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Effectiveness of Ultrasound-Guided Erector Spinae Plane Block vs. Modified Pectoral Nerves Block for Postoperative Pain in Modified Radical Mastectomy

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Abstract

Background: Globally, breast cancer is the most prevalent malignancy amongst females. The principal symptom of a syndrome denoting the presence of pain in and around the site of mastectomy for a duration exceeding three months after the procedure is chronic post-mastectomy pain (PMP)

Aim and objectives: To compare Erector Spinae Plane Block modified pectoral nerves block following modified radical mastectomy regarding postoperative pain relief.

Subjects and methods: This prospective, randomized, masked clinical trial was performed at Al-Azhar University Hospitals for Boys in Cairo. This research was performed on (60) individuals subjected to 2 groups: Group A: Erector Spinae Plane Block group (ESPB): (30) cases underwent ESP block after injection of general anesthesia. Group B:(Modified Pectoral Nerves Block (MPNP)): (30) cases underwent modified pectoral nerve block after induction of general anesthesia.

Results: There was no statistically significant variance among the examined groups concerning age, BMI, duration of surgery, ASA status, heart rate before and after procedure, complications, while a statistically significant variance amongst the examined groups concerning after-surgery VAS score at 6, 12, 18, 24 hours, duration of Analgesia, duration of block, morphine consumption dose and satisfaction.

Conclusion: We concluded that the PECS block was more effective in terms of reduced morphine consumption and lower pain scores in the first day postoperative period, in contrast to the ESP block in cases undergoing modified radical mastectomy surgeries.

Keywords: Erector Spinae Plane Block; Modified Pectoral Nerves Block; Radical Mastectomy

1. Introduction

The prevailing malignancy in females is breast cancer.¹ About forty to sixty percent of females with breast surgery experience significant acute pain following the procedure. More than 10% of patients have severe pain lasting six to twelve months (after mastectomy pain syndrome).² Complications of severe pain include complicated regional pain syndrome (causalgia), adhesive capsulitis of the shoulder, and altered sensibility, and long-term disability that interferes with daily activities & costs the health care system money.³

Since its initial mention in 2016, the ultrasound (US)-guided ESPB has been implemented as a treatment option for both

acute and chronic thoracic pain. A local anesthetic was injected deeply into the erector spinal muscle during a para-spinal facial plane block, whereas the thoracic transverse processes were kept superficial. The RSPB has minimal contraindications due to the distance between the injection site and pleura, major blood vessels, and spinal cord. In the paravertebral region, injected local anesthetic medication obstructs spinal nerve dorsal and ventral rami.⁴

In the past decade, additional regional strategies for intraoperative and after-operation pain management of MRM have been developed. Several treatments, including intercostal nerve blocks, pectoral nerve blocks (PECS 1 & 2), and serratus anterior plane block, aim to achieve greater efficacy and minimize complications compared to the gold standard techniques.⁵

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Two components comprise MPNP, a peripheral technique known as PECS I and PECS II. Four intercostal nerves (nerves III to VI), the intercostobrachial, and the long thoracic nerve are all obstructed. This block is characterized by its motor and sensory nerve block integration, excluding the sympathetic block commonly found in paravertebral and epidural blockades. As a result, it effectively mitigates postoperative distress during major breast cancer operations straightforwardly and uninterruptedly. ⁶

The purpose of this research was to compare the pain after surgery alleviation provided by ESPB and the modified pectoral nerve block after a modified radical mastectomy.

2. Patients and methods

This prospective, randomized, single-blinded clinical research involved (sixty) cases subjected into two groups: Group A: ESP: (30) cases underwent ESPB post administration of general anesthesia. Moreover, Group B (Modified Pectoral Nerves Block (MPNP)): (30) cases underwent modified pectoral nerve block after induction of general anesthesia. This study was conducted in Al-Azhar University Hospitals for Boys in Cairo, & was approved by the local ethical Committee.

2.1. Inclusion criteria: Patients accepted to join the study, Age: between 21-60 years, BMI < 30 kg/m², ASA physical status I and II. Moreover, patients underwent modified radical mastectomy under general anesthesia.

2.2. Exclusion criteria: Patient refusal, Patient with coagulation disorders, Infection at the site of injection, Patient's sensitivity to used drugs, and patients with a history of analgesic dependence.

2.3. Sample size: The required sample size was calculated using the G power program to 3.1.9.4. Based on the study by BICAK on the period of both blocks, the minimal sample size in each group is 15 cases to get a power level of 0.80, an alpha level of 0.05 (two-tailed), and an effect size of 1.08 for the period. ⁷

2.4. Methods

All cases were divided into Complete history taking, Physical examinations (General et al., breast Examination, and psychological Assessment), and investigative studies (Routine laboratory and Radiological investigations).

2.5. Procedures

All patients were premedicated with 0.01 mg/kg atropine following venous access insertion; 1 mg of metoclopramide and 20 mg of famotidine were also injected IV prior to the procedure. Baseline measurements of mean arterial blood pressure, HR, and PO₂ were obtained in addition to preoperative monitoring. Following GA induction in the operating room, blocks were performed using a completely aseptic method.

Analgesic Techniques of ESP block: After

general anesthesia induction, cases allocated to the ESP group underwent ESP block. Level T5 was the block. Except for a feeble image of the pleura, the T5 transverse process tip was detected as flat, squared-off acoustic shadows when the instrument was positioned transversely on the back. As seen through the US, the epidermis, subcutaneous layer, trapezius, and erector spinae muscle were to be traversed to insert the needle until it reached the transverse process beneath the erector spinae muscle. Separation was observed with 30 mL of 0.25 percent levobupivacaine after aspiration, which was administered to circumvent intravascular injection. Analgesic Techniques of MPNP block: MPNPB was performed after induction of general anesthesia under ultrasonographic guidance using a low-frequency convex transducer. The cases were positioned themselves in a recumbent position. A high-frequency linear probe positioned caudal to the lateral 3rd of the clavicle identified the first rib by establishing the location of axillary arteries beneath the pectoralis major and subclavian muscles. The probe was subsequently advanced distally in the direction of the axilla until it reached the third rib. The pectoralis minor was positioned above the serratus anterior in this arrangement. clavipectoral fascia, which functions as Gerdy's ligament, extends into the axilla. After identifying the structures with the US, we administered 10 ml of 0.25 percent levobupivacaine into the interfascial plane among the two pectoralis muscles and 20 ml into the interfascial plane among the pectoralis minor and serratus anterior muscles utilizing an in-plane medial-to-lateral approach.

The failure rate of the block was computed by determining whether the Patient needed rescue analgesia for more than two dosages within the initial hour after the operation. Patients who failed the analgesia injection were substituted with another individual. Every Patient needed to communicate any indications of systemic toxicity caused by local anesthetics, including paralysis in the tongue or circumoral region, visual or auditory impairment, vertigo, or tinnitus.

2.6. Postoperative evaluation: Measured Parameters were patient demographic data; postoperative pain was evaluated by the visual analog scale (VAS) pain score, mean arterial blood pressure, heart rate oxygen saturation, duration of the block, Patient satisfaction, and any adverse effects or complications were recorded.

2.7. Ethical Consideration: Written informed consent was obtained from each case after a comprehensive explanation of the study's objectives. The information collected from participants was kept strictly confidential. Furthermore, the identities of the study participants were withheld in all reports and publications about this research.

2.8.Statistical analysis: Utilizing the statistical computer application SPSS (IBM et al., USA), the gathered data was systematically arranged, tabulated, and subjected to statistical analysis. The means ± standard deviations were utilized to summarize the normally distributed numerical variables, including body weight and Age. An independent t-test compared the mean values of both groups. The median and interquartile range (IQR) represented non-normally distributed variables. To assess their significance, the Mann–Whitney U-test was applied. The chi-squared test was employed to ascertain the significance of the qualitative data, which were presented as numbers and percentages. Statistical significance was attributed to a two-sided p-value that was less than 0.05.

3. Results

Table 1. Comparison of patient characteristics among the research groups

	ERECTOR SPINAE PLANE BLOCK (N = 30)		MODIFIED PECTORAL NERVES BLOCK (N = 30)		TEST OF SIG.	
	Mean	SD	Mean	SD	z/x ²	P value
AGE (YEARS)	49.17	5.75	49.03	6.18	0.086	0.931
BMI	24.63	3.43	24.98	2.72	-0.438	0.663
DURATION OF SURGERY	83.30	8.40	83.17	7.85	0.064	0.95
ASA	N	%	N	%		
I	22	73.3%	17	56.7%	1.832	0.176
II	8	26.7%	13	43.3%		

Table 1 showed statistically insignificant difference between patients have modified pectoral nerves block & patients with Erector Spinae Plane Block regarding age, BMI, duration of surgery and ASA status (P above 0.05).

Table 2. Comparison of heart rate among the studied groups

	ERECTOR SPINAE PLANE BLOCK (N = 30)		MODIFIED PECTORAL NERVES BLOCK (N = 30)		TEST OF SIG.	
	Mean	SD	Mean	SD	t	P value
HR IMMEDIATELY	74.66	2.75	73.9	2.63	1.102	0.275
HR 30MIN	75.8	3.26	75.06	3.23	0.874	0.386
HR 60MIN	76.23	3.34	76.4	3.51	-0.188	0.851
HR 90MIN	76.5	3.69	76.86	3.99	-0.369	0.713
HR 2H	79.16	3.31	79.00	4.72	0.158	0.875
HR 4H	84.9	3.04	83.36	2.83	2.019	0.048
HR 6H	86.06	2.34	85.53	2.19	0.909	0.367
HR 8H	86.4	1.90	86.03	1.56	0.815	0.419
HR 12H	86.56	1.81	86.30	1.53	0.615	0.541

HR 24H | 84.83 2.87 83.76 3.03 1.397 0.168
 P-value > 0.05: Non significant; P-value < 0.05: Significant; P-value < 0.001: Highly significant

Table 2 revealed statistically insignificant differences between patients have modified pectoral nerves block & patients with Erector Spinae Plane Block regarding their heart rate before and after procedure (P > 0.05).

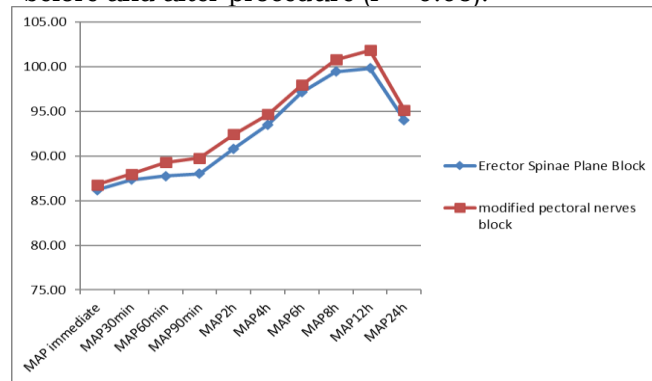


Figure 1. The mean blood pressure among the studied groups

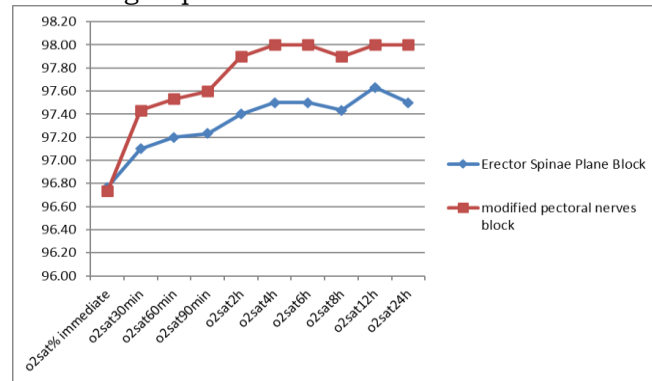


Figure 2. Oxygen saturation amongst the examined groups

Table 3. Comparison of the VAS score amongst the examined groups

	ERECTOR SPINAE PLANE BLOCK (N = 30)		MODIFIED PECTORAL NERVES BLOCK (N = 30)		TEST OF SIG.	
	Mean	SD	Mean	SD	t	P value
VAS.AT.REST IMMEDIATELY	0.10	0.31	0.03	0.18	1.027	0.309
VAS.AFTER.COUGH IMMEDIATELY	0.27	0.45	0.10	0.31	1.68	0.098
VAS.AT.REST 6H	4.00	1.11	2.43	0.86	6.101	0.0001
VAS.AFTER.COUGH 6H	4.70	1.15	3.10	1.12	5.449	0.0001
VAS.AT.REST 12H	4.17	0.95	2.53	1.11	6.137	0.0001
VAS.AFTER.COUGH 12H	4.60	0.97	3.27	1.26	4.601	0.0001
VAS.AT.REST 18H	3.30	0.84	2.57	0.68	3.728	0.0001
VAS.AFTER.COUGH 18H	3.90	0.96	3.10	1.12	2.964	0.004
VAS.AT.REST 24H	2.10	0.31	1.77	0.50	3.099	0.003
VAS.AFTER.COUGH 24H	2.60	0.50	2.00	0.45	4.871	0.0001

Table 3 revealed statistically significant lower post-operative VAS score in patients have modified

pectoral nerves block than patients with Erector Spinae Plane Block at 6, 12, 18, 24 hours post-operative (P below 0.05).

Table 4. Comparison of analgesia use among the studied groups

	ERECTOR SPINAE PLANE BLOCK		MODIFIED PECTORAL NERVES BLOCK		TEST OF SIG.	
	(N = 30)		(N = 30)		z	P value
	Mean	SD	Mean	SD		
DURATION.OF.ANALGESIA	271.23	35.92	414.13	48.95	-12.891	0.0001
FIRST.ANALGESIC.REQUEST	261.10	35.36	404.27	50.15	-12.779	0.0001
MORPHINE.CONSUMPTION.DOSE	7.34	1.06	4.57	0.83	8.488	0.0001
DURATION.OF.BLOCK	361.50	38.42	524.03	58.48	-12.723	0.0001
NUMBER OF PATIENTS REQUIRED POSTOPERATIVE MORPHINE	N	%	N	%	X2	P-value
REQUIRED	27	90%	14	53.3%	13.017	0.0001*
NOT REQUIRED	3	10%	16	46.7%		

Table 4 showed statistically significant shorter duration of Analgesia, earlier first analgesic request and higher morphine consumption dose and shorter duration of. block and higher number of patients required postoperative morphine in patients with ESPB than patients with modified pectoral nerves block (P below 0.05).

Table 5. Comparison of postoperative outcome amongst the study groups

	MODIFIED PECTORAL NERVES BLOCK		ERECTOR SPINAE PLANE BLOCK		TEST OF SIG.	
	(N = 30)		(N = 30)		x ²	P value
	N	%	N	%		
NEVER INJURY	0	0%	0	0%	---	---
HEMATOMA	0	0%	0	0%	---	---
LOCAL.ANESTHETIC.TOXICITY	0	0%	0	0%	---	---
PNEUMOTHORAX	0	0%	1	3.3%	1.017	0.313
NAUSIA	3	10%	5	16.7%	0.557	0.448
VOMITING	2	6.7%	4	13.3%	0.741	0.389
HYPOTENSION	1	3.3%	5	16.7%	2.963	0.085
BRADYCARDIA	4	13.3%	1	3.3%	1.964	0.161
TACHYCARDIA	0	0%	3	10%	3.158	0.076
HYPERTENSION	0	0%	2	6.7%	2.069	0.150

x²: Chi- Square test

Table 5 showed statistically insignificant difference between patients have modified pectoral nerves block & patients with ESPB regarding their complications (P above 0.05)

Table 6. Comparison of patient satisfaction amongst the study groups

SATISFACTION	ERECTOR SPINAE PLANE BLOCK		MODIFIED PECTORAL NERVES BLOCK		TEST OF SIG.	
	(N = 30)		(N = 30)		z/x ²	P value
	N	%	N	X		
EXCELLENT	1	3.3%	16	53.3%	32.692	0.00001*
GOOD	2	6.7%	8	26.7%		
FAIR	15	50%	6	20%		
POOR	12	40%	0	0%		

Table 6 revealed statistically significant lower satisfaction in patients with ESPB than patients with modified pectoral nerves block (P < 0.05).

4. Discussion

The current study showed statistically insignificant differences in age, BMI, duration of surgery, and ASA status between patients with modified pectoral nerve block and patients with erector spinae plane blocks.

This study aligns with the findings of Cesur et al., who conducted a comparative analysis of the analgesic effectiveness of ESPB and ultrasound-guided modified pectoral nerve (PECS) block for individuals undergoing radical mastectomy. They stated that there was no statistically significant variance amongst the examined groups concerning age, BMI, and ASA. A statistically significant variance (p=0.007) regarding the duration of surgery was noticed among the two studied groups. ⁸

Our results showed that a statistically insignificant difference was found between patients with modified pectoral nerve block and patients with Erector Spinae Plane Block regarding their heart rate before and after the procedure.

The present study agreed with Kabir et al., who reported no statistically significant variance amongst both examined groups concerning heart rate before and after the procedure. ⁹

The present research showed that statistically insignificant variance was noticed among patients who had modified pectoral nerve block and patients with Erector Spinae Plane Block regarding their mean blood pressure before and after the procedure (P > 0.05) except at 12 hours postoperative that demonstrated significantly lower MBP in patients had ESPB than patients with modified pectoral nerves block.

Our findings agreed with Altıparmak et al., who demonstrated no statistically significant variance concerning mean arterial pressure amongst both examined groups.¹⁰

The present study reported a statistically insignificant difference between patients with modified pectoral nerves block and patients with Erector Spinae Plane Block regarding their oxygen saturation before and after the procedure ($P > 0.05$) except at 4-, 6-, and 24-hour postoperative, which demonstrated significantly lower O₂sat% in patients with ESPB than patients with modified pectoral nerves block.

Also, our findings agreed with Singariya et al., who revealed no statistically significant variance in hemodynamic parameters, including HR, NIBP, SpO₂, and RR, during the perioperative period between the groups.¹¹

Our results showed a statistically significantly lower postoperative VAS score in patients with modified pectoral nerve block and patients with Erector Spine Plane Block at 6, 12, 18, 24, and 24 hours post-operatively current research is consistent with Gad et al., who reported that the VAS score revealed no significant variance among both examined groups at the postoperative 0 value. The ESP group recorded significantly greater values at all other time points, in contrast to the PECS group VAS score.¹²

The current study revealed a statistically significant shorter duration of analgesia, earlier first analgesic request, higher morphine consumption dose, shorter duration of the block, and higher number of patients requiring postoperative morphine in patients with Erector Spine Plane Block than patients with a modified pectoral nerve block.

Our outcomes were based on Sinha et al., who reported that the PECS group had a statistically significant longer period of analgesia and a lesser morphine consumption dose a day after surgery than the ESP group.⁶

The present study demonstrated a statistically insignificant difference between patients with modified pectoral nerve block and patients with Erector Spinae Plane Block regarding their complications.

Also, our results agreed with those of Gad et al., who revealed no statistically significant variations in the occurrence rates of complications after surgery among the two cohorts.¹²

However, Kabir et al. reported that cases receiving PECS block had developed significantly higher complications after surgery, like nausea and dizziness, in contrast to ESP block, which disagreed with our findings.⁹

Our findings showed a statistically significantly lower satisfaction in ESPB patients than in

patients with a modified pectoral nerve block.

Also, our results agreed with Singariya et al., who reported that the case's satisfaction score was better in Group P than Group E, while the variance was not statistically significant ($P = 0.48$).¹¹

4. Conclusion

We found a statistically significant shorter duration of analgesia, earlier first analgesic request, higher morphine consumption dose, higher duration of the block, and a higher number of patients who required postoperative morphine in the ESP group. Also, we revealed a statistically significant lower satisfaction score in the ESP group. We conclude that PECS block was more effective in terms of reduced morphine consumption and lower pain scores in the first day postoperative period in contrast to ESP block in cases undergoing modified radical mastectomy surgeries.

Disclosure

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Authorship

All authors have a substantial contribution to the article

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There are no conflicts of interest.

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