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Efficacy of Erector Spinae Plane Block in Modified Radical Mastectomy Regarding Postoperative Analgesia and Stress Response: Randomized-Controlled Trial

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ABSTRACT

Background: Erector spinae plane block (ESPB) is one modality technique, which had great outcomes among many surgeries. However, its efficacy in modified radical mastectomy remains to be fully explored.
Objective: To compare between using ESPB vs traditional intravenous analgesia for control pain after breast surgeries.
Patients and methods: 40 cases were included splitted into two groups. **Group A** included 20 cases who received ultra-sonography guided erector spinae plane block. **Group B** included 20 cases who had only postoperative morphine. We compared between the two groups regarding pain scores by numerical rating scale, stress response, overall fentanyl consumption, morphine consumption, intraoperative changes among mean arterial blood pressure, heart rate as well as presence of postoperative complications.
Results: A statistically significant decrease in pain scores among group A was found compared to group B at all intervals ($P<0.05$). Also, we found statistically significant decrease among postoperative morphine consumption ($P=0.001$), decrease in intraoperative fentanyl needs ($P<0.001$), decrease in serum cortisol level 1 hour after operation ($P<0.001$), decrease in postoperative nausea and vomiting among group A compared to group B. While, we found non-significant change in intraoperative fentanyl consumption and in pain scores at other time intervals.
Conclusion: Our study showed that erector spine plane block had a more impressive analgesic effect than intravenous analgesia in modified radical mastectomy with lower morphine consumption and lower postoperative cortisol level.
Keywords: ESPB, Intravenous analgesia, modified radical mastectomy, Stress response.

INTRODUCTION

Surgery is the cornerstone of breast cancer treatment, which is often supplemented by other methods like chemotherapy, radiation therapy, and hormonal management. However, after having breast cancer surgery, many people experience chronic pain. There is a negative impact on quality of life and functionality for women who have persistent pain after breast cancer surgery. Other research has also linked preoperative breast pain and immediate postoperative pain to the onset of Chronic pain after breast cancer surgery (CPBCS) [(1)].

The sympathetic nervous system as well as the hypothalamic-pituitary-adrenal axis undergo neuronal activation in response to surgical pain and trauma, resulting in a variety of hormonal alterations. Traditionally, glucocorticoid production and release are stimulated by hypothalamic activation leading to the release of adrenocorticotropic hormone (ACTH) from the pituitary [(2)]. Thus came the need for better ways of control of postoperative pain one of them is erector spinae plane block, cases who had severe chronic thoracic neuropathic pain as well as cases undergoing video-assisted thoracoscopic surgery were the first to benefit from the ESP block, which is a unique interfascial paraspinal plane approach developed by **Forero *et al.*** [(3)].

We aimed at this work to compare between using ESPB vs traditional intravenous analgesia for control pain after breast surgeries.

PATIENTS AND METHODS

This Randomized controlled clinical trial (single blinded) was done on 40 female patients aged between 35 to 60 years old who were undergoing modified radical mastectomy under general anesthesia in Helwan and Cairo University Hospitals for 24 months. Subjects were randomly organized into two groups using block randomization method. Patients were randomly classified into ten blocks of 4 patients. Each block is formed of 2 patients for group A and 2 patients for group B then the 10 blocks were randomly sequenced.

Group A: consisted of 20 cases who received ultra-sonography guided erector spinae plane block.
Group B: consisted of 20 cases who received intravenous morphine only.

Study procedure:

Pre-operative patient assessment:

History, physical exam, laboratory (CBC, INR, AST, ALT, urea. serum creatinine and random blood sugar), electrocardiograph for patients older than 45 years or patients with history of cardiac disorders and chest x-ray were done at preoperative assessment clinic.
Pre-surgery evaluation in the evening before the operation. The patients were taught to use the Numeric Pain Rating scale, which ranges from zero (no agony) to ten (the greatest pain imaginable). This was done with the participant's knowledge and agreement. Fasting is required prior to surgery, with a minimum of 6 hours

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without food and 2 hours without clear fluids. A 20 G IV cannula was used to draw blood, and the patient's baseline serum cortisol level was calculated from this sample. Patients were given intravenous doses of midazolam ranging from 0.01-0.02mg/kg 30 minutes before surgery.

General anesthesia:

Electrocardiogram, pulse oximeter, non-invasive arterial blood pressure, as well as capnography were all used for monitoring in the operating room. After that, a 15 mL/kg/h intravenous infusion of ringer was begun. 100% oxygen was used for preoxygenation, and then 2 µg/kg fentanyl and 2-3 mg/kg propofol were used to induce anesthesia.

The use of 0.5 mg/kg atracurium assisted endotracheal tube insertion. Every 30 minutes an additional 0.1 mg/kg was administered. After surgery, patients were given 4 mg of ondansetron and 8 mg of dexamethasone intravenously to prevent nausea and vomiting. Isoflurane in a 50% oxygen/air mixture was used to keep patients sedated, with an expired isoflurane content of 1.2 and breathing parameters set to keep end-tidal CO_2 at around 30-40 mmHg. The total amount of intravenous fentanyl administered was recorded if a patient's HR or mean blood pressure rose by more than 20% from their baseline readings. Before induction, and then every 15 minutes until the end of the operation, hemodynamic data (heart rate, mean arterial blood pressure and saturation, as well as end tidal CO_2) were measured. Stopping the isoflurane and reversing it with 0.05 mg/kg neostigmine and 0.02 mg/kg atropine intravenously was done after the skin closure was complete. Patients were sent to the PACU once extubation was successful. These previous steps were done for both of the two groups.

Group A Erector spinae plane block technique:

After inducing anaesthesia and waiting 15 minutes before making an incision in the skin, the block was performed sterilely. The block was performed in a lateral posture with the arm abducted, at the level of T5. If you place an ultrasound probe on your back at a 45-degree angle, you should be able to see the squared-off acoustic shadows that mark the tip of the T5 transverse process. The ribs could be seen as spherical acoustic shadows separated by a hyperechoic pleural line if the transducer was placed too far to the side. Transverse process acoustic shadows were seen in the following layers because the ultrasound probe was rotated longitudinally when the distal tip of the transverse process was in the centre of the ultrasound screen: The transverse process of the fifth thoracic vertebra (T5) was contacted with a needle inserted in the plane of the ultrasound beam from the cervical to lumbar spine. To verify that the needle tip is in the correct place in the fascial plane deep to the erector spinae muscle, 0.5-1 ml of normal saline can be injected and the muscle lifted off the transverse process without the muscle becoming distended. Separation was observed 30 minutes after injecting 0.25% bupivacaine (after aspiration to prevent intravascular injection). Throughout the process, the entire needle was view, and every effort was made to steer clear of any blood arteries as the needle made its way into the soft tissue. This slab was scanned using a linear transducer with a frequency range of 6-13 MHz on a MINDRAY ultrasonic instrument at a depth of 1 cm to 4 cm.

Group B: Patients weren't given any blocks after induction of anesthesia.

Ethical approval: Helwan and Cairo Medical Ethics Committees of Faculties of Medicine Helwan University and Cairo University gave their approval to this study. All participants gave informed written consents after receiving all information. The Helsinki Declaration was followed throughout the study's conduct.

Statistical Analysis

The collected data were represented in many ways, including the mean ± SD, ranges, figures, and percentages. Chi-square (X^2) and Fischer exact tests were used to assess nominal variables. Unpaired Student's t-tests and one-way and two-way repeated measures analyses of variance (ANOVA) with Dunnett's tests for post hoc comparisons were used to examine continuous variables. The Mann-Whitney U test was used for the analysis of categorical and non-normally distributed data. SPSS version 18.0 for Windows and Microsoft® Office Excel 365 was used for the statistical analysis. When the probability level was less than 0.05, it was considered significant.

RESULTS

The groups were well-matched since non statistical significant differences were found in age, weight, or length of operation between groups (Table 1).

Table (1): Patients' basic data, among studied groups

Variable	Group A (Twenty)	Group B (Twenty)	Test *P* value
Age (years) Mean± SD Range	47±7.54 (35-59)	45.65±5.40 (37-55)	0.510
Weight Mean± SD Range	80.60±8.68 (65-98)	80.95±8.83 (66-98)	0.904
Duration of surgery (min) Mean± SD Range	83.50±7.16 (70-95)	80.65±7.26 (65-92)	0.248

Non-statistical significant difference was found regarding respiratory depression and sedation scores (Table 2). We discovered a considerable drop in cortisol levels after surgery. At every time point, the latter group

had lower mean arterial blood pressure and heart rates compared to the other group. Group B (35% of patients) experienced more postoperative nausea and vomiting than group A (5%) (Tables 2, 3).

Table (2): Anesthesia complication among studied groups

Variables		Group A (Twenty)		Group B (Control) (Twenty)		*P* value
		No.	%	No.	%	
Nausea and vomiting	**No**	20	100	13	65	**0.006***
	Yes	0	0	7	35	
Respiratory depression	**No**	18	90	20	100	4.138
	Yes	2	10	0	0	

Table (3): serum cortisol before and after surgery among studied groups

Variable	Group A (Twenty)	Group B (Control) (Twenty)	*P* value
Serum cortisol before surgery (ng/ml) Median (IQR)	2.25 (1.6-5.7)	1.9 (1.6-4.6)	0.818
Serum cortisol 1 hour after surgery (ng/ml) Median (IQR)	10.85 (8.25-16.2)	22 (18.25-49)	<0.001*

Median & IQR**:** non-parametric test.

Intraoperative fentanyl usage decreased significantly between the two groups (Less in group A, P<0.001) (Table 4).

The pain scores of the two groups were significantly different across all time points, also statistically significant decrease in postoperative morphine consumption (p<0.001) between two groups (been less in group A) (Tables 4, 5)**.**

Table (4): Intra-operative fentanyl consumption and total morphine consumption among studied groups

Variable	Group A (Twenty)	Group B (Control) (Twenty)	Tests *P* value
Total morphine consumption mg Median (IQR)	4.18 (3.29-6.38)	16.25 (13.4-18)	<0.001**
Intraoperative fentanyl consumption (mcg) Median (IQR)	43 (35.5-47.5)	100 (88.5-128)	<0.001**

Median & IQR**:** non-parametric test.

Table (5): Pain score at different intervals among studied groups

Variable	Group A (Twenty)	Group B (Control) (Twenty)	Tests *P* value
PACU Median (IQR)	1 (1-2)	5.5 (4-7)	<0.001**
2 hours Median (IQR)	2 (1-3)	4 (3-5)	0.002*
4 hours Median (IQR)	2 (1-3)	3.5 (2.25-4.75)	0.004*
6 hours Median (IQR)	2 (1.25-3)	4.5 (3.25-5.75)	<0.001**
12 hours Median (IQR)	4 (3.25-5.75)	4 (3-4)	0.044*
24 hours Median (IQR)	3 (2-3)	4.5 (2.25-5.75)	0.002*

Median & IQR**:** non-parametric test.

DISCUSSION

When it comes to treating breast cancer, a modified radical mastectomy is a typical surgical option. Reducing pain after surgery is essential for a speedy recovery. The erector spinae plane block (ESPB) is a relatively new form of regional anaesthetic that has been more popular as a mean of controlling postoperative pain following a variety of surgical procedures, involving modified radical mastectomy [(4)].

Negative psychological and physiological effects can result from inadequate postoperative pain management. Suppressing the surgical stress response and reducing the need for opioids and general anaesthetics through effective treatment of acute pain that allows the immunological response to be preserved [(5)].

In the current study pain scores using NRS scale were recorded at 0, 2, 4, 6, 12 and 24 hours. At every time point, we observed a statistically significant difference in pain scores between the two groups we compared. (p<0.05). They were less in group A (ESPB). **Sharma *et al.*** [(6)] have studied erector spinae plane block in complete mastectomy with axillary clearance for postoperative pain relief. They found decrease in pain scores in block group in contrast to control group at all intervals (at 0 P=0.017, at 0.5 h P=0.001, at 1hour P=0.01, at 2 hours P=0.002, at 4 hours P=0.012, at 6 hours P<0.001, at 12 hours 0.009 and at 24 hours P=0.006) except at 8 hours interval (P=0.137). However, **Aksu *et al.*** [(7)] looking into erector spinae plane block injection after breast surgery for pain control reported no statistically significant reduction in pain levels (P > 0.05) at all intervals but found significant decrease in postoperative morphine

consumption. This discrepancy in results may be attributed to the subjective nature of the pain score and pain tolerance of the patients in the two groups.

We also found significant decrease in postoperative morphine consumption between group A and B (P<0.001) and significant decrease in intraoperative fentanyl consumption that were less in group A (ESPB). **Seelam *et al.*** [8] assessed erector spinae plane block (ESP) in mastectomy patients. There was a statistically significant reduction in postoperative morphine use compared to those in the control group (p<0.001). **Abdella *et al.*** [9] studied patients undergoing breast cancer surgery who had an erector spinae plane block where they had significantly lower postoperative morphine use in the first 24 hours compared to patients who did not receive the block (P<0.001).

Regarding serum cortisol level, our study showed decrease in group A compared to group B (P < 0.001). **Su *et al.*** [10] studied serum cortisol levels and other stress hormones, which were decreased in the first 24 hours following thoracoscopic radical resection for lung tumours when combination erector-spinae plane blocks were used (P<0.001). **Ebrahim *et al.*** [11] studied erector spinae plane block used in rib fractures to decrease stress response and found statistically significant decrease in serum cortisol level in erector spinae group compared to control group (P < 0.05).

At our study postoperatively, group A had lower mean arterial blood pressure and heart rate than group B at all-time points examined (P <0.05). **Abdella *et al.*** [9] reported that those receiving ESP showed significant reductions in mean arterial blood pressure and heart rate at (0, 4, 12 and 24 hours). **Ebrahim *et al.*** [11] found statistically significant decrease in MAP and heart rate at all-time intervals in ESP group (P < 0.05) compared to control group .

We also found that the incidence of postoperative nausea and vomiting was much lower in group A than in group B. **Abdella *et al.*** [9] compared the prevalence of postoperative nausea and vomiting between the ESP and control group and discovered a statistically significant difference (p<0.001). ESP group showed much lower stress response and better analgesia than control group alone this can be contributed to the effect of these blocks in blocking stress response and preventing the cascade before it begins with lower requirement for opioids and less complications.

CONCLUSION AND RECOMMENDATIONS

We conclude that the erector spinae plane block showed higher analgesic effect in breast surgeries decreasing analgesic consumption and also decreasing pain scores however larger studies are needed to confirm this improved analgesia.

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