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Ultrasound-guided Erector Spinae Plane block compared to Modified Pectoral Plane Block for Post- operative analgesia in Modified Radical Mastectomy Operations

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Abstract

For context, it should be noted that breast cancer is by far the most common form of cancer in women. It accounts for approximately (38.8 percent) of all cancers that affect Egyptian women. Following any surgical procedure, postoperative discomfort is a major worry for patients. Pregnant women who have breast reconstruction surgery need a multimodal pain management strategy that is both effective and safe. A single injection or continuous infusion of a peripheral regional analgesic technique can provide analgesia superior to that provided by systemic opioids and may even lead to improvements across a number of outcomes. Local anaesthetic is injected between the deep fascial plane of the erector spinae muscle and the tip of the transverse process using ultrasound-guided erector spinae plane block (ESPB). Modified pectoral nerve block and erector spinae plane block are being compared for post-operative pain relief after modified radical mastectomy procedures. The study was conducted at Benha University Hospital using prospective, randomised, and double-blinded methods. Group (E) received 20 millilitres of 0.5 percent bupvicaine, while group (P) received 30 millilitres of 0.5 percent bupvicaine. The patients were divided equally between the two groups. Results: There was no statistically significant difference in the visual analogue scale between the two groups. Preoperative morphine consumption in the first 24 hours was not significantly different between the two groups, nor was the number of morphine increments. Both groups had similar levels of sensory block, ease of the technique, surgery time, anaesthesia time and adverse effects, with only a small difference in the onset and incidence of side effects. Mean arterial blood pressure and heart rate were found to be significantly different between the two groups of participants. In surgical procedures, various regional pain management techniques can be used. Intercostal nerve blocks in the pectoral muscles appear to block the anterior cutaneous medial branch, which results in better bilateral analgesia than the ESB and reduces the need for opioids. ESB, on the other hand, may be linked with larger hemodynamic alterations but less clinical importance because of its closeness to the intrathecal and epidural spaces.

Key words: Ultrasound, guided Erector Spinae Plane block, Modified Pectoral Plane Block, Post - operative analgesia, - Modified Radical Mastectomy Operations**.**

1. Introduction

One of the most frequent operations for women is a breast augmentation or reduction. [1] Patients who have these types of procedures are often plagued with postoperative pain management issues that may lead to complications such as prolonged hospital stays and chronic pain development. [1].

Interventional techniques such as high thoracic epidural anaesthesia, cervical epidural anaesthesia, and thoracic paravertebral block have all been utilised to manage postoperative pain in the past. However, because to the close closeness of the pleura and the central neuraxial system, these procedures are extremely difficult. ESPB, or ultrasound-guided erector spinae plane block, involves injecting local anaesthetic into the erector spinae muscle's deep fascial plane and then removing it by a small incision just under its tip [3].

Initially, Forero et al. [4] characterised it as a therapy for neuropathic pain in the thoracic region. As a postoperative analgesic approach, it has since been employed in operations ranging from the shoulder to the hip. Analgesia in the postoperative period after a radical mastectomy may be improved by using ESPB, a safe, new method that is simple to execute and reduces the need for opioids. It helps patients recover more quickly by providing effective pain control. [7-8] Altparmak et al. used ultrasound guidance to perform ESPB with two different concentrations of bupivacaine in the same volume (0.375 percent and 0.25 percent bupivacaine in 20 ML solution), and found that 0.375 percent bupivacaine reduced postoperative tramadol consumption more significantly than ESPB performed with 20 ml of 0.25 percent bupivacaine [8].

For post-operative analgesia, a modified pectoral plane block is also used. The pectoral nerves, intercostal obrachial, intercostals, and long thoracic nerves are all inhibited in this block. With mastectomy procedures, it was shown to have a significant analgesic effect [7, 8].

Modified pectoral nerve block and erector spinae plane block are being compared for post-operative pain relief after modified radical mastectomy procedures.

2. Patients and methods

2.1. Study design

Prospective, randomized, double-blinded

Study setting and location

Benha University Hospital

Study population

American Society of Anesthesiologists (ASA) (I-II-III) patients scheduled for elective breast cancer surgery

Eligibility Criteria

Inclusion criteria

1. Age: 18 to 65 years.
2. ASA physical status (I-II&III).
3. Undergoing elective breast cancer surgery.

Exclusion criteria

1. ASA physical status>III.
2. Body mass index > 35 kg/m2

3. Patients with previous difficulty in evaluating their level of pain.
4. Contraindications for local anaesthesia: As patient refusal of local anaesthesia, coagulopathy (thrombocytopenia (platelet count below 100000 platelets per microliter), prothrombin time greater than 14 seconds), therapeutic anticoagulation and skin infection or hematoma in the vicinity of the puncture site.
5. Allergy to any of the study drugs.
6. Renal, cardiac hepatic or neurological diseases patient.

All patients will be assessed clinically and investigated for exclusion of any of the above mentioned contraindications. Laboratory work needed would be: Complete blood count (CBC); prothrombin time and concentration (PT & PC); partial thromboplastin time (PTT); kidney (creatinine clearance) and liver function tests (bilirubin, alanine aminotransferase test <ALT>, aspartate aminotransferase test <AST>.)

Intravenous access is secured and intravenous crystalloid commenced, patient monitoring is applied including ECG, noninvasive blood pressuer, pulse oximetry, capnography.

2.2. Study Procedures

Randomization (in RCT only)

Computer-generated random numbers will be used for simple randomization of subjects.

Study Protocol

patients would be allocated into two groups: group E (n=36): this group will receive ESPB (20 mL of 0.25%bupvicaine solution) and group P (n=36): this group will receive modified PPB (30 mL of 0.25%bupvicaine solution).

General anesthesia:General anesthesia In the operating room, monitoring including, noninvasive arterial blood pressure, pulse oximeter, capnography). An intravenous line (22 guage) will be inserted; then balanced crystalloid solutioninfusion will be started intravenously with a rate of 15 mL/ kg/h. After preoxygenation with 100% oxygen, anesthesia will be inducted by 2 µg/kg fentanyl and 2–3 mg/kg propofol; endotracheal tube intubation will facilitated by 0.5 mg/kg atracurium. All patients will receive intravenous ondansetron 4 mg and dexamethasone 8 mg for nausea and vomiting postoperatively. Maintenance of anesthesia will be achieved by isoflurane in a 50% oxygen/air mixture with minimum alveolar concentration 1.2 and ventilation parameters to maintain end-tidal CO2 of approximately 35–45 mmHg. Intravenous fentanyl will be given in a dose of 1 µg/kg per hour, and its total amount was recorded. Hemodynamic parameters were recorded before induction and every 5 min till the end of the operation. When the skin closure ended, isoflurane will be stopped and neuromuscular reversal will be achieved with 0.05 mg/kg neostigmine and 0.02 mg/kg atropine, intravenously.

Bradycardia less than 50 beats/min must be managed by atropine at adose of 0.3-1 mg or 0.04 mg/kg IV every 5min, no more than 3 mg.

Tachycardia more than 100 beats/min must be managed by propanolol at a dose of 1 to 3 mg at a rate not exceeding 1 mg/min. A second dose may be given after 2 minutes tell heart rate decreases.

Hypotension of systolic less than 80 mmhg and diastolic less than 50 mmhg must be managed be 500 ml saline bolus and ephedrine of 5mg can be added every 5 minutes if needed.

After successful extubation, patients will be transported to the postanesthetic care unit (PACU).

Technique of block

Following the introduction of anaesthesia immediately and 15 minutes before skin incision, a 100 mm 21G needle will be used to conduct the investigated block under full aseptic circumstances under the guidance of a linear US probe with a frequency range of 6–13 MHz (Siemens, CA 94043, USA). A unilateral ESP block will be conducted in the first group (E) of patients, as shown by Chin and colleagues [9] to perform the block, a sagittal approach will be used, with the probe positioned 2–3 cm lateral to the spine. As the transverse processes and the erector spinae muscle are identified, the needle will be injected deeply into the muscle to perform the procedure. 20 mL of the study solution (0.25 percent bupivacaine) will be injected between the erector spinae muscle and transverse process for blocking and LA distribution cranially and caudally, with the needle being directed craniocaudally. The M PECS block will be done unilaterally in the second group (P). Supine patients will be positioned with their upper limbs abducted 90 degrees to the left and right of the clavicle below the lateral third. Inferolaterally, the US-probe will be turned until the serratus anterior and the two pectoralis muscles (major and minor) can be seen in one plane following the identification of the axillary vessels. The same research solution, 10 mL, was injected into the interfascial plane between the two pectoralis muscles. After that, the probe was pointed toward the axilla, and 20 mL of the study solution was injected above the serratus anterior muscle, which can be found between the third and fourth ribs.

Patients having either a total or partial failure block will be ruled out of the research altogether.

Patients are admitted to the post-anaesthesia care unit (PACU) for two hours after surgery is completed and they are then discharged. A scoring system based on Marshall and Chung's criteria was used to evaluate the patient's hemodynamic, spo2, conscious level, nausea and vomiting [10].

Visual Analogue Scale (VAS) will be used to measure pain, which is a "10 cm" horizontal line with labels at either end indicating no pain or the most intolerable amount of discomfort. The patients will draw a line where they feel the most pain.

Patients were instructed in the use of the Visual Analog Scale (VAS) for assessing postoperative pain as part of their preoperative evaluation. After 30 minutes, 2

hours, 4 hours, 6 hours, 8 hours, 12 hours, and 24 hours, the length of the line to the patient's mark will be recorded.

Analgesics are administered when the VAS rises to three (90 mg/24 hours maximum daily dosage) and when the VAS rises to five or higher (2.5 mg intravenous) in the form of gradual intravenous infusions of 30 grammes of ketorolac every 12 hours (maximum daily dose of 90 mg/24 hours). In all groups, the total morphine dosage increases will be recorded every 24 hours.

Primary outcome

First postoperative 24 hours intravenous Morphine consumption will be recorded.

Secondary outcome(s)

1. Visual Analogue Scale for pain: it will be measured and recorded postoperative after 30 min., 2,4, 6, 8,12 and 24 hours. It is consisted of a "10 cm" line with one end labeled no pain and other end labeled worst intolerable pain. The patients will mark the line at the point that best describing the pain intensity. The preoperative assessment included training of the patients about (VAS) for postoperative pain.
2. Patients who are unable to comply with VAS will be excluded.
3. Duration of surgery (from skin incision till skin closure) and general anaesthesia (from induction of general anaesthesia till extubation).
4. Incidence of complications, such as: Nerve injury, Hematoma formation, local anesthetic toxicity, and intravascular injection.
5. Postoperative nausea and vomiting: Incidence of postoperative nausea and vomiting will be recorded.
6. Hemodynamics in the form of heart rate and mean arterial blood pressure will be recorded after 30 mins, 2, 4, 6, 8, 12 and 24 hours.

Sample size

Based on a previous study [8], sample size was calculated according to the difference in the mean value of morphine consumption 24 hours postoperatively between two different blocks, So a sample size of 35 patients/group would be required (G Power 301 http:www.psycho.uni-duesseldorf.de) We add one patients in each group for dropout compensation.

Total number of patients will be 72 patients

2.3Statistical analysis

Data were collected, revised, coded and entered to the Statistical Package for Social Science (IBM SPSS) version 23. The quantitative data were presented as mean, standard deviations and ranges when parametric and median, inter-quartile range (IQR) when data found non-parametric. Also qualitative variables were presented as number and percentages. The comparison between groups with qualitative data were done by using **Chi-square test**s.

The comparison between two groups with quantitative data and parametric distribution were done by using **Independent t-test.**; While the comparison between two groups with quantitative data and non parametric distribution was done by using **Mann-Whitney test.**

The confidence interval was set to 95% and the margin of error accepted was set to 5%. So, the p-value was considered significant as the following:

- P > 0.05: Non significant
- P < 0.05: Significant
- P < 0.01: Highly significant.

3. Results

Table (1) Comparison between group A and group B regarding demographic data, increments of morphine and number of increments of morphine in 24 hours

		Group A No. = 36	Group B No. = 36	Test value	P-value	Sig.
Age	**Mean ± SD**	33.39 ± 9.80	30.72 ± 9.29	1.185•	0.240	NS
	Range	18 – 60	17 – 57			
Sex	**Female**	36 (100.0%)	36 (100.0%)	NA	NA	NA
Increments of morphine (2mg) in 24hr	**No**	0 (0.0%)	34 (94.4%)	64.421*	0.000	HS
	Yes	36 (100.0%)	2 (5.6%)			
Number of increments of morphine (2mg) in 24hr	**0**	0 (0.0%)	34 (94.4%)	64.615*	0.000	HS
	1	24 (66.7%)	2 (5.6%)			
	2	9 (25.0%)	0 (0.0%)			
	3	3 (8.3%)	0 (0.0%)			

P-value >0.05: Non significant (NS); P-value <0.05: Significant (S); P-value< 0.01: highly significant (HS)

***:Chi-square test; •**: Independent t-test

The previous table shows that there was no statistically significant difference found between group A and group B regarding age of the studied patients with p-value = 0.240; the table also shows that the all patients of group A (100.0%) need increments of morphine in 24 hours versus (5.6%) of group B with statistically significant difference between both groups at p <0.001 and also the number of increments of morphine in group A was found higher than group B with p-value <0.001.

Table (2) Comparison between group A and group B regarding mean arterial blood pressure (mmHg)

Mean arterial blood pressure (mmHg)		Group A No. = 36	Group B No. = 36	Test value•	P-value	Sig.
30 minute	**Mean ± SD**	90.11 ± 9.39	90.53 ± 9.05	-0.192	0.848	NS
	Range	67 – 104	72 – 113			
2hr	**Mean ± SD**	94.50 ± 8.61	92.22 ± 8.29	1.144	0.257	NS
	Range	67 – 108	68 – 108			
4hr	**Mean ± SD**	96.31 ± 13.06	93.28 ± 10.16	1.098	0.276	NS
	Range	57 – 117	67 – 109			
6hr	**Mean ± SD**	96.94 ± 8.45	92.78 ± 10.11	1.898	0.062	NS
	Range	78 – 110	69 – 109			
8hr	**Mean ± SD**	105.06 ± 10.17	101.28 ± 8.99	1.670	0.099	NS
	Range	85.5 – 125	85 – 120			
12hr	**Mean ± SD**	106.74 ± 11.73	102.56 ± 10.05	1.624	0.109	NS
	Range	85 – 135	83.5 – 125			
24hr	**Mean ± SD**	96.53 ± 7.90	91.83 ± 8.05	2.497	0.015	S
	Range	75 – 110	82 – 107			

P-value >0.05: Non significant (NS); P-value <0.05: Significant (S); P-value< 0.01: highly significant (HS)

•: Independent t-test

The previous table shows that there was no statistically significant difference found between group A and group B regarding mean arterial blood pressure (mmHg) at different times of measurement except after 24 hours the level of mean arterial blood pressure (mmHg) was found significantly higher in group A than group B with p-value = 0.015.

Table (3) Comparison between group A and group B regarding visual analogue scale (VAS) score .

VAS score		Group A No. = 36	Group B No. = 36	Test value‡	P-value	Sig.
30 minute	**Mean±SD**	2.19 ± 0.40	2.28 ± 0.81	-1.377	0.168	NS
	Median (IQR)	2 (2 - 2)	2 (2 - 3)			
	Range	2 – 3	0 – 3			
2hr	**Mean±SD**	2.58 ± 0.55	1.97 ± 0.81	-3.463	0.001	HS
	Median (IQR)	3 (2 - 3)	2 (2 - 2)			
	Range	2 – 4	0 – 3			
4hr	**Mean±SD**	3.00 ± 0.93	2.19 ± 0.47	-4.135	0.000	HS
	Median (IQR)	3 (2 - 4)	2 (2 - 2)			
	Range	2 – 5	1 – 3			
6hr	**Mean±SD**	2.94 ± 0.75	2.31 ± 0.62	-3.530	0.000	HS
	Median (IQR)	3 (2 - 3)	2 (2 - 3)			
	Range	2 – 5	0 – 3			
8hr	**Mean±SD**	3.39 ± 0.84	2.25 ± 0.55	-5.480	0.000	HS
	Median (IQR)	3 (3 - 4)	2 (2 - 3)			
	Range	2 – 5	1 – 4			
12hr	**Mean±SD**	3.17 ± 0.81	2.33 ± 0.59	-4.795	0.000	HS
	Median (IQR)	3 (3 - 3)	2 (2 - 3)			
	Range	2 – 6	1 – 4			
24hr	**Mean±SD**	2.86 ± 0.49	2.64 ± 0.49	-1.839	0.066	NS
	Median (IQR)	3 (3 - 3)	3 (2 - 3)			
	Range	2 – 4	2 – 3			

P-value >0.05: Non significant (NS); P-value <0.05: Significant (S); P-value< 0.01: highly significant (HS)

‡: Mann Whitney test

The previous table shows that there was no statistically significant difference found between group A and group B regarding VAS score at 30 minutes with p-value = 0.168 while there was statistically significant increase in the VAS score in group A than group B at 2 hours, 4 hours, 6 hours, 8 hours and 12 hours with p-value = 0.001, <0.001, <0.001, <0.001 and <0.001; respectively. Finally, at 24 hours there was no statistically significant difference found between both groups regarding VAS score with p-value = 0.066.

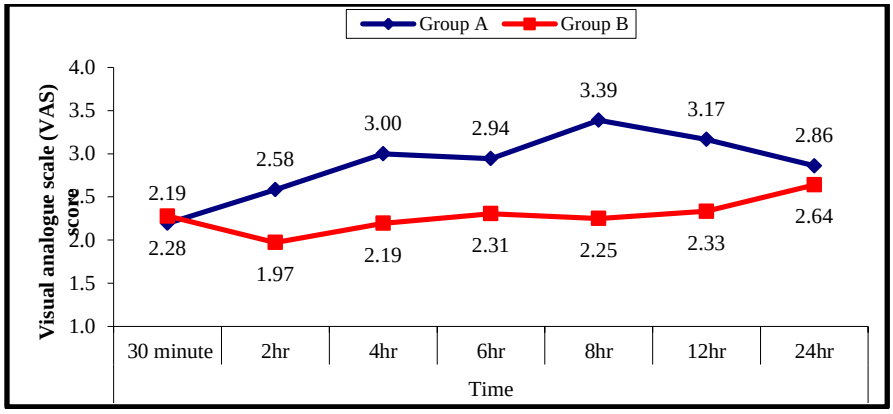

Fig. (1) Comparison between group A and group B regarding visual analogue scale (VAS) score

Table (4) Comparison between group A and group B regarding adverse effects.

Adverse effects		Group A		Group B		Test value*	P-value	Sig.
		No.	%	No.	%			
Never injury	**No**	36	100.0%	36	100.0%	NA	NA	NA
Hematoma formation	**No**	36	100.0%	36	100.0%	NA	NA	NA
Local anesthetic toxicity	**No**	36	100.0%	36	100.0%	NA	NA	NA
Intravascular injection	**No**	36	100.0%	36	100.0%	NA	NA	NA
Pneumothoa	**No**	36	100.0%	35	97.2%	1.014	0.314	NS
	Yes	0	0.0%	1	2.8%			

P-value >0.05: Non significant (NS); P-value <0.05: Significant (S); P-value< 0.01: highly significant (HS)

*:Chi-square test

The previous table shows that there was no incidence of never injury, hematoma formation, local anesthetic toxicity and intravascular injection in both groups; only one patients of group B have pneumothoa but with no statistically significant difference between groups with p-value = 0.314.

4. Discussion

There was a substantial difference between the two groups in our VAS investigation.

ESP block injection dosages recorded in the literature were examined by Luftig et al. With injection doses ranging from 20mL to 40mL and concentrations ranging from 0.25%–0.5%, the most often administered LAs in these cases were bupivacaine and ropivacaine. This author developed an ESP block LA dosage and volume recommendations based on weight in view of the significance of applying the right dose. They propose ropivacaine dosages be kept at three milligrammes per kilogramme, and bupivacaine at two milligrammes per kilogramme (a maximum of 175 milligrammes) [11].

Even while a greater LA concentration could allow for better diffusion into the paravertebral area, Kashani remarked that it would seem natural that a bigger volume would give a much more broad distribution in the interfascial plane deep to the erector spinae muscle [12].

This research found significant differences between the two groups in terms of morphine increments and overall initial preoperative 24-hour morphine use.

In a case series of five patients, Nair et al. documented the effectiveness of this block in a comparable procedure [13].

They also found that none of these patients need opioids for postoperative analgesia rescue.

Kimachi et al. employed US-guided ESP for full surgical anaesthesia for a right-sided mastectomy and axillary dissection in a patient with a significant cardiovascular risk, unlike other case reports/series [14].

Complete surgical anaesthesia was not only achieved, but also minimum postoperative analgesia was required.

A single-shot ESP block at the T4 level of the thorax, according to Altparmak B et alfindings,.'S dramatically decreased postoperative morphine use in a randomised controlled trial of breast cancer surgery [8].

Wahba et al. [15] examined the morphine requirements and duration of postoperative analgesia in 60 patients who had MRM. When compared to PVB, patients who had PECS block experienced superior pain relief and used fewer narcotics. Our findings are in line with these results.

After a PECS block, Bakshi et al. [16] reported difficulties in surgery because of fluid-filled gaps. None of the patients we examined had this issue. This might be owing to the fact that there was a 30-minute interval between the block and the operation, which could have allowed the local anaesthetic to be absorbed.

There was no statistically significant difference in mean arterial blood pressure (mmHg) between groups A and B at any of the measurement periods, except after 24 hours, when group A's mean arterial blood pressure

(mmHg) was substantially higher than group B's (p-value = 0.015), our data revealed.

In addition, none of the patients in our research had any problems related to regional anaesthesia, such as local anaesthetic toxicity, nerve damage, or intravascular injection, and only one occurrence of pneumothorax was seen in group P, compared to NIL in group E.

Pneumothorax following ESPB has been described by both Ueshima and Ueshima, who disagree with our findings. [17] According to Hamilton et al. [3] and Selvi et al. [18], ultrasound-guided ESPB is a novel and popular block method with just two documented problems. Pneumothorax and motor paralysis occurred when an ESPB procedure was conducted from a lower thoracic position.

ESPB pneumothorax is rare when conducted under ultrasound guidance, although it may occur if there is a problem with synchronisation between the hands and the eyes or if the depth is incorrectly calculated.

It has also been discovered by Tulgar et al. that motor weakness may arise when the LA progresses to or from the lumbar region. In hip, knee, and femur surgery, our findings that ESPB from L4 may provide good postoperative analgesia have of therapeutic value. In order to ascertain whether there is a correlation between volume and the LA spread, further research is necessary.

5. Conclusion

It was shown that the mean ascetic level of MBL in the SBP group was considerably lower than the non SBP group. Cirrhosis patients with spontaneous bacterial peritonitis may benefit from ascitic fluid MBL as a predictor and prognosticator of liver failure and poor prognosis.

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