Case Report

Serratus Plane Block for Persistent Pain after Partial Mastectomy and Axillary Node Dissection

Kayo Takimoto, MD, Kaoru Nishijima, MD, and Mayu Ono, MD

From: Department of Anesthesiology, Ikeda City Hospital, Ikeda City, Osaka, Japan

Address Correspondence:
Kayo Takimoto, MD
Department of Anesthesiology
Ikeda City Hospital
3-1-18 Jyonan
Ikeda City, Osaka 563-8510, Japan
E-mail: kayota1219@yahoo.co.jp

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Persistent pain after breast cancer surgery (PPBCS) is defined as chronic neuropathic pain that persists for more than 3 months after surgery. The pain can be sufficiently severe to cause long-term disabilities and interfere with sleep and daily life. Serratus plane block (SPB) is a novel, ultrasound-guided regional anesthetic technique that is suggested to achieve complete anesthesia of the anterolateral chest wall. Here, we demonstrate the efficacy of SPB as one of the treatment modalities for patients with PPBCS. A 73-year-old woman underwent a left partial mastectomy and axillary node dissection for breast cancer. Four months after surgery, she experienced burning pain with nocturnal exacerbation rated 10/10 on a numerical rating scale (NRS), hot flashes, numbness, and hyperesthesia of the left axilla. Pharmacological therapy did not improve her symptoms, and 15 months after the surgery, she experienced depression. We treated her with SPB with 10 mL of 1% lidocaine; this treatment was repeated 10 times over 6 months at 2- to 4-week intervals and she was simultaneously treated with pharmacological, physical, and cognitive behavioral therapy. With her improved pain control, she was able to perform physical therapy and subsequently experienced marked improvement in her functional status and ability to perform daily activities. She has not required any interventional pain management since the last SPB performed 11 months ago. SPB represents one of the treatment modalities for PPBCS and is an advantageous technique because it can be performed more safely and easily than neuraxial approaches.

Key words: Persistent pain after breast cancer surgery, serratus plane block, SPB, chronic pain, peripheral nerve block, ultrasound, interventional pain management

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Mastectomy is one of the most commonly performed surgical procedures worldwide; however, persistent pain after breast cancer surgery (PPBCS) is a common problem, occurring in 25% – 60% of patients who undergo breast cancer procedures (1,2). PPBCS is defined as chronic neuropathic pain that persists for more than 3 months after surgery and is associated with activation or inflammation of high-threshold peripheral sensory neurons or direct nerve injury in the axilla and/or chest wall during breast cancer surgery (3-7). The nerves innervating the breast arise from intercostal nerves T2-T6, and the intercostobrachial nerve from T2 is also vulnerable to injury during surgery (3). In particular, dissection of the axillary lymph nodes is a critical component in the etiology of PPBCS (4); therefore, the intercostobrachial nerve may play an important role in the pathology of PPBCS (3). The severity of this pain can be sufficient to cause long-term disability and interfere with sleep and daily life (8). Similar to other chronic neuropathic

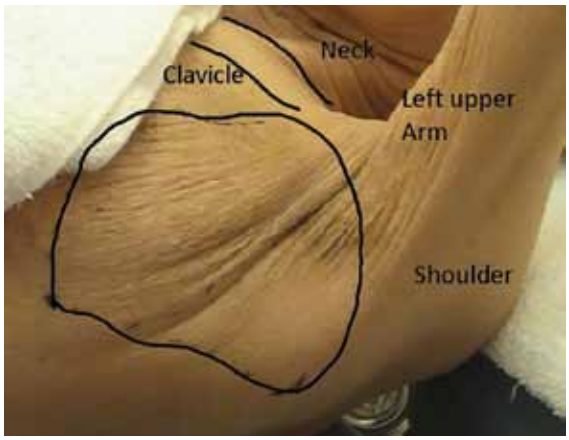

Fig. 1. *The black circle indicates the area in which the patient reported pain.*

pain disorders, some patients with PPBCS may require multiple modalities for pain relief. Modalities including pharmacological therapy, physical medicine, behavioral medicine, neuromodulation, and interventional or surgical approaches have been suggested (8). Neuraxial or peripheral nerve blockade is widely used to diagnose and treat PPBCS; however, no well-designed, placebo-controlled study of nerve blockade has been published to date (3). Furthermore, no study has focused on the intercostobrachial nerves, even though they play an important role in the pathology of PPBCS (3,8,9).

Described by Blanco et al (10), serratus plane block (SPB) is a novel, ultrasound-guided regional anesthetic technique that has been advocated for complete paresthesia of the anterolateral chest wall. Lateral and anterior cutaneous branches of the second to sixth intercostal nerves, including the intercostobrachial nerve, pierce the external intercostals and the serratus anterior muscle in the anterior-to-mid axillary line. SPB achieves sensory blockade of the anterolateral thoracic wall by depositing local anesthetics in a plane that is either superficial to or deep underneath the serratus anterior in the mid-axillary line between the fourth and fifth ribs (10,11).

Here, we report the case of an outpatient with PPBCS who was successfully managed with SPB as one of the treatment modalities. To the best of our knowledge, this is the first clinical report describing the efficacy of SPB for PPBCS.

Case Presentation

A 73-year-old woman with mild hypertension underwent left partial mastectomy and axillary node dissection for breast cancer under general anesthesia without regional anesthesia. During surgery, the long thoracic and thoracodorsal nerves were preserved, along with one of the intercostobrachial nerves. During her hospitalization, she experienced mild-to-moderate pain rated 2/10 on a numerical rating scale (NRS) and was administered nonsteroidal anti-inflammatory drugs (NSAIDs) on several occasions; opioids and ketamine were not required. After she was discharged from the hospital, she complained of pain with nocturnal exacerbations, anxiety, hyperesthesia, hot flashes, and numbness of the left axilla. Subsequently, she received chemotherapy (docetaxel and cyclophosphamide), radiation therapy to the breast (50 Gy in 6 weeks external irradiation), hormonal therapy, and a monoclonal antibody against human epidermal growth factor receptor type 2 (HER2). Her symptoms became continuous during the 5 months that followed these therapies, despite treatment with NSAIDs and benzodiazepine. She underwent computed tomography and mammography, but no recurrence or metastasis of breast cancer, infection, or fluid collection was found. Nine months after surgery, she was referred to our clinic because she presented with intense burning and shooting pain rated 10/10 on the NRS and hyperesthesia of the left axilla (Fig. 1). She positively responded to the Douleur Neuropathique 4 Questions (12), which indicated her pain was neuropathic. Chemical neuropathy was excluded because her symptoms were limited to the operated arm. Radiation induced neuropathy was excluded because the irradiation field was the breast, and her symptoms were identified before radiation therapy. In addition, cervical radiculopathy was excluded based on clinical findings and neurological examination. Consequently, we diagnosed the patient with PPBCS. Pharmacological therapy, including pregabalin, duloxetine hydrochloride, acetaminophen, and NSAIDs, was started, and the patient was referred to physical medicine to restore the normal range of motion in her shoulder. After 6 months of treatment, however, none of these therapies improved her symptoms. We did not prescribe an opioid because her anxiety and nervousness was a risk factor for opioid abuse. Fifteen months after breast surgery, she reported depression, decreased appetite, and sleep disturbance. We prescribed the antipsychotic sulpiride (50 mg daily). We observed a decreased passive range of motion in the left shoulder in which forward flexion was 90°, abduction was 80°, and internal rotation motion was 20° with the shoulder abducted to

90°. The deep, aching, and shooting pains disturbed the patient, and there was no obvious allodynia. We recommended an interventional approach for pain relief. However, she did not consent to thoracic epidural block or thoracic paravertebral block, but she agreed to undergo SPB.

Left SPB was performed under ultrasound guidance (M-turbo® System with a linear HFL 38 × 6- to 13-MHz transducer; SonoSite, Inc., Bothell, WA, USA). The patient was placed in the supine position, and the left anterior to lateral thoracic wall was sterilized. The transducer was positioned perpendicular to the thoracic wall and caudal to the coracoid process in a sagittal plane (Figure 2a). We identified the second rib below the axillary artery and vein and counted ribs inferiorly and laterally until the fifth rib was identified in the mid axillary line (Fig. 2b). The serratus anterior and latissimus dorsi muscles were identified overlying the fifth rib using ultrasound. A 38-mm needle (25 gauge) was introduced in-plane with respect to the ultrasound transducer in a superoanterior-to-posteroinferior direction. The skin was then infiltrated with 1 mL of 1% lidocaine, and 10 mL of 1% lidocaine was injected above the serratus muscle fascia (Fig. 3).

Success of the block was confirmed by a loss of cold sensation over the axilla 15 minutes after SPB. After the first block, the patient reported that her pain had decreased from 10 to 6 on the NRS. A second block was attempted one week later, reducing her pain from 6 to 4 on the NRS. We repeated SPB with 10 mL of 1% lidocaine 8 times over 6 months at 2- to 4-week intervals, and she was simultaneously treated with pharmacological, physical, and cognitive behavioral therapy. With improved pain control, she was able to perform physical therapy and subsequently experienced marked improvement in her functional status and ability to perform daily activities. In addition, she showed an improved passive range of motion in her left shoulder in which flexion was 120° and abduction was 90°. Her psychological health also improved, and she was satisfied with her pain relief. She has not required any interventional pain management since the last SPB performed 11 months ago.

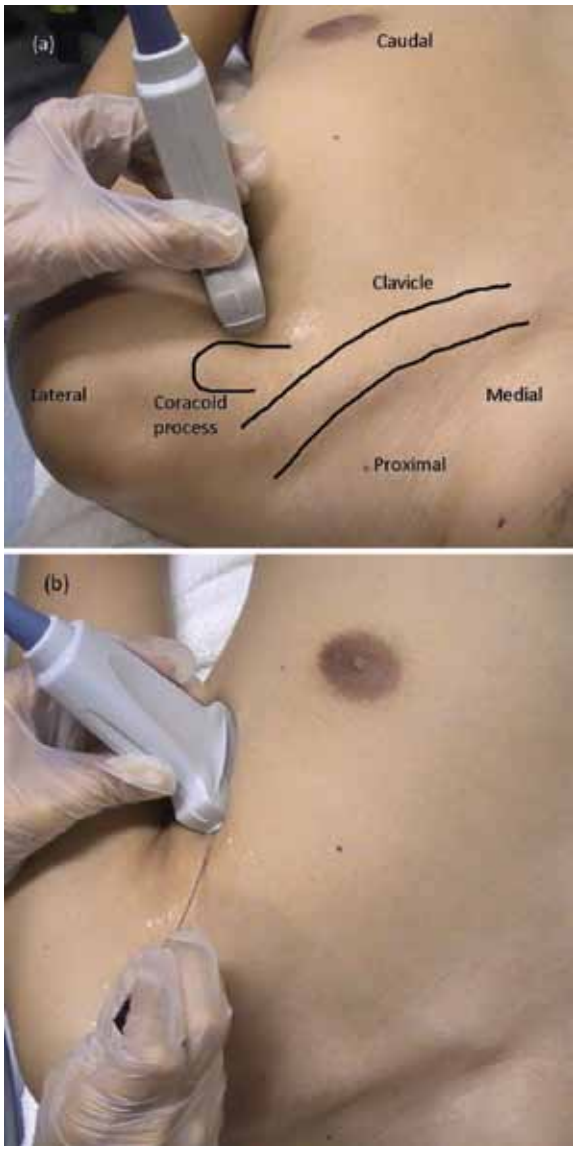

Fig. 2. *The external position of the ultrasound transducer and injection needle. A. The transducer was positioned perpendicular to the thoracic wall and caudal to the coracoid process in a sagittal plane. We identified the second rib below the axillary artery and vein. B. We counted ribs inferiorly and laterally until the fifth rib was identified in the midaxillary line. We inserted the needle in a cranial to caudal direction using the in-plane technique.*

Discussion

The present case demonstrates the efficacy of SPB as a multimodal treatment for patients with PPBCS. A PPBCS diagnosis is based on characteristic symptoms identified in the breast, lateral chest wall, or ipsilateral extremity following a breast cancer operation in the absence of an infection or recurrent disease (3,4). PPBCS is a type of neuropathic pain; it is a complex, chronic pain state that is typically associated with nerve fiber injury sustained during breast cancer surgery, particularly to the intercostobrachial nerve (3,9). Pharmacological therapies, such as antiepileptic and antidepressant

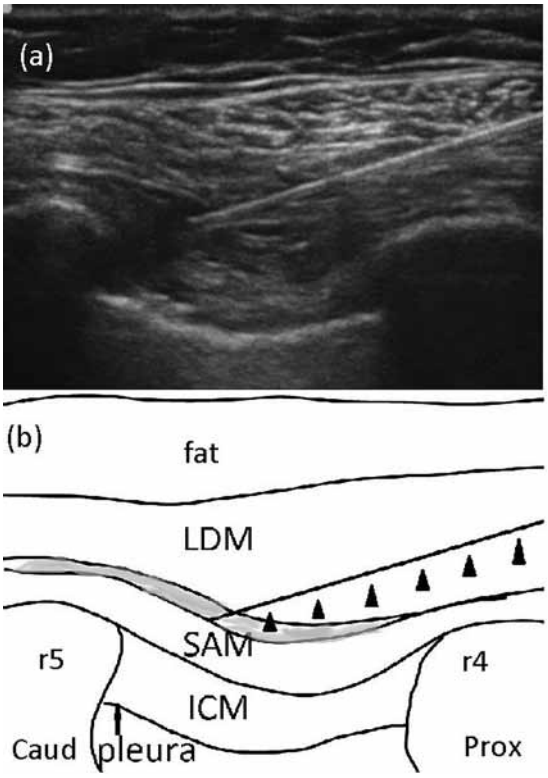

Fig. 3. *A. Ultrasound image for the superficial serratus plane block. The injection needle was inserted through the subcutaneous tissue and fat in-plane with respect to the ultrasound transducer in a superoanterior-to-posteroinferior direction. B. The drawing indicates the distribution of local anesthetic (gray) between the latissimus dorsi (LDM) and serratus anterior (SAM) muscles. Triangles indicate the injection needle. ICM, intercostal muscle; r4, fourth rib; r5, fifth rib; Prox, proximal; and Caud, caudal.*

drugs, are frequently used to treat PPBCS (8). However, adverse effects prevented our patient from receiving antiepileptics or serotonin–norepinephrine reuptake inhibitors. Regional analgesia, including treatment with epidural or paravertebral steroids or local anesthetic injections, has not yet been established as an effective treatment for reducing neuropathic symptoms or improving patients' quality of life (3). Furthermore, it involves a risk of central neurological side effect profiles and pleural puncture or pneumothorax resulting from inadvertent entry of the block needle (10,13,14). Although SPB has not yet been documented as an effective peripheral nerve block for chronic pain, it is less invasive than thoracic paravertebral block because the layer of injection is more superficial and more peripheral in SPB.

SPB is a novel peripheral nerve block technique first described in 2013 by Blanco et al (10) to provide analgesia for breast and thoracic wall surgeries. Lateral and anterior cutaneous branches of the second to sixth intercostal nerves pierce the external intercostals and serratus anterior in the anterior-to-mid axillary line (12). SPB involves deposition of local anesthetics in a plane that is superficial to or deep underneath the serratus anterior muscle in the mid axillary line between the fourth and fifth ribs. This technique achieves blockade of sensory nerves through the axillary compartment. SPB is surely effective for the T2 intercostobrachial nerves, which play an important role in the pathology of PPBCS (9). Pectoral nerves (PECS) II block was introduced as a deposition of local anesthetics in 2 layers, with one layer located between the intercostal and serratus anterior muscles and the other between the pectoralis major and minor at the level of the third and fourth ribs (10,15). Both SPB and PECS II blocks provide some degree of analgesia in the anterolateral thoracic wall, similar to the transversus abdominis plane blocks that are effective for somatic pain management of the anterolateral abdominal wall. Although SPB has been described as a progression from the PECS II block (10), it has not yet been proven as an effective treatment for PPBCS or more advantageous than the PECS II block. We attempted SPB for our patient because we believed that it is a simpler and safer procedure compared to the PECS II block in outpatients. It is certain that the deposition of local anesthetics superficial to the serratus anterior poses a lower risk of pneumothorax or vascular trauma compared to that by the deep approach below the serratus anterior. Adverse events related to SPB have not yet been revealed because neither a randomized controlled trial nor a review of a substantial number of patients receiving SPB has been conducted. However, we can easily identify the serratus anterior superficially and achieve precise needle positioning with real-time ultrasound guidance, with the hope of lowering the risk of trauma to surrounding structures associated with an epidural, paravertebral, or intercostal blockade.

There are some limitations of this study. First, a single lidocaine injection provides only a short duration of analgesia. A longer duration of analgesia is often necessary in patients with chronic pain, therefore we repeated SPB for several months. Repeated SPB increases the risk of adverse effects such as infection, bleeding, or

hyperalgesia. To avoid repeated injections, continuous blockade using a catheter, thermal or pulsed radiofrequency, or neurolytic agents such as alcohol or phenol may have advantages over lidocaine only (16,17). In this case, continuous blockade was not used because of its difficult management over a long period of time. Radiofrequency or neurolysis can semipermanently block the long thoracic nerve, causing the limitation of shoulder elevation and scapular winging with limited medial translation of the scapula, rotation of the inferior angle toward the midline, and prominence of the vertebral border. Therefore, we repeated single injections of local anesthetics at a defined interval. In this case, the pain-relieving effect of each single-shot SPB lasted for 3 days. We consider that the temporary analgesia established by SPB is useful to advance physical therapy and break the pain cycle. Second, there is not enough evidence of sympathetic blockade by SPB. Sympathetic postganglionic neuron blockade has an anti-inflammatory effect and provides a significant amount of pain relief (18). However, peripheral nerve blockade has the potential to improve chronic neuropathic pain because lidocaine itself washes out inflammatory mediators and modulates or attenuates the neuropathic components of A δ and C-fibers by blocking voltage-gated sodium channels and signal transduction in the peripheral nerves (18,19). This possibility is supported by previous studies. In a retrospective case series, ilioinguinal/iliohypogastric nerve blockade effectively treated chronic inguinal pain following surgery (20). In one case report, continuous transversus abdominis plane block was useful for chronic postsurgical abdominal pain relief (21). Third, another possibility remains in which the interventions are affected by psychological factors. Psychosocial factors are associated with a higher risk of developing PPBCS (1).

Conclusion

We demonstrated that SPB is an alternative method for treating patients with PPBCS. The duration of analgesia produced with a single local anesthetic injection is limited; however, we achieved sustained analgesia. The goals for treating neuropathic pain are maximizing analgesia and relieving emotional distress. Multimodal interventions should be used to meet a patient's needs. SPB represents an interventional approach for PPBCS that is advantageous because it can be performed more safely and simply than neuraxial approaches. Further studies are warranted to assess the efficacy, adverse effects, and complications of SPB for PPBCS.

Acknowledgment and Conflict of Interest/ Disclosure Summary

The patient provided informed consent for the publication of this case report, including the clinical pictures. All authors declare no conflict of interest, financial or otherwise, in relation to this article.

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