

Serratus-Intercostal Plane Block versus Erector-Spinae Plane Block for Post-Mastectomy Pain Relief

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Abstract

Background: Post-mastectomy pain remains a major clinical concern because inadequate control of acute postoperative pain can delay recovery, increase opioid requirements, and contribute to chronic post-mastectomy pain syndrome. Ultrasound-guided fascial plane blocks, particularly the serratus-intercostal plane block (SIPB) and the erector-spinae plane block (ESPB), have emerged as practical components of multimodal analgesia for breast surgery.

Aim: This review aims to compare the anatomical basis, analgesic coverage, clinical efficacy, safety, advantages, and limitations of SIPB and ESPB for post-mastectomy pain.

Conclusion: Both SIPB and ESPB can improve postoperative pain control and reduce opioid consumption after mastectomy. SIPB is superficial, technically simple, and well suited to procedures involving the anterolateral chest wall and axilla, whereas ESPB generally provides broader multidermatomal coverage that may include the anterior, lateral, and posterior thoracic walls, although its spread can be variable. Selection of the block should therefore be individualized according to surgical extent, required dermatomal coverage, patient factors, and clinician expertise.

Keywords: Post-mastectomy pain; serratus-intercostal plane block; erector-spinae plane block.

Introduction

Postoperative pain following breast surgery, including mastectomy, remains a significant clinical concern due to its intensity, duration, and potential progression to chronic pain syndromes. Effective pain control is not only essential for patient comfort but also contributes to enhanced recovery, reduced opioid consumption, improved respiratory function, and decreased length of hospital stay (Mamoun et al., 2023).

Traditional analgesic strategies, such as systemic opioids, thoracic epidurals, and paravertebral blocks, although effective, are often limited by complications, contraindications, or technical challenges. More recently, ultrasound-guided regional anesthesia techniques have gained popularity due to their safety, simplicity, and efficacy in controlling thoracic and breast-related pain. Among these, the serratus-intercostal plane block (SIPB) and the erector-spinae plane block (ESPB) have emerged as promising alternatives (Xie et al., 2021).

Postmastectomy Pain Syndrome

Postmastectomy pain syndrome (PMPS) is a chronic pain condition that affects a substantial proportion of patients following surgical treatment for breast cancer. Despite significant advances in surgical techniques, anesthetic strategies, and postoperative care, PMPS continues to be a common and challenging clinical entity.

Defined as persistent pain lasting for more than three months after mastectomy or breast surgery, PMPS is often neuropathic in nature and can significantly impair quality of life (Narusawa et al., 2024).

The pain is typically localized to the anterior thorax, axilla, and upper arm, corresponding to the distribution of intercostobrachial, intercostal, and other peripheral nerves that may be injured during surgery. Given the high global incidence of breast cancer and the increasing number of survivors due to improved detection and treatment, the prevalence of PMPS highlights the importance of understanding its mechanisms, risk factors, diagnosis, prevention, and management (Valero et al., 2025).

Pathophysiology of Postmastectomy Pain Syndrome

The pathophysiology of PMPS is complex and multifactorial, with neuropathic pain playing a central role. Surgical trauma to peripheral nerves, particularly the intercostobrachial nerve, is a key contributor. During mastectomy or axillary dissection, this nerve is often stretched, transected, or entrapped in scar tissue, leading to abnormal ectopic nerve firing and neuroma formation. Damage to other nerves, including intercostal and thoracodorsal branches, can also contribute. Peripheral sensitization, resulting from inflammatory mediators released during tissue injury, further lowers the threshold for nociceptor activation (Chang et al., 2021).

Central sensitization also develops as spinal dorsal horn neurons and higher pain processing centers undergo neuroplastic changes, amplifying pain signals and contributing to the chronicity of PMPS. Additionally, psychological factors such as anxiety, depression, and catastrophizing can enhance central pain perception, creating a biopsychosocial model of persistent pain. The interplay of these mechanisms explains the variability in clinical presentation and the challenge of achieving effective management (Kakati et al., 2023).

Prevention Strategies

Given the difficulty of treating established PMPS, prevention has become a major focus of research and clinical practice. Effective perioperative pain control is one of the most important strategies. Regional anesthesia techniques, such as paravertebral blocks, serratus-intercostal plane blocks, and erector-spinae plane blocks, have demonstrated efficacy in reducing acute postoperative pain and potentially lowering the risk of chronic pain development (Shah et al., 2024).

The use of multimodal analgesia, incorporating non-opioid analgesics and regional anesthesia techniques, is encouraged to minimize reliance on opioids and address different pain pathways. Surgical techniques that preserve the intercostobrachial nerve whenever possible can also reduce the incidence of PMPS. Additionally, early identification and aggressive management of acute postoperative pain, along with psychological support and education, may further decrease the transition to chronic pain (Yuksel et al., 2022).

Anatomical Considerations of the Serratus-Intercostal Plane Block

The serratus-intercostal plane block (SIPB) is performed by depositing local anesthetic between the serratus anterior muscle and the external intercostal muscle. This anatomical plane provides access to the lateral cutaneous branches of the thoracic intercostal nerves, typically from T2 to T9. These nerves are responsible for the sensory innervation of the anterolateral thoracic wall, axilla, and lateral aspect of the breast, making SIPB particularly relevant for breast surgery analgesia (De León-Herrera et al., 2025).

The block is typically performed at the mid-axillary line around the level of the fourth or fifth rib using ultrasound guidance. The ultrasound probe facilitates identification of the serratus anterior muscle and intercostal space, allowing for precise deposition of the local anesthetic. The technique is considered relatively superficial, simple, and safe, with minimal risk of pleural puncture or neuraxial spread. However, its analgesic coverage is limited primarily to the lateral and anterior chest wall, and it does not reliably extend to the posterior thoracic wall (Perez-Herrero et al., 2024).

Clinical Efficacy of the Serratus-Intercostal Plane Block

Several clinical studies have evaluated the role of SIPB in breast surgery analgesia. The block consistently demonstrates reductions in postoperative pain scores, decreased opioid consumption, and improved patient satisfaction. Its ease of application, superficial location, and minimal complications make it an attractive option in both elective and emergency thoracic procedures. SIPB provides reliable coverage of the anterolateral chest wall and axilla, which are major sources of pain following mastectomy and axillary dissection (Zaballos et al., 2023).

However, one limitation is that SIPB does not adequately cover posterior structures, making it less effective in surgeries that extend posteriorly or involve wide thoracic dissection. Despite this, for procedures limited to the breast and axillary regions, SIPB is considered highly effective and safe. The use of ultrasound significantly enhances its accuracy and decreases the risk of inadvertent complications such as vascular puncture or pneumothorax (Chen et al., 2023).

Clinical benefit and evidence from previous techniques:

The principal advantages of serratus-intercostal/serratus plane techniques are their superficial ultrasound target, relative technical simplicity, broad anterolateral thoracic coverage, and avoidance of needle placement close to the neuraxis. These features make them useful opioid-sparing components of multimodal analgesia for mastectomy and axillary surgery. Previous investigators have directly compared ultrasound-guided serratus-based blocks with thoracic paravertebral block (TPVB) for post operative analgesia after modified radical mastectomy (MRM). They found that ultrasound-guided SPB is an alternative analgesic technique to thoracic PVB for MRM although TPVB provides a longer duration of analgesia. (346 ± 57 min vs. 245.6 ± 58 min). (Pérez Herrero et al., 2016).

Gupta et al. (2017) subsequently reported that serratus-based blocks and TPVB techniques provided postoperative analgesia after modified radical mastectomy, although TPVB produced a longer duration of analgesia and lower 24-hour morphine consumption. But et al. (2024) compared serratus anterior plane block (SAPB), ESPB, and PVB and found comparable intraoperative analgesia; SAPB was comparable to PVB for postoperative analgesia, whereas ESPB showed higher postoperative morphine requirements. Collectively, these studies support serratus-based blocks as practical alternatives to TPVB when a more superficial approach is desirable, while recognizing that the magnitude and duration of analgesia may vary among studies and techniques (Pérez Herrero et al., 2016; Gupta et al., 2017; But et al., 2024).

Erector-Spinae Plane Block (ESPB)

Anatomical Considerations of the Erector-Spinae Plane Block

The erector-spinae plane block (ESPB) involves deposition of local anesthetic deep to the erector spinae muscle, superficial to the transverse processes of the thoracic vertebrae. Ultrasound guidance is employed to identify the bony landmarks and ensure accurate placement of the needle tip (Chen et al., 2023).

Once the drug is injected, it spreads in a cranio-caudal direction along the fascial plane, and importantly, it may extend anteriorly into the paravertebral space, reaching both the dorsal and ventral rami of spinal nerves. This wider spread accounts for the multidermatomal analgesia associated with ESPB, covering the anterior, lateral, and posterior chest wall (Abd Ellatif et al., 2025).

For breast surgery, the block is often performed at the T4 or T5 level to provide optimal analgesia across the surgical field. Compared to SIPB, ESPB has the potential for broader and deeper coverage, but its effectiveness is sometimes variable due to inconsistent anterior spread. The block is technically deeper than SIPB but remains relatively safe and easy to perform under ultrasound guidance (Zaballos et al., 2023).

Clinical Efficacy of the Erector-Spinae Plane Block

The erector-spinae plane block has attracted significant attention in recent years due to its versatility and wide field of analgesic coverage. Clinical trials and case series have demonstrated its efficacy in a range of procedures, including breast surgery, thoracotomy, rib fractures, and spinal surgeries (Yang et al., 2024).

In breast surgery, ESPB reduces postoperative pain, lowers opioid requirements, and enhances patient comfort. Importantly, its analgesic distribution extends to both anterior and posterior thoracic walls, providing broader coverage compared to SIPB. This makes it particularly valuable in extensive surgeries such as modified radical mastectomy (Liang et al., 2021).

Furthermore, ESPB is associated with fewer complications compared to paravertebral blocks, such as hypotension and accidental dural puncture. However, its analgesic efficacy can be variable due to inconsistent spread to the paravertebral space, which may limit its reliability in some patients. Nonetheless, when effective, ESPB provides robust analgesia that rivals traditional neuraxial techniques but with a more favorable safety profile (Pawa et al., 2023).

Comparison with PECS block and prior clinical experience:

PECS blocks provide analgesia by targeting the pectoral nerves and lateral thoracic/intercostal branches in the anterior and axillary chest wall, whereas ESPB relies on longitudinal fascial spread with variable anterior extension toward the paravertebral space. Randomized studies in modified radical mastectomy have compared these approaches. Gad et al. (2019) found that PECS block resulted in lower 24-hour morphine consumption and a longer duration of analgesia than ESPB. Bakeer and Abdallah (2022), using 20 mL of 0.25% bupivacaine for each technique, similarly reported lower postoperative morphine requirements, longer analgesia, and lower early postoperative pain scores with PECS-II than with ESPB. Evidence therefore suggests that PECS-II can be particularly advantageous when the surgical field is predominantly anterior and axillary, while ESPB remains attractive when wider posterior-to-anterior thoracic coverage and a posterior injection site are desired (Gad et al., 2019; Bakeer & Abdallah, 2022).

Comparative Advantages and Limitations

When comparing SIPB and ESPB, it is important to recognize that both techniques offer distinct advantages depending on the surgical context. SIPB is technically simpler, more superficial, and faster to perform, with highly predictable coverage of the anterolateral thoracic wall. It is particularly useful in procedures restricted to the breast and axilla. ESPB, on the other hand, offers a wider and often deeper dermatomal spread, extending analgesia to the posterior thoracic wall (De Cassai et al., 2023).

This broader coverage makes ESPB more versatile, but its anterior spread is sometimes inconsistent, which can affect reliability in surgeries requiring extensive anterior analgesia. SIPB has the advantage of a lower risk of neuraxial spread, while ESPB, though safe, carries a theoretical risk of paravertebral or pleural involvement.

Implications for Post-Mastectomy Pain Management

Chronic post-mastectomy pain is a debilitating condition that can impair quality of life for breast cancer survivors. Effective acute pain management is one of the most important strategies to prevent the development of chronic pain. Both SIPB and ESPB contribute significantly to reducing acute postoperative pain and opioid requirements, which in turn lowers the risk of chronic pain development (Yang et al., 2024).

SIPB offers an efficient and straightforward option for cases limited to the anterolateral chest wall, while ESPB provides a broader analgesic field for more extensive surgeries. As such, these blocks represent essential tools in multimodal analgesia protocols for mastectomy patients (De Cassai et al., 2023).

Conclusion

Both the serratus-intercostal plane block and the erector-spinae plane block are effective components of multimodal analgesia for mastectomy. SIPB is a superficial and technically straightforward technique that provides reliable analgesia for the anterolateral chest wall and axilla, whereas ESPB may offer broader multidermatomal coverage involving the anterior, lateral, and posterior thoracic walls. However, the extent of ESPB spread can be variable. The choice between the two techniques should therefore be guided by the surgical field, required dermatomal coverage, patient-related factors, safety considerations, and clinician expertise.

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