ORIGINAL ARTICLE

Combined Transversus Thoracic Muscle Plane Block with Pectoral Nerve Block for Pain Relief of Breast Cancer Surgery. A Comparative Controlled Study

Tarek M. Abo Elanin, Abdalla M. Abdalla, Mahmoud E. R. Turky *

Department of Anesthesia, Intensive care and Pain Management, Faculty of Medicine for Boys, Al-Azhar University, Cairo, Egypt

Abstract

Background: ***Patients undergoing breast cancer surgery may have emotional and physical challenges during and after the procedure, making pain management a critical component of their postoperative rehabilitation. It is possible for around 20% of breast surgery patients to experience chronic pain after the procedure.***

Aim and objectives: ***To compare the effectiveness of TTMP, pectoral nerves, and pectoral nerves alone in reducing postoperative pain following breast cancer surgery.***

Subjects and methods: ***This randomized controlled experiment had 110-patients who were enrolled at Al-Azhar University Hospitals(Sayed Galal and Al-Hussien) from March 2023 to January 2025. Two equal groups were formed from the patients:The 55-patients in Group-A underwent transversus thoracic muscle plane and pectoral nerves blocks, while the 55-patients in Group-B underwent pectoral nerves blocks.***

Results: Group A experienced a markedly longer delay compared to group B in the time it took to initiate the use of rescue analgesics. Compared to group B, group A consumed a substantially lower total dose of morphine. Group A had significantly lower VAS than group-B at 4hours, 6 hours, and 8hours, but there was no significant difference between the two groups at 30minutes, 60minutes, 2hours, 12hours, and 24hours.

Conclusion: ***When compared to PECS blocks alone, TTP-PECS improved pain management following breast cancer procedures by reducing VAS score, heart rate, maximum opioid consumption (MAP), and latency to first request of rescue analgesia.***

Keywords: Breast cancer; TTMP; Pectoral Nerve Block

1. Introduction

Perioperative pain management after breast cancer surgery can be achieved with the use of regional anesthetic procedures, including the Transversus Thoracic Muscle Plane(TTMP) block and pectoral nerve block.[1]

The transversus thoracic muscle plane and the intercostal muscles make up the chest wall, and the TTMP entails administering a local anesthetic into this plane. For the purpose of sensory innervation of the breasts and chest wall, this block is aimed at the intercostal nerves. There is evidence that the TTMP helps alleviate postoperative pain and lessens the need for further painkillers.[2]

When you want to block the pectoral nerves, you'll need to inject a local anesthetic into the area under your arm. The breasts and the wall of the chest are also innervated sensorily by these neurons. When it comes to breast cancer surgery, a well-established and straightforward method for reducing perioperative pain is the pectoral nerve block.[3]

The TTMP may be preferable to blocking just the pectoral nerves since it reaches a wider region of the chest wall, which includes the breasts. If this is the case, it might alleviate pain in that area more effectively. If you're looking to cut back on post-operative painkillers like opioids, the TTMP might be the way to go.[4]

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* Corresponding author at: Anesthesia, Intensive care and Pain Management, Faculty of Medicine for Boys, Al-Azhar University, Cairo, Egypt.
E-mail address: turkeymahmoud808@gmail.com (M. E. R. Turky).

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More and more people are looking at using a new regional analgesic approach called "TTP-PECS" after breast surgery. It combines the pectoral and serratus nerves plane block(PECS) with the TTP block, making it a less intrusive option. Patients having modified radical mastectomy (MRM) were shown to have less postoperative pain when treated with TTP-PECS as opposed to PECS or thoracic paravertebral block(TPVB), according to two randomized clinical trials conducted by Wang and Zhao.[5]

The aim of this study was to compare the effectiveness of TTMP, pectoral nerves, and pectoral nerves alone in reducing postoperative pain following breast cancer surgery.

2. Patients and methods

This randomized controlled study was carried out on 110 patients at Al-Azhar University Hospitals(Sayed Galal and Al-Hussien) from March 2023 to January 2025.

Inclusion criteria:

Age:38-70 years, ASA physical status I and II, patients who were scheduled to undergo breast cancer surgery, including breast conservation surgery, partial mastectomy, or simple mastectomy, individuals who were competent to provide their informed permission to take part in the research, patients who had no contraindications to receiving a TTMP or pectoral nerves block, such as allergies to local anesthetics or previous nerve injury in the chest wall, and patients who were deemed to be at moderate to high risk for postoperative pain, as determined by the surgeon or anesthesiologist.

Exclusion criteria:

Individuals with a history of opioid abuse or persistent pain, as well as individuals who refuse treatment, as these factors may complicate pain management after surgery, patients who had underlying conditions that may affect pain perception, such as neuropathic pain or fibromyalgia, patients who had previously received a TTMP or pectoral nerves block and had experienced adverse effects or inadequate pain relief, Allergy to bupivacaine, and coagulation profiles.

Randomization:

Each patient's code was placed in an opaque, sealed envelope, and the allocation was done randomly using numbers produced by a computer. Similarly, patients were randomly assigned to one of two groups with a 1:1 ratio:Group-B included 55-patients who underwent pectoral nerve blocks, whereas Group-A included 55-patients who underwent transversus thoracic muscle plane treatments.

Methods:

Preoperative assessment:

Complete history taking and demographic data collection, including age, weight, height, BMI, ASA, and duration of surgery, complete physical examination, and general examination.

Each patient was instructed about postoperative pain assessment with the visual analog scale(VAS). VAS(0 represents “no pain” while 10 represents “the worst pain imaginable”).

To induce general anesthesia, fentanyl(1 mcg/kg) and propofol(2mg/kg) were administered. After intubating the trachea, a neuromuscular block was accomplished using atracurium at a dosage of 0.5 mg/kg. The dose of isoflurane in oxygen was 40-60 to keep the patient anesthetized.

The same SonoSite Edge II US machine and a linear array probe(6-13MHz frequency) were used for all US scans. Depth, penetration frequency range, gain, and other characteristics were fine-tuned to produce the best possible US image. A 22-gauge echogenic needle was used to execute the blocks.

The gel was then placed to the US transducer following sterile preparation. Sleeved in a sterile plastic was the transducer and its cable.

Intraoperative:

Technique of TTP block:

Using the longitudinal plane, the US transducer was placed 1 cm laterally to the sternal boundary, where the T4-5 intercostal gap was discovered under US. From the fourth to the fifth ribs, the transversus thoracic muscle and the internal intercostal muscles can be seen above the pleura in a parasternal sagittal view.

Before injecting 15ml of 0.25% bupivacaine, the needle was positioned in-plane to the transducer. A single dose of 175mg of bupivacaine is not to be exceeded, and the maximum dosage for a day is 400mg.

Technique of PECS II block:

The serratus anterior muscle should be visible above the 2nd, 3rd, and 4th ribs after the needle has been moved mediolaterally along the plane of the US transducer. Transfer 15milliliters of 0.25% bupivacaine into the space between the pectoralis major and pectoralis minor muscles on the fascial plane, and 20milliliters of 0.25% bupivacaine into the space between the pectoralis minor and serratus anterior muscles on the same plane.

Neostigmine(0.08mg/kg) and atropine(0.02mg/kg) were administered to overcome any residual neuromuscular blockade following the surgery, and the patient was then extubated. Upon achieving full consciousness, patients were transferred to the post-anesthesia care unit(PACU).

The patient was transferred to the ward as soon as the Aldrete score reached 8 points, which is the exit threshold. Vital signs, including

heart rate, oxygen saturation, and blood pressure, were closely watched in the postoperative ward.

The patient was discharged to the ward after the anesthesia, according to the post-anesthesia modified Aldrete recovery score.[6]

Postoperative assessment:

For the first twenty-four hours following surgery, patients were asked to rate their pain at rest and every six hours using the Visual Analog Scale(VAS), which can be used on a scale between 0-10.

One gram of paracetamol is administered intravenously every six hours to all patients. As long as the respiration rate is greater than 10 breaths per minute, a rescue dosage of morphine(0.05mg/kg) is administered if the VAS is greater than 3.

A 4-point scale was used to measure the degree of patient satisfaction. On a scale where one is excellent and four is terrible, patients' levels of satisfaction were graded.[7]

The number of patients who require postoperative analgesia, first-time patients who need analgesia, and the total postoperative morphine given during the first postoperative hours were recorded.

In order to evaluate the side effects, the following were administered: 10mg of ephedrine for hypotension, 0.02mg/kg of atropine intravenously for bradycardia, as well as 8milligrams of ondansetron to ward off nausea and vomiting after surgery(PONV).

Measurement:

Patient demographics, VAS pain score for postoperative pain assessment, the following variables were recorded: time to first request rescue analgesia and total dose of morphine consumed; number of patients requiring postoperative analgesia; first time patients requiring analgesia; total postoperative morphine administered during the first postoperative hours Intraoperatively, every 30 minutes, we measured the patient's mean arterial blood pressure, heart rate, and oxygen saturation. At time 0, we checked in with the postoperative anesthesia care unit. At 30, 60, 90, 2, 4, 6, 8, 12, and 24 hours after the procedure, we assessed patient satisfaction and recorded any complications.

Ethical considerations:

After the study was approved by the local research ethics council, all participants provided written informed consent.

Sample size:

The G Power software 3.1.9.4 was used to determine the necessary sample size. Previous research[8] has shown that a minimum of 110-patients, split evenly between two groups of 55-patients each, is required to draw valid conclusions. A 95% confidence level on both sides, with an 80% power. a margin of error of 5%.

Primary outcomes:

How long did each block type provide relief from pain, as measured by the first analgesic request, how severe was the pain according to the VAS pain score, and how much morphine was consumed on the first day?

Secondary outcomes:

Patient satisfaction, and any adverse effects or complications.

Statistical Analysis:

For the statistical study, we utilized SPSS v26, which was developed by IBM Inc. and is located in Chicago, IL, USA. Using histograms and the Shapiro-Wilks test, we made sure the data distribution was normal. The quantitative parametric variables, presented as means and standard deviations(SD), were compared between the two groups using an unpaired Student's T-test. Quantitative non-parametric data were presented using the median and interquartile range(IQR). The Mann-Whitney test was used to analyze this data. The frequency and percentage(%) of qualitative variables were reported, and when applicable.

3. Results

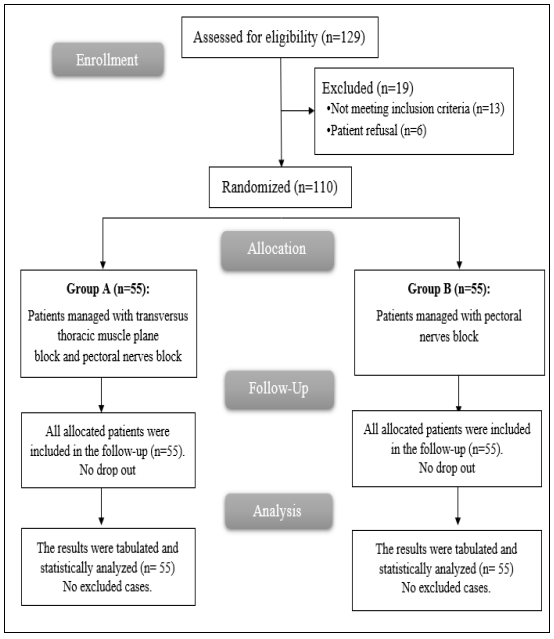

Figure 1. Enrolled patients' CONSORT flowchart.

Table 1. Demographic information and length of surgery for the groups under study.

		GROUP-A (N=55)	GROUP-B (N=55)	P-VALUE
AGE(YEARS)	Mean±SD	54.07±6.28	52.13±8.93	0.189
	Range	43-64	41-68	
WEIGHT(KG)	Mean±SD	89.87±14.52	90.49±15.62	0.830
	Range	63-115	64-116	
HEIGHT(CM)	Mean±SD	165.36±5.32	166.56±5.27	0.237
	Range	154-173	156-175	
BMI(KG/M^2)	Mean±SD	32.9±5.44	32.74±6.15	0.884
	Range	24.1-46.1	22.3-44.4	
ASA PHYSICAL STATUS	I	40(72.73%)	37(67.27%)	0.533
	II	15(27.27%)	18(32.73%)	
DURATION OF SURGERY(MIN)	Mean±SD	100.09±23.58	97.73±16.44	0.543
	Range	60-140	65-130	

BMI:Body mass index, ASA:American society of anesthesiologists.

There were negligible differences between the two groups in terms of age, sex, height, weight, BMI, ASA physical status, and length of operation.

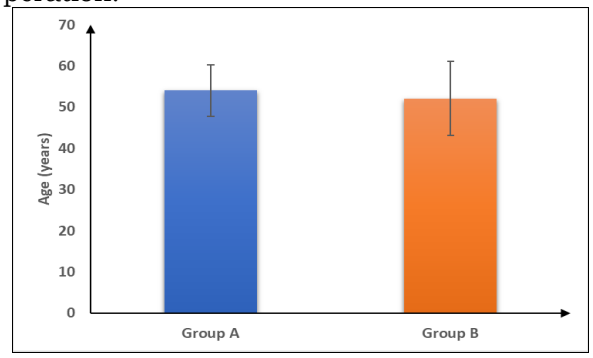

Figure 2. Ages of the groups under study.

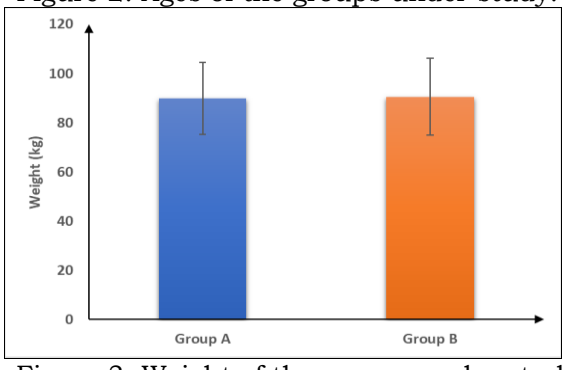

Figure 3. Weight of the groups under study.

Table 2. VAS of the groups under study.

	GROUP-A (N=55)	GROUP-B (N=55)	P-VALUE
PACU	0(0-0)	0 (0-0)	0.729
30MIN	1(1-2)	1(1-2)	0.134
60MIN	1(1-2)	2(1-3)	0.212
90MIN	2(1-3)	2(1-3)	0.342
2H	2(1-3)	2(2-3)	0.401
4H	2(1.5-3)	3(2-3)	0.015*
6H	2(1-4)	3(2-4)	0.031*
8H	2(2-3)	3(2.5-3)	0.023*
12H	3(3-4.5)	4(3-5)	0.085
24H	4(3-4)	4(4-5)	0.051

Data presented as median (IQR), VAS:Visual Analogue Scale, *:Significantly different as P-value≤0.05, PACU:Post-anesthesia care unit.

At PACU, 30minutes, 60minutes, 2hours, 12hours, and 24hours, there was no significant difference in VAS between the two groups; however, at 4hours, 6hours, and 8hours, group-A's VAS was considerably lower than group-B's(P-value<0.05).

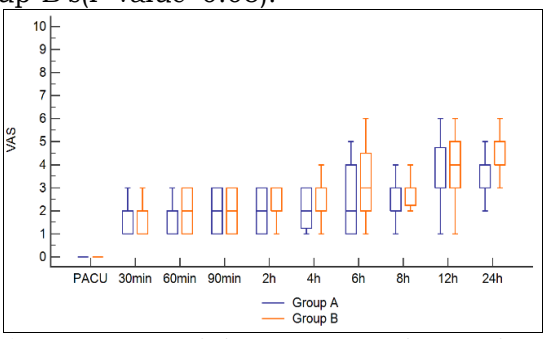

Figure 4. VAS of the groups under study.

Table 3. Patient satisfaction of the groups under study.

		GROUP-A (N=55)	GROUP-B (N=55)	P-VALUE
PATIENT SATISFACTION	Excellent	39(70.91%)	33(60%)	0.399
	Good	9(16.36%)	11(20%)	
	Fair	7(12.73%)	9(16.36%)	
	Poor	0 (0%)	2(3.64%)	

Patient satisfaction was insignificantly different between both groups.

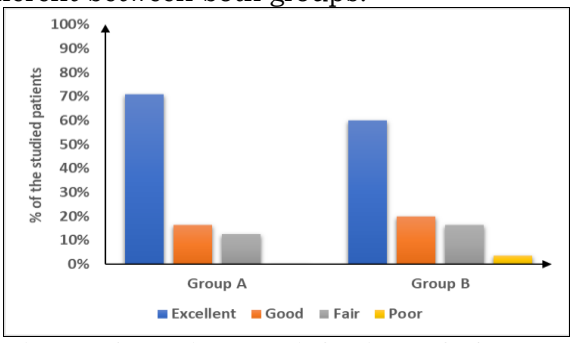

Figure 5. Patient satisfaction of the groups under study.

Table 4. Time it took for the study groups to request rescue analgesia and the total amount of morphine they consumed.

		GROUP-A (N=55)	GROUP-B (N=55)	P-VALUE
TIME TO FIRST REQUEST OF RESCUE ANALGESIA (H)	Mean±SD	7.27±1.15	5.69±1.15	<0.001*
	Range	6-9	4-7	
TOTAL DOSE OF MORPHINE CONSUMPTION (MG)	Mean±SD	8.93±3.01	11.25±3.68	<0.001*
	Range	3-15	5-21	

Group-A experienced a considerably longer time to first request rescue analgesia than group-B (P-value<0.001). Group-A consumed substantially less morphine overall than group-B (P-value<0.001).

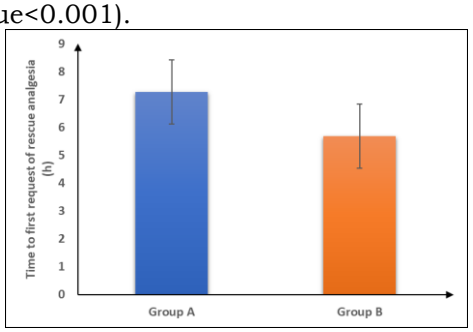

Figure 6. Time to first request of rescue analgesia of the groups under study.

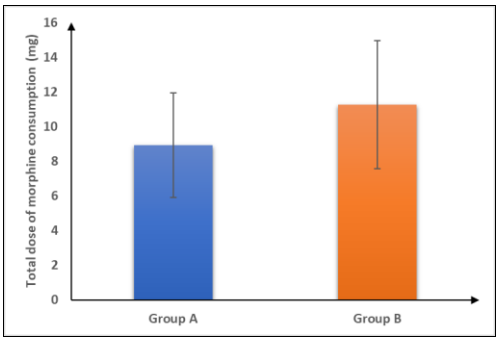

Figure 7. Total dose of morphine consumption of the groups under study.

Table 5. Postoperative mean arterial pressure of the groups under study.

	GROUP-A (N=55)	GROUP-B (N=55)	P-VALUE
PACU	100.44±7.14	101.75±7.54	0.352
30MIN	100.38±7.11	102.27±7.59	0.180
60MIN	100.75±7.2	102.65±7.56	0.178
90MIN	101.24±7.18	103.84±7.42	0.065
2H	102.27±7.16	103.64±7.6	0.335
4H	103.27±7.2	111.64±10.1	<0.001*
6H	107.47±12.3	113.82±11.88	0.007*
8H	108.76±10.43	113.56±7.73	0.007*
12H	109.64±12.32	113.67±12.28	0.088
24H	113.25±10.35	117.25±11.84	0.062

Data presented as mean (±SD), *Significantly different as P-value≤0.05, PACU:Post-anesthesia care unit.

At PACU, 30minutes, 60minutes, 2hours, 12hours, and 24hours, the two groups' postoperative mean arterial pressures were not substantially different; however, at 4hours, 6hours, and 8hours, group-A's mean arterial pressure was significantly lower than group-B's(P-value<0.05).

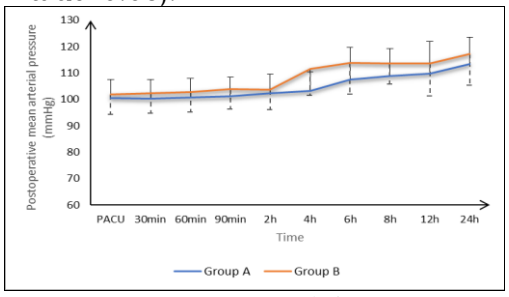

Figure 8. Mean arterial pressure after surgery for the groups under study.

4. Discussion

When used together, the two blocks reach more neural pathways that are involved in pain transmission and sympathetic control, making for a more thorough anesthetic effect. When combined, these effects produce much greater hemodynamic stability than would be possible with only a pectoral nerve block.[9]

The time to first request rescue analgesia was much later in group A than in group B in this trial. Group A consumed a substantially lower total dose of morphine compared to group B.

Following the same line as our findings, Ueshima et al.,[10] subjected 70-adult female patients to general anesthesia for a unilateral mastectomy as part of a prospective research. The patients were divided into two equal groups and given either the PECS block alone or the thoracic muscle plane(TTP) block in a random order. Both the PT and C groups used much less opioids overall, according to the results.

Also, Zhao et al.,[9] 80 female breast cancer patients were randomly assigned to one of two groups: one group received a thoracic paravertebral nerve block(TPVB) with 30milliliters of 0.5% ropivacaine, and the other group received ultrasound-guided transperitoneal chemoembolectomy (TTP-PECS; n=40 in each group). When comparing the TTP-PECS group to the TPVB group 12hours after surgery, they found that the former consumed less opioids overall and had lower VAS scores both at rest and during exercise.

Perpendicular to it, Elamaym et al.,[11] studied 45 women who had a radical mastectomy while under general anesthesia. They were divided into two groups: one that had general anesthesia and a combination of PECS II and TTP blocks(n=45), and another that received general anesthesia solely(n=45). They discovered that opioid use was reduced when PECS II and TTP blocks were used together. There was no statistically significant difference between the two groups in the first twelve hours after surgery regarding the time it took to get rescue analgesia.

This was consistent with Eloraby et al.,[12] 90 adults undergoing elective open-heart surgery were placed into three equal-sized groups for the purpose of a randomized, double-blind controlled experiment. The first group, which served as a control, got standard systemic analgesia without any additional procedures; the second group got bilateral TTP; and the third group got bilateral pectointercostal fascial blocks(PIFBs), guided by ultrasound. They demonstrated that over the course of twenty-four hours, the TTB group significantly reduced their overall opioid intake for rescue purposes and significantly delayed the beginning of initial rescue analgesia.

Within this setting, Aydin et al.,[13] 48-adult patients undergoing cardiac surgery were randomly assigned to receive TTP with either 20mL of 0.25% bupivacaine or saline bilaterally(control group). The trial was prospective, randomized, and double-blind. They demonstrated that the TTP group required fewer opioids overall and that the time it took for the first rescue analgesic to be needed was later in the TTP group than in the control group.

In support of our outcome, Ueshima et al.,[10] discovered that compared to the PECS group, the PECS+TTP group had consistently reduced VAS pain values across all time points, including rest and movement.

Within this setting, Eloraby et al.,[12] Results showed that compared to the control group, the TTB group saw a statistically significant decrease in pain score.

On the identical line, Fujii et al.,[14] randomized 17 patients to receive either TTP or a control group following cardiac surgery; the trial was conducted at a single center and was designed to be as feasible as possible. Compared to the control group, those in the TTP group reported much less pain.

Research has shown that PECS blocks can affect heart rate, maximum arterial pressure(MAP), pain score, and overall opioid use.

Along with this, there was Fouad et al.,[15] the researchers randomly assigned 40 adult female patients to one of two groups: one group received

preoperative PECS blocks in addition to general anesthesia for the elective unilateral modified radical mastectomy, and the other group received only general anesthesia. Results showed that compared to the control group, the PECS group had significantly reduced intraoperative and postoperative HR, MAP, VAS score, and total opioid use in the first 24 hours after surgery.

Also, Mirkheshti et al.,[16] 22-female breast cancer patients participated in a randomized clinical trial. One group received propofol general anesthesia with peripheral epinephrine contrast stimulation(PECS), while the other group received regular propofol general anesthesia(control group). They demonstrated that both groups' HR and MAP were similar before and after induction, but that the PECS group required more time to initiate analgesic requests than the control group.

In addition, Versyck et al.,[17] The 85 patients with breast cancer who were having a mastectomy were split into two groups: one that received PECS and another that received a control. All participants were blinded to the outcome of the study. Two blocks, one containing 0.25% levobupivacaine and the other a saline placebo, were randomly given to the patients. Postoperative pain levels were much lower, and opioid use was significantly reduced in the PECS group compared to the control group.

Moreover, Bashandy et al.,[18] subjected 120 adult female patients slated for elective unilateral modified radical mastectomy under general anesthesia to a randomized clinical experiment. The patients were split into two groups: one that received general anesthesia+PECS block(n=60), and another that received only general anesthesia(n=60). The results showed that in the first twelve hours following surgery, when contrasted with the control group, those undergoing PECS had lower VAS scores and required less morphine following surgery.

4. Conclusion

In breast cancer surgeries, the combination of TTP-PECS was more effective than PECS block alone in pain relief, as it was associated with lower VAS score, HR, MAP, total amount of opioids taken after surgery, and the duration it takes to go from the initial request for rescue medication.

Disclosure

The authors have no financial interest to declare in relation to the content of this article.

Authorship

All authors have a substantial contribution to the article

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Conflicts of interest

There are no conflicts of interest.

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