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Efficacy of pectoral nerve block type-2 (Pecs II block) versus serratus plane block for postoperative analgesia in breast cancer surgery: a retrospective study

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ABSTRACT

Thoracic wall nerve blocks reduce postoperative acute pain after breast cancer surgery (BCS); however, their short-term effects and the most effective technique remain unclear. To compare the effects of pectoral nerve block type-2 (Pecs II block) and serratus plane block for postoperative short-term analgesia, we retrospectively reviewed 43 BCS patients who underwent Pecs II block (n=22) or serratus plane block (n=21). The primary outcome was the proportion of patients with no complaints of pain 2 months post-BCS. The odds ratio (OR) was assessed, adjusting for axillary lymph node dissection. The secondary outcomes were pain severity 24 hours and 2 months post-operation using the numerical rating scale score, and morphine consumption within 24 hours. The proportion of patients without pain 2 months post-BCS was significantly less with Pecs II block than in patients with serratus plane block (55% vs. 19%, adjusted OR, 5.04; 95% confidence interval, 1.26–20.07; P=0.02); the median [interquartile range] score for pain 2 months post-operation was also significantly lower with Pecs II block (Pecs II block 0.5 [0–1] vs. serratus plane block 1 [1–2]); P=0.03). Regarding post-BCS acute analgesia, the median [interquartile range] postoperative 24-hour pain score was 2 [1–3] and 3 [1.5–3.5], and the median morphine consumption within 24 hours was 1.5 [0.75–5.5] and 3 [1.5–10] mg in Pecs II block and serratus plane block (P=0.47 and P=0.11), respectively. This study suggests that Pecs II block prevents short-term post-BCS pain better than serratus plane block. However, further studies are needed in order to support this finding.

Keywords: pectoral nerve block, serratus plane block, postoperative analgesia, breast cancer surgery

Abbreviations:
Pecs II block: pectoral nerve block type-2
BCS: breast cancer surgery
TPVB: thoracic paravertebral block
NRS: numerical rating scale
ALND: axillary lymph node dissection

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INTRODUCTION

Postoperative acute and chronic pain after breast cancer surgery (BCS) has a negative influence on a patient's enhanced recovery after surgery and quality of life.[1-3] Postoperative acute pain is also a risk factor in the development of postoperative chronic pain,[1-3] and 25%–60% of women will develop chronic pain after BCS.[4-7] Thoracic paravertebral blocks (TPVB) are widely used for the perioperative analgesia for BCS[8-10] and to reduce severity and prevalence of postoperative acute and chronic pain after BCS.[11-15] However, TPVB can have severe complications such as pneumothorax, hematoma, and hypotension, and not all anesthesiologists feel comfortable using this invasive technique for BCS.

Recently, Blanco et al described novel thoracic wall nerve blocks for breast surgery, as alternatives to TPVB.[16-18] Among them, the pectoral nerve block type-2 (Pecs II block) targets the lateral and median pectoral nerves through first injection of local anesthetic between the pectoralis major and minor muscles, and targets the lateral branches of intercostal nerves (T3-T6) and the intercostobrachial nerve, followed by second injection between the pectoralis minor and the serratus anterior muscles. Alternatively, the serratus plane block targets the lateral branches of intercostal nerves (T3-T9) and intercostobrachial nerve by a single injection of a local anesthetic between the serratus anterior and the latissimus dorsi muscles. Previous studies have reported these thoracic wall nerve blocks provide postoperative acute analgesia for BCS.[19-21] However, the short-term and long-term analgesic effects of these blocks are unknown. In addition, it is unclear which thoracic wall nerve block is most effective for the post-BCS analgesia, the Pecs II block or the serratus plane block. In some reports comparing post-mastectomy acute pain control, the Pecs II block was superior to TPVB.[22] Moreover, the serratus plane block was inferior to TPVB in another study.[23] Therefore, we hypothesized that the Pecs II block was more effective for postoperative pain management after BCS than the serratus plane block. The purpose of this observational study was to assess the effects of these two blocks on postoperative acute and short-term pain.

METHODS

Study Design and Patients

This single center, retrospective, observational study was approved by the Nagoya University Hospital Ethics Committee (ref: 2015–0104). All patients who underwent BCS from March to December of 2014 were screened, and only those patients on whom the Pecs II block or serratus plane block was performed were included in the study. Surgical procedures included partial mastectomy and mastectomy with sentinel lymph node biopsy or axially lymph node dissection (ALND). Male patients, and patients with American Society of Anesthesiologists physical status ≥3 or body weight <40 kg were excluded. Based on these criteria, 43 patients were identified.

Anesthesia and Thoracic Wall Nerve Blocks

All patients underwent general anesthesia induced by propofol with target-controlled infusion, remifentanil, and rocuronium. After the tracheal intubation, anesthesia was maintained with a propofol target-controlled infusion and remifentanil guided by the bispectral index within the range 40–60. The Pecs II block or the serratus plane block was performed using 30 ml of 0.5% ropivacaine under general anesthesia. Each thoracic wall block was selected and performed by independent board certified anesthesiologist with sufficient training in ultrasound-guided these thoracic wall nerve blocks.

In the Pecs II block (Pecs group), the first injection was 10 ml of 0.5% ropivacaine between the pectoralis major and minor muscles at the third rib level on the middle to outer clavicle line, and the second injection was 20 ml of 0.5 % ropivacaine between the pectoralis minor and the serratus anterior muscles at the fourth rib level on the anterior axillary line (Fig. 1).[17] In the serratus plane block (Serratus group), 30 ml was injected once above the serratus anterior muscle at the fifth rib level on the middle axillary lines (Fig. 1).[18]

As postoperative adjuvant analgesia, 50 mg of flurbiprofen was intravenously administered during the closing of the surgical incision. Intravenous patient-controlled analgesia with morphine was used for postoperative pain management (bolus dose, 1 mg; lockout interval, 5 minutes).

As the follow-up after BCS, an independent physician who did not perform thoracic wall blocks assessed the Numerical Rating Scale (NRS; an 11-point scale with range 0–10, 0 indicates no pain and 10 indicates the worst imaginable pain) score at 24 hours post-operation by visiting the patient's ward and at 2 months post-operation by telephone.

Outcome Measurements

The primary outcome measured was the proportion of patients in each group who did not complain of postoperative pain 2 months after surgery, as determined by the NRS = 0. In addition, the association of postoperative no pain with the two thoracic wall blocks was assessed, adjusting for surgical procedures performed for each patient, especially ALND which is a major risk factor for chronic postoperative pain.[4-5]

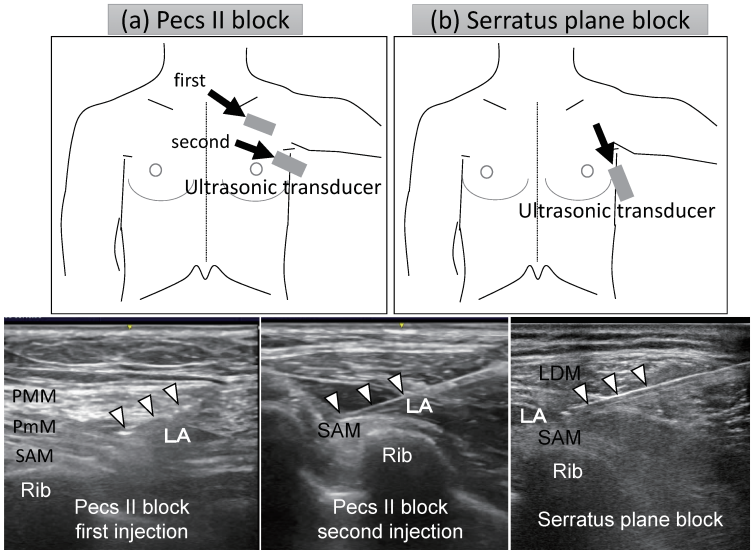

Fig. 1 Ultrasound-guided Pecs II block and serratus plane block

The patient is positioned in the supine position and the surgical side arm is abducted 90 degrees. (a) In the Pecs II block, the linear array transducer is placed on the lateral side of the mid-clavicular line at the third rib level (first injection) and moved along the anterior axilla line at the fourth rib level (second injection). (b) In the serratus plane block, the linear transducer is placed on the middle axilla line at the fifth rib level. A block needle is inserted in a medial-to-lateral direction from the outer edge of the transducer and advanced until the needle tip reaches into each thoracic interfascial plane on the ultrasound image (white arrow head).

Pecs II, pectoral nerve block type-2; PMM, pectoralis major muscle; PmM, pectoralis minor muscle; SAM, serratus anterior muscle; LDM, latissimus dorsi muscle.

The secondary outcomes measured were the NRS pain scores 24 hours and 2 months post-operation for each group. Finally, morphine consumption (in milligrams) within the first 24 hours was compared between groups.

All patients' data was acquired via the anesthesia charts, medical records, and questionnaire.

Statistical Analyses

Baseline and intraoperative characteristics of patients were compared by Student's t-test or Fisher's exact test. As the primary outcome, the proportion of patients in each group without pain 2 months post-BCS was compared by Fisher's exact test. Multivariate logistic regression was used to assess the adjusted odds ratio of the primary outcome, adjusting for ALND. For the secondary outcome, NRS pain scores 24 hours and 2 months post-operation, and morphine consumption in the first 24 hours were compared by Mann-Whitney U test. Categorical variables were expressed as numeric values (proportion), and continuous variables as means (standard deviation) or medians [interquartile range]. $P<0.05$ was considered statistically significant. All statistical analyses were performed using R software version 3.5.1 (The R Foundation for Statistical Computing, Vienna, Austria).

RESULTS

We analyzed all 43 patients who received the Pecs II block (n=22) or the serratus plane block (n=21) for perioperative analgesia of BCS. There was no significant difference between the two groups in baseline and perioperative characteristics of patients (Table 1).

The proportion of patients without postoperative pain (NRS=0) at 2 months was significantly different between the Pecs group and the Serratus group (55% vs. 19%; Table 2). The Pecs II

Table 1 Baseline and perioperative characteristics of patients

	Pecs group (n=22)	**Serratus group (n=21)**	***P* value**
Age (years)	56.0 (11.7)	53.9 (12.6)	0.58
BMI (kg/m^2)	21.8 (2.6)	21.5 (2.1)	0.75
ASA-PS (I/II)	15 / 7	12 / 9	0.54
Operation time (min)	127.8 (54.5)	114.9 (51.7)	0.43
Anesthesia time (min)	199.2 (53.7)	172.4 (50.5)	0.10
In-out balance (ml/kg/h)	3.75 (2.47)	3.68 (2.07)	0.92
Required remifentanil dose (μg/kg/min)	0.13 (0.05)	0.14 (0.03)	0.83
Surgical procedures			
Mastectomy + ALND	3 (7.0%)	2 (4.7%)	
Mastectomy + SNB	8 (18.6%)	3 (7.0%)	0.36
Partial mastectomy + ALNB	2 (4.7%)	4 (9.3%)	
Partial mastectomy + SNB	9 (20.9%)	12 (48.8%)	
ALND (+)	5 (22.7%)	6 (28.6%)	0.74
Adjuvant radiation therapy (+)	9 (40.9%)	9 (45.0%)	1.00

Values are mean (standard deviation) or number (proportion).
BMI: body mass index, ASA-PS: American Society of Anesthesiologists - physical status, ALND: axillary lymph node dissection, SNB: sentinel lymph node biopsy.

Table 2 Pain condition at postoperative 24 hours (acute pain) and two months (short-term pain)

	Pecs group (*n*=22)	Serratus group (*n*=21)	*P* value
<primary outcome>			
No pain (NRS=0): at 2 months	12 (55%)	4 (19%)	
unadjusted odds ratio	5.10 (95% CI, 1.29–20.17)		0.03*
†adjusted odds ratio	5.04 (95% CI, 1.26–20.07)		0.02*
(ALND)	1.74 (95% CI, 0.35–8.66)		0.50
<secondary outcomes>			
NRS score: at 2 months	0.5 [0.5, 1]	1 [1, 2]	0.03*
NRS score: at 24 hours	2 [1, 3]	3 [1.5, 3.5]	0.47
Morphine consumption (mg)	1.5 [0.75, 5.5]	3 [1.5, 10]	0.11

Values are median [interquartile range] or number (proportion). *significantly difference between Pecs group and Serratus group ($P<0.05$).
†The adjusted odds ratio was evaluated by the multivariable logistic regression, adjusting for axillary lymph node dissection.
NRS, numerical rating scale; CI, confidence interval; ALND, axillary lymph node dissection.

block had a reduced risk of pain 2 months post-BCS (unadjusted odds ratio, 5.1; 95% confidence interval, 1.29–20.17; P=0.03). After adjustment for ALND, the Pecs II block still had a decreased risk of pain 2 months post-BCS (adjusted odds ratio, 5.04; 95% confidence interval, 1.26–20.07; P=0.02). In addition, the median NRS score [interquartile range] of pain 2 months post-operation was significantly lower in the Pecs group than in the Serratus group (0.5 [0, 1] vs. 1 [1, 2], P=0.03; Table 2). As for postoperative acute pain, there were no significant differences between the two groups for median NRS score of pain 24 hours post-operation (Pecs group 2 [1, 3] vs. Serratus group 3 [1.5, 3.5]; P=0.47; Table 2) or morphine consumption in the first 24 hours (Pecs group 1.5 [0.75, 5.5] mg vs. 3 [1.5, 10] mg; P=0.11; Table 2).

DISCUSSION

In this retrospective, observational study, the proportion of patients without postoperative pain at 2 months after BCS was significantly less with the Pecs II block than with the serratus plane block. NRS score of postoperative pain 2 months after BCS was also lower in the Pecs II block. Therefore, we suggest that the Pecs II block may be more effective for short-term postoperative analgesia after BCS.

The difference between the two thoracic wall blocks on short-term postoperative analgesia may be explained by the different ranges of spreading of the local anesthetics. The Pecs II provides two interfascial injections, and the first injection between the pectoralis major and minor muscles may be important to prevent postoperative pain for BCS. In past reports, which compared postoperative acute pain between TPVB and thoracic wall nerve block, Kulhari et al reported that the Pecs II block was more effective than the TPVB.[22] In addition, Gupta et al reported that the serratus plane block was less effective than the TPVB.[23] We predict that this difference was caused by the first injection of the Pecs II block acting on the pectoral nerves of the brachial plexus branch. Our current study also showed that the Pecs II block might be more effective for postoperative analgesia than the serratus plane block, in accordance with the previous studies.

In contrast, we did not find a significant difference in postoperative acute pain and morphine consumption between the two blocks. Although this study did not compare the postoperative analgesia to the no block group (only general anesthesia group), previous reports have shown that these thoracic wall blocks were effective for postoperative acute pain in BCS.[19-21] Since postoperative acute pain delays enhanced recovery after surgery, its management may require multimodal analgesia including postoperative adjuvant analgesics. Morphine consumption tended to be lower with the Pecs II block than with the serratus plane block (median 1.5mg vs. 3mg; P=0.11). If the patient sample size had been larger, differences in morphine consumption could have potentially been detected. Further additional studies are needed.

Our study has several limitations. First, this study was a retrospective observational study, in which patients were not randomized into the two thoracic wall blocks. While there was no significant difference in patient characteristics between the groups, further randomized controlled trials are required. Second, the sample size may be too small to evaluate patient outcomes adjusted for factors, such as patient's age or postoperative adjuvant therapy. Third, surgical procedures for breast cancer are variable, including the extent of resection for the primary tumor and involved lymph nodes. In this study, multivariate analysis was performed to control for ALND, because ALND is a significant risk factor for chronic postoperative pain.[4-5] Finally, we did not follow-up on long-term postoperative pain. This study evaluated the short-term postoperative pain after 2 months. Because postoperative chronic pain reduces the quality of life in women, further long-term prospective studies are needed to overcome this limitation.

In conclusion, our findings suggest that Pecs II block may prevent the development of short-term postoperative pain in BCS better than the serratus plane block. However, further studies are needed in order to support this finding. In the future, these findings may lead to reduced postoperative chronic pain and improved patient quality of life.

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DISCLOSURE STATEMENT

All authors declare that they have no conflicts of interest.

REFERENCES

1) Perkins FM, Kehlet H. Chronic pain as an outcome of surgery: a review of predictive factors. *Anesthesiology*. 2000;93(4):1123–1133.
2) Hinrichs-Rocker A, Schulz K, Järvinen I, Lefering R, Simanski C, Neugebauer EA. Psychosocial predictors and correlates for chronic post-surgical pain (CPSP) - a systematic review. *Eur J Pain*. 2009;13(7):719–730.
3) Chapman CR, Donaldson GW, Davis JJ, Bradshaw DH. Improving individual measurement of postoperative pain: the pain trajectory. *J Pain*. 2011;12(2):257–262.
4) Gartner R, Jensen MB, Nielsen J, Ewertz M, Kroman N, Kehlet H. Prevalence of and factors associated with persistent pain following breast cancer surgery. *JAMA*. 2009;302(18):1985–1992.
5) Andersen KG, Kehlet H. Persistent pain after breast cancer treatment: a critical review of risk factors and strategies for prevention. *J Pain*. 2011;12(7):725–746.
6) Poleshuck EL, Katz J, Andrus CH, et al. Risk factors for chronic pain following breast cancer surgery: a prospective study. *J Pain*. 2006;7(9):626–634.
7) Macrae WA. Chronic post-surgical pain: 10 years on. *Br J Anaesth*. 2008;101(1):77–86.

8) Klein SM, Bergh A, Steele SM, Georgiade GS, Greengrass RA. Thoracic paravertebral block for breast surgery. *Anesth Analg*. 2000;90(6):1402–1405.
9) Schnabel A, Reichl SU, Kranke P, Pogatzki-Zahn EM, Zahn PK. Efficacy and safety of paravertebral blocks in breast surgery: a meta-analysis of randomized controlled trials. *Br J Anaesth*. 2010;105(6):842–852.
10) Tahiri Y, Tran DQ, Bouteaud J, et al. General anaesthesia versus thoracic paravertebral block for breast surgery: a meta-analysis. *J Plast Reconstr Aesthet Surg*. 2011;64(10):1261–1269.
11) Harue Morioka, Yoshinori Kamiya, Takayuki Yoshida, Hiroshi Baba. Pectoral nerve block combined with general anesthesia for breast cancer surgery: a retrospective comparison. *JA Clin Rep*. 2015;1(1):15.
12) Karmakar MK, Samy W, Li JW, et al. Thoracic paravertebral block and its effects on chronic pain and health-related quality of life after modified radical mastectomy. *Reg Anesth Pain Med*. 2014;39(4):289–298.
13) Hiroki Shimizu, Yoshinori Kamiya, Hironobu Nishimaki, Sadahei Denda, Hiroshi Baba. Thoracic paravertebral block reduced the incidence of chronic postoperative pain for more than 1 year after breast cancer surgery. *JA Clin Rep*. 2015;1(1):19.
14) Andreae MH, Andreae DA. Regional anaesthesia to prevent chronic pain after surgery: a Cochrane systematic review and meta-analysis. *Br J Anaesth*. 2013;111(5):711–720.
15) Kairaluoma PM, Bachmann MS, Rosenberg PH, Pere PJ. Preincisional paravertebral block reduces the prevalence of chronic pain after breast surgery. *Anesth Analg*. 2006;103(3):703–708.
16) Blanco R. The 'pecs block': a novel technique for providing analgesia after breast surgery. *Anaesthesia*. 2011;66(9):847–848.
17) Blanco R, Fajardo M, Parras Maldonado T. Ultrasound description of Pecs II (modified Pecs I): a novel approach to breast surgery. *Rev Esp Anestesiol Reanim*. 2012;59(9):470–475.
18) Blanco R, Parras T, McDonnell JG, Prats-Galino. Serratus plane block: a novel ultrasound-guided thoracic wall nerve block. *Anaesthesia*. 2013;68(11):1107–1113.
19) Versyck B, van Geffen GJ, Chin KJ. Analgesic efficacy of the Pecs II block: a systematic review and meta-analysis. *Anaesthesia*. 2019;74(5):663–673.
20) Singh PM, Borle A, Kaur M, Trikha A, Sinha A. Opioid-sparing effects of the thoracic interfascial plane blocks: a meta-analysis of randomized controlled trials. *Saudi J Anaesth*. 2018;12(1):103–111.
21) Mazzinari G, Rovira L, Casasempere A, et al. Interfascial block at the serratus muscle plane versus conventional analgesia in breast surgery: a randomized controlled trial. *Reg Anesth Pain Med*. 2019;44(1):52–58.
22) Kulhari S, Bharti N, Bala I, Arora S, Singh G. Efficacy of pectoral nerve block versus thoracic paravertebral block for postoperative analgesia after radical mastectomy: a randomized controlled trial. *Br J Anaesth*. 2016;117(3):382–386.
23) Gupta K, Srikanth K, Girdhar KK, Chan V. Analgesic efficacy of ultrasound-guided paravertebral block versus serratus plane block for modified radical mastectomy: a randomised, controlled trial. *Indian J Anaesth*. 2017;61(5):381–386.