. Anesth 2013; 68 (4):430-31.

24.Jin Z, Li R, Gan TJ, He Y and Lin J: Pectoral Nerve (PECs) block for postoperative analgesia-a systematic review and meta-analysis with trial sequential analysis. Int J Physiol Pathophysiol Pharmacol 2020; 12 (1): 40–50.

25. Arsalani-Zadeh R, Elfadl D, Yassin N, et al. Evidence-based review of enhancing postoperative recovery after breast surgery. Br J Surg 2011;98:181–96.

26. Versyck B, van Geffen GJ, Van HP. Prospective double blind randomized placebo-controlled clinical trial of the pectoral nerves (Pecs) block type II. J Clin Anesth 2017;40:46–50.

27.Gan TJ. Poorly controlled postoperative pain: prevalence, consequences, and prevention. J Pain Res 2017;10:2287–98.

28.Garimella V, Cellini C. Postoperative pain control. Clin Colon Rectal Surg 2013;26:191–6.

29. Steyaert A, Forget P, Dubois V, et al. Does the perioperative analgesic/anesthetic regimen influence the prevalence of long-term chronic pain after mastectomy? J Clin Anesth 2016;33:20–5.