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Breast

Intraoperative Techniques for the Plastic Surgeon to Improve Pain Control in Breast Surgery

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Summary: In recent years, there has been a growing emphasis placed on reducing length of hospital stay and health costs associated with breast surgery. Adequate pain control is an essential component of enhanced recovery after surgery. Postoperative pain management strategies include use of narcotic analgesia, nonnarcotic analgesia, and local anesthetics. However, these forms of pain control have relatively brief durations of action and multiple-associated side effects. Intraoperative regional blocks have been effectively utilized in other areas of surgery but have been understudied in breast surgery. The aim of this article was to review various intraoperative techniques for regional anesthesia and local pain control in breast surgery and to highlight areas of future technique development.
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INTRODUCTION

Recently, the surgeon general has called for increased vigilance by all physicians to curb the pandemic of opioid addiction based on excessive prescription. Opioids have been traditionally the centerpiece of pain control regimens after breast surgery. They are associated with nausea, vomiting, ileus, constipation, pruritus, sedation, increased hospital costs, and increased hospital length of stay.[1–3] Regional anesthesia offers an effective, prolonged method of analgesia (Table 1).[4] Patients who undergo breast surgery with placement of a regional anesthetic have significantly decreased pain, consumption of opioid medications, nausea, and vomiting.[5] The local and regional anesthetic techniques specific to breast surgery may improve patient's overall postoperative experience, reduce adverse drug events, and potentially shorten hospital lengths of stay.

ANATOMY

Any approach toward regional anesthesia requires an understanding of the relevant anatomy. There are predictable patterns of innervation around the breast. The intercostal nerves arise from the anterior rami of the thoracic spinal nerves. They then pass anteriorly with the intercostal vessels, between the inner and innermost intercostal muscles.[6] Posterior to the angle of the rib, the intercostal nerve divides into 3 main branches. First is the anterior cutaneous branch, which lies in the subcostal groove and supplies the majority of the intercostal space. Second is the lower collateral branch, which variably runs along the superior border of the rib below it. Third is lateral cutaneous branch.[7] Each sensory pathway may be selectively targeted via various routes to achieve safe and effective analgesia.

REGIONAL BLOCKS

Paravertebral Block

Paravertebral blocks (PVBs) in patients undergoing breast surgery report reduced pain scores, opioid consumption, nausea, and vomiting.[8–15] The triangular paravertebral space is adjacent to the vertebral column and defined anteriorly by the parietal pleura, posteriorly by the superior costotransverse ligament and medially by the vertebrae.[16] When performing PVB, local anesthetic is injected into the space immediately lateral to the intervertebral foramina where the spinal nerves emerge. Anesthetic infiltration in this space acts at the spinal root and sympathetic chain, thus serving as a sensory, motor, and sympathetic block within multiple dermatomes. One study reports that postoperative supplemental opioid

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Table 1. Local Anesthetics[4]: Table of Maximum Dosages of Local Anesthetics, with and without Epinephrine

Drug	Maximum Dose (with Epinephrine)	Duration (with Epinephrine)
Bupivacaine	2.5 mg/kg (3 mg/kg); PVB: 3–4 mL 0.5% bupivacaine with 1:400,000 epinephrine. Intercostal block: ~1 mL of 0.5% bupivacaine in each intercostal space	4 h (8 h)
Chloroprocaine	10 mg/kg (15 mg/kg)	30 min (90 min)
Etidocaine	2.5 mg/kg (4 mg/kg)	4 h (8 h)
Levobupivacaine	2.0 mg/kg or 400 mg in 24 h; Serratus block: 0.4 mL/kg of 0.125% levobupivacaine	4–6 h (8–12 h)
Lidocaine	4.5 mg/kg (7 mg/kg)	120 min (240 min)
Mepivacaine	5 mg/kg (7 mg/kg)	180 min (360 min)
Prilocaine	5 mg/kg (7.5 mg/kg)	90 min (360 min)
Procaine	8 mg/kg (10 mg/kg)	45 min (90 min)
Ropivacaine	2–3 mg/kg	3 h (6 h)
Tetracaine	1.5 mg/kg (2.5 mg/kg)	3 h (10 h)

administration, as well as hospital stay, were significantly lower in patient who were administered PVBs.[17] However, the odds of block failure are elevated with increased body mass index, as the technique requires identification of the transverse process. Consequently, some authors advocate restricting PVB to those patients with body mass index of < 25.[18] Complications of PVB include hypotension, vascular puncture, pleural puncture, pneumothorax, epidural spread, and epinephrine absorption.[19–21] Given the possibility of bilateral pneumothoraces, some recommend that bilateral PVB should only be performed by an experienced anesthesiologist.

Intercostal Block

Intercostal nerve blocks have been utilized in various studies in patients undergoing breast surgery. In 1979, Huang et al.[22] performed over 300 outpatient breast surgeries utilizing a combination of intravenous sedation and intercostal nerve block. The authors described very few complications and no pneumothoraces or injection-site hematomas.[22] Similarly, Shimizu et al.[23] utilized intercostal nerve block and tumescent as an "awake anesthesia" technique for breast augmentation. The authors were able to perform subglandular and subpectoral breast augmentation in 35 patients without any oral or intravenous sedation, thereby shortening recovery time and patients can be discharged immediately after the operation. Theoretical complications associated with intercostal nerve block have been reported as follows: injection-site pain, systemic toxicity, pleural effusion, vascular puncture, and pneumothorax. However, few of these adverse events have been actually reported.

Serratus Block

The serratus anterior plane block has been described as a technique to obtain regional thoracic anesthesia through blockade of the intercostal nerves at the T2–T12 level. Detailed ultrasound examination of the relevant anatomy of the thoracic wall has revealed 2 potential spaces for injection: superficial or deep to the serratus anterior.

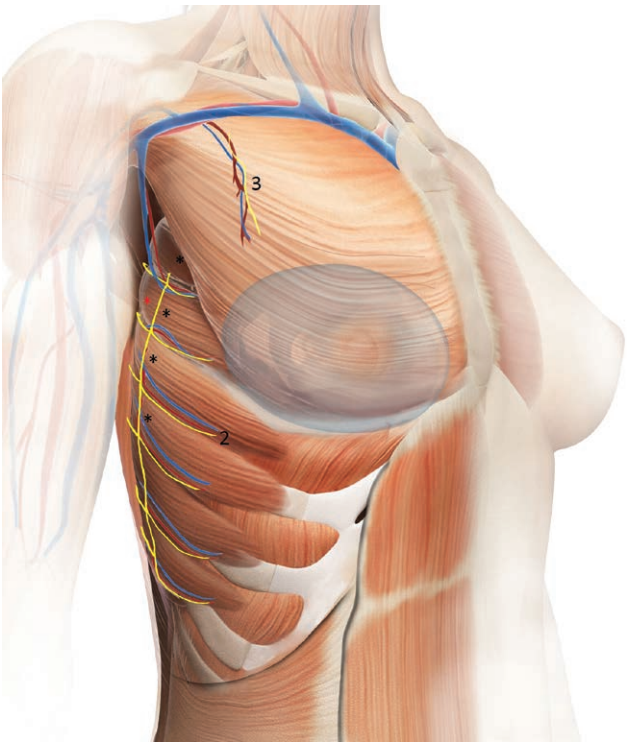
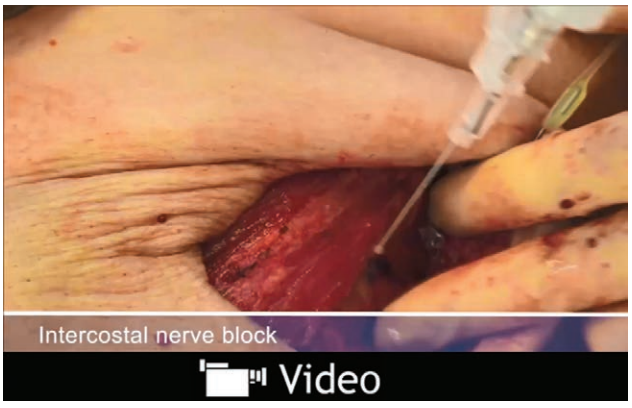


Fig. 1. The innervation of the breast consists of 3 components: (1) medial innervation from the anterior cutaneous branches of the first through sixth intercostal nerves; (2) lateral innervation from the lateral cutaneous branches of the second through seventh intercostal nerves (labeled); and (3) superior innervation from the supraclavicular nerves (labeled). The nipple-areola complex is supplied by the anterior and lateral cutaneous nerves branches of the fourth intercostal nerve, with contributions from the third and fifth intercostal nerves as well. Black asterisk indicates location of intercostal blocks, red asterisk indicates location of serratus block.



Video 1. See video, Supplemental Digital Content 1, which demonstrates the intercostal, pectoralis, and serratus blocks. This video is available in the "Related Videos" section of PRSGlobalOpen.com or at http://links.lww.com/PRSGO/A598.

The lateral cutaneous branches of intercostal nerves can be targeted as they traverse these planes. Blanco et al.[24] observed that the thoracodorsal artery can differentiate the plane superficial to serratus. Patients who were blocked anterior to serratus with levobupivacaine were found to

have long-lasting paraesthesia and dermatomal blockade from T2 to T9 with no side effects.[24] The serratus anterior plane block could easily be performed as an intraoperative technique, since the exposure afforded to the plastic surgeon after extirpative breast surgery virtually presents the serratus anterior muscles in their entirety.

Pectoralis Block

Postoperative pain following immediate breast reconstruction with tissue expanders and implants is often related to division and tension placed on pectoralis major muscle fibers and muscle spasm. Paralyzing these muscles with the pectoralis block may alleviate this pain. The pectoralis major and minor muscles are innervated by the medial and lateral pectoral nerves, respectively, and the block could easily be employed intraoperatively, as the surgical field exposes the pectoralis muscle. Anatomic study by Desroches revealed 3 potential planes of injection to block (1) the medial pectoral nerve on the deep surface of the pectoralis major muscle; (2) the perforating branches of the medial pectoral nerve that penetrate the deep surface of the pectoralis major muscle; and (3) the lateral pectoral nerve that parallels the thoracoacromial vessels.[25] Its clinical use is limited in the literature. Thus, the complication profile is unknown (Fig. 1; **see video, Supplemental Digital Content 1**, which demonstrates the intercostal, pectoralis, and serratus blocks, http://links.lww.com/PRSGO/A598).

CONCLUSIONS

Improving postoperative pain control in patients undergoing breast surgery is an important area of focus to enhance recovery after surgery, decrease patient morbidity, and reduce both hospital costs and length of stay. Regional blocks are effective in achieving increased length of analgesic duration without the adverse effect profile of opioids. However, these forms of analgesia are underutilized in this patient population and are far from becoming the standard of care. Few studies have evaluated these techniques in patients undergoing breast surgery and even fewer have compared these various techniques to one another. Future areas of study will aim to refine intraoperative methods that can be performed under direct visualization and to develop techniques for prolonged duration of action of postoperative analgesia, including additives such as clonidine to local anesthetics, while limiting associated side effects.[26]

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