THE ANALGESIC EFFICACY OF PECTORAL NERVE AND TRANSVERSUS THORACIC MUSCLE PLANE BLOCK IN RADICAL MASTECTOMY

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Abstract

Background: The aim of our study was to evaluate the analgesic efficacy of the combination of pectoral nerve (Pecs II) block and transversus thoracic muscle plane (TTP) block in modified radical mastectomy.

Methods: Forty-five women undergoing radical mastectomy under general anesthesia with a combination of Pecs II and TTP blocks were retrospectively compared with 45 control patients who received only general anesthesia. Analgesic efficacy was evaluated by intraoperative fentanyl dose, postoperative pain score, time until first postoperative rescue analgesia and the frequency of rescue analgesia in the first 12 postoperative hours.

Results: Intraoperative fentanyl dose was significantly lower in patients receiving Pecs II and TTP blocks compared with general anesthesia alone [mean (standard deviation), 285.6 (76.2) µg *versus* 345.3 (120.9) µg, respectively; p = 0.006], but there was no significant difference in postoperative pain scores.

Conclusion: Combined Pecs II and TTP blocks provided effective intraoperative analgesia for mastectomy, but there did not appear to be any significant postoperative therapeutic benefit.

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Introduction

Breast cancer is currently the most common cancer in women; approximately 1 million new cases are diagnosed every year, a number that is expected to increase in the future[1]. Surgery is one of the mainstays of the management strategies for breast cancer; 30%-40% of patients with breast cancer undergo mastectomy[2].

Uncontrolled perioperative pain can lead to adverse events such as tachycardia, hypertension, myocardial ischemia, decrease in alveolar ventilation, immobility, deep vein thrombosis, poor wound healing and chronic pain[3].

Many modalities have been used to manage pain during and after radical mastectomy, including regional techniques such as thoracic paravertebral block, thoracic epidural block and continuous catheter-based local anesthetic wound infiltration, and systemic techniques such as intravenous patient controlled analgesia (IV-PCA). Thoracic paravertebral block reportedly provides potent analgesia but is technically challenging and carries the risk of complications such as systemic hypotension, pneumothorax and spinal cord trauma[4]. Novel local anesthetic blocks such as pectoral nerve (Pecs II) block[5,6], transversus thoracic muscle plane (TTP) block[7] and serratus plane block[8] have been identified as means of potentially providing safe and effective analgesia, but the evidence underpinning the clinical use of these new methods is still insufficient.

The aim of this study was to evaluate the efficacy and safety of combined Pecs II and TTP block for women undergoing modified radical mastectomy.

Methods

Patients and study design

This was a retrospective study undertaken with ethics committee approval (Hiroshima University Hospital Center for Integrated Medical Research, reference number E-587).

Data were collected from the computerized clinical records of patients treated in 2015 and 2016. Ninety women were identified who had undergone radical mastectomy. Patients were classified into two groups, the Pecs + TTP group (n = 45), who received combined Pecs II and TTP blocks with general anesthesia, and the control group (n = 45), who underwent general anesthesia only. Patients' demographic and clinical characteristics were extracted from clinical records, including age, weight, height, American Society of Anesthesiologists (ASA) physical status, duration of surgery and anesthesia, and surgical procedure (with or without of resection of sentinel or axillary lymph nodes).

Outcome measures

The analgesic effect was assessed using the intraoperative dose of intravenous fentanyl, the Wong-Baker FACES pain rating scale on postoperative days 0 and 1, the frequency of use of rescue analgesia in the first 12 postoperative hours and the time to rescue analgesia (from the end of anesthesia until the first request for postoperative analgesia). Pain intensity was measured by ward nurses three or four times a day; we extracted the highest score of the day to represent the pain intensity for each of the first two postoperative days. We also recorded the nature and incidence of adverse events.

Intraoperative management

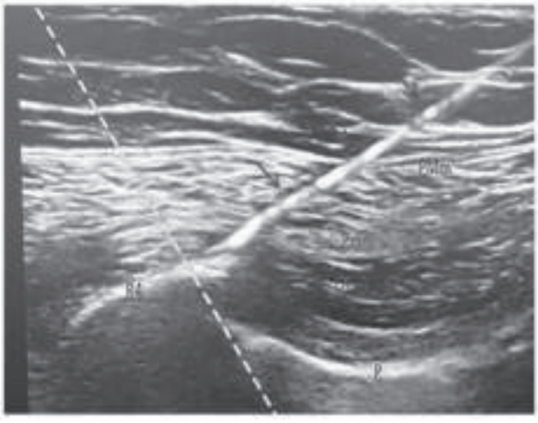
An electrocardiogram, non-invasive blood pressure, pulse oximetry, capnography, bispectral index and neuromuscular function monitor were used in all patients. General anesthesia was induced using an intravenous propofol infusion (TE-371; Terumo, Tokyo, Japan), and intravenous boluses of 100 μg fentanyl and rocuronium (0.6 mg/kg). Mechanical ventilation was provided using a 2:1 mixture of air and oxygen via a supraglottic airway device. Anesthesia was maintained using a propofol infusion, rocuronium and fentanyl were given at the discretion of the attending anesthesiologist guided by neuromuscular and hemodynamic status.

Technique

All blocks were performed after induction of general anesthesia under ultrasound guidance (Sonosite S-Nerve, Fujifilm, Tokyo, Japan) with a high frequency linear probe (6–13 MHz). We used

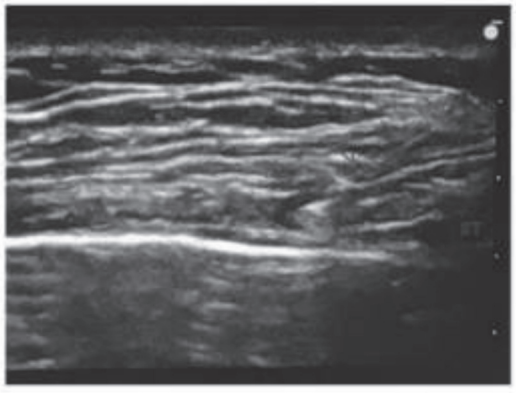
the technique described by Blanco for the Pecs II block (Fig. 1)[6]. Briefly, 20 ml of 0.25% ropivacaine was injected between pectoralis minor and serratus anterior, and 10 ml of 0.25% ropivacaine was injected between the pectoralis minor and major muscles using an 8-cm 20 G needle (UNIEVER, UNISYS, Saitama, Japan).

Fig. 1
Ultrasound image of a pectoral nerve block showing the needle between pectoralis minor and serratus anterior at the level of the fourth rib



The TTP block was performed as described by Ueshima[7]; 15 ml of 0.25% ropivacaine was injected between the internal intercostal and transversus thoracic muscles between the fourth and fifth ribs at the sternum (Fig. 2). At the end of surgery the patients were administered 50 mg flurbiprofen or 1,000 mg acetaminophen. For postoperative pain, nonsteroidal anti-inflammatory drugs or acetaminophen were given at patient request or on the judgment of ward nurses.

Fig. 2
Ultrasound image of transversus thoracic muscle plane block showing the needle between the internal intercostal muscle and transverus thoracic muscle.



Statistical analysis

Statistical analysis was performed using SPSS Statistics software (version 20; IBM, Armonk, NY, USA). Parametric datasets were compared using the unpaired t-test and data are presented as the mean ± standard deviation. Nonparametric data were compared using Mann-Whitney U-test or the chi-squared test, and are presented as the median and interquartile range. A p value <0.05 was considered statistically significant.

Table 2
Intraoperative fentanyl consumption and postoperative pain intensity

	Pecs + TTP (n = 45)	Control (n = 45)	p-value
Intraoperative fentanyl consumption (μg)*	285.6 ± 76.2	345.3 ± 120.9	0.006
Pain score POD0	2 (1-2)	2 (1-3)	0.66
Pain score POD1	2 (1-2)	2 (1-2)	0.51
Time to rescue analgesia (h)	6 (3-9.5)	6 (1.5-10)	0.89
Frequency of rescue analgesia (first 12 postoperative hours)	1 (1-1)	1 (0.5-2)	0.38

Data are expressed as the median (range) or *the mean ± standard deviation.
Abbreviations: Pecs + TTP, pectoral nerve and transversus thoracic muscle plane blocks; POD, postoperative day.

Table 1
Patients' demographic and clinical characteristics

	Pecs + TTP (n = 45)	Control (n = 45)	P-value
Age	61 ± 14	57 ± 13	0.43
Height (cm)	154.2 ± 6.4	155.0 ± 6.4	0.53
Weight (kg)	54.5 ± 8.8	53.1 ± 8.1	0.44
ASA status I/II*	4/41	9/36	0.23
Duration of surgery (min)	115 ± 30	112 ± 31	0.70
Duration of anesthesia (min)	175 ± 36	158 ± 33	<0.001
SND*	26 (57.8%)	30 (66.7%)	0.52
ALND*	19 (42.2%)	20 (44.4%)	1.0

Data are expressed as the mean ± standard deviation or * the numbers (%) of patients in each group.
Abbreviations: Pecs + TTP, pectoral nerve and transversus thoracic muscle plane blocks; ASA, American Society of Anesthesiologists; SND, sentinel node dissection; ALND, axillary lymph node dissection.

Results

Age, height, weight, ASA physical status, duration of surgery, and the proportion undergoing sentinel lymph node (SND) or axillary lymph node (ALND) dissection were comparable between the Pecs + TTP and control groups (Table 1). The duration of anesthesia was significantly longer in the Pecs + TTP group than the control group (mean 175 ± 36 min versus 158 ± 33 min, respectively ($p < 0.001$). Intraoperative fentanyl consumption was significantly lower in the Pecs + TTP group than controls (mean 285.6 ± 76.2 µg *versus* 345.3 ± 120.9 µg, respectively; $p = 0.006$).

There was no significant difference between the groups with respect to postoperative pain intensity, time to rescue analgesia or the frequency of rescue analgesia in the first 12 postoperative hours (Table 2).

Nine patients (20.0%) each in the Pecs + TTP and control complained of nausea or vomiting. No block-related complications, such as bleeding, pneumothorax or local anesthetic toxicity, were observed throughout.

Discussion

We found that combined Pecs II and TTP blocks provided safe and effective intraoperative analgesia for radical mastectomy, but that there were no apparent postoperative therapeutic beneficial effects.

Acute severe pain after mastectomy is strongly associated with subsequent persistent postsurgical pain, which occurs in 30%-70% of patients[9] and may also trigger anxiety and depression[10]. Thoracic paravertebral block is a conventional regional analgesic technique for breast surgery, and there is strong evidence for its therapeutic benefits[4]. Nonetheless, the thoracic paravertebral space lies close to the pleura and spinal nerve roots; even with ultrasound guidance the technique can be challenging. The Pecs II block described by Blanco reportedly blocks the lateral and medial pectoral nerves, the intercostobrachial nerve and the lateral pectoral cutaneous branches of the intercostal nerves[6]. Ultrasound guided Pecs II block is not technically difficult. The target muscle compartment is easily identified without changing the patient's position, which is necessary for epidural anesthesia and thoracic paravertebral block.

The clinical efficacy of the Pecs II block has been examined in several studies. Bashandy and Abbas reported that the addition of Pecs II block to general anesthesia significantly decreased visual analog scale for pain intensity and postoperative morphine consumption after breast surgery[11]. Kulhari and colleagues recently reported that the range of sensory block afforded by the Pecs II block spreads

cephalad compared with thoracic paravertebral block, and that the duration of analgesia after a single shot injection was longer after Pecs II block than thoracic paravertebral block with the same dose of local anesthetic[12].

Pecs II block is suitable for total mastectomy with ALND as it can block the second thoracic dermatome (T2), but as it does not reliably block the anterior pectoral branch of the intercostal nerve, analgesia of the internal breast tissue may be insufficient. The TTP block as described by Ueshima provides analgesia for the internal mammary region; consequently the combination of Pecs II and TTP block would be expected to provide analgesia for the whole breast[13]. Another advantage of both blocks is that they can be performed in patients receiving anticoagulant therapy, because the injection site is superficial. The combination of Pecs II and TTP blocks can therefore reportedly provide analgesia of all parts of breast[7].

In our study, the analgesic effect of Pecs + TTP blocks was restricted to the intraoperative period. There are several reasons that postoperative efficacy may not have been detected. First, ours was a retrospective study, and although pain scores were recorded regularly three or four times a day, they may not have coincided with the expected duration of the block, which is reportedly approximately 8 h[6]. Second, although the FACES scale is easy to for patients to understand, in adults the sensitivity is inferior to an 11-point numeric rating scale or visual analog scale[14]. Moreover, we did not assess pain intensity on movement; Pecs II blocks the lateral and medial pectoral nerves that have no sensory component but are associated with postoperative pectoralis major muscle spasm[15].

Although the intraoperative consumption of fentanyl was lower in the Pecs + TTP group, the incidence of postoperative nausea and vomiting was the same as the control group. As none of the patients requested additional opioid analgesia postoperatively, remifentanil may be more suitable than fentanyl for intraoperative analgesia during mastectomy augmented by Pecs II and TTP blocks.

Our study had the following limitations. First, it was retrospective in nature and patients were not randomized into the experimental groups. Second, as Pecs II and TTP blocks were performed after induction of general anesthesia, it was not possible to assess whether the block had worked or not. Third, there were no clear criteria to inform the administration of intra-or postoperative analgesia, which were given according to the anesthesiologist's discretion, patient request or on the nurses' recommendations.

In conclusion, the combination of Pecs II and TTP blocks provided effective intraoperative analgesia for radical mastectomy, enabling reduced opioid consumption, but did not appear to have a postoperative therapeutic benefit.

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