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The authors certify that there is no conflict of interest with any financial organization regarding the material discussed in the manuscript.

*Authors' contributions*
Francesco Marrone and Carmine Pullano have given substantial contributions to study conception, Francesco Marrone, Saverio Paventi and Marco Tomei to data acquisition, analysis and interpretation, Francesco Marrone, Carmine Pullano, Saverio Paventi, Marco Tomei and Mario Bosco to manuscript writing, Mario Bosco to manuscript critical revision. All authors contributed equally to the manuscript. All authors read and approved the final version of the manuscript.

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# Serratus posterior superior intercostal plane block for breast surgery: a report of three cases, novel block and new indication

Breast surgery is a common surgical procedure in the world. Since it affects the postoperative recovery and mobilization, pain after breast surgery is an important issue.[1] Several regional techniques such as interpectoral/pectoserratus blocks (PECS I/II), erector spinae plane block (ESPB), and rhomboid intercostal plane block (RIB) are used for pain relief after breast surgery. PECS I-II blocks most commonly used techniques for breast analgesia.[2] However, they are closed to the surgical area, and the local anesthetic distribution may be affected by the surgical incision of the pectoral muscles. ESPB may be performed from the cervical to the sacral vertebrae. The clinical, cadaveric, and radiological results of ESPB are inconsistent.[3] RIB provides focused hemithoracic analgesia; however, RIB fails to cover the cranial aspect of the T2 dermatome.[4] Recently, we have described a novel interfascial plane block technique: serratus posterior superior intercostal plane block (SPSIB).[5] SPSIB is performed in the fascial plane between the serratus posterior superior muscle and the intercostal muscles at the level of the second and third rib. Ultrasound (US)-guided SPSIB provided anteroposterior hemithoracic analgesia from C3 to T10 levels. Herein, we want to report our successful analgesic experiences of SPSIB in three female patients who underwent breast surgery. Written informed consent was obtained from the patients for this report. The demographic data of the patients are seen in Table I. We performed unilateral SPSIB in our patients according to the side of the operation at the end of the surgery before extubation. We used a high-frequency (4-12 MHz) linear transducer, and a 22G, 80 mm block needle. The SPSIB was performed while the patient was in lateral decubitus position with the surgical site up. The probe was placed on the spinae scapula in the sagittal plane to identify the second and third ribs. Then the probe was moved medially to the upper medial border of the scapula. The trapezius, rhomboid, serratus posterior superior muscle (SPSm) were visualized. Then, the transducer was slightly rotated to obtain an oblique visualization. The needle was inserted just above the third rib deeply into the SPSm. Five mL isotonic was administrated for the correction. Then, 30 mL of 0.25% bupivacaine was administrated between SPSm and rib (Figure 1A). We performed 400 mg ibuprofen and 100 mg tramadol intravenously (IV) to our patients 10 min before the end of the surgery. After extubation, we transferred the patients to the postoperative care unit. We evaluated the dermatomal coverage of SPSIB with a pin-prick test at the postoperative 1st hour (Figure 1B). We administrated 400 mg ibuprofen IV every eight hours postoperatively. We evaluated the pain levels with the Numeric Rating Scale (NRS) for the postoperative 24-hour period. The NRS, dermatome levels, and need for additional analgesics are seen in Table I. According to our experiences, SPSIB provided successful postoperative analgesia management in three patients who underwent breast surgery. The pain scores were <3, and the patients needed no extra analgesia during the postoperative 24-hour period. There was extended sensorial coverage from C3 to T10 dermatomal areas in our patients. The SPSIB provided hemithoracic analgesia from the paraspinal region to the anteromedial of the chest wall including the axillary area. Chest wall blocks symbolize several terms that include several successful techniques that have been described.[4] Novel blocks are defined if previous ones cannot achieve the intended purpose. In the historical development of plan blocks, ESPB is a cornerstone of interfascial plane blocks. After its first description, it has been the main subject of countless studies due to its advantage of it can be done on multiple levels. However, the mechanism of action is still not fully elucidated. Another chest wall block is RIB, it provides more focused analgesia than ESPB due to its target area. However, RIB cannot cover the third thoracic dermatome, and it cannot reach adequately the axillary area. Considering all these points, the SPSIB may be a good alternative to both ESPB and RIB. SPS muscle

TABLE I.—*The NRS, dermatome levels, and need for additional analgesics.*

| | | | | |
|---|---|---|---|---|
| Descriptive | Patient N. | 1 | 2 | 3 |
| | Age/gender | 58/F | 31/F | 46/F |
| | Height (cm)/weight (kg) | 170/69 | 166/76 | 169/68 |
| | Operation | Segmental mastectomy/ breast conserving surgery + axillary dissection | Mastectomy + axillary dissection | Radical mastectomy + axillary dissection + unilateral breast augmentation (sub pectoral prosthesis) |
| | Length of surgery | 90 min | 60 min | 270 min |
| | Opioids used during surgery | Remifentanil infusion (0.05-2 µg/kg/min) | Remifentanil infusion (0.05-2 µg/kg/min) | Remifentanil infusion (0.05-2 µg/kg/ min) |
| Block application | Application | Right in-plane | Left in-plane | Right in-plane |
| | Volume (mL) | 30 | 30 | 40 |
| | Content | 0.25% bupivacaine | 0.25% bupivacaine | 0.25% bupivacaine |
| Sensorial evaluation | Paraspinal | + | + | + |
| | Posterolateral | + | + | + |
| | Anterolateral | + | + | + |
| | Anteromedial | + | + | + |
| | Axilla | + | + | + |
| | Dermatomal Coverage | C4-T7 | C3-T6 | C3-T10 |
| | NRS | <2/10 | <3/10 | <2/10 |
| Analgesia requirement | Additional analgesic drug/opioid | None | None | None |

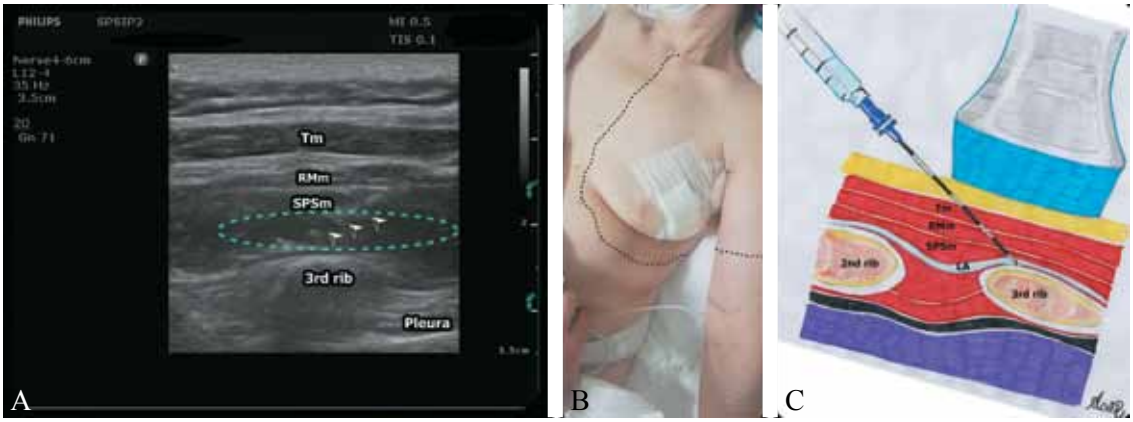


Figure 1.—A) Sono-anatomy and spread of LA during SPSIB. White small arrows indicate needle tip and needle. The discontinuous line indicates the spread of local anesthetic. B) Anterior dermatomal coverage of SPSIB in patient 1. C) Anatomical illustration of SPSIB.
Tm: trapezius muscle; RMm: rhomboid major muscle; SPSm: serratus posterior superior muscle; LA: local anesthetic.

(SPSm) has an unusual oblique course. It is a periscapular muscle, and it lies from C7-T2/T3 spinous process to the 2nd-5th ribs. After its oblique localization, SPSm extends deeply below the scapula. Due to its features, injecting local anesthetic deeply into the SPSm results in coverage of dorsal ramus and lateral cutaneous branches of intercostal nerves at these levels. Since SPSm is a thin and membranous muscle, the injected solution can spread over a wider area. In a cadaveric investigation, it has been reported that there was an extended dye spread from C7 to T7 intercostal muscles. The lateral cutaneous branches of the intercostal nerves were stained by 30 mL of methylene blue. In this study, the authors performed 20-, 30-, and 40-mL volumes of SPSIB to the patients with chronic myofascial pain.[5] Due to the aforementioned anatomical features, SPSIB targets lateral cutaneous branches of the intercostal nerves. Since SPSIB has a dermatomal coverage like RIB and ESPB, SPSIB may cover the dorsal and ventral rami of spinal nerves. In our patients, there was a dermatomal coverage in the brachial plexus area (shoulder and neck; C3-C5), thus SPSIB may target the brachial plexus. SPSIB may provide pain relief for acute and chronic shoulder pain. Due to the extensive spread over erector spinae muscle, whether SPSIB has central (epidural and paravertebral) spread should be investigated. In our cadaveric investigation, we did not evaluate the spread of the brachial plexus and central areas. Further cadaveric investigations and prospective randomized trials are needed to understand the exact mechanism of SPSIB. We performed SPSIB for different breast surgery procedures. We used 30- and 40-mL volumes for SPSIB. The first patient underwent

segmental mastectomy/breast-conserving surgery + axillary dissection. We performed SPSIB with 30 mL. The NRS was maximally two and there was no need for additional analgesic drug. The second patient underwent mastectomy + axillary dissection surgery. We performed 30 mL, and the results of 24-hour follow-ups were similar to those of the previous patient. The NRS was maximally three and there was no need for additional analgesia. The third patient underwent radical mastectomy + axillary dissection + breast augmentation surgeries at the same time. The mentioned surgeries all cause severe pain. Thus, we decided to perform high-volume (40 mL) SPSIB. The static/dynamic NRS of the patient were under two, and there was no need for extra analgesics. SPSIB is safe and simple due to US guidance. The rib plays an important role to prevent pneumothorax; it is a natural barrier in front of the pleura. SPSIB may be a good choice for postoperative analgesia management as a part of multimodal analgesia after breast surgery.

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*Authors' contributions*
Bahadir Ciftci, Selcuk Alver, Ali Ahiskalioglu, Bora Bilal and Serkan Tulgar have given substantial contributions to study conception and design, data acquisition, analysis and interpretation, manuscript writing and critical revision for important intellectual content. All authors read and approved the final version of the manuscript.

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# Peripheral nerve block for acute limb ischemia

We would like to share our experience regarding the use of peripheral nerve block as an adjunctive therapy in critical care setting to treat acute limb ischemia. Acute hand ischemia (Figure 1A) was observed in a patient (height 182 cm and weight 88 kg) that underwent femoral venoarterial extracorporeal membrane oxygenation (ECMO) implementation after cardiac arrest related to acute coronary syndrome the day before. Initially, ECMO flow was optimized up to 6 L/min and vasopressors weaned without any clinical improvement. Ultrasound found a subocclusion of the right radial artery (which was used for the coronarography) and a narrowed left radial artery both not accessible to endovascular or surgical treatment. As right-hand ischemia was more severe, a right axillary block with 15 mL or ropivacaine 4.75 mg/mL was performed under ultrasound guidance to improve distal blood perfusion. Thirty minutes later, we observed a recoloration of both hands (Figure 1B) whereas the block was only performed on the right side. The effect was prolonged over the time without recurrence of ischemia. Limb and digital ischemia are