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Neuroanatomic Map for Nerve Block Design in Breast Surgery

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We have read with interest a recent publication of Puentes-Gutiérrez and colleagues about post-breast surgery pain syndrome.¹ Perioperative pain has been identified as one of the risk factors for post-breast surgery pain syndrome.² There has been increasing literature regarding locoregional anesthesia techniques to cope with perioperative pain after breast surgery. In the PROSPECT guideline published in 2020, paravertebral block was recommended as the first choice with or without wound infiltration and pectoral nerve block was considered an alternative to paravertebral block.³

However, we would like to point out that paravertebral block, which acts on the intercostal nerves, is effective for pain from skin and the intercostal muscles. Pectoral nerve block, which acts on the lateral and medial pectoral nerves is effective for pain from pectoralis major and minor muscles. Paravertebral block and pectoral nerve block could work better together instead of replacing each other.

Pectoral nerve block can be achieved by infiltrating local anesthetics between the pectoralis major muscle and the pectoralis minor muscle as well as between the pectoralis minor muscle and the serratus anterior muscle.⁴

As the target of paravertebral block, the intercostal nerves give rise to their lateral cutaneous branches which go forward subcutaneously after penetrating the chest wall muscles near the mid-axillary line and supply the skin over the arm pit as well as the lateral and inferior aspects of the breast. The anterior

cutaneous branches of the intercostal nerves arise more distally near the lateral border of the sternum and course back medially to supply the skin over the medial and superior aspects of the breast. Paravertebral injection blocks both branches of the intercostal nerves and numbs the skin of both the axilla and anterior chest. After paravertebral block, only a small area of skin of the chest around the clavicle, which is innervated by the supraclavicular nerve, is spared. Paravertebral block requires repositioning the patient, is more skill demanding, is contraindicated in patients with bleeding tendency, and carries the risk of pneumothorax.⁵ Thoracic epidural block and erector spinae plane block (injection between the erector spinae muscle and the transverse process of the spine) also have similar problems. Serratus anterior plane block could be a simple technique to block the lateral cutaneous branches of the intercostal nerves by infiltrating local anesthetics between the latissimus dorsi muscle and the serratus anterior muscle within the axillary fossa.⁶ The anterior cutaneous branches of the intercostal nerves could be blocked by parasternal subcutaneous infiltration or transversus thoracic plane block (injection between the innermost intercostal muscle and the internal intercostal muscle).

Multimodal analgesia for perioperative pain has been strongly recommended to enhance recovery after breast surgery.^{3, 7} Comprehensive locoregional anesthesia minimizes the requirement of sedation or the depth of general anesthesia, reduces perioperative pain, facilitates early mobilization, and reduces opioid requirement and associated side effects such as constipation and post-operative nausea and vomiting. Table 1 classifies related nerve block options according to their level of spinal nerve origins. Although distant from each other proximally, their peripheral analogs could be approached around the surgical field in the supine position (Figure 1). In our

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practice, we perform serratus anterior plane block and/or transverse thoracic plane block in supine position pre-operatively based on anticipated skin incision instead of paravertebral block if the intercostal muscles are not involved. But if the intercostal muscles are involved, paravertebral block or other locoregional anesthesia techniques targeting the intercostal nerves may be required. We also consider pectoral nerve block when pain from the

pectoral muscles is a concern. Besides image findings, it would be helpful to identify pain from the pectoral muscles if there is referred pain in C5-T1 dermatome because the pectoral nerves arise from brachial plexus. According to preoperative image studies, pre-existing pain and its referral pattern, as well as anticipated surgical procedure, a patient-tailored locoregional anesthesia plan based on the understanding of neuroanatomy is recommended.

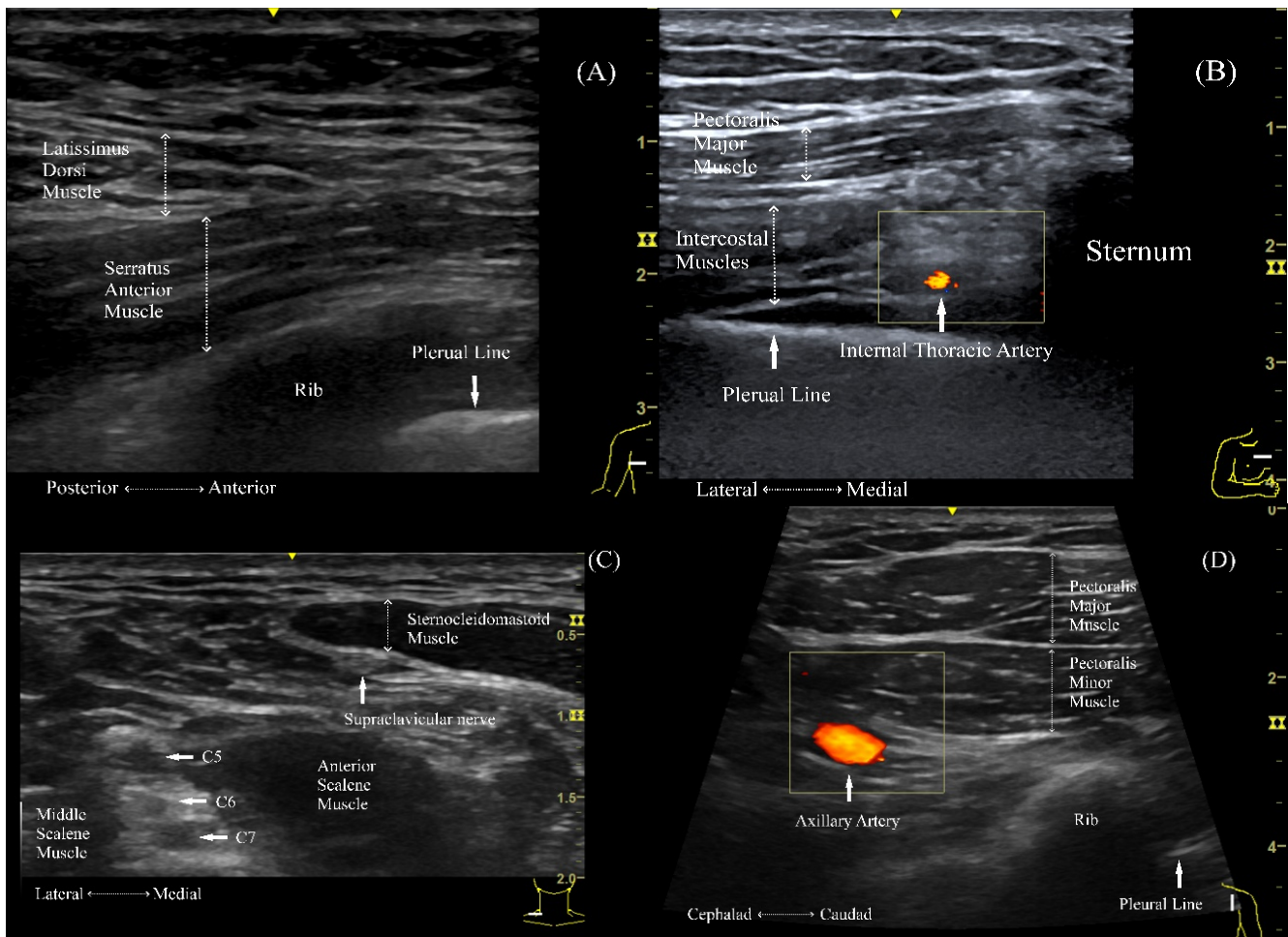
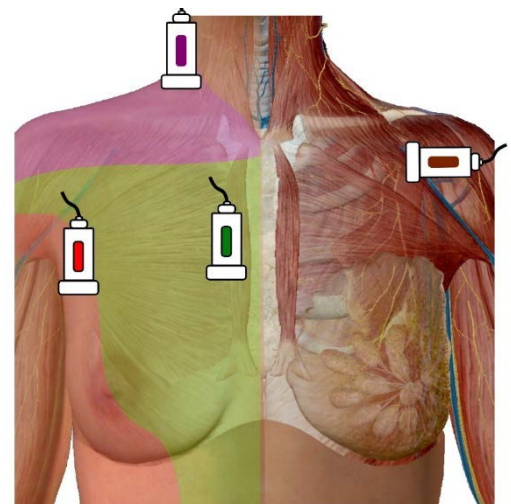


Figure 1. Surface and ultrasound anatomy in different techniques (Image courtesy of Visible Body with modification): A: The red probe illustrates the site of injection for serratus anterior plane block which blocks the cutaneous sensation of the red area innervated by the lateral cutaneous branches of the intercostal nerves. B: Serratus anterior plane block could be done by injection between the latissimus dorsi muscle and the serratus anterior muscle or deep to the serratus anterior muscle. The green probe illustrates the site of injection for transversus thoracic plane block which blocks the cutaneous sensation of the green area innervated by the anterior cutaneous branches of the intercostal nerves. C: The internal thoracic artery helps to identify the target plane of transversus thoracic plane block between the innermost intercostal muscle and the internal intercostal muscle. The purple probe illustrates the site of injection for supraclavicular nerve block which blocks the cutaneous sensation of the purple area innervated by the supraclavicular nerve. D: The supraclavicular nerve emerges beneath the sternocleidomastoid muscle. The brown probe illustrates the site of injection for pectoral nerve block which blocks the sensation of the pectoralis major and minor muscles. Pectoral nerve block could be done by injection between the pectoralis major muscle and the pectoralis minor muscle and deep to the pectoralis minor muscle.



**Table 1.** Neuroanatomic map for nerve block design.

Origin	Peripheral nerve	Sensory innervation	Proximal block	Peripheral block
C3/C4	Supraclavicular nerve	Skin of the lower neck, shoulder and around clavicle	Cervical plexus block	Subcutaneous local infiltration or supraclavicular nerve block
C5/C6/C7	Lateral pectoral nerve	Major and Minor pectoral	Brachial plexus block	Pectoral plexus block
C8/T1	Medial pectoral nerve			
T2/T3	Intercostobrachial nerves	Skin of axilla and medial upper part of the arm	Paravertebral, epidural, erector spinae plane block	Serratus anterior plane
T3/T4/T5/T6	Intercostal nerves (lateral branches)	Skin of lateral and inferior aspects of breast		
T3/T4/T5	Intercostal nerves (anterior branches)	Skin of medial and superior aspects of breast		Subcutaneous local infiltration or transverse thoracic plane block

CONFLICT OF INTEREST

The authors declare no conflicts of interest.

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