Comparison of the Effects of Ultrasound-Guided Erector Spinae Plane Block Versus Retrolaminar Block on Postoperative Analgesia after Modified Radical Mastectomy in Suez Canal University Hospitals

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Abstract

BACKGROUND: The increasing incidence of breast cancer has led to an increased number of patients getting operated for breast surgery. Blockade of nociceptive inputs via the intercostal nerves is important for postoperative pain control after breast surgery, because cutaneous innervation of the breast is mainly derived from the intercostal nerves, with a small contribution from the supraclavicular nerves.**AIM:** This study aimed to improve pain management in patients undergoing modified radical mastectomy through setting regional blocks as a protocol at Suez Canal university hospitals.**PATIENTS AND METHODS:** This prospective comparative randomized double blinded clinical trial study was carried out at the operative theatre in Suez Canal University Hospitals. This study included 122 American Society of Anesthesiologists (ASA) physical status I and II female patients aged 18-65 years scheduled for elective unilateral modified radical mastectomy under general anesthesia were enrolled into the study. Patients were randomly allocated into two groups Group I (Group E): 61 Patients received ultrasound-guided erector spinae plane block with 30 ml of bupivacaine 0.25%. Group II (Group R): 61 Patients received ultrasound-guided retrolaminar block with 30 ml of bupivacaine 0.25%.**RESULTS:** The mean time to 1st request of analgesia in group E was (6.54 ± 4.653 hours), in the group R (5.93 ± 4.457 hours), without statistically significant difference between them (p=0.630). The mean morphine consumption in the group E was (7.21 ± 4.340 mg), in the group R (7.11 ± 4.219 mg), without statistically significant difference between them (p=0.909). Regarding the satisfaction score in the studied groups. In group E, it was found that most participants 32 (52.5%) were very satisfied, 18 (29.5%) were satisfied, 11 (18.0%) were neither, nor 0 (0.0%) were dissatisfied. In group R, it was found that most participants 23 (37.7%) were satisfied, 21 (34.4%) were very satisfied, 14 (23.0%) were neither, nor 3 (4.9%) were dissatisfied, without statistically significant difference between both groups any of the satisfaction score (p=0.100). About the relevant postoperative complications in the current study, no statistically significant difference between both groups regarding any of the postoperative complications. Concerning time to complete block in the current study, the mean time to complete block was shorter in group E than group R, without significant difference between both (p= 0.076). Regarding block difficulty in the current study, in group E; most cases 41 (67.2%) had an easy procedure, rather difficult in 19 (31.1%), and difficult in 1 (1.6%). While in group R, about half of patients 31 (50.8%) had an easy procedure, rather difficult in 27 (44.3%), and difficult in 3 (4.9%), without significant difference between both (p= 0.151).**CONCLUSION:** This study failed to detect a difference in terms of time to first post-operative rescue analgesic administration after the block procedure between ESPB and RLB in patients undergoing breast surgery. Future clinical studies are needed to confirm the anatomical mechanisms of action of both blocks, as well as the appropriate concentration, the optimal timing and volume of local anesthetics required for adequate ESPB or RLB.

KeyWords:ESPB, RLB, Breast surgery, VAS, NRS.

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INTRODUCTION:

A recent review revealed that the nerves that lead to pain vary, depending on the type of the surgery, and that different regional anesthesia techniques cover different parts of the surgical field [1]. However, each of these blocks had its peculiar limitations. These regional techniques may be associated with problems such as vascular puncture, epidural hematoma, pneumothorax, nerve damage, hypotension or certain parts of inadequate block [2].

Nonetheless, a relatively novel compartment or truncal block, the erector spinae plane block (ESPB) was first described in 2016 as an

alternative to conventional thoracic regional anesthetic techniques such as thoracic epidural and paravertebral injections [3].

Clinical studies have demonstrated that the block targets both the ventral and dorsal spinal rami [4].

One of the advantages of ESPB compared to more conventional techniques is that this block targets a plane that is far away from the pleura and neuraxial structures, improving its safety profile. The mechanism of action of ESPB has also been shown to involve both transforaminal and epidural spread, giving the technique an advantage over direct intercostal nerve blockade. In ESPB procedure, LA is injected into the fascial plane deep to the erector spinae muscle group to achieve analgesia of the thoracic and abdominal walls [5].

Specifically, ESPB applied at T7 has been shown to significantly decrease postoperative pain following laparoscopic bariatric surgery. Recent literature has shown that ESPB is efficacious not only in the acute but also in the chronic setting. The block has been successfully used to treat patients with unrelenting refractory thoracic neuropathic pain and chronic shoulder pain, allowing patients to not only decrease their opioid load but also improve their overall quality of life [6].

Another alternative interfacial or truncal block to the thoracicparavertebral block (TPVB) is the retrolaminar block (RLB) that was described in 2006 [7] as a simpler surface landmark-guided block. Rather than seeking to pierce the superior costotransverse ligament and enter the paravertebral space, the aim in the RLB is merely to contact the bony vertebral lamina. LA is injected into the fascial plane between the posterior surface of the thoracic lamina and the overlying transversospinalis muscles. In the ultrasound-guided approach to the RLB, the lamina, overlying muscle, and the LA spread between them is directly visualized [8]. Cadaveric studies have confirmed that the injectate subsequently spreads anteriorly through the intertransverse ligaments into the paravertebral and epidural spaces over 2-4 segmental levels [9].

The advantage of RLB is that it is a technically easier procedure than paravertebral block (PVB) and thoracic epidural anesthesia (TEA). The needle tip of RLB is not closer to pleura and spinal nerve roots than that of TEA and PVB. Furthermore, using ultrasound (US) images allows for visualization of the needle and LA distribution. Anatomically, ESPBtargets the tips of the transverse processes, giving it a distinct advantage over RLB, which targets the laminae and involves injection over the thick spinalis and transversospinalis muscle groups that increase the variability of LA spread [10].

It has been reported that the clinical effect of ESPB and RLB can be explained by epidural and neural foraminal spread of LA. However, the intercostal spread with the ESPB is greater than that with the RLB [10]. Since cutaneous innervation of the breast is mainly derived from the intercostal nerves with a small contribution from the supraclavicular nerves, we hypothesized that the ESPB would more effectively provide postoperative analgesia after breast cancer surgery than the RLB. Thus, this prospective comparative randomized clinical trial was conducted to evaluate the efficacy of ultrasound-guided ESPB versus RLB for postoperative pain relief in patients undergoing modified radical mastectomy.

AIM OF THE STUDY

This study aimed to improve pain management in patients undergoing modified radical mastectomy through setting regional blocks as a protocol at Suez Canal university hospitals.

PATIENTS AND METHODS

This randomized double blinded clinical trial was conducted at the operative theatres in Suez Canal University Hospitals. After obtaining approval from the research Ethics Committee of the Suez Canal University Hospitals and written informed consent from the patients with an explanation regarding to the purpose, methods, effects and complications, 122 American Society of Anesthesiologists (ASA) physical status I and II female patients aged 18-65 years old scheduled for elective unilateral modified radical mastectomy under general anesthesia were enrolled into the study.

Patients were randomly allocated into one of two equal groups on alternative basis using a closed envelope method; 61 patients for each group.

- **Group I (Group E):** 61 Patients who received ultrasound-guided erector spinae plane block with 30 ml of bupivacaine 0.25%.
- **Group II (Group R):** 61 Patients who

received ultrasound-guided retrolaminar block with 30 ml of bupivacaine 0.25%.

To qualify for participation in this trial, the patients had to meet the following inclusion and exclusion criteria:

A) Inclusion criteria:

1. Female patients (18 to 65 years old).
2. Patients are ASA I and II.
3. Patients are scheduled for elective unilateral modified radical mastectomy.

B) Exclusion criteria:

1. Infection at the site of the block.
2. Coagulopathy (INR more than or equal 1.6 , PTT more than or equal 40 and platelets less than 60,000)
3. Morbid obesity [body mass index (BMI) > 40 kg/m2].
4. A known allergy to study drugs.
5. Neurological or any systemic diseases causing neurological abnormalities.
6. Major cardiovascular diseases (as coronary heart disease, stroke, peripheral arterial disease and aortic disease).
7. Decreased pulmonary reserve (obstructive or restrictive lung disease).
8. Metastatic cancer to brain, lung, liver or vertebral column.
9. Anatomical abnormalities of vertebral column (as scoliosis or kyphosis).
10. Renal dysfunction (s.creatinine more than 1.5).
11. Psychiatric illness.
12. Uncooperative and mentally retarded patients.
13. Chronic pain syndrome.
14. Addict patient or that who is on long-term use of opioid medications.

All the patients were subjected to preoperative assessment included history taking (The patient's age, weight, height and body mass index (BMI)), Medical history, Physical examination, Anesthetic assessment and Laboratory investigations. At the preoperative holding area, the researcher explained to the patient what will be done in the morning of surgery. The patient was blinded to the used drug and the used block and was asked to choose a sealed envelope with her code number inside. The name, file number and body weight were recorded on the sealed envelope after been chosen. The on-duty anesthetist was blinded to the used drug and the used block. A detailed preoperative anesthesia evaluation was done and patients were educated about numeric rating scale (NRS) of pain score. All patients were kept fasting as per standard ASA protocol. All patients were cannulated and pre-medicated using midazolam 0.03 mg/kg IV and atropine 1mg IM upon arrival to the preoperative holding area. All block applications were done after sedation and standard monitorization. Group (E) patients received ESPB, whereas group (R) received RLB with 30 ml of bupivacaine 0.25% in the preoperative area 20 min before surgery with all aseptic precautions under continuous monitoring of heart rate (HR), noninvasive blood pressure (NIBP), and oxygen saturation (SpO2). The blocks were performed on the side of surgery with a sterile 18-gauge Tuohy needle using ultrasound machine (Sonosite, M Turbo Inc., Bothell, WA, USA) and linear array probe (38 mm, 6–13 MHz frequency).

Intra-operative: Group I (group E) received ultrasound-guided erector spinae plane block at the level of T4. The patient was placed in a sitting position and a high-frequency linear ultrasound transducer was placed in a longitudinal orientation 3 cm lateral to the thoracic spinous process. Three muscles were identified superficial to the hyperechoic transverse process shadow as follows: trapezius, rhomboid major, and erector spinae.The area was prepared and draped in a sterile fashion, and lidocaine infiltrated subcutaneously at the point of anticipated needle entry. A sterile Tuohy needle was introduced and advanced towards the corresponding transverse process. Hydrodissection was ensured that the proper plane was located. Once the erector spinae musculature was separated from the rib, a total of 30 ml of 0.25% bupivacaine was injected here [2,11]. Close monitoring of the vital signs was done at regular intervals till end of the procedure. Group II (group R) received ultrasound-guided retrolaminar block at the level of T4. The patient was placed in a sitting position and the retrolaminar space was identified sonographically. Ultrasound scanning was performed with the probe in paramedian sagittal plane. First, the ribs and the intercostal spaces were identified 4–5 cm lateral to the spinous process of the corresponding vertebral bodies. In this view, the round contours of the ribs were visualized with the pleural line between them located ~0.5 cm deeper. The scanning probe was

slide from lateral to medial (maintaining sagittal orientation) until the transverse processes (TPs) then were come into view. The transition was seen as a "step down" change. In contrast with ribs, the appearance of TPs was more rectangular with a pleural line located deeper. In this view, the paravertebral space was visualized with the costotransverse ligament (CTL) located above it. Advancing the probe more medially, the transition of TPs to vertebral laminae was then visualized, followed by the view of the adjacent vertebral laminae. The laminae, targeted with the retrolaminar approach, appeared sonographically as flat continuous interrupted "notched" hyperechoic structures, constituting the location of optimal needle-bone contact end point. The area was prepared and draped in a sterile fashion, and lidocaine infiltrated subcutaneously at the point of anticipated needle entry. An in-plane approach using a sterile 18-gauge Tuohy needle was employed. The needle was introduced at the cephalic end of the ultrasound probe aiming caudally and was advanced until contact with vertebral lamina was achieved and confirmed both by imaging and "by feel". Then, 30 ml of bupivacaine 0.25% was injected through the needle under real-time ultrasound visualization. The criterion for assessment of correct spread of the injectate was created a plane/hypoechoic space between the lamina and the deep paraspinous muscles. Hydrodissection had ensured that the proper plane was located [12]. Close monitoring of the vital signs was done at regular intervals till end of the procedure.

After performing the block, the sensory level of block was assessed with pin prick sensation every 5 min in each dermatomal distribution from T1 to T8 for the first 20 min by an anesthesiologist who was not aware of study group. Total number of dermatomes that had less pain to pin prick compared with opposite side was noted. If the pin prick sensation did not decrease in any segment up to 20 min, it was considered as block failure and these patients were excluded from the study (i.e. withdrawal group). Any block-related complication, such as vascular puncture, local anesthetic toxicity, Horner's syndrome, or pneumothorax, was recorded. Any side-effect in the form of nausea, vomiting, respiratory depression, hypotension, pruritus, or chest pain in the perioperative period was noted. After 20 min of block, the patient was shifted to the operating room.

General anesthesia was induced in all patients with fentanyl (1 μg/kg), propofol (2 mg/kg), and cisatracurium (0.15 mg/kg) then the patient was intubated and mechanically ventilated. Anesthesia was maintained with air (50%), oxygen (50%), isoflurane with minimum alveolar concentration (MAC) of 0.9–1.2. Supplemental analgesia was provided with fentanyl (0.5μg/kg) IV bolus, if HR or mean arterial blood pressure (MABP) exceeded 20% of the baseline values. Continuous monitoring of HR, NIBP, peripheral SpO2, and end-tidal carbon dioxide (EtCO2) were done every 15 min till the end of surgery. The number of doses and total dose of fentanyl used as supplement analgesia intraoperatively were recorded for comparison between two groups. After completion of surgery, presence of attempts of spontaneous breathing and proper oxygenation, residual neuromuscular blockade was reversed using the titration method with neostigmine and atropine IV (2.5 mg : 1 mg ratio) guided both clinically by the ability of the responsive patient to sustain as many voluntary activities as possible as head lifting, leg raising, hand gripping, eye opening, tongue protrusion, adequate swallowing, and adequate coughing and by the train of four (TOF) neuromuscular monitoring then extubated and transferred to postoperative recovery unit. The total duration of the surgery was also recorded.

Temperature monitoring was done throughout the operation using a temperature probe which was placed nasopharyngeally. The patients were monitored at 0, 2, 4, 6, 8, 12, 16, 20 and 24 hours postoperatively for HR, NIBP, SpO2, respiratory rate (RR), and NRS. The NRS was a segmented numeric version of the visual analog scale (VAS) in which a respondent selected a whole number (0–10 integers) that best reflects the intensity of her pain. The common format was a horizontal bar or line which contains 11-point numeric scale ranging from "0" representing one pain extreme (e.g., "no pain") to "10" representing the other pain extreme (e.g., "pain as bad as you can imagine" or "worst pain imaginable"). NRS was assessed during rest (NRS-R) and on movement (NRS-M) at predefined intervals postoperatively.

Duration of analgesia defined as the time interval from completion of local anesthetic (LA) administration till first need of rescue analgesic. The rescue analgesic regime included slow IV morphine (0.05mg/kg) whenever NRS is ≥ 4 at rest or patient's demand. Total rescue analgesic

consumption per patient as described in total dose of morphine used in initial 24 hours postoperatively was also recorded.

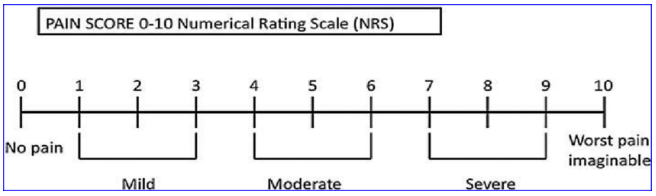

Figure 1: Numerical rating scale [13].

In both groups, if the NRS pain score was ≥ 4 at rest at any time or on demand, a dose of 0.05mg/kg morphine slow IV was given for control of pain. If the NRS pain score was still ≥ 4, a dose of 0.1 mg/kg morphine slow IV was given. Pethidine was used in case of contraindication to morphine as in asthmatic patients.

Means of total morphine consumption during the first postoperative 24 hours was our primary objective. Total intraoperative fentanyl consumption, the postoperative numeric rating scale of pain score at rest (NRS-R), the postoperative numeric rating scale of pain score on movement (NRS-M), time to the first analgesic request postoperatively, duration of analgesia, patient satisfaction with postoperative pain control was rated 24 hours after surgery using a 5-point Likert scale [14] were our secondary objectives.

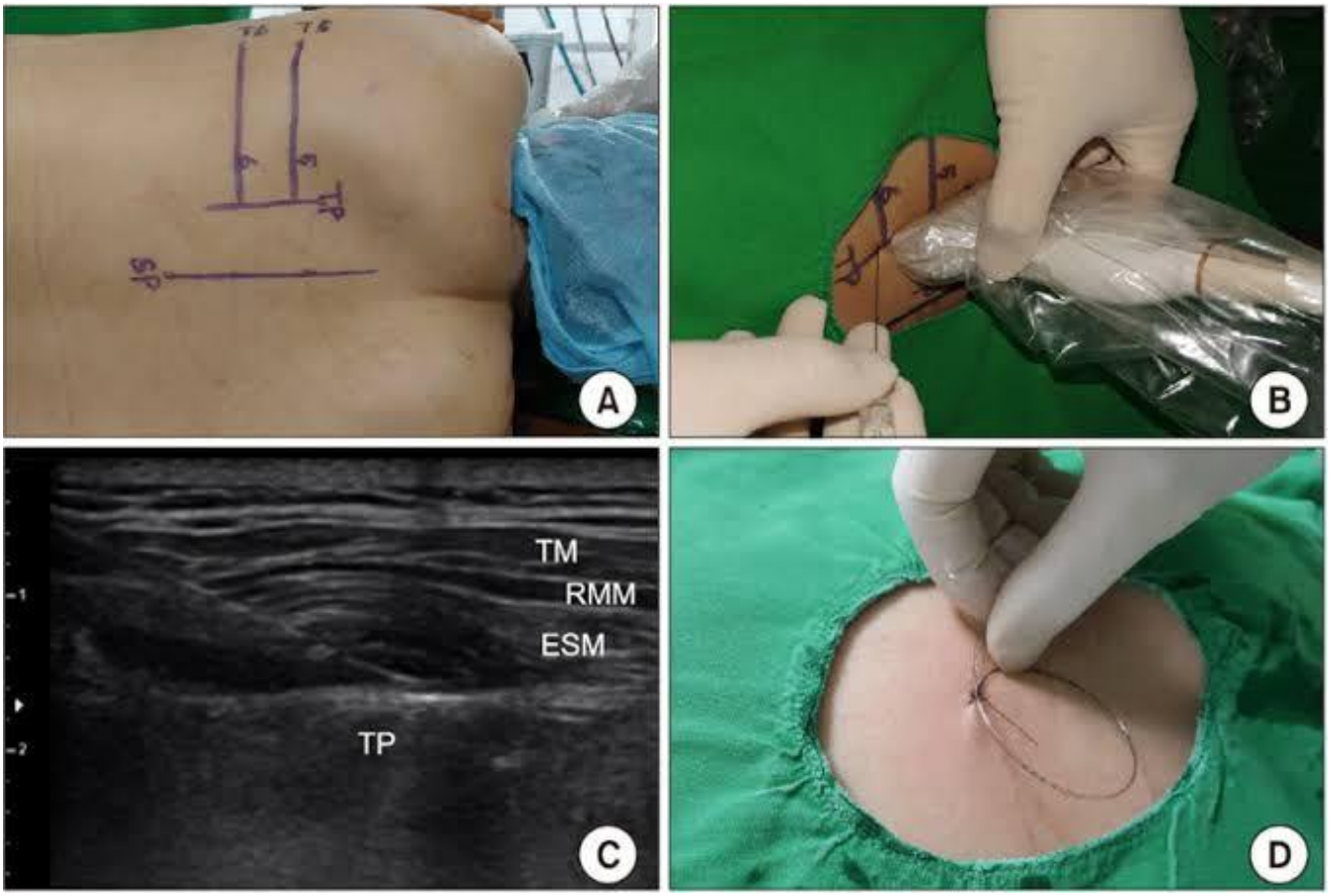

Figure 2: The erector spinae plane block. (A) The level of the T5 rib and transverse process was located using a counting-down approach from the first rib; this was marked on the skin at the lateral position. (B) After placing a linear probe parallel to the vertebral axis, a needle was inserted toward the transverse process. (C) After confirming proper position of needle tip, we injected the local anesthetic. ESM: erector spinae muscle, RMM: rhomboid major muscle, TM: trapezius muscle, TP: transverse process, SP: spinous process of vertebra [15].

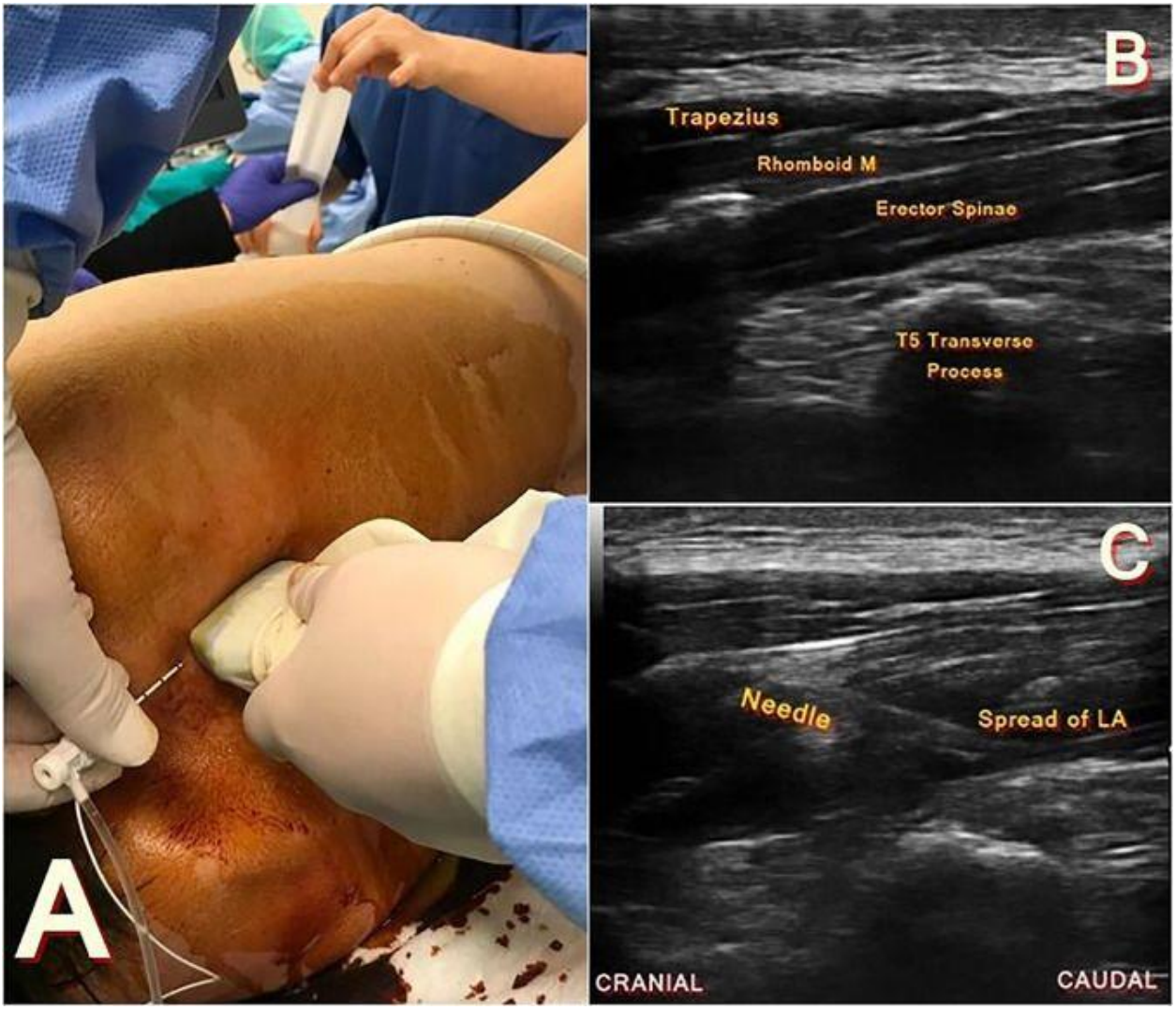

Figure 3: (A) Ultrasound and patient setup for block preparation. (B) Sonographic anatomy. (C) Craniocaudal spread of local anesthetic. Spread is visible within the erector spinae plane (below erector spinae muscle, above the transverse process) [16].

Data management and statistical analysis

SPSS statistics for windows (Statistical Package for the Social Sciences) version 26 (IBM, Armonk, NY, USA) was used for statistical analysis of the collected data. Shapiro-Wilk test was used to check the normality of the data distribution. All tests were conducted with 95% confidence interval. P (probability) value < 0.05 was considered statistically significant. Charts were generated using SPSS' chart builder and Microsoft Excel for windows 2019. Quantitative variables were expressed as mean and standard deviation while categorical variables were expressed as frequency and percentage. Independent sample T and Mann Whitney tests were used for inter-group (between subjects) comparison of parametric and non-parametric continuous data with no follow up readings respectively.

RESULTS

A total number of 122 patients were evaluated in the Suez Canal University Hospitals. Patients were randomly allocated into one of two equal groups using a closed envelope method: 61 patients for each group. Group I (Group E): Patients who received ultrasound-guided erector spinae plane block with 30 ml of bupivacaine 0.25%, and Group II (Group R): Patients who received ultrasound-guided retrolaminar block with 30 ml of bupivacaine 0.25%.

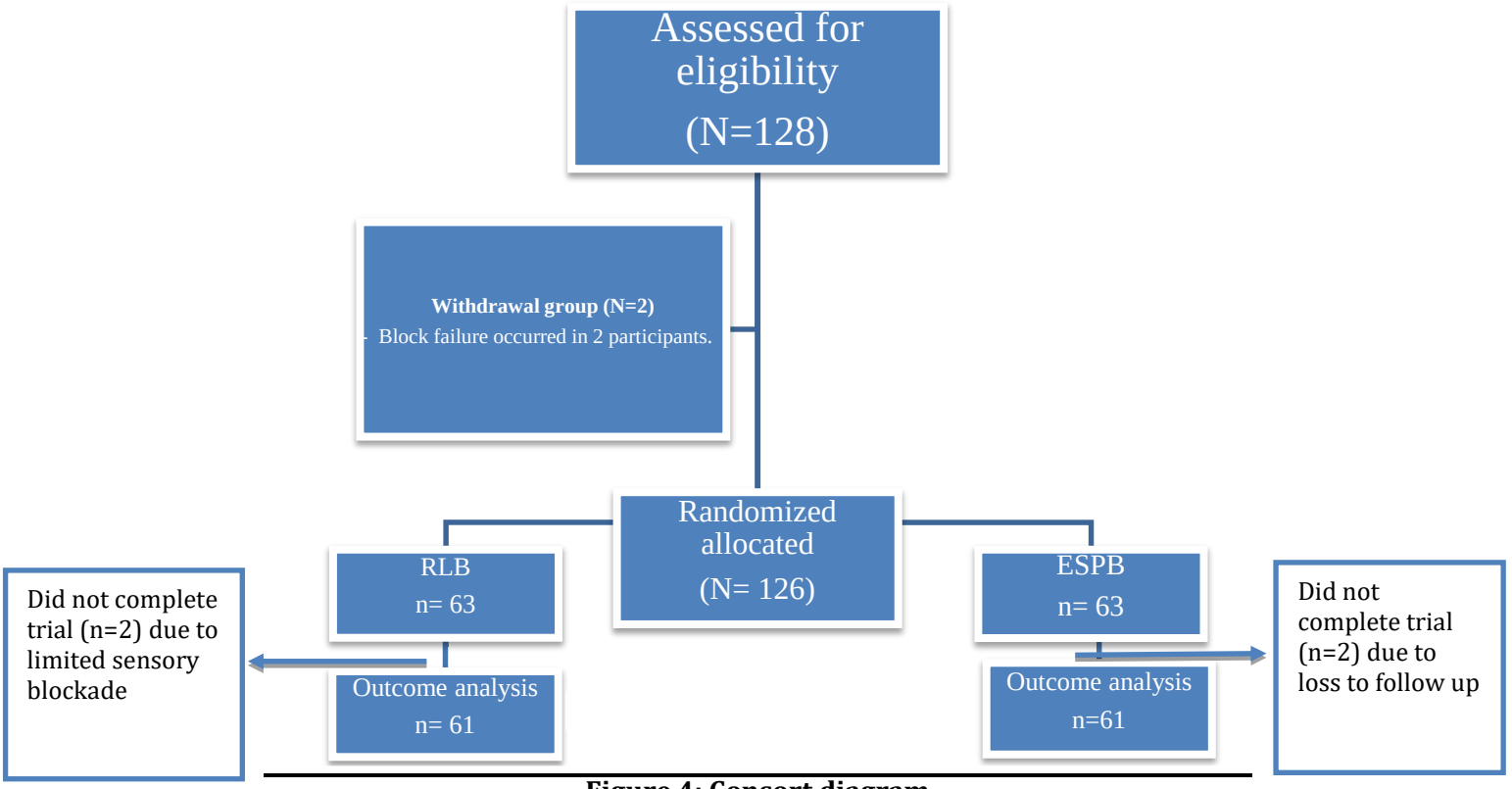

Figure 4: Consort diagram

Table 1 shows the demographic characteristics of the studied groups, there were no statistical significant differences between both groups.

Table (1): Demographic characteristics of the studied groups:

	Group E (n= 61)	Group R (n= 61)	95% CI	P
Age (years)	45.93 ± 8.037	45.72 ± 8.104	-2.7, 3.1	0.884
Weight (kg)	80.15 ± 11.423	79.78 ± 11.662	-3.8, 4.5	0.862
Height (m)	1.66 ± 0.064	1.67 ± 0.068	0.0, 0.0	0.723
BMI (kg/m2)	28.97 ± 3.387	28.72 ± 3.615	-1.0, 1.5	0.693
Duration of surgery (hours)	2.26 ± 0.379	2.35 ± 0.388	-0.2, 0.0	0.177
Intraoperative fentanyl/kg (µg)	1.51 ± 0.206	1.67 ± 0.240	-0.15, 0.02	0.108
Data are expressed as mean and standard deviation. 95% CI: 95% confidence interval of the mean difference between both groups. P is significant when < 0.05.				

It was found that the baseline and intraoperative heart rate and MAP readings at different time periods in both groups were similar, with no statistically significant difference between any of them, while there were a significantly decreased heart rate and MAP at different time periods in each group compared to their baseline value.

Table 2 shows that postoperative NRS of pain score at rest at different study periods were comparable and similar in both groups, with no statistically significant difference between any of them.

Table (2): Baseline and postoperative NRS of pain score at rest at different time intervals: Time (hour).

	NRS of pain score at rest			
Time (hour)	Group E (n= 61)	Group R (n= 61)	95% CI	P
Baseline	0 ± 0	0 ± 0	-	1
1 hour	0.56 ± 0.501	0.48 ± 0.504	-0.1, 0.3	0.367
2 hours	1.97 ± 1.169	2.26 ± 1.079	-0.7, 0.1	0.207
4 hours	2.87 ± 1.455	3.34 ± 1.377	-1.0, 0.0	0.094
6 hours	3.62 ± 1.003	4.00 ± 1.111	-0.8, 0.0	0.080
8 hours	3.79 ± 0.951	4.13 ± 1.040	-0.7, 0.0	0.089
12 hours	3.59 ± 1.055	3.85 ± 0.891	-0.6, 0.1	0.241
16 hours	3.46 ± 0.941	3.82 ± 1.162	-0.7, 0.0	0.162
20 hours	3.28 ± 0.968	3.56 ± 1.088	-0.6, 0.1	0.172
24 hours	3.33 ± 0.978	3.52 ± 0.887	-0.5, 0.1	0.252
Data are expressed as mean and standard deviation. 95% CI: 95% confidence interval of the mean difference between both groups. P is significant when < 0.05.				

Table 3 demonstrates that the mean time to 1st request of analgesia in group E was (6.54 ± 4.653 hours), in the group R (5.93 ± 4.457 hours), without statistically significant difference between them (p=0.630). Mean morphine consumption in the group E was (7.21 ± 4.340 mg), in the group R (7.11 ± 4.219 mg), without statistically significant difference between them (p=0.909).

Table (3): Time to first request of analgesia and morphine consumption during first postoperative day:

	Group E (n= 61)	Group R (n= 61)	95% CI	P
1st request of analgesia (hours)	6.54 ± 4.653	5.93 ± 4.457	-1.0, 2.2	0.630
Morphine consumption (mg)	7.21 ± 4.340	7.11 ± 4.219	-1.4, 1.6	0.909
Data are expressed as mean and standard deviation. 95% CI: 95% confidence interval of the mean difference between both groups. P is significant when < 0.05.				

There were no statistically significant differences between both studied groups regarding any of the baseline, 12 hours, or 24 hours in CRP, TLC, lymphocyte, NLR and PLR.

Table 4 shows that there were no statistically significant differences between both studied groups regarding any of the baseline (p=0.988), 12 hours (p=0.832), or 24 hours (p=0.163) cortisol. The cortisol values in each group were significantly lower at 12 and 24 hours compared to the baseline value (p < 0.001).

Table (4): Baseline cortisol and postoperative follow-up in the current study:

	Cortisol (mcg/dl)			
Time (hour)	Group E (n= 61)	Group R (n= 61)	95% CI	P
Baseline	18.88 ± 2.400	18.89 ± 2.538	-0.9, 0.9	0.988
12 hours	15.76 ± 2.092	15.84 ± 2.237	-0.9, 0.7	0.832
24 hours	11.05 ± 2.893	11.77 ± 2.768	-1.7, 0.3	0.163
Data are expressed as mean and standard deviation. 95% CI: 95% confidence interval of the mean difference between both groups. P is significant when < 0.05.				

Table 5 shows the satisfaction score in the studied groups. In group E, it was found that many participants 32 (52.5%) were very satisfied, 18 (29.5%) were satisfied, 10 (16.4%) were neither, nor1 (1.6%) were dissatisfied. In group R, it was found that the majority of participants 29 (47.5%) were verysatisfied, 17 (27.9%) were satisfied, 13 (21.3%) were neither, nor2 (3.3%) were dissatisfied. There was no statistically significant difference between both groups in the satisfaction score (p=0.825).

Table (5): Satisfaction score of the studied groups:

Satisfaction score	Group E (n= 61)	Group R (n= 61)	P
Very satisfied	32 (52.5%)	29 (47.5%)	0.825
Satisfied	18 (29.5%)	17 (27.9%)	
Neither	10 (16.4%)	13 (21.3%)	
Dissatisfied	1 (1.6%)	2 (3.3%)	
Very dissatisfied	0 (0.0 %)	0 (0.0%)	
Data is expressed as percentage and frequency. P is significant when < 0.05.			

Table 6 shows the relevant postoperative complications in the current study. In group E, it was found that most participants 12 (19.7%) had nausea, 6 (9.8%) had vomiting, 1 (1.6%) had bradycardia, and no one had hypotension or respiratory depression. In group R, it was found that most participants 14 (22.9%) had nausea, 8 (13.1%) had vomiting, 1 (1.6%) had bradycardia, and no one had hypotension or respiratory depression. There was no statistically significant difference between both groups regarding any of the postoperative complications.

Table (6): Relevant postoperative complications in the current study:

Complications	Group E (n= 61)	Group R (n= 61)	Odds ratio	P
Bradycardia	1 (1.6%)	1 (1.6%)	1	1
Hypotension	0 (0.0%)	0 (0.0%)	1	1
Respiratory depression	0 (0.0%)	0 (0.0%)	1	1
Nausea	12 (19.7%)	14 (22.9%)	1.71	0.207
Vomiting	6 (9.8%)	8 (13.1%)	2.48	0.081

Data is expressed as percentage and frequency. Odds ratio was calculated for Group R compared to Group E. P is significant when < 0.05.

Table 7 shows that the mean time to complete block was (8.13 ± 1.072 min) in group E, and (8.51 ± 1.178 min) in group R, without significant difference between both (p= 0.076).

In group E, most cases 41 (67.2%) had an easy procedure, rather difficult in 19 (31.1%), and difficult in 1 (1.6%). While in group R, about half of patients 31 (50.8%) had an easy procedure, rather difficult in 27 (44.3%), and difficult in 3 (4.9%), without significant difference between both (p= 0.151).

Table (7): Time to complete block and its difficulty in the studied groups:

		Group E (n= 61)	Group R (n= 61)	95% CI	P
Time to complete block (minutes)		8.13 ± 1.072	8.51 ± 1.178	-0.78, 0.02	0.076
Difficulty of the procedure	**Easy**	41 (67.2%)	31 (50.8%)	-	0.151
	Rather difficult	19 (31.1%)	27 (44.3%)		
	Difficult	1 (1.6%)	3 (4.9%)		

Data is expressed as mean and standard deviation or as percentage and frequency. 95% CI: 95% confidence interval of the mean difference between both groups. P is significant when < 0.05.

Discussion:

Numerous pain relief techniques, including several new regional anesthesia techniques, are available for control of acute pain after breast surgery [17,18].

RLBis an easy and safe technique and was previously reported to be satisfactory for postoperative analgesia after breast surgery [19].

Forero et al. (2016) developed the ESPB block in 2016 as a paraspinal fascial plane block entailing the LA injection into the plane beneath the erector spinae muscle and to the tips of the TPs [20]. The ESPB block is introduced as a safer alternative to TE anesthesia and PV block to avoid pleural injury due to using the TP as a barrier [21]. After injection at the level of T4, a craniocaudal spread of LA provides a multidermatomal sensory block. Thus, ESPB can deliver analgesia for abdominal or thoracic surgery [10]. The LA also spreads to the thoracic PV space via the costotransverse foramina. Therefore, it can block spinal nerves' dorsal and ventral rami [22].

So, our study was carried out to determine analgesic efficacy of ultrasound guided ESPB compared with RLB in patients undergoing modified radical mastectomy using the total morphine consumption in the first postoperative

24 hours as an indicator.

We hypothesized that ESPB would provide better postoperative analgesia than RLB after breast surgery, due to wider spread of the local anesthetic. However, contrary to our expectation, we demonstrated that ESPB isequivalent, and not superior to RLB in terms of the time to first postoperative rescue analgesic administration after the block procedure. We also confirmed that there was no significant difference in the consumption of remifentanil during anesthesia, pain intensity at rest for 24 h postoperatively, and in the occurrence of PONV between the group.

Our study results have revealed that there was no significant difference in any of the patients' demographic characteristics between the two groups.

Like Sotome et al. (2021) study that compare erector spinae plane block versus retrolaminar block for postoperative analgesia after breast surgery and found that there were no significant differences between the groups regarding any of the patients' basic characteristics [23].

In our study, the mean duration of surgery in group E was (2.26 ± 0.379 hours) while the duration of surgery in group R was (2.35 ± 0.388 hours), with no statistically significant difference between both groups (p=0.177).

This is in line with Sotome et al. (2021) study that compare erector spinae plane block versus retrolaminar block for postoperative analgesia after breast surgery and reported that. Although there was no significant difference, duration of surgery in the RLB group tended to be longer than that in the ESPB group (P = 0.06), and the duration of anesthesia in the ESPB group was significantly shorter than that in the RLB group. They consider that the reason for the longer duration of anesthesia in the RLB group was related to the longer duration of surgery in the RLB group compared to the ESPB group [23].

In the current study, the mean intraoperative fentanyl requirement in group R was 1.67 ± 0.240 µg), while in group E was (1.51 ± 0.206µg), without statistically significant difference between them (p=0.108).

Similarly, in Park et al. (2021) randomized clinical trial study, in which adult women undergoing IBR with a tissue expander after mastectomy were randomly assigned to either intravenous patient-controlled analgesia (IV-PCA) alone (group P) or IV-PCA plus ESPB (group E), found that there was a significant reduction in the consumption of intraoperative fentanyl in group E (46.4 ± 33.8 µg, 95% CI: 33.3 to 59.5 vs. 21.6± 29.7 µg, 95% CI: 10.3 to 32.8, P = 0.004) [14].

Also, Bakeer and Abdallah (2022) compared the analgesic efficacy of ultrasound-guided ESPB and PECS-II blocks in patients undergoing unilateral modified radical mastectomy and found that there was no statistically significant difference between the two groups in baseline characteristics, operative time, and total intraoperative fentanyl consumption [24].

In this study, no significant difference was found between the two studied groups regarding any of intraoperative heart rate and MAP changes or postoperative respiratory rate or oxygen saturation changes

In Sharma et al. (2020) randomized controlled trial that used ESPB in total mastectomy and axillary clearance, hemodynamic parameters including HR, NIBP (systolic/diastolic/mean), and SPO2 at various time intervals beginning from preinduction till the completion of surgery results were founded to be comparable in both groups [25].

Also, in agreement to the present study, D'Ercole et al. (2018)studied ESPB in unilateral modified radical mastectomy surgery and reported that compared to PVB, there was no significant change at any of the postoperative studied times as regard HR and MABP [26].

In our study, postoperative NRS scores at rest at different study periods were comparable and similar in both groups, with no statistically significant difference between any of them, NRS during movement at different study periods were comparable and similar in both groups, with no statistically significant difference between any of them.

In concordance with Sotome et al. (2020) study which reported that there was no significant difference in pain intensity at rest for 24 h postoperative breast surgery between ESPBB and RLB groups [23].

On the other hand, Ivanusic et al. (2018) reported that the 20 mL of dye injected for ESPBdid not spread into theparavertebral space and intercostal nerves were not stained with dye in their cadaveric experiments. They also demonstrated that the injectate for ESPB was laterally distributed as an interfascial plane block and did not affect the lateral cutaneous branches of the intercostal nerves

[27].

Although the area stained with dye following ESPB and RLB differed among cadaveric studies, Onishi et al. (2019) summarized the patterns of injectate distribution with ESPB and RLB in their review. They concluded that, following ESPB, the dye spreads laterally and could block the intercostal nerves and lateral cutaneous branches of the intercostal nerve via a lateral pathway, while distribution into the paravertebral space was limited in both ESPB and RLB.

Nevertheless, numerous studies confirmed the analgesic efficacy of EPS in patients undergoing radical breast surgery. In five cases of MRM, ESPB using 25 mL 0.25% bupivacaine provided adequate pain relief [28].

Chin & El-Boghdadly, (2021) meta-analysis demonstrated that pain scores and opioid use were significantly reduced in patients receiving ESPB after breast surgery. The result indicated that ESPB could affect the dorsal and ventral rami of the thoracic spinal nerves [29].

Bakeer and Abdallah (2022) compared the analgesic efficacy of ultrasound-guided ESPB and PECS-II blocks in patients undergoing unilateral modified radical mastectomy, he found that pain intensity was higher in the ESPB group 1, 2, and 6 hours after the surgery. Moreover, 12 and 24 hours after the surgery, NRS scores were comparable between the two groups [24].

The pain score on the NRS scale in Sharma et al. (2020) randomized controlled trial that used ESPB in total mastectomy and axillary clearance was found to be significantly lower in the ESPB group as compared to control at 0, ½, 1, 2, 4, 6, 12, and 24 h ($P < 0.05$) of surgery [25]. Also, by Nair et al. (2018) who also found a lower pain score (VAS = 1) at 1, 3, and 6 h of surgery in five patients who underwent a mastectomy [30]. Bonvicini et al. (2018) also reported a pain score of <3 on NRS up to 24 h of surgery in a patient who underwent breast cancer surgery with reconstruction [31].

Other clinical studies have had conflicting results. According to some studies, ESPB has an opioid-sparing effect and could be as effective as the thoracic paravertebral block (TPVB) in postoperative pain control for various types of thoraco-abdominal surgery [32], but there have been some reports that showedlimited effect of the ESPB on postoperative pain control [11,33].

However, another cadaveric study has shown that the paravertebral spread following the ESPB depends on anesthetic volume, and that multiple levels of paravertebral space would be affected if sufficient anesthetics (>30 mL) had been properly injected beneath the ESM [11]. This could be supported by a recently described mid-point transverse process to pleural block [34], the retrolaminar block [19].

Several studies have demonstrated the analgesic efficacy of TRLB. Nobukuni et al. (2021) compared the postoperative efficacy of TRLB and thoracic epidural analgesia after video-assisted tho¬racoscopic surgery and found that TRLB was as effective as epi¬dural analgesia in controlling postoperative pain in terms of pain scores and opioid consumption [35].

Zhao et al. (2022) found that the analgesic effects of TRLB were superior to those of erector spinae blocks in patients with multiple rib fractures [36].

Wang et al. (2021) compared ultrasound-guided TRLBs and paravertebral blocks for postoperative analgesia in patients undergoing vid¬eo-assisted thoracoscopic surgery and found that the paraverte¬bral block resulted in better analgesia than the TRLB [37].

In contrast, Hwang et al. (2020) conducted a randomized placebo study that aimed to assess the analgesic efficacy of a single injection of ultra¬sound-guided TRLB after breast surgery and reported that TRLB did not reduce postoperative analgesic consumption. It is postu¬lated that the lack of efficacy of TRLB in reducing opioid consump¬tion after radical mastectomy could be attributed to the complexi¬ty of the surgery, which includes axillary lymphadenectomy [38].

In the current study, the mean time to 1st request of analgesia in group E was (6.54 ± 4.653 hours), in the group R (5.93 ± 4.457 hours), without statistically significant difference between them (p=0.630).

Similarly, Sotome et al. (2020) found that there was no significant difference in the median time until the first postoperative rescue analgesic after the block procedure between the two groups, as it ranged widely in both groups (ESPB and RLB) (8.6 [range 2.7–24] vs. 4.8 [3.0–24] h; P = 0.83) after breast surgery [23].

Dautzenberg et al. (2019) examined the spread of dye injected for ESPB at two different puncture levels in 11 fresh frozen cadavers and showed that spread was variable among the cadavers.

Furthermore, they revealed that the dye spread more extensively when injected at the eight thoracic vertebrae compared to when injected at the second thoracic vertebra [39].

In the current study, mean morphine consumption in the group E was (7.21 ± 4.340 mg), in the group R (7.11 ± 4.219 mg), without statistically significant difference between them (p=0.909).

Sharma et al. (2020) found 42% decrease in 24-hour morphine consumption in EPS block group compared to the control group [mean(SD), 2.9 (2.5) vs 5.0 (2.1), respectively, P = 0.01] [25].

In Abdelfatah et al. (2022) study, the total PCA nalbuphine consumption in unilateral modified radical mastectomy surgery postoperative 24 hours in ESPB group had a mean of 3.33 ± 1.63 mg [40].

Correspondingly, Singh and Kumar (2019) studied 40 patients (20 in each group) underwent MRM. The 24-hour morphine consumption was less in US guided ESPBgroup when compared with the control group who received no block and it was statistically significant (1.95 ± 2.01 mg vs 9.3 ± 2.36 mg, P = 0.01) [41].

Similarly, in a randomized controlled trial by Gurkan et al. (2018) authors found 65% reduction in 24-hour morphine consumption in ESPB group compared to control [mean (SD), 5.6 (3.8) mg 16.6 (6.9) ESPB group and control, respectively, P < 0.001] [42].

Another randomized study compared two concentrations of bupivacaine during ESPB, 0.375% and 0.25%, in 42 patients scheduled for MRM. The authors reported that the higher concentration of bupivacaine significantly reduced postoperative opioid consumption [43].

Also, in Park et al. (2021) randomized clinical trial study, in which adult women undergoing IBR with a tissue expander after mastectomy were randomly assigned to either intravenous patient-controlled analgesia (IV-PCA) alone (group P) or IV-PCA plus ESPB (group E), it was found that the total amount of opioid consumption at 24 hours postoperatively was significantly less in group E than in group P (285.0 ± 92.0 μg, 95% confidence interval [CI]: 250.1 to 320.0 vs. 223.2 ± 83.4 μg; 95% CI: 191.5 to 254.9, P = 0.005) [14].

Yao et al. (2020) clinical study reported that ESPB provides adequate analgesic effect and decreases morphine consumption after breast surgery [44].

In Bakeer and Abdallah (2022) study that compared the analgesic efficacy of ultrasound-guided ESPB and PECS-II blocks in patients undergoing unilateral modified radical mastectomy, it was found that after the surgery, significantly more patients needed rescue morphine analgesia in the ESPB group than those in the PECS group (P = 0.002). Additionally, the ESPB group showed significantly higher total morphine consumption and a significantly shorter time to request analgesia (P < 0.001 for both) [24].

The difference in the morphine consumption between studies could be due to the different analgesic regimen.

To find all ESPB -related publications, Tsui et al. (2019) a pooled review of 242 cases was done. Reports of ESPB single shot, continuous infusion, and intermittent bolus, as well as human and cadaveric trials, were all considered. This study stated that there was a reduction in opioid use in 76% of the cases [45].

In this study, there were no statistically significant differences between both of the studied groups regarding any of CRP, TLC, neutrophils values, lymphocytes values, NLR, or PLR. However, each of these variables in every group had significantly lower value at 12 and 24 hours compared to the baseline value.

This could be explained by the immunomodulatory mechanism of ESPB blocks that was recently postulated in a porcine study where dye spread to paraspinal lymph nodes, but not the paravertebral space, was observed [46].

The lymphatic system is an important circulatory system for endogenous and exogenous macromolecules that is increasingly being explored as a route for targeted drug therapies [47].

Bidirectional interaction between nociceptor neurons and the immune system is also a well-established phenomenon [48].

It is therefore intriguing to consider if the delivery of local anesthetic via lymphatic channels to resident lymphocytes in lymph nodes might contribute to an immune-mediated, anti-inflammatory analgesic effect. Although much of the attention in immune-mediated peripheral nociception is focused on innate immune cells such as neutrophils and mast cells, T-lymphocytes also release cytokines (e.g., interleukin-5, interleukin-17, interferon gamma) that similarly activate

peripheral nociceptors. Furthermore, T-lymphocytes have a role in central sensitization, participating in crosstalk with microglia, astrocytes, and oligodendrocytes to modulate synapses between nociceptor neurones and second-order interneurons in the dorsal horn [49].

Any analgesic response mediated by the adaptive immune system would, however, likely be delayed compared with direct local anesthetic inhibition of neural transmission, and this would limit its contribution to acute postsurgical analgesia. For now, a lymphatic-based immunomodulatory mechanism of action for the ESPB block, while not entirely improbable, remains more speculative than evidence-based [29].

Our study results have revealed that there were no statistically significant differences between both of the studied groups regarding any of the baseline (p=0.988), 12 hours (p=0.832), or 24 hours (p=0.163) cortisol. Though, the cortisol values in each group were significantly lower at 12 and 24 hours compared to the baseline value ($p < 0.001$).

Similar to Gad et al. (2019) study of ultrasound-guided erector spinae plane block compared to modified pectoral plane block for modified radical mastectomy operations, they found that the two blocks decreased stress hormone levels compared by basal values [50].

Nasr and Abdelhamid (2013) found that caudal dexmedetomidine provided better postoperative analgesic effect and reducing stress response to surgical trauma[51].

In this study, regarding the satisfaction score in the studied groups. In group E, it was found that the majority ofparticipants 32 (52.5%) were very satisfied, 18 (29.5%) were satisfied, 11 (18.0%) were neither, nor 0 (0.0%) were dissatisfied. In group R, it was found that the majority of participants 23 (37.7%) were satisfied, 21 (34.4%) were very satisfied, 14 (23.0%) were neither, nor 3 (4.9%) were dissatisfied, without statistically significant difference between both groups any of the satisfaction score (p=0.100).

Similarly, in Park et al. (2021) randomized clinical trial study, in which adult women undergoing IBR with a tissue expander after mastectomy were randomly assigned to either intravenous patient-controlled analgesia (IV-PCA) alone (group P) or IV-PCA plus ESPB (group E), found that the patient satisfaction for pain management assessed at 24 hours after surgery in group E was significantly greater (6.9± 1.8 vs. 7.8± 1.4, P = 0.042) than in group P [14].

In the current study, regarding the relevant postoperative complications in the current study. In group E, it was found that the majority of participants 12 (19.7%) had nausea, 6 (9.8%) had vomiting, 1 (1.6%) had bradycardia. In group R, it was found that the majority of participants 18 (29.5%) had nausea, 13 (21.3%) had vomiting, 1 (1.6%) had bradycardia. Without statistically significant difference between both groups regarding any of the postoperative complications.

Similar toSotome et al. (2020) who reported that there was no significant difference in the occurrence of PONV between the two groups (ESPB and RLB) (1 [5%] vs. 3 [13%] cases; P = 0.61). No complications related to the blocks, such as hematoma or infection at the block site, were observed in either group post breast surgery.

Also, Gurkan et al. (2018) reported nausea and vomiting in 8 patients in the ESPB group vs 10 in the control group, however, both the groups were comparable (P > 0.05) [42].

Finneran et al. (2018) study found that patients with breast diseases undergoing the erector spinae muscle plane block technique have basically no adverse reactions such as nausea, vomiting, and respiratory depression, among others [52].

This low complication incidence in our study could be explained by that ultrasound guided RLB is simple, easy to perform, and theoretically safer than thoracic epidural analgesia and paravertebral blocks since the block needle is inserted to¬wards the vertebral lamina and thus away from any important vessels, the pleura, and the dura [53]. Also, the relatively superficial location of ESPB block, distant from any neurovascular structure, minimizes concerns regarding anticoagulation and development of a significant hematoma [54].

Regarding time to complete block in the current study, the mean time to complete block was (8.13 ± 1.072 min) in group E, and (8.51 ± 1.178 min) in group R, without significant difference between both (p= 0.076). Regarding block difficulty in the current study, in group E; most cases 41 (67.2%) had an easy procedure, rather difficult in 19 (31.1%), and difficult in 1 (1.6%). While in group R, about half of patients 31 (50.8%) had an easy procedure, rather difficult in 27 (44.3%), and difficult in 3 (4.9%), without significant difference

between both (p= 0.151).

This could be explained by that the spinous process, lamina and zyga-pophyseal joint capsule joint acted as anatomical barriers to the retrolaminar injection, there may be less pressure in a postero-anterior direction and less space for diffusion into the paravertebral space when compared with ESPB blocks. Thus, the effective injectate volume (spreading to the thoracic spinal nerves) seems to be larger in the ESPB block than in the retrolaminar block [12].

On the other hand, the LCTL originates from the tubercle of the rib and attaches to the superior lateral lip of the transverse process [55]. The LCTL tightly covers the costotransverse joint, allows for adequate costotransverse articulation to support the weight of the upper body, and is thus more rigid than the SCTL [56]. Hence, we cannot disregard the LCTL or the lateral tip of the transverse process as potential pathways to the paravertebral space, especially in ESPB blocks. Nevertheless, it is less likely that the LCTL is a more critical posterior barrier to the paravertebral space than the SCTL

We acknowledge that there are some potential pitfalls in our study, the first limitation was that we did not assess the anesthetized dermatomes resulting from ESPB or RLB in this study. Consequently, the exact area of anesthesia produced by both blocks was not clearly delineated. To assess the anesthetized area resulting from the blocks, we need to administer ESPB or RLB to awake patients prior to induction of anesthesia. However, both puncture with the block needle and injection of local anesthetics into the interfascial space might cause discomfort in awake patients. Since we administered ESPB or RLB to anesthetized patients, we evaluated the time until the first postoperative rescue analgesic as an alternative to assessing the anesthetized area, to compare the analgesic efficacy of ESPB and RLB in this study. Second, the smallest effec¬tive volume of local anesthetics is unknown; we used a relatively large volume (30 ml of bupivacaine 0.25%) to ensure the effi¬cacy of the block. Third, a single injection of a local anesthetic was used in this study, which resulted in a limited duration of an-algesia. Therefore, continuous infusions of local anesthetics are rec¬ommended in future studies to obtain more prolonged analgesia. Finally, we did not measure the serum concentration of bupiva¬caine because of the unavailability of the above technology in our institutional hospital.

Conclusions:

In conclusion, contrary to our expectations, this study failed to detect a difference in terms of time to first post-operative rescue analgesic administration after the block procedure between ESPB and RLB in patients undergoing breast surgery. Future clinical studies are needed to confirm the anatomical mechanisms of action of both blocks, as well as the appropriate concentration, the optimal timing and volume of local anesthetics required for adequate ESPB or RLB.

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