Retrospective Case Series

Pectoralis I and Serratus Anterior Plane Block Analgesia for Bilateral Mastectomy: A Case Series

Kinjal M. Patel, MD[1], Kiana D. de Guzman, MD[2], Keri Cronin, BS[2], Noud van Helmond, MD, PhD[1], Sandeep Krishnan, MD[3], Ludmil Mitrev, MD[1], Keyur C. Trivedi, MD[1], and Ronak G. Desai, DO[1]

From: [1]Department of Anesthesiology, Cooper University Health Care, Cooper Medical School of Rowan University, Camden, NJ; [2]Cooper University Health Care, Cooper Medical School of Rowan University, Camden, NJ; [3]Department of Anesthesiology, Wayne State University School of Medicine, Pontiac, MI

Address Correspondence:
Kinjal M. Patel, MD
One Cooper Plaza
Cooper University Hospital
Camden, New Jersey 08103
E-mail:
patel-kinjal@cooperhealth.edu

Disclaimer: There was no external funding in the preparation of this article.

Conflict of interest: Each author certifies that he or she, or a member of his or her immediate family, has no commercial association (i.e., consultancies, stock ownership, equity interest, patent/licensing arrangements, etc.) that might pose a conflict of interest in connection with the submitted article.

Article received: 11-13-2023
Revised article received: 06-08-2024
Accepted for publication: 08-26-2024

Free full article:
www.painphysicianjournal.com

Background: Poorly controlled acute breast surgery postoperative pain is associated with delayed recovery, increased morbidity, impaired quality of life, and prolonged opioid use during and after hospitalization. Recently, ultrasound-guided pectoralis nerve (PECS) I block and serratus anterior plane (SAP) block, together or individually, have emerged as a potential method to relieve pain, decrease opioid requirements, and improve patient outcomes.

Objective: The aim of this study was to assess if the addition of a PECS I/SAP block in patients undergoing bilateral mastectomies provides more effective perioperative analgesia compared to standard analgesia.

Study Design: Retrospective case series.

Setting: Tertiary academic medical center.

Methods: For patients undergoing breast cancer surgery, different approaches to analgesia by anesthesiologists at our institution provided an opportunity to compare patients who received a PECS I/SAP block to patients who received standard peri- and postoperative pain control from May 1, 2019 through November 30, 2020. Adult women who had bilateral mastectomy and reconstruction with tissue expanders for breast cancer were included. Bilateral PECS I/SAP blocks were performed with 60 mL 0.25% bupivacaine and 266 mg liposomal bupivacaine. The standard analgesia group had a balanced general anesthetic with volatile anesthetic, opioids (fentanyl or hydromorphone), and muscle relaxant. The postoperative analgesic regimen was similar in both groups. Pain scores (Numeric rating Scale) and opioid consumption (converted to oral morphine milligram equivalent [MME]) intraoperatively, and on postop day (POD) 0 up to POD 3 were collected. Length of stay data were collected as a secondary outcome.

Results: Forty patients were included (n = 17 PECS I/SAP block; n = 23 standard analgesia). Baseline characteristics were similar between groups; most patients in the PECS I/SAP block (93%) and standard analgesia (96%) groups were discharged on POD 1 or 2. Intra-operative opioid requirements were lower in the PECS I/SAP block vs the standard analgesia group (median 56 MME, interquartile range [IQR] 44-62 vs median 65 MME, IQR 63-83, respectively, $P = 0.002$). Opioid requirements were similar in the block group compared to the standard analgesia group from POD 0 to POD 2. Pain scores from POD 0 to POD2, postanesthesia care unit length of stay, and hospital length of stay were also similar between the PECS I/SAP block and standard analgesia group.

Limitations: The retrospective nature of this study and its reliance on medical records are limitations.

Conclusion: The PECS I/SAP block may potentially reduce pain in patients having breast surgery for cancer by providing analgesia to the lateral and anterior chest wall. While this analysis showed a reduction in intraoperative opioid consumption, no significant postoperative benefit in either pain scores, opioid consumption, or length of stay was observed. This may be in part due to the PECS I/SAP block not providing adequate analgesia to the medial portion of the breast.

Key words: Serratus anterior plane block, intercostal nerve block, liposomal bupivacaine, fascial plane block, analgesia, opioid analgesia, regional anesthesia, pain

Pain Physician 2024: 27:E1117-E1122

Mastectomy is one of the most common procedures performed. It has been shown to produce moderate-to-severe acute pain in 30%-50% of patients (1). Poorly controlled acute postoperative pain is associated with delayed recovery, increased morbidity, impaired quality of life, and prolonged opioid use during and after hospitalization (2). While opioids provide postoperative analgesia, they are associated with adverse effects including nausea and vomiting, urinary retention, ileus, and chronic pain (3).

There appears to be an association between acute pain following surgery and the progression of persistent, chronic pain (2). The incidence of chronic pain in patients who have undergone breast surgery is 50% or more, with the risk being higher in those with increased severity of acute pain in the postoperative period (4). Since this chronic postsurgical pain can persist for years and is associated with a reduced quality of life, there is a large effort to optimally manage postmastectomy pain using a multimodal approach in order to mitigate long-term consequences (5,6).

Regional anesthesia has an important role in the multimodal analgesia regimen following breast surgery (7). The paravertebral block is considered the traditional regional anesthetic procedure of choice for postmastectomy pain and has shown its ability to reduce postoperative pain scores, opioid consumption, and the severity of chronic pain compared to general anesthesia alone (8). However, this block is also associated with negative effects and complications such as hypotension, unintentional epidural injection, and difficulties with optimal placement.

The emergence of fascial plane blocks has provided a simple, easy-to-learn alternative that lacks many of the side effects seen with previous regional techniques used for oncological breast procedures (8,9). In particular, the serratus anterior plane (SAP) and pectoral nerve (PECS) blocks are effective in breast surgery by providing analgesia to the anterior and lateral chest walls (10). The SAP block involves injecting local anesthetic to the plane either superficial or deep to the serratus anterior muscle, while the PECS block can be given by one of 2 techniques: PECS I involves the plane between the pectoralis major and minor muscles, and PECS II combines the PECS I block with the addition of a superficial serratus anterior plane block (10). The PECS block has been shown to decrease postoperative analgesic requirements, nausea and vomiting, postoperative pulmonary complications, and postanesthesia care unit (PACU) length of stay following breast surgery (11).

At our institution, postmastectomy pain was routinely managed with standard anesthesia care combined with intraoperative local anesthetics administered by the surgeon and postoperative oral and intravenous opioid medications. Recently, our anesthesiologists have performed ultrasound-guided PECS I and SAP blocks together or individually, using plain or liposomal bupivacaine for breast surgery with the goal of relieving pain, decreasing opioid requirements, and improving patient outcomes.

The aim of our study was to assess if adding a PECS I/SAP block in patients undergoing bilateral mastectomies provides more effective perioperative analgesia compared to standard analgesia without an anesthesiologist-administered block. We hypothesized that the addition of a PECS I/SAP block would lead to superior analgesia compared to the standard analgesia group as evidenced by lower intraoperative and postoperative opioid consumption, lower postoperative pain scores, and reduced PACU and hospital length of stay (LOS).

Methods

Study Design

Following approval from the Cooper University Health Care Institutional Review Board (IRB number: 20-417), we conducted a retrospective case series to evaluate the effects of the PECS I/SAP block completed for bilateral mastectomies and reconstruction with tissue expanders for breast cancer treatment.

Patient Selection

Patients included in the study were aged 18 years or older, had uncomplicated extubation, and had a cancer-related diagnosis for which they underwent bilateral mastectomies with insertion of tissue expanders from January 1, 2017 through November 30, 2020. Exclusion criteria included chronic opioid use (defined as > 3 months preoperatively), chronic pain diagnosis, prolonged intubation, and pregnancy.

Pectoralis and Serratus Anterior Plane Blocks

PECS I block: After inducing general anesthesia, a linear 5-18 MHz ultrasound probe was placed in a craniocaudal fashion below the clavicle; both the pectoralis major and pectoralis minor muscles were identified. A 22G echogenic needle (B Braun) was introduced (directed caudally) in-plane until the fascial plane between the pectoralis major and minor muscles was reached. Once a satisfactory plane was developed

with hydrodissection via normal saline, 15 mL of 0.25% bupivacaine and 66.5 mg liposomal bupivacaine were injected into the space.

SAP block: After placing the patient in a lateral decubitus position, A 22G echogenic needle (B Braun) was introduced (directed caudally) in-plane using a linear 5-18 MHz ultrasound probe until the 4th rib was contacted. At this point, 10 mL saline was injected in an attempt to elevate and separate the serratus anterior muscle from the rib, creating a new plane between the serratus anterior muscle and the ribs extending both cranially and caudally. Once a satisfactory plane was created, 15 mL of 0.25% bupivacaine and 66.5 mg liposomal bupivacaine was injected into the space.

Pain Management

All of our patients received our institutional multimodal Enhanced Recovery Pathway. On the morning of surgery, patients received 975 mg of oral acetaminophen. Intraoperative pain management was left to the discretion of the anesthesia team in the operating room with the goal of minimizing opioid administration. Traditional sympathetic markers of pain such as increased heart rate, blood pressure, and respiratory rate were monitored to determine the need for opioids. Postoperatively, nonopioid analgesics such as acetaminophen and ketorolac were given intravenously for breakthrough pain in the recovery room based on patient request for pain medicine or at nursing staff discretion. Opioids were only administered if patients reported pain scores of 7 or higher on a the Numeric Rating Scale (NRS-11) despite treatment with nonopioid medications as per recovery room protocol at the time. Scheduled dose and patient-controlled intravenous opioids were not utilized in either cohort.

Outcomes

The primary outcome measure was opioid consumption converted to oral morphine milligram equivalents (MMEs) intraoperatively and on postoperative days (PODs) 0, one, 2, and 3 in patients who received a PECS I/SAP block compared to those who did not receive a block for bilateral mastectomy pain. Additionally, postoperative pain between the 2 groups was compared using NRS-11 pain scores on postoperative days 0 to 3. Secondary outcome measures included PACU LOS and total hospital LOS.

Data Collection

Data in the study was obtained from the electronic health record (OpTime, Epic Systems Corporation). Demographic information, relevant medical history; surgical characteristics; intraoperative and postoperative (until POD 3) opioid and nonopioid requirements; pain scores (using the NRS-11) until POD 3; time to first rescue opioid and first antiemetic in the PACU; and LOS in the PACU and hospital were collected.

Study Power

Based on preliminary data collected in preparing our research, mean (SD) opioid requirement on POD one was estimated to be 39 (15) MME. Using an α of 0.05 and a β of 0.2, a sample size of 30 (15 per arm) was estimated to be required to detect a 40% reduction in opioid requirement on POD one with a PECS I/SAP block vs standard analgesia.

Statistical Analysis

Data were analyzed with IBM SPSS Statistics 29.0 (IBM Corporation) and visualized using SigmaPlot 14.5 (Systat Software Inc.). Categorical data are presented as n (%); continuous variables are presented as mean ± SD or median ± interquartile range (IQR), depending on the distribution of the data. Normality of the data was assessed using the Shapiro-Wilk test. Demographic characteristics, treatment characteristics, opioid requirements, and pain scores between the PECS I/SAP block and standard analgesia groups were compared using unpaired t tests, Mann-Whitney U tests, or Fisher's exact tests. PACU and hospital LOS were compared using survival analysis (logrank test). *P* values are reported for all tests; $P < 0.05$ was considered significant.

Results

Forty patients were included from the predefined study period. The PECS I/SAP block was performed by an anesthesiologist in 17 of the patients and standard analgesia was provided to 23 patients. There was no difference in baseline demographic or clinical characteristics between the 2 groups (Table 1). Most patients in both the block (93%) and control (96%) groups were discharged on POD 2 or earlier, leaving minimal data to evaluate for POD 3.

Opioid Use

Intraoperative opioid use was lower in the PECS I/SAP group compared to patients who only received standard analgesia (median 56 MME [IQR 44-62] vs median 65 MME [IQR 63-83], $P = 0.002$) (Fig. 1). Postoperative opioid requirements on POD 0 through POD 2 were

similar between the PECS I/SAP and standard analgesia groups: POD 0, median 10 MME (IQR 0-25) vs median 12 MME (IQR 10-26), *P* = 0.289); POD 1, median 20 mg MME (IQR 2-25 vs median 15 mg MME (IQR 5-30), *P* = 0.590; POD 2, median 7 MME (IQR 0-19) vs median 20 MME (IQR 0-40), *P* = 0.857.

Table 1. *Demographic and clinical characteristics of patients in the PECS I/SAP and standard analgesia groups.*

	PECS I/ SAP Block (n = 17)	Standard Analgesia (n = 23)	*P* Value
Age in years, mean ± SD	48 ± 12	45 ± 12	0.455[a]
Body mass index in kg/ m^2, Median (IQR)	25 (20, 27)	25 (21, 28)	0.74[5b]
American Society of Anesthesiologists status, n (%)			0.326[c]
II	13 (77)	20 (87)	
III	4 (23)	3 (13)	
Medical history, n (%)			
Hypertension	1 (6)	1 (4)	1.000[c]
Congestive heart failure	0 (0)	1 (4)	1.000[c]
Diabetes mellitus	0 (0)	1 (4)	1.000[c]
Smoking status, n (%)			1.000[c]
Current	1 (6)	2 (9)	
Former	4 (23)	5 (22)	
Never	12 (71)	16 (70)	

[a]Unpaired t test
[b]Mann-Whitney U test
[c]Fisher's exact test
IQR, interquartile range

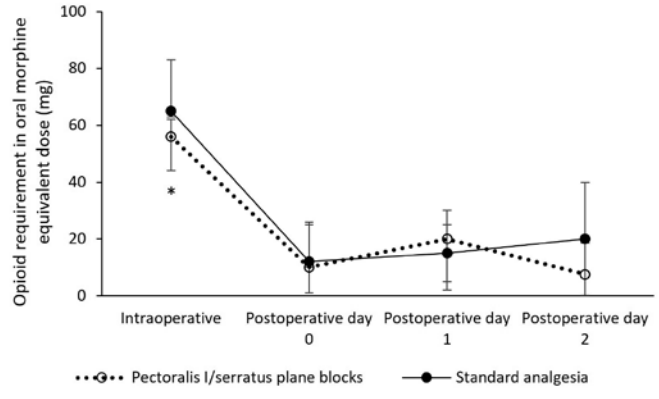

Fig. 1. *Daily median and interquartile range opioid requirements intraoperatively and up to postoperative day 2. *P < 0.05*

Postoperative Pain

Average daily NRS-11 pain scores on postoperative days 0 through 2 did not differ significantly between the PECS I/SAP and standard analgesia groups: POD 0, median 3 (IQR 1-4) vs median 2 (IQR 1-4), *P* = 0.763; POD one, median 5 (IQR 3-6) vs median 6 (IQR 3-7), *P* = 0.292; POD 2, median 6 (IQR 4-7) vs median 5 (IQR 4-7), *P* = 1.000 (Fig. 2).

Postanesthesia Care Unit and Hospital Length of Stay

Both the PACU length of stay (PECS I/SAP: median 173 minutes, IQR 101-368 vs control: median 131 minutes, IQR 111-204, *P* = 0.113) and total hospital LOS (PECS I/SAP: median one day, IQR one-2 vs control: median one day, IQR one-one, *P* = 0.108) were similar between the 2 groups.

Discussion

Principal Findings

The aim of our study was to compare the analgesic efficacy of PECS I/SAP blocks to only standard anesthesia for postoperative breast cancer surgery pain. We found that the PECS I/SAP block lowered intraoperative opioid requirements when compared to standard anesthesia. Postoperative opioid requirements, pain scores, and PACU and total hospital LOS were comparable between the 2 groups.

Previous studies on SAP and PECS Blocks for breast Surgery

Several groups have studied how SAP and PECS blocks, together and separately, affect opioid requirements and acute postoperative pain. In a meta-analysis by Sun, et al (12), patients undergoing breast cancer surgery who received PECS blocks had lower intraoperative and postoperative opioid requirements compared to those who had general anesthesia and a standard analgesic regimen (12). They also found reduced Visual Analog Scale pain scores up to 24 hours postoperatively in the group receiving the block (12). A separate meta-analysis found that breast surgery with PECS blocks (defined as PECS I, PECS II, and SAP blocks in combination or alone) lowered pain scores and opioid requirements up to 24 hours postoperatively compared to a group that did not receive a block (13). Similarly, Wang et al (14) found that performing a PECS I

block with an SAP block in patients undergoing modified radical mastectomy was superior to standard general anesthesia, as reflected in lower intraoperative opioid requirements and Visual Analog Scale pain scores at various time points up to 48 hours postsurgery.

In addition to acute postoperative pain, the role of fascial blocks in preventing chronic postsurgical pain has been explored as well. Qian et al (15) found that SAP blocks with 0.5% ropivacaine decreased chronic postsurgical pain at both 3 months (relative risk, 0.47) and 6 months (relative risk, 0.72) when compared to SAP blocks performed with normal saline.

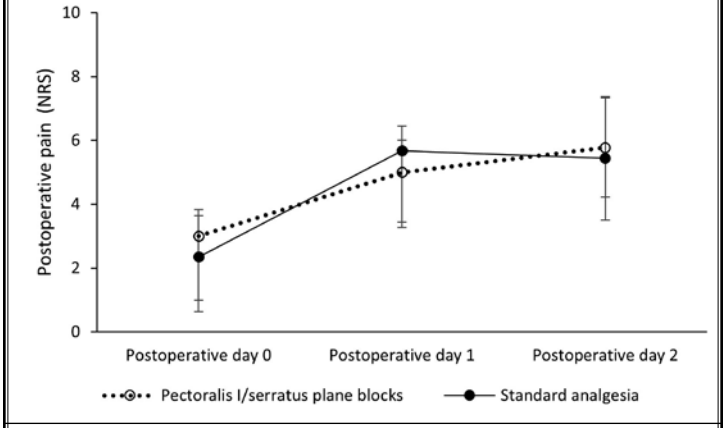

Fig. 2. *Median (interquartile range) pain scores up to postoperative day 2.*

Clinical Implications

The findings from our study show that a PECS I/SAP block does not have a significant effect on postoperative pain or opioid requirements, bringing into question their use for breast surgery analgesia. One explanation for the results may be the baseline severity of pain associated with these procedures, as pain scores were generally low across all patients. The lack of significant pain at postsurgery baseline in these patients would make it unlikely to find a statistical difference in pain scores between the 2 groups. Another explanation might be the nature of the PECS I/SAP block itself, as it is possible that the block fails to anesthetize the medial portion of the breast. Analgesic effects limited to the lateral-to-mid chest wall might prevent a relevant difference in analgesia between the 2 groups. Perhaps replacing the PECS I block with a pectointercostal fascial plane block may be the answer to providing improved analgesia for this cohort of patients (16,17).

Furthermore, our study only assessed the analgesic effects of the PECS I/SAP block early in the postoperative period. Prior research has shown that various regional anesthetic methods might reduce the risk of developing chronic postsurgical pain after breast surgery. Future studies examining the effect of a PECS I/SAP block on chronic postsurgical pain would provide more information about the potential long-term benefits of this specific analgesic method.

It is also possible that a PECS I/SAP block as a method of analgesia is not helpful for managing acute postoperative pain, as our study might suggest. In a society where there is a growing need for regional anesthetic techniques, using the time and resources required for a PECS I/SAP block for procedures other than breast surgery might have greater benefit.

Limitations

The limitations of our study are its retrospective approach and dependence on the electronic medical record. Additionally, a relatively small sample of patients was assessed and there is a potential for inter-physician variability in performing the described techniques.

Conclusion

A PECS I/SAP block likely does not lead to clinically relevant reductions in opioid requirements, pain, or LOS in the context of mastectomy. Acute postoperative pain was generally well-controlled with conventional approaches.

References

1. Leong RW, Tan ESJ, Wong SN, Tan KH, Liu CW. Efficacy of erector spinae plane block for analgesia in breast surgery: A systematic review and meta-analysis. *Anaesthesia* 2021; 76:404-413.
2. Gan TJ. Poorly controlled postoperative pain: Prevalence, consequences, and prevention. *J Pain Res* 2017; 10:2287-2298.
3. Tripathy S, Rath S, Agrawal S, et al. Opioid-free anesthesia for breast cancer surgery: An observational study. *J Anaesthesiol Clin Pharmacol* 2018; 34:35-40.
4. Habib AS, Kertai MD, Cooter M, Greenup RA, Hwang S. Risk factors for severe acute pain and persistent pain after surgery for breast cancer: A prospective observational study. *Reg Anesth Pain Med* 2019; 44:192-199.
5. Woodworth GE, Ivie RMJ, Nelson SM,

Walker CM, Maniker RB. Perioperative breast analgesia: A qualitative review of anatomy and regional techniques. *Reg Anesth Pain Med* 2017; 42:609-631.

6. Rai AS, Khan JS, Dhaliwal J, et al. Preoperative pregabalin or gabapentin for acute and chronic postoperative pain among patients undergoing breast cancer surgery: A systematic review and meta-analysis of randomized controlled trials. *J Plast Reconstr Aesthet Surg* 2017; 70:1317-1328.
7. Versyck B, van Geffen GJ, Chin KJ. Analgesic efficacy of the Pecs II block: A systematic review and meta-analysis. *Anaesthesia* 2019; 74:663-673.
8. Wong HY, Pilling R, Young BWM, Owolabi AA, Onwochei DN, Desai N. Comparison of local and regional anesthesia modalities in breast surgery: A systematic review and network meta-analysis. *J Clin Anesth* 2021; 72:110274.
9. Fujii T, Shibata Y, Akane A, et al. A randomised controlled trial of pectoral nerve-2 (PECS 2) block vs. serratus plane block for chronic pain after mastectomy. *Anaesthesia* 2019; 74:1558-1562.
10. Jack JM, McLellan E, Versyck B, Englesakis MF, Chin KJ. The role of serratus anterior plane and pectoral nerves blocks in cardiac surgery, thoracic surgery and trauma: A qualitative systematic review. *Anaesthesia* 2020; 75:1372-1385.
11. Eldeen HMS. Ultrasound guided pectoral nerve blockade versus thoracic spinal blockade for conservative breast surgery in cancer breast: A randomized controlled trial. *Egypt J Anaesth* 2016; 32:29-35.
12. Sun Q, Liu S, Wu H, et al. Clinical analgesic efficacy of pectoral nerve block in patients undergoing breast cancer surgery: A systematic review and meta-analysis. *Medicine (Baltimore)* 2020; 99:e19614-e19614.
13. Grape S, Jaunin E, El-Boghdadly K, Chan V, Albrecht E. Analgesic efficacy of PECS and serratus plane blocks after breast surgery: A systematic review, meta-analysis and trial sequential analysis. *J Clin Anesth* 2020; 63:109744.
14. Wang W, Song W, Yang C, et al. Ultrasound-guided pectoral nerve block I and serratus-intercostal plane block alleviate postoperative pain in patients undergoing modified radical mastectomy. *Pain Physician* 2019; 22:E315-E323.
15. Qian B, Huang S, Liao X, Wu J, Lin Q, Lin Y. Serratus anterior plane block reduces the prevalence of chronic postsurgical pain after modified radical mastectomy: A randomized controlled trial. *J Clin Anesth* 2021; 74:110410.
16. Hozien AI, Helmy AM, Koptan HM, Elfeil YE, Yakout MMS, Elwafa H. Analgesic effect of addition of pectointercostal block to serratus anterior plane block in breast surgeries: A randomized, controlled trial. *Pain Physician* 2023; 26:E679-E685.
17. Patel KM, van Helmond N, Trivedi K, Desai RG. Fascial plane blocks for cardiac surgery: Less is more? *Anesth Analg* 2020; 131:e166-e167.