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CASE REPORT REGIONAL ANESTHESIA

Deep serratus anterior plane block and superficial parasternal block for awake mastectomy in a high-risk patient

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ABSTRACT

General anesthesia is the most common anesthesia technique for breast surgery, and opioid administration represents the cornerstone for proper intra- and post-operative pain management. However, opioid use is associated with many side effects (delayed awakening, hyperalgesia, nausea, vomiting, itching, and respiratory depression), affecting the patient's clinical outcome and satisfaction. Furthermore, evidence suggests that opioids promote disease progression, affecting both cellular and humoral immune function in humans. Indeed, general anesthesia increases the risk of postoperative pulmonary complications, especially in elderly patients with comorbidities. In this setting, regional anesthesia represents an intriguing and innovative approach to managing perioperative pain, decreasing opioid consumption and related adverse effects, and reducing the risk of postoperative pulmonary complications.

Here, we describe the safety and effectiveness of the deep serratus anterior plane block and superficial parasternal block, combined with deep sedation with propofol and dexmedetomidine, as a primary anesthetic technique in a patient with an assessed high risk for the development of postoperative pulmonary complications and scheduled for mastectomy with sentinel lymph node biopsy, followed by axillary lymph node dissection.

Abbreviations: dSAPB - deep serratus anterior plane block; NRS - Numerical Rating Scale; PPCs - postoperative pulmonary complications; sPSB - superficial parasternal block; SA - serratus anterior

Keywords: Breast surgery, superficial parasternal block, deep serratus anterior plane block

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1. INTRODUCTION

Breast cancer is the most common cancer in females, with 2.4 million cases worldwide, and more than half of them are diagnosed above the age of 60 y. In 30-40% of the patients, surgery represents the cornerstone in early, localized, or operable diseases, with sentinel node biopsy with or without axillary lymph node dissection.[1] General anesthesia is the most common anesthesia technique for breast surgery, and opioids are commonly administered for intra and post-operative pain management. However, opioid use leads to many side effects, such as delayed awakening, hyperalgesia, nausea, vomiting, itching, and respiratory depression etc., affecting the clinical outcome and patient satisfaction. Furthermore, evidence suggests that opioids promote disease progression, affecting both cellular and humoral immune function in humans.[2] It should also be considered that general

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anesthesia exposes an increased risk of postoperative pulmonary complications (PPCs), especially in elderly patients with comorbidities. An alternative approach for perioperative pain management includes the use of regional anesthesia, which has been increased in popularity during the past two decades. It can be used as a single modality, or in combination with either general anesthesia or with deep sedation.

Here, we describe the safety and effectiveness of the deep serratus anterior plane block (dSAPB) and superficial parasternal block (sPSB), combined with deep sedation, as a primary anesthetic technique in a patient with an estimated high risk for the development of PPCs and scheduled for mastectomy with sentinel lymph node biopsy, followed by axillary lymph node dissection.

2. CASE REPORT

A 76-year-old woman presented with a 9-mm right breast nodule in the transition area of the inferior quadrant. She was scheduled for mastectomy with sentinel lymph node biopsy and, eventually, axillary lymph node dissection. In her past medical history: hypertension, obesity (BMI 34 kg/m^2), idiopathic paroxysmal atrial fibrillation, NYHA class 3, COPD requiring continuous oxygen therapy at least 18 hours a day (room air SpO_2 90%). Her home therapy included furosemide, dabigatran, olmesartan, flecainide, and bisoprolol.

Two months back a right lung wedge resection for cancer had been performed. The preoperative respiratory functional tests revealed the presence of a severe obstructive pattern. Her predicted forced expiratory volume in 1 second (FEV_1) was 36%. A multidisciplinary discussion involving anesthesiologists, breast surgeons, oncologists, and pneumologist defined the perioperative approach.

The PPCs rate after general anesthesia requiring endotracheal intubation was considered high. ARISCAT score was 50 points (the ARISCAT score is used to identify patients at higher risk for PPCs. It is derived from numerous variables, including age, oxygen saturation, previous respiratory infections, anemia, abdominal or thoracic surgery, duration of surgery, and

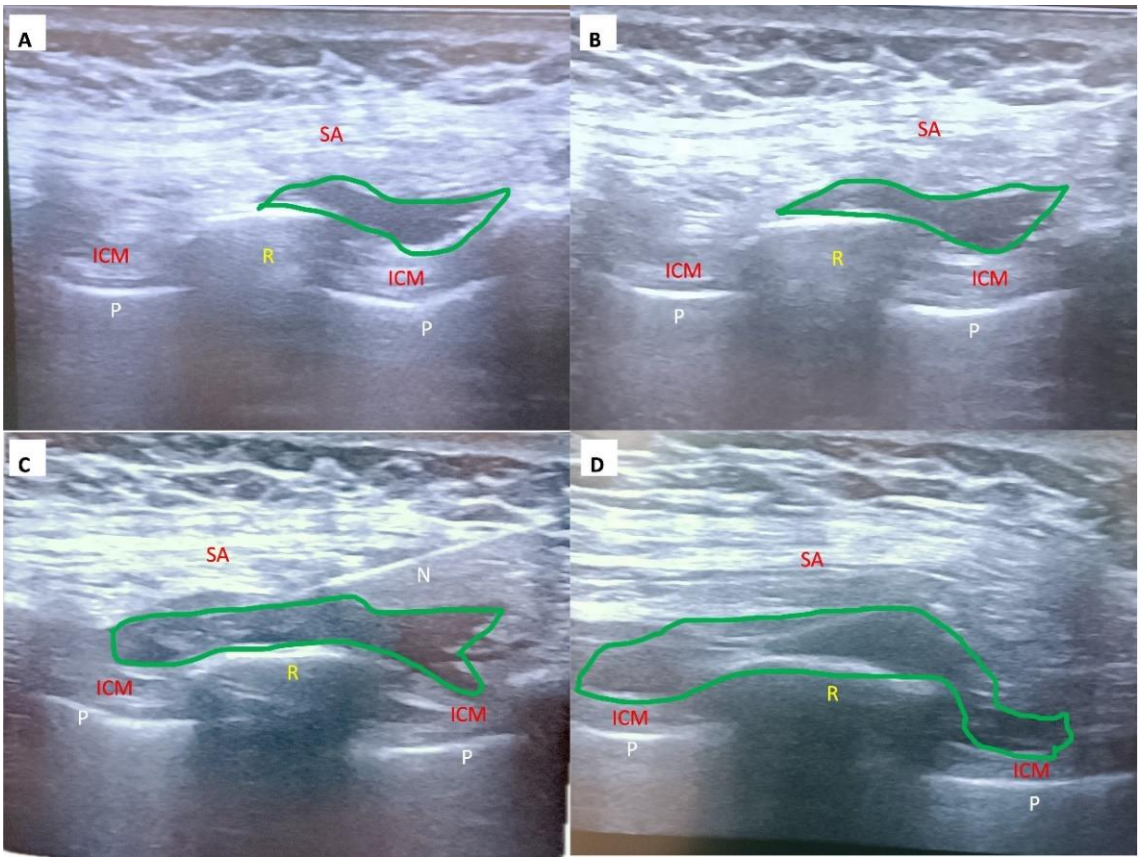

Figure 1: Local anesthetic spread (green line) during the ultrasound-guided dSAPB (in-plane approach), performed at the 5th rib (R) between the deep surface of the serratus anterior (SA) and intercostal muscles (ICM) in the middle axillary line (P = pleura; N = needle).

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emergency surgery). Pulmonary complication rate was 42.1%, hence a thoracic fascial block was chosen. The patient was timely informed about the risks and advantages of regional anesthesia and was assured of proper intraoperative pain management. Furthermore, she was informed that, if needed, the anesthesiologist would convert regional into general anesthesia with possible admission to the intensive care unit. The patient signed written informed consent.

Before entering the operating room, two intravenous lines were placed in the left arm. The patient was positioned supine with right arm abduction. The standard intraoperative monitoring consisted of SpO_2, heart rate, five-electrode ECG, and non-invasive blood pressure. Supplemental oxygen therapy was provided by Venturi mask (FiO_2 50%) to reach stable $SpO_2 > 92\%$.

In anticipation of a long duration of the surgery and to ensure the patient comfort, before proceeding for the block, we started propofol, target-controlled infusion, 0.8 µg/mL and dexmedetomidine 0.8 µg/kg/h infusions, reaching Richmond Agitation Sedation Scale -3.

In aseptic conditions, ultrasound-guided dSAPB and sPSB were performed. After lateral positioning, for dSAPB, a total of 20 mL of ropivacaine 0.75% and dexamethasone 4.0 mg were injected at 5-mL increments between the serratus anterior (SA) and intercostal muscles at the level of the 5th rib, using a 22-gauge, 90-mm needle, via in-plane approach, cranial-oriented direction to block the branches of the intercostal nerves in the mid-axillary line (Figure 1). Then for sPSB, in the supine position a high-frequency ultrasound probe was positioned immediately lateral to the sternum, identifying the 2nd and 4th intercostal spaces. An echogenic 50 mm needle was advanced through the skin with an in-plane approach, and 8 mL of 0.5% ropivacaine was injected between the pectoral major and intercostal muscles. The double hypoechogenic V sign suggested the correct presence of local anesthetic between the two muscular fasciae.

After 20 min, a pin-prick test confirmed sensory anesthesia from T_2 to T_8, allowing surgical procedure. Good surgical conditions were assured, and patient vital parameters remained stable during the intervention (2 h). No opioids were administered during the procedure, and the Numerical Rating Scale (NRS) score at the end was 0. As post-operative pain therapy, the anesthesiologist prescribed paracetamol 1 g every 12 h. Mobilization started 2 h after the surgery. During the post-operative length of stay, NRS ranged from 0 to 2, and no other drugs were needed for pain management. No complication occurred, and the patient was discharged after 48 h.

3. DISCUSSION

For major breast surgery, regional anesthesia techniques are performed mainly for better postoperative pain control and are used with general anesthesia to allow optimal surgical conditions and perioperative pain management. Thota et al.,[3] in their case series, showed that combined fascial plane blocks (erector spinae plane block, pectoralis I, and SAP blocks) could be effectively utilized as a sole regional anesthesia modality with continuous sedation in high-risk patients scheduled for breast cancer surgery. Our case report suggests that major breast surgery can be performed with dSAPB and sPSB plus intraoperative sedation in patients considered at high risk for PPCs. Furthermore, our approach allowed us to reduce the total amount of local anesthetic (ropivacaine, 150 mg for dSAPB and 40 mg for sPSB), contrary to Thota et al. (bupivacaine 250 mg), reducing the risk of adverse reactions.

Understanding the anatomy and extent of resection for each type of breast surgery is essential for planning the proper choice for thoracic fascial blocks. The female breast has a complex innervation.[4] From 2nd to 6th intercostal nerves with the supraclavicular nerve innervate the skin. In detail, the supraclavicular nerve innervates the skin of the upper region, the anterior cutaneous branch of the intercostal nerve innervates the inner skin, and the lateral cortex of the intercostal nerve innervates the outer skin. The axillary region and the inner side of the upper arm are innervated by the intercostobrachial nerve, formed by the confluence of the lateral branches of the 2nd and 3rd intercostal nerves. Moreover, the intercostobrachial nerve exhibits extrathoracic anatomy variations, accepting contributions from other intercostal nerves (T_1, T_4), and forms various confluences with branches of the brachial plexus (forearm medial cutaneous nerve, posterior forearm nerve). The 4th intercostal nerve mainly innervates the nipple-areola complex, although the exact innervation remains controversial because of numerous anatomical variations. Branches of the brachial plexus innervate the thoracic wall muscles: the lateral pectoral nerve innervates the upper part of the pectoralis major, whereas the medial pectoralis nerve innervates the lower part of the pectoralis major and the pectoralis minor.

Given the complexity of the innervation, it is unlikely that a single locoregional technique can guarantee a good level of intraoperative analgesia. In our case, we performed dSAPB plus sPSB. SAPB is a fascial plane block technique. The literature describes three approaches.[5] In the superficial approach, the local anesthetic is injected on the midaxillary line, between the latissimus dorsi and the SA, at the level of the 5th rib; with the deep approach, local anesthetic is injected between the deep surface of the SA and the external

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intercostal muscle, at the level of the 5th rib; in the modified approach local anesthetic is injected between the latissimus dorsi and SA at the level of the 6th rib on the posterior axillary line. SAPB blocks the lateral cutaneous branch of the intercostal nerves ($T_{2–9}$) passing through the SA and infiltrates the thoracic dorsal and long thoracic nerves, providing analgesia in the anterior and lateral chest wall and axilla. Despite it was reported that the superficial SAPB was more effective regarding anesthesia diffusion and duration of effect than dSAPB, Biswas et al., in a fresh cadaver study, demonstrated that superficial and dSAPB injections had the same diffusion area but that the former could prevent excessive advancement of the needle tip into the pleura, with greater safety.[6] Even though the optimal level for SAPB remains controversial, dSAPB can block more branches and collaterals before the intercostal nerves pass through the superficial layer of the SA, which is more conducive to analgesia. Further studies on this topic are needed.

SAPB does not provide anesthesia for the medial part of the breast. The sPSB is an ultrasound-guided anesthetic technique that blocks the anterior and the lateral rami of the intercostal nerves to ensure complete anesthesia of the medial quadrants of the breast.[7] Local anesthetic is deposited between the pectoralis major muscle and external intercostal muscles. To avoid a pleural puncture, placing the needle tip on the costal surface and below the pectoralis major muscle is recommended. Bagaphou et al. showed in two case reports that PSB plus pectoral nerve II block represents an interesting alternative to general anesthesia for patients with a contraindication due to severe pulmonary or cardiac comorbidities and thoracic paravertebral block.[8]

A second aspect that should be considered is that, regardless of the type of loco-regional anesthesia technique, maximum comfort must be guaranteed to the patient, who must remain as still as possible for a variable period. If fascial blocks can be used to ensure excellent analgesic conditions during surgery, the patient's negative perception of the event and pre-operative anxiety can determine the appearance of agitation. From the perspective of a multimodal strategy, sedation represents a fundamental aspect. In our case, we used both propofol and dexmedetomidine. The former made it possible to quickly reach the required sedation target, while we chose dexmedetomidine due to its analgesic and opioid-sparing effects. Indeed, intra-operative administration of dexmedetomidine exerts favorable post-operative effects such as lower fatigue and pain scores, decreased morphine consumption, and a longer time to first morphine request on days following surgery.[9]

In the present case report, we administered dexamethasone 4 mg with ropivacaine for dSAPB. Kirkham et al., in a systematic review and meta-analysis, concluded that there is currently very low-quality evidence that 4 mg of perineural dexamethasone represents a ceiling dose that prolongs analgesia duration by a mean period of 6-8 hours when combined with short-, intermediate- or long-acting local anesthetic, respectively.[10] Although data in the literature suggest that dexamethasone can prolong the effects of peripheral nerve blocks, its effects as an adjuvant for fascial blocks are yet to be proven. Further well-designed clinical trials are needed to explore this topic.

4. CONCLUSION

In conclusion, thoracic fascial blocks have the potential to become the future sole regional anesthetic modality in high-risk patients presenting for breast surgery. In our case, ultrasound-guided dSAPB and sPSB were valid approaches to performing mastectomy with axillary lymph node dissection in patients at high risk for PPCs. Sedative drugs should guarantee the patient's comfort with opioid-sparing and long-lasting effects. Further randomized control studies are needed to delineate the best technique combination for local anesthetic-sparing effect.

5. Ethical considerations

The patient has given her consent for images and other clinical information to be reported in the journal.

6. Conflicts of interest

The authors declared no conflicts of interest.

7. Authors Contributions

CC: Collected data, wrote the manuscript draft and the final version

AR, RG: Wrote the manuscript draft and the final version

The final version of the manuscript has been read and approved by all the authors. All authors fulfilled authorship criteria, and each believes the manuscript represents honest work.

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