CLINICAL REPORT

Ultrasound-Guided Serratus Plane Block for Treatment of Postmastectomy Pain Syndromes in Breast Cancer Patients: A Case Series

Jennifer A. Zocca, MD; Grant H. Chen, MD; Vinay G. Puttanniah, MD; Joseph C. Hung, MD; Amitabh Gulati, MD

Department of Anesthesiology and Critical Care, Memorial Sloan Kettering Cancer Center, New York, New York, U.S.A.

■ **Abstract:** Postmastectomy pain syndrome is common after surgical treatment for breast cancer and may be challenging to manage. Currently, there are a wide variety of approaches to treat this type of pain, including medications, physical therapy, and interventional procedures. However, because of the complexity of innervation of the breast, the serratus plane block may better target the web of nerves innervating the anterior chest wall including the breast. We present a case series of 8 patients who were successfully treated with serratus plane block for pain after treatment for breast cancer. We feel that this particular application for the serratus plane block deserves further investigation, as it is relatively easy to perform and has good clinical utility for this type of pain. ■

Key Words: serratus plane block, postmastectomy pain, breast cancer, cancer pain

BACKGROUND

Pain after surgery for breast cancer is common, and it can be difficult to manage. Studies estimate that postmastectomy pain syndrome occurs in about 20% to 60% of women.[1–3] Currently, there are a wide variety of approaches to treat this type of pain. Gabapentinoids have been widely studied for prevention and treatment of chronic pain after surgery for breast cancer. The antidepressant venlafaxine has also been utilized, as well as opioid medications.[1] Physical therapy has been employed as a modality to improve physical function.[4] As far as interventional procedures, intercostal nerve blockade, stellate ganglion blockade, and paravertebral blockade have all been utilized with varying degrees of success.[5]

Another potential target for an interventional procedure for chronic pain after treatment for breast cancer is the serratus plane. The serratus plane block is a novel ultrasound-guided nerve block, which is able to anesthetize the hemithorax.[3] The serratus plane block relies on the fact that there are branches of the intercostal nerves following within 2 potential spaces, one superficial and one deep, surrounding the serratus anterior muscle. The serratus anterior muscle arises as strips from the first 9 ribs and converges posteriorly on the scapula to form the medial wall of the axilla.[6] The innervation of the serratus anterior muscle is via the long thoracic nerve (Bell's nerve), and the nerve itself is covered by the fascia of the serratus anterior muscle and lies anterior to the muscle[6] (Figures 1 and 2). The intercostobrachial nerve, which arises from the lateral cutaneous branch

Address correspondence and reprint requests to: Amitabh Gulati, MD, Memorial Sloan Kettering Cancer Center, 1275 York Avenue, New York, NY 10065, U.S.A. E-mail: gulatia@mskcc.org.

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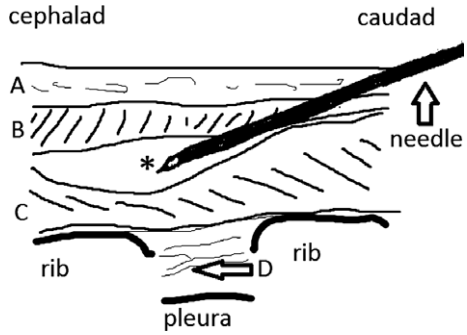

Figure 1. Serratus anterior plane anatomy. A = skin, B = latissimus dorsi muscle, C = serratus anterior muscle, D = intercostal muscles and neurovascular bundle, *Local anesthetic spread.

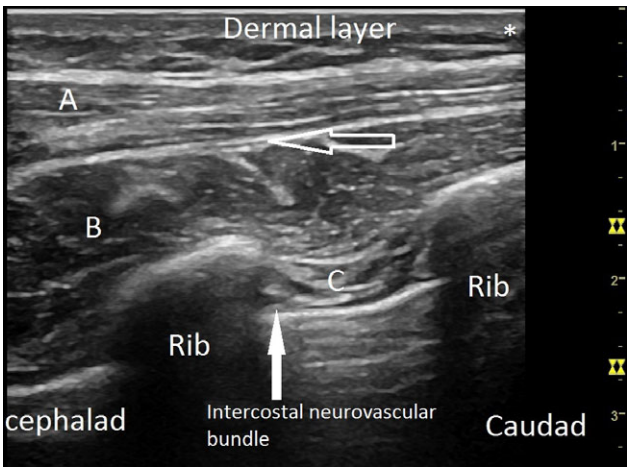

Figure 2. Serratus anterior plane with surrounding anatomy prior to block. A = latissimus dorsi, B = serratus anterior, C = intercostal muscles; open arrow = fascial plane/target.

of the second intercostal nerve, perforates the serratus anterior muscle in the midaxillary line as it passes through to the upper arm.[7]

In the original study describing the serratus plane block, either the superficial or deep potential space was effective in providing chest wall anesthesia; however, the superficial plane appeared more effective in terms of anesthetic spread and sensory distribution, as well as duration of action.[3] The latissimus dorsi muscle is superficial to the serratus anterior muscle and provides the bounds of the superficial potential space upon which the serratus plane block relies (Figure 3). The deep potential space is bounded by the parietal pleura and the ribs. Infiltrating either of these potential spaces targets primarily the intercostal nerves, which pierce the serratus anterior muscle, although it is possible that this nerve block may also affect the intercostobrachial nerve. This article presents a case series of the use of the serratus

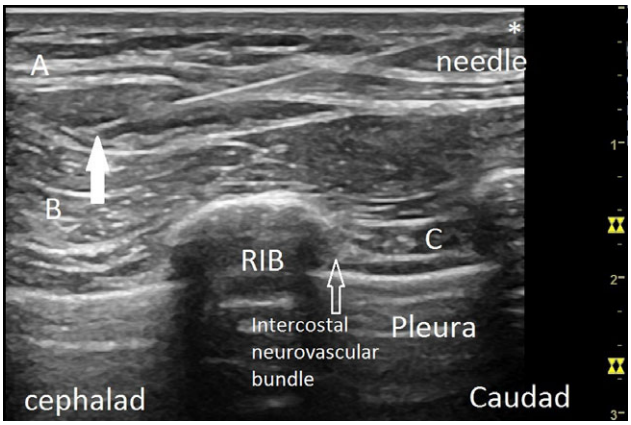

Figure 3. Serratus anterior plane with surrounding anatomy after block. A = latissimus dorsi, B = serratus anterior, C = intercostal muscles; solid arrow = spread of local anesthetic.

plane block for chronic pain after surgery for breast cancer.

METHODS

Data were obtained via retrospective chart review and approved by the institutional review board at Memorial Sloan Kettering Cancer Center. Breast cancer patients were seen at the pain clinic who were suffering from symptoms of postmastectomy-related pain. Each patient was offered a serratus plane block (described in the next paragraph) as an option for pain control. Risks and benefits were discussed with the patient prior to the procedure. Postprocedure chart review was performed to analyze type of pain treatment and efficacy of the procedure.

To date, we have only performed the serratus plane block targeting the superficial plane, as the original article suggested greater efficacy of this plane as compared to the deep plane. To perform the block, patients were placed in the lateral decubitus position with the affected side facing up, or in the prone position with the affected side facing the operator. After sterile preparation, a linear ultrasound probe was utilized to identify the latissimus dorsi and serratus anterior muscles in a sagittal plane. The plane superficial to the serratus anterior muscle and below the latissimus dorsi muscle was identified. The skin was topicalized with 1 mL of 1% lidocaine using a 30-gauge needle. Using an in-plane approach, a 25-gauge 1.5-cm needle was used to inject a total of 10-mL of 0.25% bupivacaine with 40 mg of methylprednisolone acetate under direct ultrasound visualization (Figure 4). No immediate complications were noted.

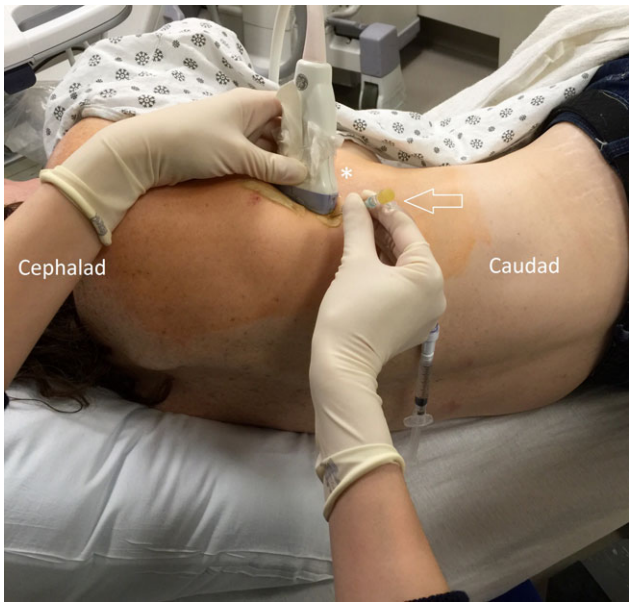

Figure 4. In-plane approach to serratus anterior plane block. *Orientation of ultrasound probe going at an angle following the edge of the latissimus dorsi muscle. Note: patient has arm across her body allowing latissimus dorsi to be more lateral over the chest wall.

RESULTS

Eight patients underwent the procedure between June and October 2015. Each case is presented in detail in Table 1. All 8 women included in the study experienced pain relief initially following the serratus plane block procedure. This initial improvement in symptoms ranged from 25% relief to near complete pain relief. Numbness postprocedure was inconsistent. The duration of pain relief ranged from 2–3 days to 12 weeks, although some women included in this study demonstrated continuing pain relief from the procedure at the date of publication and are still being followed to determine the ultimate duration of benefit. There were no complications associated with the procedure.

DISCUSSION

We present a case series of a diverse group of patients who had a serratus plane block in our clinic for chronic pain after breast surgery. The women varied in terms of surgery performed, reconstruction or no reconstruction, axillary node dissection, and radiation therapy received (see Table 1). The women had varying degrees of success with the serratus plane block, which is worth discussing. Additionally, some of our experiences with these patients may be extrapolated to other types of procedures, for example, neurolysis of the serratus plane.

With regard to a treatment paradigm using the serratus plane block, based on our clinical experiences to date, we would advocate repeating the block as needed, with a minimum interval between procedures of 2 months. Although this procedure interval is slightly less than the average duration of effectiveness of this block, this duration has been selected by our group in an effort to minimize systemic steroid effects. We feel that a shorter interval of treatment has risks associated with steroids that outweigh the benefit of the pain relief from the block. If the improvement seen with local anesthetic and steroid injection is not sustainable, we would consider neurolysis for malignant, end-of-life pain, as the potential for inadvertent neurolysis of the thoracodorsal nerve and long thoracic nerve could result in winging of the scapula postprocedure. Additionally, one could consider peripheral nerve field stimulation as an option for long-term relief, with potential targets being field stimulation in the painful areas identified by the patient, or the intercostal branches, although we have not attempted this to date.

As far as consideration of different types of pain syndromes that could potentially be addressed by the serratus plane block, we saw a wide variety of pain descriptors used by these patients. Pain syndromes included descriptions such as “sharp,” “shooting,” “pressure,” “pins and needles,” and “burning.” Multiple different types of pain complaints were alleviated by the serratus plane block, but in particular, we have noted that women with pain relating to their reconstructive implant did particularly well in terms of meaningful reduction in their pain and duration of pain relief. These women tended to describe their pain primarily as “pressure,” and we feel that this may be helpful in selecting candidates for the serratus plane block based upon their history. In addition, this finding suggests that chronic pain secondary to breast reconstruction may be a particularly good target for this nerve block. Finally, we feel that this may be further generalizable to allow consideration of the serratus plane block for women who are having pain relating to initial placement of breast tissue expanders in preparation for subsequent reconstruction, as this is likely similar to the pain experienced from a breast implant. We feel that this particular application of the serratus plane block deserves further investigation.

The use of steroids in conjunction with local anesthetic in a nerve block has been shown to increase the duration

Table 1. Case Series

Patient Demographics	Cancer Treatment	Pain Symptoms	Clinical Course Postprocedure	Duration
55-year-old woman	Mastectomy, no radiation, plus reconstruction	Burning, sharp, sore	Patient had improvement from initial pain score of 8/10 to 3/10 on the day of the procedure and had relief for 2 to 3 days postprocedure. At 1 month, she noticed minimal improvement	2 to 3 days, at 1 month pain was back to baseline
61-year-old woman	Mastectomy, no radiation, plus reconstruction	Sharp, hot, aching	Patient had almost complete relief from her pain on the day of the procedure and afterward. At 2 months postprocedure, still with good relief in certain areas of chest wall pain; overall using less breakthrough medication	2 months postprocedure still using less medication
50-year-old woman	Lumpectomy, sentinel node biopsy, radiation, no reconstruction	Pins and needles	Patient had good improvement in her pain for about 3 weeks after nerve block procedure	3 weeks
40-year-old woman	Lumpectomy, sentinel node biopsy, radiation, no reconstruction	Heavy, sharp, tender	Patient had 25% reduction in initial pain score of 6/10 after the first procedure. The procedure was repeated 3 weeks later, and she continues to have 10% to 20% relief 3 months postprocedure	1 to 2 days, second attempt gave 12 weeks of relief, continuing to follow
68-year-old woman	Mastectomy, radiation, plus reconstruction	Pressure	Patient had good improvement on the day of the procedure and 1-day postprocedure from initial VAS score of 6/10. Relief began to wear off at 2 months postprocedure	2 months
53-year-old woman	Mastectomy, no radiation, plus reconstruction	Pressure	Patient had initial improvement from initial VAS score of 8/10 to 4/10 on the day of the procedure. She was weaned off of all pain medications by 1 month postprocedure. At this time, she had return of "pressure," and repeat procedure was performed with no residual pain 5 days postblock	At 1 month, she still had some relief with return of "pressure," repeat block performed, pain completely gone after second block, still following
76-year-old woman	Mastectomy, no radiation, plus reconstruction	Pressure/tightness, burning, shooting/stabbing	Patient had 50% reduction in her pain from initial VAS score of 8/10 at 2 days postprocedure. Full pain relief was achieved for 2 weeks, and she still had some relief at 1 month	1 month with partial relief, repeat block performed at this time
71-year-old woman	Mastectomy, no radiation, plus reconstruction	Sharp, pressure	Patient had 50% reduction in pressure at 2 weeks postprocedure	2 weeks, repeat block performed at this time

of the nerve block.[8] In the case of the serratus plane block, particularly in considering women with pain relating to pressure from a breast implant, it is possible that the addition of steroid has additional theoretical basis in the sense that it may serve to ameliorate a continuous inflammatory condition. For example, the most commonly recognized complication in the surgical literature following breast implant placement is capsular contracture, which is thought to be secondary to an overproliferation of an inflammatory reaction to the foreign body causing excessive fibrosis.[9] The addition of steroid to the serratus anterior block may treat this inflammatory process, and this mechanism may serve as an explanation as to why these women, in particular, benefited particularly well from the serratus plane block, as discussed earlier in this article.

Based on the anatomy of the serratus plane, there are some important considerations regarding the block. We did have a patient in whom the block initially worked, but only briefly, and in whom the second block worked very minimally. In considering her treatment history, it is possible that the radiation therapy that she received sclerosed the serratus plane making it difficult or impossible to truly distribute the injectate along the superficial plane. This was visible on ultrasound: the typical separation of the superficial serratus plane by the injectate was not seen during the procedure. It is also important to note that during surgical axillary node dissection, the latissimus dorsi muscle is dissected away from the thoracodorsal bundle and the fascia overlying the serratus anterior muscle, creating the potential for subsequent scarring.[10] This scarring may make successful separation of the superior serratus plane during the block more difficult. In these patients, it is possible that the deep serratus plane described previously may be a better target than the superficial plane.

Additional considerations regarding the anatomy of the serratus plane relate our experiences to the

inconsistency of numbness following the procedure. This may be due in part to the neural structures not being fully delineated in this muscular plane. It is likely that there is variation in the precise locations and relationships between the thoracodorsal, long thoracic, and intercostobrachial nerves, as well as the medial and lateral pectoral muscles. There may also be nerves targeted that do not provide cutaneous sensation to the skin. It is additionally conceivable that, given the difficulty in separating the serratus plane, certain patients who experienced minimal numbness with pain relief were experiencing benefit from a muscular trigger point injection. However, the pain complaints that were most effectively addressed by this procedure were anterior, which is challenging to explain by trigger point injections into the latissimus dorsi and serratus anterior muscles, which are primarily lateral structures. Further anatomic studies should be performed to clearly investigate the neuromuscular relationships within the serratus plane.

We feel that given the anatomy of the serratus plane and the location of the long thoracic nerve on the superior surface of the serratus anterior muscle, it may be prudent to perform a diagnostic block in the superficial plane but neurolysis below the serratus anterior muscle in order to attempt to spare this nerve and its motor function, namely to prevent winging of the scapula when the arm is lifted up. In considering neurolysis of the serratus plane, the serratus plane block is unique in the sense that there are two different potential spaces that can be used to achieve similar results. This becomes important because we have seen in other instances that repeated neurolysis procedures can cause sclerosis of fascial planes, making subsequent blocks extremely difficult or impossible to perform. In one case, our patient had 4 successful neurolytic tranversus abdominus plane (TAP) block procedures performed over the span of 2 years. In attempting to do the fifth neurolysis, it was noted on ultrasonography that there was no longer a plane that could be separated. If this were to happen with the serratus plane block, the other, nonsclerosed, plane could be utilized, thus increasing the length of time over which neurolytic procedures could be performed.

Lastly, in understanding indications for the serratus plane block, it is also important to consider 2 cases in which we performed serratus plane blocks that were completely unsuccessful. In these cases, both women presented with pain in their posterior chest wall that they began experiencing post-thoracotomy. Using the serratus plane block, we did achieve satisfactory anesthesia of the anterior chest wall, with no improvement in their overall pain syndrome. Thus, we would argue that it is likely that only anterior chest wall pain is appropriately treated with this block, although, as discussed above, it is reasonable to consider this block for a wide variety of pain complaints.

CONCLUSION

Pain management for chronic pain after surgery for breast cancer can be very challenging, and it is not rare for women to struggle with this type of pain even after they have recovered from treatment for their cancer. This type of pain has been shown to significantly affect quality of life.[11] The serratus plane block provides a novel, alternative means of managing this pain in the clinic. In our experience, this block is most appropriate for anterior chest wall/breast pain and may become more technically challenging or impossible in patients with scarring from radiation or axillary node dissection, although it is possible that utilizing the deep serratus plane would be more successful in this subset of patients. We have also found that women who experience pain relating to their breast implant did particularly well after the serratus plane block, and this type of pain syndrome may be especially amenable to treatment with this block. This study is limited in that it is a retrospective case series; however, the efficacy of this block in these 8 women warrants further investigation.

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