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Original Article

Comparative evaluation of PECS II versus RISS block for postoperative analgesia in breast cancer surgery: a randomized controlled trial

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Abstract: Objective: This study aimed to investigate the analgesic effects of Pectoral Nerve Block Type II (PECS II) versus Rhomboid Intercostal and Subserratus Plane Block (RISS) after modified radical mastectomy (MRM) for breast cancer. Methods: This prospective, double-blind, randomized controlled trial recruited 67 female patients undergoing unilateral MRM from December 1, 2023, to December 1, 2024 at Inner Mongolia Baogang Hospital. Patients were randomly assigned (1:1) to the PECS II group (n=30) or the RISS group (n=30). Primary outcomes included Quality of Recovery (QoR-40) scores at 6 and 24 hours and Visual Analogue Scale (VAS) pain scores in the PACU and at 2, 6, 12, 24, and 48 hours postoperatively. Secondary outcomes included sufentanil consumption via PCIA, the number of effective compressions, remifentanil use during surgery, additional analgesic administrations, sleep quality, and adverse events. Results: The PECS II group demonstrated significantly lower VAS scores than the RISS group at rest and during movement in the PACU and at 2, 6, 12, and 24 hours ($P<0.05$). The QoR-40 score at 6 hours was significantly higher in the PECS II group ($P<0.0001$). The remifentanil consumption, sufentanil dosage and effective compressions via PCIA during surgery were also significantly lower in the PECS II group, compared to the RISS group ($P<0.0001$). Conclusion: PECS II block appears to be a more effective analgesic technique than RISS block for patients undergoing breast cancer surgery, providing better pain control, reducing opioid consumption, and potentially facilitating faster recovery.

Keywords: Breast cancer, multimodal analgesia, pectoral nerve block type II, pain, rhomboid intercostal and subserratus plane block

Introduction

Breast cancer is a type of malignant tumor that occurs in the breast epithelial tissue [1], represents a major global health threat with profound gender disparity - 99% of cases occur in women, while male patients account for only 1%. Being the most frequently diagnosed cancer among women, breast cancer has become one of the most common malignant tumors, posing significant threats to physical and mental health [2, 3]. Globally, approximately 630,000 women worldwide die from breast cancer every year. In China, the incidence of breast cancer continues to rise alarmingly, now ranking first among all newly diagnosed female cancers and exhibiting a concerning trend toward younger-onset disease [4].

Modified radical mastectomy (MRM) is a commonly used surgical treatment method for patients with early and intermediate breast cancer [5]. However, postoperative pain remains a critical concern [6, 7]. Effective analgesia is not only crucial for patient comfort but also helps to promote early patient mobilization, reduce postoperative complications, and improve the overall rehabilitation situation. Regional anesthesia techniques have become pivotal in managing postoperative pain after breast surgery [8, 9].

Recent advances in interfacial plane blocks have expanded analgesic options, including pectoral nerve block type I (interpectoral), pectoral nerve block type II (interpectoral and subpectoral), serratus anterior plane block (SAPB),

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erector spinae plane block (ESPB), retrolaminar block, rhomboid-intercostal and serratus anterior plane block (RISS), pectoral-intercostal fascia block (PIFB), and transversus thoracis plane block (TTP). The growing number of available block modalities raises the question of how to choose the appropriate method [7, 10, 11].

PECS II block, a type of interfacial plane block technique, has proven effective in improving analgesic effect for breast cancer patients undergoing mastectomy [12, 13]. It involves injecting local anesthetics into the plane between the pectoralis major and pectoralis minor muscles (PECS I), and between the pectoralis minor and serratus anterior muscles at the third rib level (PECS II). In 2018, Elsharkawy et al. [14] introduced a new interfacial plane block technique for analgesia in the chest and upper abdomen, namely the rhomboid-intercostal and subserratus plane (RISS) block. This technique involves injecting local anesthetics between the rhomboid and intercostal muscles and between the serratus and intercostal muscles, theoretically blocking the lateral cutaneous branches of the intercostal nerves. RISS block offers recognizable ultrasound images and flexible puncture ranges, providing effective analgesia for multiple rib fractures, breast surgeries, lung transplants and other situations [15-17].

Despite reports on the efficacies of these two block methods, direct comparative studies between PECS II and RISS in breast cancer surgery are limited. Understanding the relative effectiveness, safety characteristics, and potential advantages or disadvantages of these two techniques is crucial for both anesthesiologists and surgeons. This randomized controlled trial aims to address these knowledge gaps and provide evidence-based guidance for selecting the optimal regional anesthesia technique for postoperative analgesia after breast cancer surgery. By comparing the analgesic effects, opioid requirements, and adverse events between PECS II block and RISS block, this study seeks to optimize perioperative care and improve patient prognosis.

Materials and methods

General information

This study has been approved by the Ethics Committee of Inner Mongolia Baotou Steel Hospital (Approval Number: 2024-MER-302), registered on the ClinicalTrials.gov (NCT06760429) and adhered to the Consolidated Standards of Reporting Trials (CONSORT) statement and the Declaration of Helsinki. Informed consent was obtained from all participants after detailing the research process, potential risks and purpose. The consent form clarified the nature of the interventions, voluntary participation, and confidentiality.

The study enrolled 67 female breast cancer patients admitted to Inner Mongolia Baotou Steel Hospital between December 1, 2023 and December 1, 2024, aged between 30 and 80 years, with a body mass index (BMI) ranging from 18 to 35 kg/m^2. Participants with American Society of Anesthesiologists (ASA) physical status of grade I to III were randomly assigned to the RISS group or the PECS II group at a 1:1 ratio using a random number table generated by an independent statistician. The allocation sequence was disclosed only after enrollment and baseline characteristic recording.

Inclusion criteria: (1) Patients meeting breast cancer diagnostic criteria; (2) Tolerance for surgery and anesthesia.

Exclusion criteria: (1) Patients with severe systemic diseases or anesthesia problems; (2) Those with coagulation disorders; (3) Patients with puncture contraindications or infections; (4) Allergy to local anesthetics; (5) Refusal to sign the informed consent form; (6) Patients with cognitive or communication issues.

Trial design

This prospective, double-blind, randomized controlled trial involved concealing patient grouping data and the ultrasound-guided puncture injection drug preparation method in consecutively numbered opaque envelopes before surgery. On the day of surgery, an anesthesiologist not involved in this study opened the envelope, prepared the appropriate medication according to the drug instructions and performed intraoperative general anesthesia. Postoperative follow-up was conducted by nurses who were spared from this study. An emergency unblinding envelope containing all grouping information was available for serious adverse events.

Methods

Interventions: Both groups fasted for 8 hours and avoided clear liquids for 2 hours before

operation. Upon entering the operating room, peripheral venous access was established, and standard monitoring was initiated, including electrocardiogram (ECG), non-invasive arterial blood pressure, and oxygen saturation (SpO_2), and supplemental oxygen inhalation.

PECS II block group: Sterile gloves were donned, and the puncture site was disinfected with iodine tincture and draped. The operator identified the axillary artery and vein using ultrasound, then located the pectoralis major, minor, and serratus anterior muscles at the third rib level. Using an ultrasound device (Model M Turbo, Sonosite Inc., Bothell, Washington, USA) and a linear array probe with a 22G echogenic needle (Sonoplex stimulating cannula, Pajunk GmbH, Geisingen, Germany, with a length of 100 mm), the block operation was performed (the probe frequency was 6-13 MHz, and the depth was 38 mm). After disinfection and draping, 15 mL of 0.375% ropivacaine was injected into the facial plane between the pectoralis minor and serratus anterior muscles, followed by another 15 mL into the plane between the pectoralis major and minor muscles. Sensory block area and local anesthetic spread were monitored using ultrasound, alcohol swabs, and pinprick tests. All the block operations were performed by a single anesthesiologist who had already carried out more than 30 RISS operations before conducting this study. To minimize bias, both the anesthesiologists performing the blocks and the surgeons were blinded to the study objectives and hypotheses. The anesthesiologist not involved in the study opened the envelope and prepared the appropriate medication according to the drug instructions. The anesthesiologist who performed the blocks was not involved in the postoperative data collection.

RISS group: Following identical sterile preparation and ultrasound/needle specifications as the PECS II group, the linear ultrasound probe was placed sagittally at the level of the 5th to 6th thoracic vertebrae (T5-6), just medial to the scapula, to visualize the trapezius, rhomboid major, and intercostal muscles. A 21G needle was inserted in a cranial-to-caudal direction into the rhomboid major-intercostal muscle plane, and 20 mL of 0.375% ropivacaine was injected after negative aspiration. After that, the ultrasound probe was moved caudolaterally to the T8-9 level to identify the tissue plane between the serratus anterior and external intercostal muscles the puncture needle was advanced from the previous insertion site, and another 20 mL of 0.375% ropivacaine was injected following the negative aspiration. All the block operations were performed by a single anesthesiologist who had already carried out more than 30 RISS operations before conducting this study. To minimize bias, both the anesthesiologists performing the blocks and the surgeons were blinded to the study objectives and hypotheses. The anesthesiologist not involved in the study opened the envelope and prepared the appropriate medication according to the drug instructions. The anesthesiologist who performed the blocks was not involved in the postoperative data collection.

General anesthesia protocol: The induction medications included midazolam (0.05 mL/kg), etomidate (0.3 mg/kg), sufentanil (2 μg/kg), rocuronium (0.6 mg/kg), and propofol (2 mg/kg). After sufficient oxygenation, tracheal intubation was performed using video larygoscopy, confirmed by bilateral lung auscultation. Anesthesia was maintained with remifentanil (0.1-0.3 μg/(kg·min)) and propofol (2-4 mg/(kg·h)) infusions, titrated to maintain a bispectral index (BIS) of 40-60. Rocuronium boluses sustained muscle relaxation. Hemodynamic stability was managed with ephedrine (MAP decreased by more than 20%) or atropine (HR<50 bpm). Upon spontaneous breathing recovery and meeting extubation criteria, patients were transferred to the post-anesthesia care unit (PACU).

Postoperative analgesic methods: Multimodal analgesia was implemented after the operation. In the PACU, patients received PCIA with sufficient sufentanil (2 μg/kg diluted to 100 mL). The background infusion rate was 3 mL/h, with a patient-controlled bolus dose of 2 mL and a lockout time of 30 minutes. If VAS ≥3 or patients requested analgesia, PCIA was initiated with an initial loading dose of 5 mL/h, the single bolus dose was 2 mL, and the lockout time was 15 minutes. If pain persisted after two PCIA administrations within 30 minutes, additional sufentanil (1 μg/kg) was administered, with records of remedial analgesic administrations and effective analgesia pump compressions within the first 24 postoperative hours. A dedicated nurse who was outside this study monitored the patients in the PACU and

on the ward for the first 24 hours postoperatively. The nurse was trained to assess pain scores and PCA usage and to administer rescue analgesia according to the protocol. The bedside physician was available on call and was immediately notified if the patient's pain was not relieved after pressing the PCIA button twice within 30 minutes.

Outcome measures

Primary outcome measures: (1) The QoR-40 is a 40-item questionnaire consisting of five subheadings: physical comfort (n=12), emotional state (n=9), patient support (n=7), pain (n=7), and physical independence (n=5). Each question was scored on a five-point Likert scale. Total score ranged from 40 points (extremely poor) to 200 points (excellent).

(2) The VAS was used to assess the intensity of exercise-induced pain. It is a pain rating scale that is commonly used to measure the intensity or frequency of various symptoms and is a frequently adopted pain rating scale. Both groups underwent VAS scoring at the time of postoperative admission to the PACU, and at 2, 4, 8, 16, and 24 hours after the operation. The VAS scores were classified as follows: 0 (no pain), 1-3 (mild pain), 4-7 (moderate pain), and 8-10 (severe pain). Exercise-induced pain was defined as abdominal pain when patients coughed (cough-induced pain). This classification provided a clear framework for analyzing and interpreting the intensity of postoperative exercise-related pain in both study groups.

Secondary outcome measures: (1) Consumption of remifentanil during surgery. (2) Postoperative sufentanil consumption in PCIA. (3) The frequency of analgesic drug use within 24 hours after the operation. (4) The incidence rates of postoperative nausea, vomiting, hematoma at the puncture site, and hypotension. (5) Patient satisfaction.

Statistical analysis

The sample size was determined a priori using PASS 15.0 software (NCSS, LLC. Kaysville, Utah, USA), based on preliminary data and clinically relevant assumptions. Data from our pilot study, involving 10 patients per group, yielded an estimated difference in mean Visual Analog Scale (VAS) pain scores at 24 hours post-surgery between the PECS II and RISS groups of approximately 1.0 (on a 0-10 scale). A difference of 1.0 on the VAS was considered clinically significant.

SPSS 24.0 software was used to analyze the data. Normal distributed measurement data were expressed as mean ± standard deviation ($\bar{x}$±SD). Independent-samples t-test was employed for comparison between groups. One-way analysis of variance was adopted for within-group comparisons, and repeated measures analysis of variance was used for comparisons at multiple time points. Count data were expressed as the number of cases [n (%)], and comparison between groups were performed by chi-square test or Fisher's exact probability analysis. The significance level was set at α= 0.05. For data with a non-normal distribution, the Mann-Whitney U test was used for between-group comparisons. Differences with a *P* value less than 0.05 were considered statistically significant.

Results

In this study, 67 patients were initially recruited, out of which 4 refused to sign the informed consent form, 2 were allergic to local anesthetics and 1 suffered from coagulation disorders, and finally 60 patients were included in the study, with 30 in each Group. See **Figure 1**.

General and baseline data

The enrolled patients were divided into 2 groups of 30 cases each using the randomized numerical table method. There was no significant difference between the baseline data of the two groups, P>0.05. See **Table 1**.

Comparison of block operation times and postoperative situation

Intraoperative consumption of remifentanil was lower in the PECS II group (622.50±162.43) μg than in the RISS group (846.86±262.10) μg, P=0.0002. Regarding the postoperative consumption of sufentanil, it was lower in the PECS II group (117.34±17.67) μg than in the RISS group (130.86±22.63) μg, P=0.0125. Effective analgesia pump compressions within 24 hours after surgery were lower in the PECS II group (6.97±3.02) than that in the RISS group

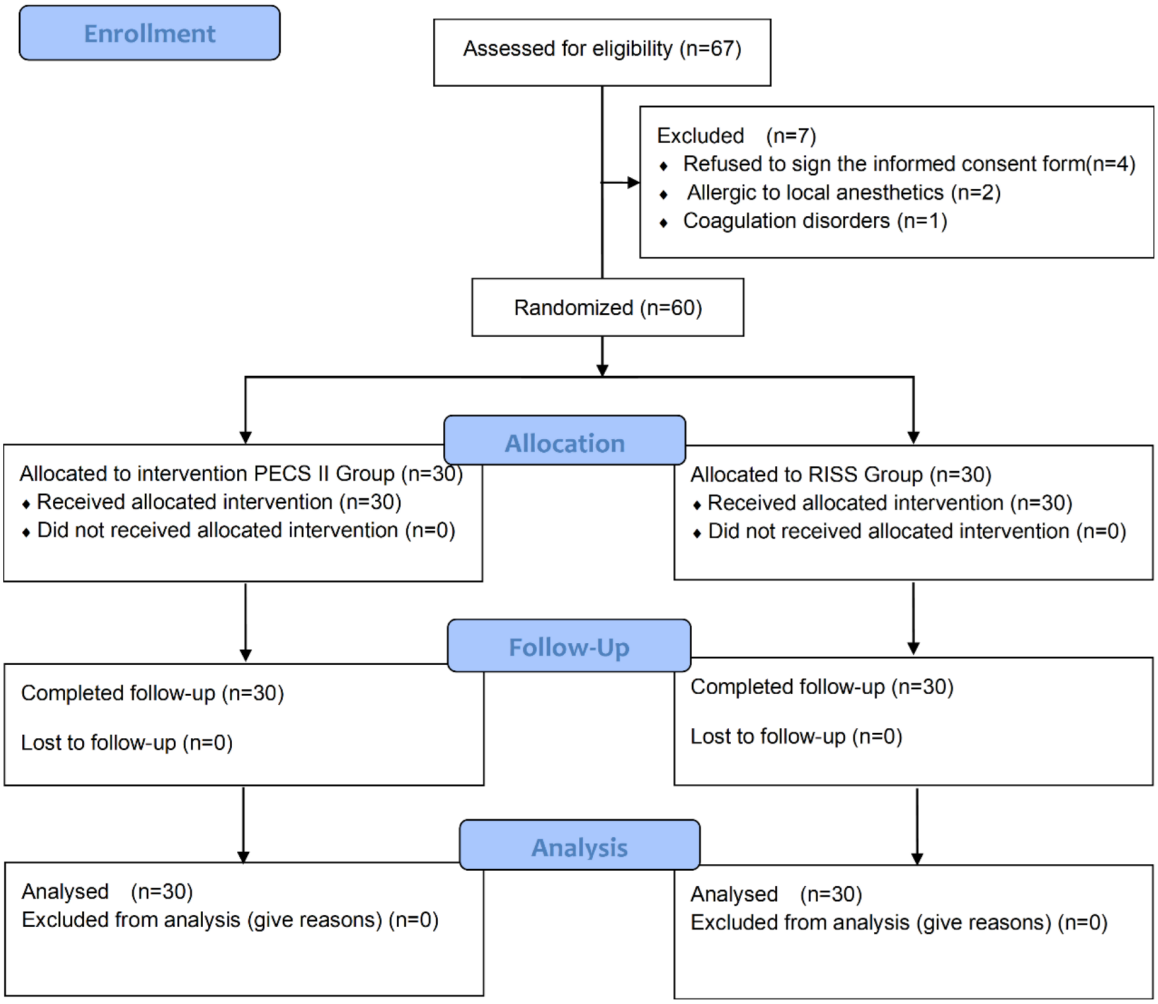

Figure 1. CONSORT study flow diagram. PECS II, type II pectoral nerve block; RISS, Rhomboid Intercostal and Sub serratus Plane Block.

Table 1. Clinical characteristics of patients in the two groups

Variable	PECS II Group (n=30)	RISS Group (n=30)	χ^2/t	P
Age (years) (mean ± SD)	52.00±10.30	52.80±8.29	0.3023	0.7635
BMI (kg/m^2)	28.14±4.44	28.86±5.38	1.0040	0.3194
ASA grade			0.4909	0.7823
ASA grading I	4	6		
ASA grading II	23	21		
ASA grading III	3	3		
Procedure of duration (min)	99.57±10.40	103.27±10.85	1.3470	0.1832
Duration of anesthesia (min)	109.44±30.16	110.09±34.95	0.0775	0.9385
Hypertension	7	8		>0.9999
Diabetes	4	5		>0.9999
Surgical incision (Left breast/right breast)	19/11	20/10		>0.9999

Note: χ^2 indicates chi-square test, and t indicates independent-samples t test. BMI: body mass index; ASA: American Society of Anesthesiologists.

(15.00±3.11), P<0.0001. Remedial analgesia administrations were lower in the PECS II group (0.45±0.60 times) than that in the RISS group (2.85±1.20 times, P<0.0001). See **Table 2**.

Table 2. Block operation times and postoperative situation

Parameters	PECS II Group (n=30)	RISS Group (n=30)	χ^2/t	P
Block operation time (min)	15.89 (±6.39)	18.45 (±4.20)	1.8370	0.0700
Time to first ambulation (h)	5.88 (±1.71)	6.42 (±1.75)	1.2170	0.2285
Remifentanil consumption (μg)	622.50 (±162.43)	846.86 (±262.10)	3.9850	**0.0002**
PCIA sufentanil dosage (μg)	117.34 (±17.67)	130.86 (±22.63)	2.5790	**0.0125**
Number of analgesic in the 24 hour	6.97 (±3.02)	15.00 (±3.11)	10.1500	**<0.0001**
Number of remedial analgesia	0.45 (±0.60)	2.85 (±1.20)	0.2315	**<0.0001**
Complications related to block				
Intraoperative hypotension	0 (0%)	3 (10%)	1.4000	0.2373
Pneumothorax	0 (0%)	0 (0%)	0.0000	>0.9999
Itch	0 (0%)	0 (0%)	0.0000	>0.9999
Arrhythmia	1 (3.3%)	1 (3.3%)	0.0000	0.6120

Note: χ^2 represents the chi-square test, and t represents the independent-samples t test. Data presented as mean ± SD or as total number of subjects and percentages, with significant values in bold.

Table 3. Stress indicators

Stress indicators	PECS II Group (n=30)	RISS Group (n=30)	t	P
SBP/mmHg				
T0	119.18±4.64	119.18±4.64	0.000	>0.999
T1	109.53±6.99	109.90±5.24	0.2341	>0.999
T2	115.15±4.93	116.54±6.35	0.8514	>0.999
T3	129.63±6.47	128.16±8.08	0.8727	>0.999
DBP/mmHg				
T0	78.17±6.06	78.80±5.68	0.4482	>0.999
T1	78.17±6.76	80.73±3.96	1.816	0.280
T2	79.70±5.18	81.50±4.07	1.274	0.820
T3	91.53±5.30	91.50±6.05	0.02359	>0.999
HR (times/min)				
T0	80.67±7.21	81.10±3.53	0.2749	>0.999
T1	77.07±5.23	78.97±5.33	1.2050	0.920
T2	80.50±5.94	81.53±5.66	0.6556	>0.999
T3	95.30±7.54	92.23±5.15	1.9460	0.220

Note: Data are presented as mean ± SD, with significant values in bold. *P* value <0.05 was considered statistically significant.

Hemodynamic stability

Hemodynamic parameters (MAP, HR, SpO_2 and RR) showed no differences between the two groups throughout perioperative timepoints: admission (T0), surgery initiation (T1), 30 minutes intraoperative (T2), and 10 minutes postoperative (T3) (all P>0.05). Detailed comparisons are presented in **Table 3**.

Comparison of QoR, VAS at rest and active, sleep quality between groups

Quality of recovery (QoR-40): at 6 hours after surgery, the PECS II group demonstrated significantly higher QoR-40 scores compared to RISS (174.83±4.5 vs. 162.03±4.18, P<0.0001). The resting VAS, upon PACU admission was 3.73± 1.36 (PECS II) vs. 4.73±1.05 (RISS), 3.27±1.01 (PECS II) vs. 4.00±1.39 (RISS) at 2 hours, 2.93±1.28 (PECS II) vs. 3.80±1.10 (RISS), at 6 hours, 2.53±0.94 (PECS II) vs. 3.27±1.28 (RISS) at 12 hours, and 1.77±0.57 (PECS II) vs. 2.80±0.71 (RISS) at 24 hours, all P<0.05. Dynamic VAS was 4.10±0.96 (PECS II) vs. 5.67± 1.40 (RISS) upon PACU admission, 3.83±1.34 (PECS II) vs. 5.03±1.21 (RISS) at 2 hours, 3.60±1.07 (PECS II) vs. 4.53±1.25 (RISS) at 6 hours, 3.00±0.98 (PECS II) vs. 3.93±1.08 (RISS) at 12 hours, and 2.17±0.79 (PECS II) vs. 3.27±0.91 (RISS) at 24 hours, all P<0.05. Full temporal profiles are summarized in **Table 4**.

Table 4. Comparison of QOR, VAS at rest and activity between groups

	PECS II Group (n=30)	RISS Group (n=30)	t	P
Quality of recovery-40 scores				
1 day before surgery	180.87±6.93	177.80±7.75	1.738	0.2518
6 h post-surgery	174.83±4.50	162.03±4.18	1.587	**<0.0001**
The first day after surgery	182.60±9.20	171.81±8.20	37.500	0.2231
VAS, at rest				
PACU	3.73±1.36	4.73±1.05	3.713	**0.002**
2 h after surgery	3.27±1.01	4.00±1.39	2.723	**0.040**
6 h after surgery	2.93±1.28	3.80±1.10	3.218	**0.010**
12 h after surgery	2.53±0.94	3.27±1.28	2.723	**0.040**
24 h after surgery	1.77±0.57	2.80±0.71	3.836	**0.001**
48 h after surgery	1.52±0.66	2.27±0.63	1.733	0.510
VAS, at active				
PACU	4.10±0.96	5.67±1.40	5.586	**<0.001**
2 h after surgery	3.83±1.34	5.03±1.21	5.942	**<0.001**
6 h after surgery	3.60±1.07	4.53±1.25	3.328	**0.006**
12 h after surgery	3.00±0.98	3.93±1.08	3.328	**0.006**
24 h after surgery	2.17±0.79	3.27±0.91	3.922	**<0.001**
48 h after surgery	1.93±0.74	2.53±0.86	1.664	0.590

Note: All results are presented using the mean with standard deviation (±SD), with significant values in bold. PECS II, type II pectoral nerve block; RISS, Rhomboid Intercostal and Sub serratus Plane Block; VAS, visual analog scale; PACU post anesthesia care unit; The QoR-40 is a questionnaire that consists of 40 items with five subheadings: physical comfort (n=12), emotional state (n=9), patient support (n=7), pain (n=7), and physical independence (n=5). Each question is scored on a five-point Likert scale. The total score ranges from 40 (very poor) to 200 (excellent). The QoR-40 was administered 1 day before surgery in the outpatient clinic of the anesthesiology department (t1), at 6 h post-surgery (t2), and before discharge from the hospital on the first postoperative day (t3).

Table 5. Comparison of side effects and patient satisfaction between groups

	PECS II Group (n=30)	RISS Group (n=30)	χ^2	P
Postoperative complications				
Hypertension	1 (3.3%)	3 (6.7%)	0.2678	0.612
Atelectasis	0 (0%)	0 (0%)	0.000	>0.999
Pleural effusion	0 (0%)	0 (0%)	0.000	>0.999
Nausea and vomiting	1 (3.3%)	5 (16.6%)	1.670	0.1945
Patient satisfaction				
Dissatisfied	1 (3.3%)	3 (6.7%)	0.268	0.612
Fair	5 (16.7%)	18(60.0%)	10.150	**0.0012**
Satisfied	15 (50.0%)	5 (16.7%)	6.075	**0.0127**
Very satisfied	9 (30.0%)	4 (13.3%)	1.570	0.2092

Note: χ^2 represents the chi-square test. Data presented as total number of subjects and percentages, with significant values in bold.

Comparison of side effects and patient satisfaction

Nausea, vomiting, puncture-site hematoma, and hypotension incidence did not differ between groups (all P>0.05). Patient satisfaction was higher in the PECS II group (neutral: 5 (16.7%), satisfied: 15 (50.0%)) compared to the RISS group (neutral: 18 (60.0%), satisfied: 5 (16.7%)), P=0.0012 and P=0.0127, respectively. Detailed data are presented in **Table 5**.

Discussion

This randomized controlled trial demonstrated that ultrasound-guided PECS II block provides

superior postoperative analgesia compared to RISS block in patients after modified radical mastectomy (MRM). As evidenced by the significantly lower Visual Analogue Scale (VAS) scores during both rest and movement in the PECS II group. Patients in the PECS II group had higher QoR at 6 hours post-surgery and better sleep quality on the first night. Intraoperative remifentanil consumption and lower postoperative sufentanil usage and frequency were lower in the PECS II group. Patients were more satisfied with the PECS II block.

The differences in analgesic effects between these two blocks are likely attributed to their different anatomical coverage. PECS II consists of two parts: a superficial injection to block the intercostobrachial, medial and lateral pectoral nerves on the fascial plane between the pectoralis major and pectoralis minor muscles; and a deep injection to block the thoracodorsal nerve, the long thoracic nerve, and the lateral branches of the thoracic intercostal nerve [18, 19]. The PECS II acts on important nerves that innervate the breast and its surrounding tissues. It effectively blocks the medial and lateral pectoral nerves, which are indispensable components of the somatic nerve supply to the breast. From an anatomical perspective [19], the breast and chest wall are jointly innervated by the intercostal, brachial plexus, and superficial cervical plexus nerves. The lateral half of the breast and its skin is supplied by the lateral cutaneous branches of the T1-T7 intercostal nerves, the medial half is innervated by the anterior cutaneous branches of the T1-T6 intercostal nerves, and the cephalic skin is also innervated by the supraclavicular nerves (superficial cervical plexus). The pectoralis major and minor muscles and related fascia are supplied by the medial and lateral pectoral nerves, and the axilla is complexly innervated by the intercostobrachial nerve and others. A cadaver study also confirmed the spread pattern of PECS II block, staining several nerves. The authors of this study evaluated the PECS II block used in breast surgery from an anatomical perspective, concluding that after the injection of the PECS II block, staining of the intercostobrachial, intercostal, thoracodorsal, long thoracic and pectoral nerves occurred. They also pointed out that injection above the serratus anterior muscle might provide better anesthetic effects for axillary surgery [20, 21].

Studies through cadaver dissections found that the RISS block can stain the lateral cutaneous branches of the T3-T9 intercostal nerves [22]. Clinical cases have also shown that it produces analgesic effects in the corresponding dermatomes, indicating that it effectively acts on these nerve branches and provide sensory innervation to the anterolateral region of the chest without affecting the thoracodorsal and long thoracic nerves. The long thoracic nerve and the thoracodorsal nerve are of great significance in breast cancer surgeries and postoperative pain management. Their anatomical locations and functional characteristics determine their potential impacts during surgery and their roles in postoperative pain generation mechanisms. The blocking effects of these nerves are also directly related to the postoperative recovery quality of patients. The PECS II, by precisely acting on these nerves, can provide a more comprehensive and effective block, and thus achieves better pain control compared with the RISS. However, the RISS block also has its unique advantages. Firstly, the injection points can be adjusted according to the dermatome distribution of pain. The injection points in the rhomboid intercostal plane can be selected between T3 and T6, and those in the subserratus plane can be chosen between T4 and T10, in order to achieve precise analgesic effects. Secondly, catheters can be placed for continuous analgesia, and their positions are relatively far from the surgical incisions, which is less likely to interfere with the surgical field, and has great advantages in actual clinical operations [23].

Danielle Lovett-Carter et al. [22] conducted a meta-analysis of seven randomized controlled trials. The results demonstrated that the pectoral nerve block (PECS block) can effectively reduce the postoperative opioid usage and pain scores after mastectomy, and have a relatively low complication rate. Therefore, it can be considered as an effective strategy to improve the analgesic effect after breast cancer mastectomy, which is consistent with our results. Barrington MJ et al. [24] found, through a multicenter randomized clinical trial, that in most breast cancer surgeries, PECS II block was not superior to the local infiltration by the surgeons in improving the scores of the Quality of Recovery-15 (QoR-15) questionnaire at 24 hours and the scores of the Brief Pain Inventory (BPI)

at 3 months after surgery. Moreover, there were no significant differences between the two groups in the secondary outcomes of postoperative pain, functional interference, PACU and hospitalization time, and opioid usage. This is inconsistent with our results. Several previous studies have investigated the analgesic effects of the pectoral nerve block (PECS block) and the rhomboid intercostal block (RIB) applied in breast surgeries [19, 25]. To the best of our knowledge, our study is the first in the literature to compare the analgesic effects of PECS II block and RISS block.

This study has several limitations. Firstly, we used 0.375% ropivacaine, so additional studies, including the use of lower or higher concentrations might be required to evaluate the efficacy of different concentrations of local anesthetic. In this study, the total volume of ropivacaine used in the RISS group was 40 mL, which was higher than the 30 mL used in the PECS II group. Although we kept the concentration consistent, the varied volumes may have contributed to our findings. Secondly, many of the included studies had relatively small sample sizes, which reduced their power and limited the external validity. Future studies with larger sample sizes are needed. Moreover, we reported only short-term results, and long-term results still needed to be followed through with. Thirdly, this study only examined the intraoperative remifentanil usage in the two groups and did not compare the usage of propofol. Therefore, its effects on patients cannot be completely excluded. Fourthly, a multimodal analgesic strategy was adopted in this study, so the postoperative use of sufentanil might have masked some of the analgesic effects of the two block methods.

The application of ultrasound-guided PECS II block provides a promising approach for clinical practice. PECS II block minimizes motor pain, reduces reliance on analgesic medications, and not only contributes to patients' comfort, but also offers potential cost-saving advantages for healthcare providers. These findings suggest that the PECS II block could become a valuable addition to the pain management toolkit for breast cancer postoperative care, yielding a more effective and patient-friendly method for postoperative care.

Conclusion

Incorporating ultrasound-guided PECS II into the pain management protocol for modified radical mastectomy (MRM) of breast cancer offers practical benefits by alleviating pain at rest and during movement, along with the quantifiable reduction in the requirement for perioperative analgesic drugs. PECS II appears more effective than RISS for postoperative analgesia in breast cancer surgery, as it provides better pain control and reduces opioid consumption. These findings suggest that PECS II should be considered the preferred method for postoperative pain management in these patients. However, further research is needed to confirm these results and explore the mechanisms underlying the benefits of PECS II.

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Disclosure of conflict of interest

None.

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