Comparative Study Between Preemptive Analgesia of Thoracic Epidural Block, Ultra-Sound Guided Modified Pectoralis Block and Serratus Plane block for Breast Surgery

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Abstract: Background: Breast Cancer is the most common cancer affects women, causing acute pain which usually progresses to chronic pain. Thoracic epidural block has been used to provide analgesia, but modified pectoralis block and serratus plane block can produce efficient analgesia without the potential risks of neuraxial block. **Aim:** The aim was to compare the preemptive analgesia of thoracic epidural block, ultra-sound guided modified pectoralis block and serratus plane block for women undergoing breast surgery. **Patients and Methods:** This randomized controlled study included 90 female aged 20 - 65 y, ASA I & II scheduled for elective breast surgery. Patients were allocated into 3 equal groups: Group I (thoracic epidural) 7 ml bupivacaine 0.25%, Group II (modified pectoralis) 10 ml bupivacaine for (pecs I) and 20 ml bupivacaine 0.25% for (pecs II) and Group III (serratus anterior plane) 40 ml bupivacaine 0.25%. The blocks were performed before induction of anesthesia. **Results**: HR revealed insignificant changes at base line, after block and after induction, but significant decrease group I compared to the other groups and in group III compared to group II at other times. While MAP showed no statistically significant difference. VAS at rest and during cough revealed no significant changes at 1 hr then decreased significantly in group I & III compared to group II from 3-24 hours post-operatively. Duration of analgesia was significantly prolonged & rescue analgesia was statistically significant smaller in group III compared to group I & II. Intraoperative fentanyl consumption showed no significant difference among three groups. **Conclusion:** Serratus anterior plane block provided better analgesia as indicated by longer duration of analgesia and lower doses of post-operative morphine consumption compared to thoracic epidural block and modified pectoralis block.

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1. Introduction

Acute pain in the postoperative period is an important risk factor for chronicity of the pain, which occurs almost in 50% of patients after breast surgery, impairing the quality of life[1, 2].

Thoracic epidural anesthesia (TEA) has been established as a corner stone in the perioperative care after thoracic and major abdominal surgery providing the most effective analgesia [3]. TEA associated with a higher incidence of adverse effects like accidental dural puncture, inadvertent high block, local anesthetic toxicity and total spinal anesthesia. Nerve injury, epidural hematoma and abscess are rare but serious complications [4].

The Pecs block type I was described as easy and superficial block [5]. A second novel version (modified Pecs block or Pecs block type II) block the axilla which is necessary for axillary clearances and also intercostal nerves, necessary for wide excisions, tumorectomy, sentinel node excision and several types of mastectomies [5].

New, safe and easily done regional anesthetic block (Serratus plane block) has been used to cover thoracic intercostal nerves blocking the lateral chest wall[6].

The aim of this study is to compare the preemptive analgesia of thoracic epidural block, ultra-sound guided modified pectoralis block and serratus plane block for women undergoing breast surgery. Our primary outcome was to reduce postoperative pain and secondary outcome was to detect duration of analgesia.

2. Patients and Methods

After approval from institutional ethics and research committee (code number 2701/08/14), this randomized controlled study was done at the General Surgery Department, Tanta University Hospitals. The duration of the study was one year from August 2014 to August 2015. An informed consent describing benefits and side effects of the technique was taken from each patient. All data were confidential with

secret codes and private file for each patient and was used for this medical research only.

The study included 90 adult female patients aged 20 - 65 years, ASA class I & II scheduled for elective breast surgery. Exclusion criteria included: patient refusal, past history of coagulation disorders, spine or chest wall deformity, uncontrolled chronic medical disease e.g. (renal or hepatic failure), patients on opioid treatment, obese patients (BMI ≥ 30), known allergy to local anesthetics or opioid, infection at the block site, coagulopathy and uncooperative patients.

Patients were allocated to one of three groups (30 patients each) by random selection of envelopes performed in the operating theatre. The envelopes were prepared in advance and contained a computer-generated randomization schedule indicating the technique to be used: Group I: Thoracic Epidural Block (TEB), Group II: Modified Pectoralis Block (pecs II block) and Group III: Serratus Plane Block (SPB).

Anesthetic technique & Monitoring

On arrival to the operating room the patient was monitored with continuous electrocardiogram (ECG), pulse oximetry, end tidal CO_2 and non-invasive blood pressure and intravenous cannula 20 gauge was inserted. The blocks were performed in the operating theatre in awake state before induction of anesthesia. For all patients, sedation by midazolam as bolus dose of 0.01mg/kg was given intravenous before regional block. General anesthesia was induced and after the end of surgery reversal of muscle relaxation was done with neostigmine 0.04-0.08 mg/kg and atropine 0.01-0.02 mg/kg.

Group I: TEB was performed with sterilized epidural set (B-BRAUN) including (Touhy needle, catheter, bacterial filter and low resistance syringe). sterile gloves, 5 ml syringe of lidocaine 2% for the local anesthetic skin infiltration, sterile towels and 4x4 gauze packs, povidine iodine disinfectant solution. While the patient in the sitting position, the skin of the back was prepared with iodine containing sterilizing solution, then draped in a sterile fashion and the selected level at the T7-8 (opposite the angle of the scapula) was marked.

Local infiltration by lidocaine 1% at the injection point (a subcutaneous wheal) at the midpoint between two adjacent vertebrae (midline approach). The epidural needle was inserted into the skin and advanced, with pointing needle slightly cephalad direction. Then advanced till a depth of 2-3 cm until sensation of increased resistance is felt as the needle passed through ligamentum flavum.

At this point, the needle stylet was removed, and the syringe was attached to the hub of the needle. The needle was grasped with the non-dominant (left) hand, while the dorsum of the left hand rested against the back. The left hand used as a “brake” to control the advancement of the needle. The dominant hand (right thumb) applies a slow, constant, steady pressure on the syringe plunger until Loss of resistance was noted. Then 7ml bupivacaine (0.25%) was injected and the patient was monitored for signs of intravascular injection (20% increase in HR and or MAP) for 5–10 min.

Equipment in groups II & III: High frequency linear probe 13:15 MHZ Phillips cx50 extreme, needle 20 guagevisioplex, local anesthetic bupivacaine (0.25%) SIGMA. Tec and 5 ml syringe of lidocaine 2% for the local anesthetic skin infiltration.

Group II Modified Pectoralis Block (pecs II block) [7]: Patients in this group underwent modified pecs block before induction of anesthesia. While the patient was in supine position. The US probe was positioned under the lateral third of the clavicle. After locating subclavian muscle, axillary artery and vein, the probe was moved distally towards the axilla, until the pectoralis minor muscle was identified. The ribs were counted, from 1st rib under the axillary artery and maintaining the pectoralis minor muscle as reference, the probe was moved distally and laterally until the lateral border of pectoralis minor muscle is reached. Over 3rd rib the extension of Gerdy’s ligament can be seen and underneath, another muscle covering 2nd, 3rd and 4th rib is the serratus anterior muscle, this point being the entrance into the axilla. 10 mL of bupivacaine (0.25%) was injected between pectoralis major and minor at the 3rd rib level to block the lateral and medial pectoral nerves. Further 20 ml of bupivacaine (0.25%) was injected between pectoralis minor and serratus anterior at the 3rd rib level. The latter injection blocks the lateral branch of the spinal nerves T2-4, and possibly the anterior branch if sufficient local anesthetic penetrates the external intercostal muscles. By entering the axilla, the long thoracic nerve may be blocked.

Group III: SPB [8]: Patients in this group underwent serratus plane block before induction of anesthesia. While the patient was in supine position. The probe of ultra sound was placed over the mid-clavicular region of the thoracic cage in a sagittal plane. Ribs were counted until the fifth rib was identified in the mid axillary line. The latissimus dorsi (superficial and posterior), teres major (superior) and serratus muscles (deep and inferior) were easily identifiable by US overlying the fifth rib. The needle depth required to reach the identified region was constant between 1-2 centimeters. As an extra reference point, the thoraco dorsal artery was used; this aids in the identification of the plane superficial to the serratus muscle. 40 mL of (bupivacaine 0.25%) was injected between latissimus dorsi and serratus anterior in the mid axillary line at the 5th rib level.

Measurement:

Hemodynamics; including heart rate (HR) and mean arterial blood pressure (MAP) before performing regional techniques, after induction and every 30 minutes intra-operative & 1, 3, 6, 12, 18 and 24 hours post-operative were measured. Intra-operative fentanyl consumption at dose of (0.5µg/kg) [79] if there was intra-operative tachycardia or hypertension. Assessment of pain: Visual analogue pain (VAS) scale from 1-10, (0 being the absence of pain and 10 the maximum level of pain) score at rest and during cough was measured at 1, 3, 6, 12, 18 and 24 hours post-operatively. Duration of analgesia was measured from time of injection of local anesthetic till first need of analgesic VAS >3. Doses of morphine required in 1st 24 hours post-operative as a rescue analgesia (morphine 0.05mg /kg intravenously over 2 to 3 minutes and lock out interval 10 minutes, 1-2 mg as bolus dose was given if needed) [80].

Intra and post-operative complications related to drugs used (e.g. hypotension, bradycardia, tachycardia, nausea, vomiting or respiratory depression) and techniques (like pneumothorax) were recorded. Chest X-ray was requested for any patient if there was any difficulty of breath, desaturation or diminished air entry at any time after the block.

The sample size (N >28) was calculated according to the results of a previous study [9]using epi- info software computer program created by center of disease prevention and control, version 2002, based on the following criteria: 95% confidence limit, 80%power of study.

The statistical software was SPSS v25 (SPSS Inc., Chicago, IL, USA). Normality of data was checked with the Shapiro-Wilk test. Numerical parametric variables were presented as mean & SD. ANOVA or F-test was used for comparison among the three groups, post-hoc test (Tukey's test) was used to find which means are significantly different from one another and student paired T test to compare between two means. Non-parametric variables were presented as median & range and Kruskal Wallis test was used for comparison between three groups, (VAS). Categorical variables were presented as patients' number and percentage (%) and were analyzed utilizing the Chi-square test or Fisher's exact test when appropriate. P value < 0.05 was considered significant.

3. Results

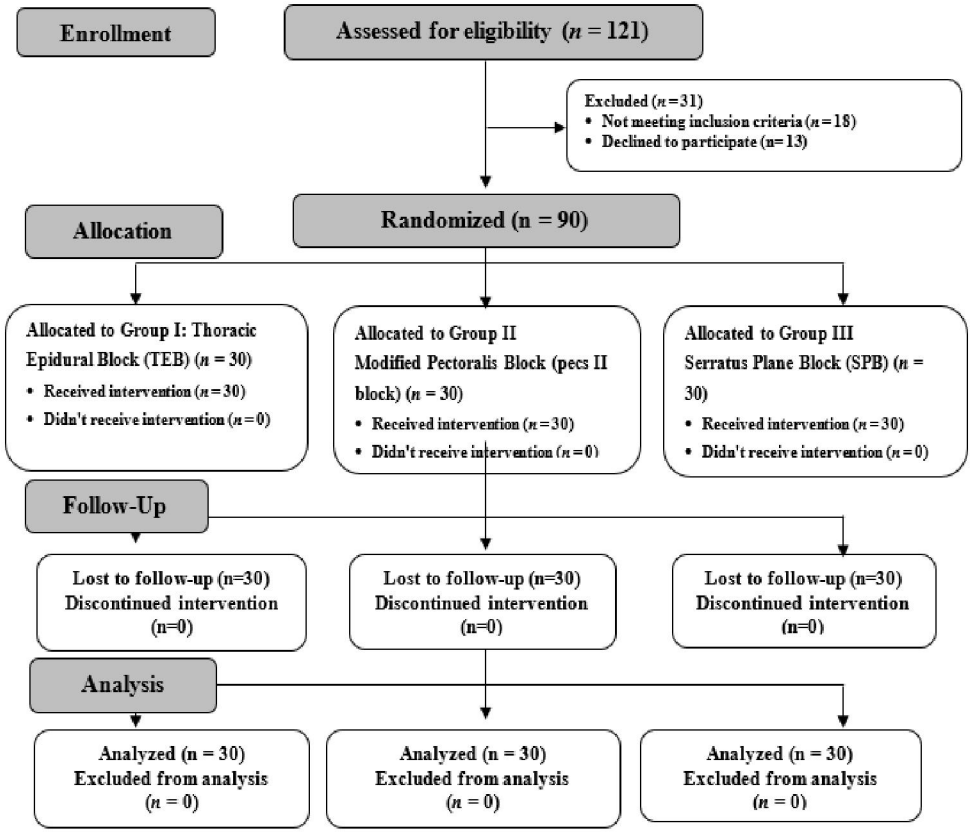

Figure (1): Patient flowchart summarizing enrollment, allocation, follow-up and analysis in the study protocol

In this study, 121 patients were assessed for eligibility; 18 patients did not meet the inclusion criteria and 13 patients refused to participate in the study. 90 patients were randomized into three equal groups 30 patients in each one as mentioned before. All patients were followed-up and analyzed [Figure (1)].

The demographic data (age, weight), type & duration of operation, intra-operative and post-operative complications were comparable among the studied groups [Table (1)].

Our results revealed insignificant changes in HR among the studied groups at base line, after block and after induction. Also, we found statistically significant decrease in HR in group I compared to the other groups and in group III compared to group II. While there was no statistically significant difference in MAP pressure among the studied groups during all intra and post-operative periods. [Figure (2, 3)]

Table (1): Demographic data and intra-operative & post-operative complication

Demographic data			Group 1	Group 2	Group 3	P value
Age (y)	**Range**		20 – 65	21 – 64	22 – 63	0.480
	Mean ± SD		41.67 ± 13.63	41.40 ± 13.97	45.27 ± 13.65	
Weight (kg)	**Range**		60 – 80	60 – 80	60 – 80	0.670
	Mean ± SD		69.30 ± 6.74	70.77 ± 7.21	70.53 ± 6.44	
Duration (min)	**Range**		75 – 90	78 – 92	80 – 90	0.367
	Mean ± SD		82.00 ± 23.28	85.50 ± 25.81	84.50 ± 20.53	
Type of operation	**Modified radical mastectomy**	**N**	23	21	22	0.896
		%	76.7%	70.0%	73.3%	
	Lumpectomy	**N**	1	3	2	
		%	3.3%	10.0%	6.7%	
	Simple mastectomy	**N**	6	6	6	
		%	20.0%	20.0%	20.0%	
Intraoperative complications	**Hypotension**	**N**	2	1	1	0.770
		%	6.7%	3.3%	3.3%	
	Tachycardia	**N**	4	8	3	0.186
		%	13.3%	26.7%	10%	
	Bradycardia	**N**	0	0	0	-
Postoperative complications	**Nausea and vomiting**	**N**	1	2	1	0.77
		%	3.3%	6.7%	3.3%	
	Pneumothorax	**N**	0	0	0	-
	Respiratory depression	**N**	0	0	0	-
	Itching	**N**	0	0	0	

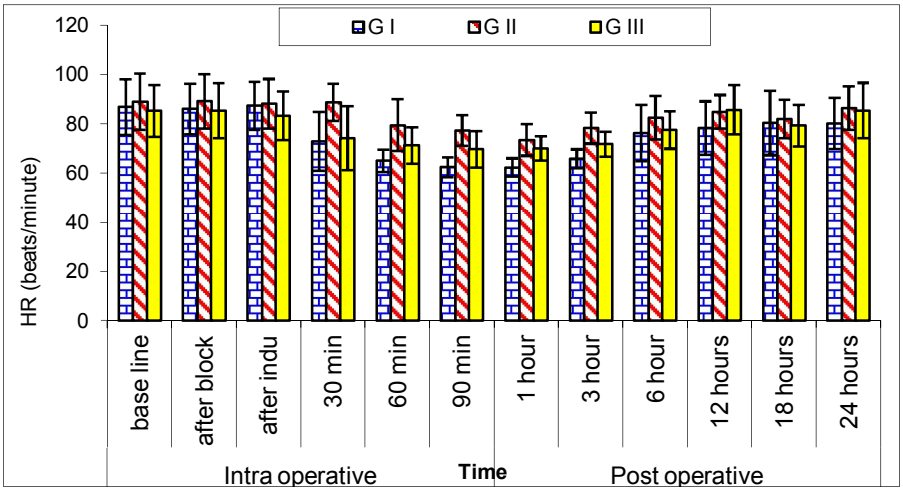

Figure (2): Comparison of heart rate changes (beats/minute) among the three groups

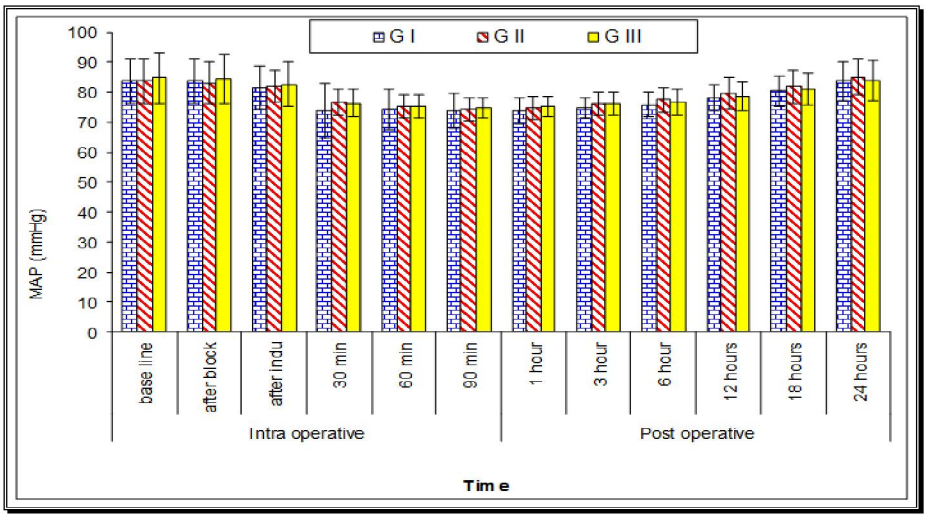

Figure (3): Comparison of mean blood pressure changes (mmHg) among the three groups

Concerning VAS pain score; which considered primary outcome; at rest and during cough our result revealed no significant changes among three groups at 1 hour. Then VAS decreased significantly in group I & III compared to group II from 3-24 hours post-operatively, while there was no significant difference between group I and III. [Figure (4, 5)]

As regard duration of analgesia; which considered secondary outcome; our results showed no significant difference between group I and group II, and there was significant longer duration of post-operative analgesia in group III compared to group I & II. As regard the intraoperative fentanyl consumption, there was no significant difference among three groups. Regarding rescue analgesia (morphine) required 24 hours post-operatively, our results showed that there was no statistically significant difference between group I & II, while there was statistically significant smaller dose of rescue analgesia required in group III compared to group I & II. [Table (2)]

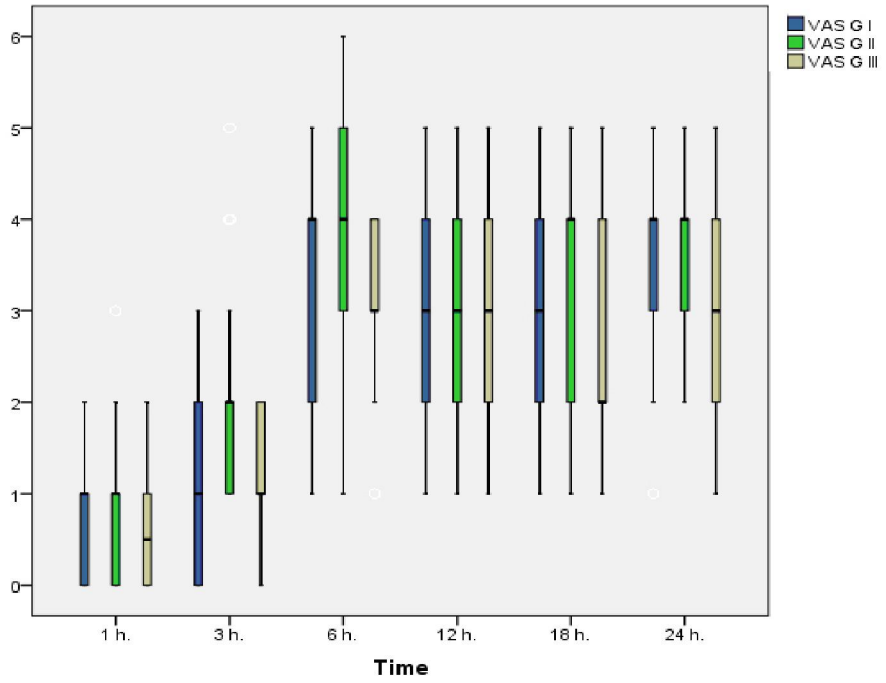

Figure (4): Comparison of visual analogue scale at rest among the three groups.

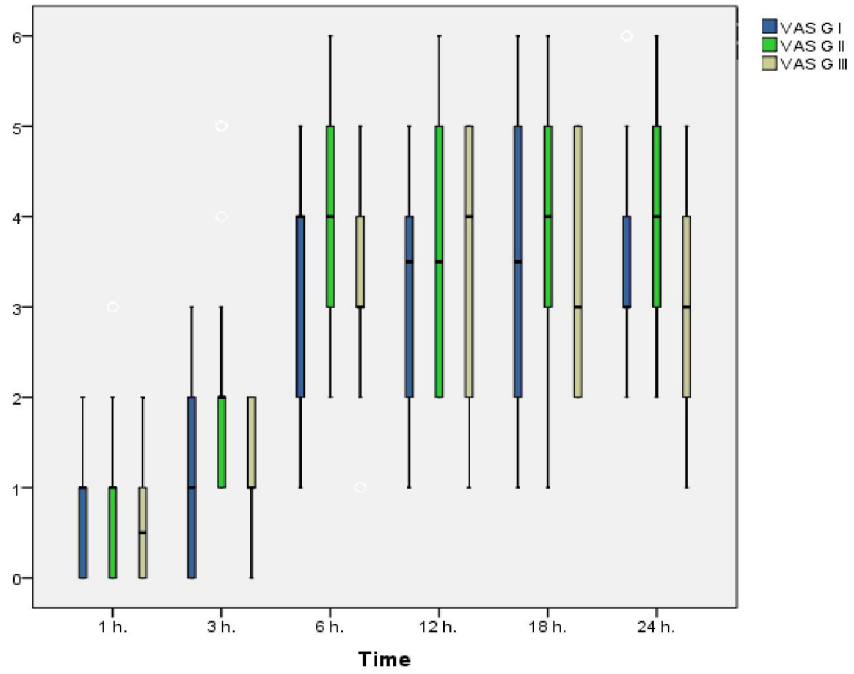

Figure (5): Comparison of visual analogue scale during cough among the three groups.

Table (2): Dose of intra-operative fentanyl consumption (µg), duration of analgesia (Hour) and total doses of morphine required (mg) in 24 hours post-operatively among the three groups:

		Group 1	Group 2	Group 3	P value	Post-hoc test (Tukey's test)	
Dose of intra-operative fentanyl consumption (µg)	**Range**	30 – 35	30 – 60	30 – 37	0.43		
	Mean ± SD	32.5 ± 2.89	37.75 ± 9.59	32.33 ± 4.04			
Duration of analgesia (Hour)	**Range**	8 – 14	5 – 14	8 – 20	0.001*	P1	0.616
	Mean (IQR)	8 (8-10)	8 (8-9)	14(8-14)		P2	0.042 *
						P3	0.038 *
Morphine required (mg) in 24 hours post-operatively	**Range**	6 – 12	6 – 12	4 – 11	0.017 *	P1	0.66
	Mean ± SD	8.01 ± 2.03	8.26 ± 1.93	7 ± 1.71		P2	0.001 *
						P3	0.001 *

*Denotes significant changes at p< 0.05, P1: comparison between group I & II, P2: comparison between group I & III, P3: comparison between group II & III

4. Discussion

Acute persistent postoperative pain enhances pathophysiologic neural changes, including peripheral and central sensitization changing into chronic pain syndromes [10]. The use of TEA has complications e.g. (infection due to iatrogenic pathogen inoculation) and contraindications [11].

The terminology of Pecs block was coined by Rafael Blanco 2011 [12] who found this block very effective for breast cancer surgery and sub-pectoral prosthesis. However, the block was inadequate if the surgery extended to axilla. So, to overcome this, Blanco et al invented an injection into the myofascial plane, between serratus anterior muscle and pectoralis minor at the 3rd and 4th rib level (modified Pecs block or Pecs block type II) [5]. Also, Blanco et al found two potential spaces in the lateral chest wall between serratus anterior muscle and intercostal nerve (SPB) can be used for blocking lateral chest wall [13].

In our randomized controlled study, the aim is to evaluate the pre-emptive analgesia of thoracic epidural block, ultra-sound guided modified pectoralis block and SPB for women undergoing breast surgery.

Our result revealed that VAS at rest and during cough showed no significant changes among three groups at 1 hour then decreased significantly in group I (thoracic epidural) and group III (SPB) compared to group II (modified pectoralis) from 3-24 hours post-operatively.

Although, there was a lack of literature concerning the comparison between the use of three blocks, in agreement with our results Khalil et al [14], in randomized study compared US guided SPB (30 ml of 0.25% levobupivacaine followed by 5ml/hr of

0.125% levobupivacaine) versus thoracic epidural block (15 ml of 0.25% levobupivacaine followed by 5ml/hr of 0.125% levobupivacaine) for thoracotomy pain, who reported that the VAS pain score was equal in two groups.

In consistence with our results, Wahba et al [15], and Hetta et al [16], evaluated the effect of US guided modified pectoralis block (Pecs) compared to thoracic PVB for elective breast surgery, and found that median values of VAS in modified pectoralis block group was 2-5 during 24 hour. Also, Eldeen[17] compared US guided pectoral nerve blockade with thoracic spinal blockade in conservative breast surgery and showed that median values of VAS with modified pectoralis block group was nearly equal to our results. In the same way, Von Dossow et al[18] concluded that post-operative pain relief was superior in general anesthesia combined with thoracic epidural anesthesia than general anesthesia for thoracic surgery, and also reported that median values of VAS pain score in thoracic epidural group was (1-5). Moreover, Dhole et al [19] found that mean values of VAS in continuous thoracic epidural group were decreased compared to baseline immediately after minimally invasive direct coronary artery bypass surgery which was nearly similar to our results.

On the Contrary to our results, Mowad et al [20] compared single dose thoracic epidural block with PVB for pain relief after renal surgery and reported that the mean value of VAS pain score (0-1) in thoracic epidural group during 24 hour post-operatively, which is less than our results, and this may be attributed to large dose and higher concentration of local anesthetic used in their study (1-1.5mg/kg bupivacaine 0.5%).

As regard duration of analgesia, our results showed no significant difference between group I (thoracic epidural) and group II (modified pectoralis), and there was significantly prolonged post-operative analgesia in group III (serratus block) compared to group I & II.

In agreement with our results, Durant et al [21] who reported that the duration of analgesia extended to 10-12 hours, which is nearly similar to our results. In the same way, Hetta et al[16], and El sheikh et al [22], compared US guided pectoralis block (30 ml of local anesthetic in each study) with thoracic PVB in for breast surgery and postulated that, the median duration of post-operative analgesia in their study was 6 hours which is nearly similar to our results. Moreover, Moon et al[23], performed US guided modified pectoralis block with sedation for breast conservative surgery (30 ml of levobupivacaine 0.25%) and found that, the duration of analgesia extended to 8 hours post-operatively, which exactly similar to our results.

In contrast with our study, Gupta et al[24] compared US guided SPB against thoracic PVB for modified radical mastectomy, and showed that, the mean value of duration of post-operative analgesia was 4 hours which is shorter than our results. This may be due to smaller volume of local anesthetic in their study. Moreover, Eldeen[17]found that the duration of analgesia in US guided pectoral nerve blockade extended to 16 hours post-operatively which is longer than our results, this could be explained by addition of corticosteroid to local anesthetic (15 µg dexmedetomidine).

Concerning the intraoperative fentanyl consumption in our study, there was no statistically difference among the three groups as regard total dose of fentanyl consumption.

Similar to our results, Abdallah et al [25] compared pectoralis and serratus fascial plane blocks for providing analgesia in retrospective study and found no difference between pecs group and SPB. In contrast to our study, Gupta et al [24]observed that the mean dose of intra-operative fentanyl consumption in serratus plane group was higher than our results, which may be explained by smaller volume of anesthetics used in their study (20 ml bupivacaine 0.25%).

Regarding rescue analgesia (morphine) required during 24 hours post-operatively, our results showed that there was no statically significant difference between group I & II, while there was statically significant smaller dose of rescue analgesia required in group III compared to group I & II.

In agreement with our results, Messina et al[26] compared thoracic epidural versus PVB in thoracic surgery and concluded that, the total dose of post-operative morphine consumption in thoracic epidural group was (9mg), which is nearly similar to our results. Also, Gupta et al[24] showed that the value of mean dose of post-operative morphine consumption in SPB was 9.5 mg which is nearly similar to our results.

On the other hand, Khalil et al[14], postulated that there was no significant difference between SPB and thoracic epidural block in post-operative morphine consumption and this difference from our results could be explained by continuous infusion in both thoracic epidural and SPB in their study. While, Abdallah et al [25] reported that there was no significant difference between Pecs block and SPB, which may be due to larger sample size (75 patients in each group).

Our hypothesis of longer duration of analgesia, lower dose of post-operative morphine consumption in group III (SPB) compared to group I (TEB) and group II (Pecs block), and a significant decrease in VAS pain score in group III & I compared to group II,

is based on the mechanism of action of the three studied blocks.

Regarding the serratus plane block, the serratus muscle is a superficial muscle and can be easily identified on US. The intercostal nerves arise from the anterior rami of thoracic spinal nerves and pass close to the intercostal artery in the intercostal muscles. The lateral cutaneous branches of intercostal nerve pierce the external and internal intercostal muscles at the mid axillary line to innervate the muscles and skin of lateral trunk[27]. When the block is performed the local anesthetic is deposited in direct contact with lateral cutaneous branches. The pain relief from the block implies that local anesthetic soak into the intercostal space to reach the intercostal nerve root that supply rib periosteum and parietal pleura[21]. Blanco et al, identified two potential compartments that could be used in this block: one superficial to the serratus muscle and deep to the muscle. They stated that the superficial plane is more effective based on the distribution of injection and sensory mapping[13].

The shorter duration of analgesia and more post-operative opioid consumed in modified pectoralis group could be explained by insufficient block of axilla and relatively large vascular space (pectoralis serratus interfacial plane) that allowed rapid clearance of bupivacaine. In addition, local anesthetic deposited in this plane block lateral cutaneous branches of intercostal nerves (T2-T4) but does not spread anteriorly to block anterior cutaneous branches that supply parasternal region of breast [16].

As regard hemodynamic parameter, our results revealed insignificant changes in heart rate among the three studied groups at base line, after block and after induction. Also, we found statistically significant decrease in heart rate in group I (TEB) compared to group II (Pecs) and III (SPB). Moreover, there was statistically significant decrease in heart rate in group III compared to group II. While there was no statistically significant difference in mean arterial blood pressure among three studied groups during all intra and post-operative periods.

Hemodynamic parameter changes in our results, could be explained by the fact that, similar to the transversus abdominis plane (TAP) block; the mechanism of action of SPB is to block the lateral cutaneous branches of the intercostal nerves (T2–T4 for SPB and T10-L2 for TAP)[27]. Because the sparing of anterior cutaneous branches of the intercostal nerves and supraclavicular nerves, SPB is expected not to produce complete anesthesia of the chest wall. Furthermore, SPB may not achieve adequate somatic and sympathetic blockade in the axillary region, as would be expected with thoracic PVB[28].

In consistence with our results, Mukherjee et al[29], and Moawad et al [20], compared the efficacy of single dose thoracic epidural with single dose PVB for post thoracotomy and renal surgery respectively, and reported that, there was a significant decrease in heart rate and mean arterial blood pressure in thoracic epidural group compared to base line (intragroup comparison). In contrast with our results, Khalil et al [14], concluded that, there was no significant difference in heart rate between two groups and MAP was significantly lower in thoracic epidural group. This difference from our study, could be attributed to continuous infusion in their study.

Concerning complications in our study, there was no statistically significant difference among three groups as regard intra-operative and post-operative complications. In agreement with our study, Abdallah et al [25] reported that there was no block related complication either in serratus plane or Pecs block. On the contrary, Khalil et al [14]reported that the incidence of hypotension was more in thoracic epidural group compared to SPB, this may be due to continuous infusion of thoracic epidural in their study.

There was a limited amount of objective data regarding the comparison among the three studied blocks. Also, the small number of patients used in our study is another limitation. Although, there was a few studies about the comparison among the three studied groups, so further prospective studies should be performed to overcome these limitations and to confirm our results.

5. Conclusion

Serratus anterior plane block provided better analgesia as indicated by longer duration of analgesia and lower doses of post-operative morphine consumption compared to thoracic epidural block and modified pectoralis block.

Conflicts of interest: Nil.
Authors' Contributions: All authors had equal role.

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References:

1. Poleshuck EL, Katz J, Andrus CH, Hogan LA, Jung BF, Kulick DI, et al. Risk factors for chronic pain following breast cancer surgery: a prospective study. J Pain. 2006;7(9):626-34.
2. Gärtner R, Jensen M-B, Nielsen J, Ewertz M, Kroman N and Kehlet H. Prevalence of and factors associated with persistent pain following breast cancer surgery. Jama. 2009;302(18):1985-92.

3. Royse C, Royse A, Soeding P, Blake D and Pang J. Prospective randomized trial of high thoracic epidural analgesia for coronary artery bypass surgery. Ann Thorac Med. 2003;75(1):93-100.
4. Cook T, Counsell D and Wildsmith J. Major complications of central neuraxial block: report on the Third National Audit Project of the Royal College of Anaesthetists†. Br J Anaesth. 2009;102(2):179-90.
5. Blanco R, Fajardo M and Maldonado TP. Ultrasound description of Pecs II (modified Pecs I): a novel approach to breast surgery. Rev Esp Anestesiol Reanim. 2012;59(9):470-5.
6. Porzionato A, Macchi V, Stecco C, Loukas M, Tubbs RS and De Caro R. Surgical anatomy of the pectoral nerves and the pectoral musculature. Clinical Anatomy. 2012;25(5):559-75.
7. Blanco R, Fajardo M and Parras Maldonado T. Ultrasound description of Pecs II (modified Pecs I): a novel approach to breast surgery. Rev Esp Anestesiol Reanim. 2012;59(9):470-5.
8. Blanco R, Parras T, McDonnell JG and Prats-Galino A. Serratus plane block: a novel ultrasound-guided thoracic wall nerve block. Anaesthesia. 2013;68(11):1107-13.
9. Arya S, Asthana V and Sharma JP. Clinical vs. bispectral index-guided propofol induction of anesthesia: A comparative study. Saudi J Anaesth. 2013;7(1):75-9.
10. Kehlet H and Wilmore DW. Evidence-based surgical care and the evolution of fast-track surgery. Ann Surg. 2008;248(2):189-98.
11. Popping DM, Zahn PK, Van Aken HK, Dasch B, Boche R and Pogatzki-Zahn EM. Effectiveness and safety of postoperative pain management: a survey of 18 925 consecutive patients between 1998 and 2006 (2nd revision): a database analysis of prospectively raised data. Br J Anaesth. 2008;101(6):832-40.
12. Blanco R. The 'pecs block': a novel technique for providing analgesia after breast surgery. Anaesthesia. 2011;66(9):847-8.
13. Blanco R, Parras T, McDonnell J and Prats‐Galino A. Serratus plane block: a novel ultrasound‐guided thoracic wall nerve block. Anaesthesia. 2013;68(11):1107-13.
14. Khalil AE, Abdallah NM, Bashandy GM and Kaddah TA. Ultrasound-Guided Serratus Anterior Plane Block Versus Thoracic Epidural Analgesia for Thoracotomy Pain. J Cardiothorac Vasc Anesth. 2017;31(1):152-8.
15. Wahba SS and Kamal SM. Thoracic paravertebral block versus pectoral nerve block for analgesia after breast surgery. Egypt J Anaesth. 2014;30(2):129-35.
16. Hetta DF and Rezk KM. Pectoralis-serratus interfascial plane block vs thoracic paravertebral block for unilateral radical mastectomy with axillary evacuation. J Clin Anesth. 2016;34:91-7.
17. ELdeen HM. Ultrasound guided pectoral nerve blockade versus thoracic spinal blockade for conservative breast surgery in cancer breast: a randomized controlled trial. Egypt J Anaesth. 2016;32(1):29-35.
18. Von Dossow V, Welte M, Zaune U, Martin E, Walter M, Ruckert J, et al. Thoracic epidural anesthesia combined with general anesthesia: the preferred anesthetic technique for thoracic surgery. Anesth Analg. 2001;92(4):848-54.
19. Dhole S, Mehta Y, Saxena H, Juneja R and Trehan N. Comparison of continuous thoracic epidural and paravertebral blocks for postoperative analgesia after minimally invasive direct coronary artery bypass surgery. J Cardiothorac Vasc Anesth. 2001;15(3):288-92.
20. Moawad HE, Mousa SA and El-Hefnawy AS. Single-dose paravertebral blockade versus epidural blockade for pain relief after open renal surgery: A prospective randomized study. Saudi J Anaesth. 2013;7(1):61-7.
21. Durant E, Dixon B, Luftig J, Mantuani D and Herring A. Ultrasound-guided serratus plane block for ED rib fracture pain control. Am J Emerg Med. 2017;35(1):3-6.
22. El-Sheikh SM, Fouad A, Bashandy GN, AL-Azzb M and Gamal R. Ultrasound guided modified pectoral nerves block versus thoracic paravertebral block for perioperative analgesia in major breast surgery. Med J Cairo Univ. 2016;84:189-95.
23. Moon E-J, Kim S-B, Chung J-Y, Song J-Y and Yi J-W. Pectoral nerve block (Pecs block) with sedation for breast conserving surgery without general anesthesia. Ann Surg Treat Res. 2017;93(3):166-9.
24. Gupta K, Srikanth K, Girdhar KK and Chan V. Analgesic efficacy of ultrasound-guided paravertebral block versus serratus plane block for modified radical mastectomy: A randomised, controlled trial. Indian J Anaesth. 2017;61(5):381-6.
25. Abdallah FW, MacLean D, Madjdpour C, Cil T, Bhatia A and Brull R. Pectoralis and Serratus Fascial Plane Blocks Each Provide Early Analgesic Benefits Following Ambulatory Breast Cancer Surgery: A Retrospective Propensity-Matched Cohort Study. Anesth Analg. 2017;125(1):294-302.
26. Messina M, Boroli F, Landoni G, Bignami E, Dedola E, N'Zepa Batonga J, et al. A comparison of epidural vs. paravertebral blockade in thoracic surgery. Minerva Anestesiol. 2009;75(11):616-21.
27. Mayes J, Davison E, Panahi P, Patten D, Eljelani F, Womack J, et al. An anatomical evaluation of the serratus anterior plane block. Anaesthesia. 2016;71(9):1064-9.
28. Tighe SQ and Karmakar MK. Serratus plane block: do we need to learn another technique for thoracic wall blockade? Anaesthesia. 2013;68(11):1103-6.
29. Mukherjee M, Goswami A, Gupta SD, Sarbapalli D, Pal R and Kar S. Analgesia in post-thoracotomy patients: Comparison between thoracic epidural and thoracic paravertebral blocks. Anesth Essays Res. 2010;4(2):75–80.