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Ultrasound guided Serratus Anterior Plane block for postoperative analgesia in patients undergoing breast surgery

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Introduction

Cases of breast surgeries have increased due to increased awareness regarding the breast related issues. There is a significant rise in cases of breast cancer in the age group of 30-50 years.[1]

Most common morbidity of the breast surgeries is acute post-operative pain. Post-operative pain, if not treated in an effective manner, can lead to chronic pain apart from various other problems like anxiety, sleep disorder, depressed immune function and decreased pulmonary function.[2]

Opioids are the most commonly used analgesics, but they are associated with many undesired side effects like nausea, vomiting, excessive sedation, constipation and respiratory depression which lead to the constant need of supervision.[3] Regional blocks like the Intercostal nerve blocks, para-vertebral block, nerve infiltrations and PECS block are now preferred and have come a long way in providing adequate analgesia in breast surgery patients. However, these blocks are associated with the complications like pneumothorax, local anaesthetic toxicity and epidural hematoma.

In recent years a new regional block technique, the Serratus Anterior Plane (SAP) block has been used to infiltrate the various branches of intercostal nerves with local anaesthetic in the plane superficial to the serratus anterior muscle in a single prick, producing paresthesia in T2 to T9 dermatomes. This new block, under the guidance of the ultrasonographic machine, is easy to apply and is not associated with complications seen with other regional block techniques used for breast surgeries.[4]

Hence, this study was conducted to study the analgesic efficacy of Serratus Anterior Plane block in cases of breast surgery, to observe the maximum duration of postoperative analgesia provided and to evaluate the analgesic sparing effect of the block.

Materials and Methods

This prospective, randomized, double blinded, placebo-controlled study was conducted in a tertiary care teaching hospital. Forty adult female patients, 18-65 years of age who belonged to American Society of Anaesthesiologists (ASA) physical status I and II, scheduled to undergo elective breast surgery/mastectomy were included. The patients were

subjected to detailed clinical history and general physical examination. Routine blood investigations, chest X-ray, ECG and any other relevant investigations were carried out. A valid written, informed consent was obtained. During the pre-anaesthetic assessment, patients were educated about the extent of pain on the 10-point numeric rating scale (NRS), where 0=no pain and 10=worst imaginable pain. A nil by mouth period of 6 hours was ensured for all the patients.

On arrival to the operating room, Intravenous access was secured. Monitoring was established for non-invasive blood pressure (NIBP), heart rate (HR), continuous electrocardiography (ECG) and pulse oximetry (spO_2). Pre-oxygenation with 100% oxygen was done for 3 minutes. Induction of anaesthesia was achieved with standard anaesthetic technique, comprising of intravenous injection fentanyl 2mcgkg^{-1}, propofol 2.5 mgkg^{-1} and vecuronium 0.1 mgkg^{-1}, to facilitate placement of a supraglottic airway or an endotracheal tube. Maintenance of the anaesthesia was done by O_2 (35 %) and N_2O (65 %) in isoflurane (1 MAC). Injection vecuronium (0.01mgkg^{-1}) and injection fentanyl (0.5 µgkg^{-1}) were repeated intermittently, as desired. At the end of surgery, injection ondansetron, 4 mg was given.

The block was performed after the completion of surgery when the patient was still under anaesthesia. The patients were randomly allocated to one of the two groups of 20 each, using a computer-generated random number for the Serratus anterior plane block. Group A-(n=20) received 30 ml of 0.25% bupivacaine and Group B-(n=20) received any drug or placebo.

The patient was kept in supine position, with a slight (20–30 degree) lateral tilt, away from the side of surgery and the ipsilateral upper limb was abducted to 90 degrees. Under strict aseptic precautions, the ribs were counted inferiorly and laterally. The fourth rib was identified in the mid-axillary line. The SAP Block was performed at this level using a high frequency linear transducer (Sonosite M-turbo). The ultrasound probe was oriented in a cranio-caudal direction. On scanning, first the fatty subcutaneous tissues were identified. At the intermediate level the Serratus anterior muscles, ribs and external and internal intercostal muscles were identified. At the deeper level, pleura and lungs were identified. Thereafter, a 23 G Quincke's spinal needle was introduced using an 'out of plane' technique, under continuous ultrasound guidance, with the tip aimed to reach just superficial to the serratus anterior muscle. To check the exact position of the tip of needle, 1 ml of normal saline was administered through the needle. Once tip was confirmed to be in the correct facial plane by hydro-dissection, the respective amount of drug was given as per the group allocation.

Following the completion of block, isoflurane and N_2O were switched off. The residual neuromuscular blockade was reversed with injection glycopyrrolate 0.01 mgkg^{-1} and injection neostigmine 0.05 mgkg^{-1}. After emergence from anaesthesia, patient was transferred to the post-anaesthesia care unit (PACU).

On arrival in the PACU pain was assessed by an observer who was not aware of the study group at the following intervals; on arrival, 30 minutes, 1 hour, 2 hours, 6 hours, 12 hours, 18 hours and 24 hours. The pain was assessed by NUMERIC RATING SCALE (NRS), where '0' denotes no pain while '10' denotes the worst imaginable pain. [41] The patient response was assessed and recorded. If the patient complained of significant pain (NRS >3) a dose of injection

paracetamol 1gm i.v. was given, with a minimum interval of at least 4 hours between each dose. If the patient complained of pain in between the paracetamol dose regimen, injection tramadol 1 $mgkg^{-1}$ i.v. was given over a period of 2 minutes as rescue analgesia.

Post-operative nausea and vomiting (PONV) was assessed on a 3-point scale, where 0=no nausea, no vomiting; 1=nausea present, no vomiting; 2=vomiting present with or without nausea. Injection ondansetron 0.1 $mgkg^{-1}$ was administered if the PONV score was ≥1. Both, intra and postoperative complications like bleeding, nausea, vomiting if any, were noted

Patient's satisfaction with pain control was assessed using the scale: Very good, Good, Fair, Poor and Very poor. Primary outcome was assessed by severity of postoperative pain in terms of NRS, time to first analgesic requirement in PACU and postoperative total analgesic dose requirement. Secondary outcome included patient's satisfaction with SAP block in terms of postoperative pain relief, comfort and the incidence of side effects, if any.

Data of various parameters, thus obtained, was compiled and analysed statistically using the software, Statistical Package for social sciences (SPSS) version 20. Qualitative data was analysed using Chi square test and Fisher's exact test. Quantitative data was analysed with proportions using percentage, student t-test (paired/unpaired) and Mann-Whitney U-test. A probability of < 0.05 was considered statistically significant.

Results

Both, group A and group B, were statistically comparable in terms of age, clinical diagnosis and the type of surgery performed. (Table 1)

The mean NRS value in the post operative period was lower in group A as compared to group B at arrival to PACU, after 30 minutes, 1 hour, 2 hours, 6 hours, 12 hours, 18 hours and at 24 hours. The difference was statistically significant at all times, indicating excellent analgesia. (Table 2)

The demand for the rescue analgesic- injection tramadol, 100 mg slow intravenous, was drastically lower in group A in comparison to group B. The number of doses of injection tramadol consumed till 18 hours post operatively, was 12 versus 71 in group A and group B, respectively and the difference was statistically significant ($p<0.01$). The demand for number of injection paracetamol also showed statistically significant difference between the two groups. The number of injection paracetamol, 1gm intravenous doses given were 10 and 34 in Group A and Group B respectively, in first 6 hours, in post operative period ($p<0.01$). (Table 2)

The incidence of PONV in Group A was 15% (3 patients) as compared to 5% (01 patient) in Group B and was not statistically significant (p). Patients were highly satisfied in the post operative period in the group A, 100% of them rated the post operative experience with the SAP block and the quality of pain relief as good to very good, the difference between the two groups was statistically significant ($p<0.01$) (table 1).

No other side effects or complications were seen.

Discussion

Recent advances in surgery have fortunately increased the survival rate of the cancer patients but this increased survival has caused a rise in acute as well as chronic, post-operative pain. As per literature, about 60% of the patients of breast surgeries experienced acute severe postoperative pain. About one fourth of

these women complained of severe pain for a month and up to 10% of them suffered for 6-12 months after surgery, which makes treatment of acute post-operative pain of prime importance. The incidence of post operative pain not only depended on the type of intra-operative analgesia given but treating acute pain adequately also significantly reduced the incidence of post operative chronic pain.[5,6]

In our study, the SAP block group had 75% of patients of carcinoma breast as compared to 85% in the placebo group. SAP block (serratus anterior plane block) causes its action by blocking the Lateral cutaneous branch of the intercostal nerves (T1-T6) piercing the internal intercostal, external intercostal and serratus anterior muscle and supplying the lateral cutaneous part of the breast.[4, 7]

The SAP block was first described by Blanco et al in which they did a pilot study to see the quality of paresthesia and its duration in four volunteers. Our study is just a step ahead to observe and prove the efficacy of the SAP block. Blanco described that the mean duration of pain free interval was 752 minutes for the intercostal nerves and it was 778 minutes for motor nerves, after injecting the drug, superficial to serratus anterior muscle. In our study we had comparable results as the mean duration of analgesia for the sensory block was 538 minutes in group A as compared to placebo group B.[4]

We determined post operative analgesia, in our study, by numeral rating score, a scale which contained a paper strip with zero to ten. NRS scoring in Group A was 2.55±0.51 in PACU, 2.6±0.59 at 30 minutes, 2.75±0.71 at one hour, 2.90±0.71 at two hours and 3.2±0.61 at six hours and 4.2±0.89 at 12 hours, post-operatively, respectively as compared to Group B with NRS scoring 5.45±2.18 in PACU, 5.45±1.82 at 30 minutes, 4.6±1.72 at one hour, 2.90±0.64 at two hours, 4.9±1.48 at six hours and 5.55±1.5 at 12 hours, respectively. The NRS scoring at 18 and 24 hours for Group A and Group B were not very statistically significantly different. In our study we found that the NRS scoring was consistently less than 4/10 in SAP block group as compared to >4/10 in the placebo group till 12 hour of duration after surgery. In our study we found that the NRS scoring was consistently <4 in SAP block group as compared to >4 in the placebo group till 12 hours after surgery. Throughout the 12 hours period the p value was <0.001, except at 02 hours, where p was >0.05. This finding may be due to administration of total 33 doses of injection tramadol, the rescue analgesic, by then in Group B versus only 4 doses in group A. This significant difference in rescue analgesic caused a decline in NRS scoring from >4, in group B, resulting in the near equal NRS score in both the Groups.

Okmen et al reported giving the SAP block with 0.25% of the bupivacaine as 20 ml of solution, in a patient posted for thoracotomy, followed by putting a catheter in the Serratus Anterior Plane. They achieved anaesthesia at the dermatomes T2-T10. The mean duration of analgesia with a VAS score <4 was 420 minutes. However, in our study the NRS score was never >4 in the SAP group until 720 minutes after the block and the mean duration of analgesia was 538 minutes. This difference may be because of the higher volume, 30 ml, we used in our study.[8]

The requirement for analgesics in the post operative period also confirms the efficacy of a block or the lack of it. The number of doses of injection paracetamol and tramadol- the recue analgesic, given to patients,

differed significantly in both the groups. From arrival in PACU till 6 hours post-operatively, total analgesic requirement was 8 doses of injection paracetamol, 1gm, i.v. infusion and 2 doses of injection tramadol in group A versus 34 doses of injection paracetamol and 44 doses of tramadol in Group B, with $p<0.01$ and <0.001 respectively.

There were 11 (55%) patients in Group B who had a higher NRS score of >4 at all-time intervals in comparison to Group A, where only 6 (30%) patients needed analgesia during the first 6 hours.

The analgesia requirement during 12 to 24 hours after surgery was comparable in both groups. In Group A, 24 doses of injection paracetamol and 6 doses of injection tramadol as compared to 23 doses of injection paracetamol and 15 doses of injection tramadol were required in Group B. Thus, it can be summarized that after 12 hours of duration the pain score/ intensity is equal in both the groups and so is the amount of analgesia required.

Incidence of post operative nausea and vomiting (PONV) was 20% in Group A and 15% in Group B and these episodes of vomiting happened during the first two hours, probably as a result of the effect of the anaesthetic drugs and gases used.

Group A patients were more satisfied as far as the quality of the pain relief was concerned, as compared to Group B patients. The high satisfaction was most likely due to due to effective prolonged analgesia. Also, patients had less pain even on movements, making their quality of life better, though we did not note dynamic NRS scores separately, which is a limitation of our study. The ultrasound guided SAP block is an easy block to apply, as proved by Kunhabdulla et al in a case report in which the block was applied for multiple rib fractures, in a morbidly obese patient who also had uncontrolled blood sugar along with obstructive sleep apnea, making thoracic epidural and opioid injections as relative contraindication. The ease of performing SAP block also adds to the patient satisfaction because of simplicity of the procedure.[9]

The SAP block not only gave adequate pain relief but reduced the associated side effects and complications like pneumothorax, intra vascular injections, sympathetic blockade, urinary retention, respiratory depression, severe PONV etc. of other relevant block techniques like, paravertebral block, intercostal nerve block, thoracic epidural and opioid consumption. Same results reflected in our study and dose of the post operative opioids was reduced in SAP block group A patients, thus reducing the side effects related to the opioids also.[10,11,12,13]

So, our study shows that the SAP block conducted in the patients of breast surgeries, provides not only adequate post-surgical analgesia for acute pain but it also reduces the opioid consumption in the block group as compared to placebo group, without any complications associated with other related blocks.

Conclusion

Ultrasound guided serratus anterior plane (SAP) block is highly efficacious, simple, safe and easy to perform technique, which provides excellent analgesia in post operative period, as observed by significantly prolonged mean duration of analgesia, consistently lower numeric pain scoring (NRS) at different time intervals and has opioid sparing action, without any notable complications related to technique or drug. Thus, SAP block can be an effective addition to the multimodal approach for treating acute post operative pain in breast surgeries, though larger studies are

needed to better define the amount, concentration and type of the local anaesthetic drug.

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Legend Tables

Table 1: Demographic and post-operative parameters

S. No.	Parameter studied	Group A	Group B	p-value
1.	Age	41.75±9.22	44.7±12.47	0.400
2.	Clinical diagnosis			
	Accessory Breast	1(5%)	1(5%)	0.403
	CA breast	15(75%)	17(85%)	
	Fibroadenoma	4(20%)	1(5%)	
	Post Ductal Ca Breast	0	1(5%)	
3.	PONV	04 (20%)	03 (15%)	0.700
4.	Patient satisfaction (for SAP block and pain relief)			
	Good	12(60%)	16(80%)	<0.01
	Very good	8(40%)	0	

Table 2: Comparison of postoperative pain assessment and analgesic requirement

Time (post-operative)	Numeric rating Scale (NRS)			Analgesic requirement					
				Injection Paracetamol (1gm) number of doses			Injection tramadol (100mg) number of doses		
	Group A	Group B	p-value	Group A	Group B	p-value	Group A	Group B	p-value
In PACU	2.55±0.51	5.45±2.18	<0.001	0	15 (75%)	<0.001	0	0	-
30 min	2.60±0.59	5.45±1.82	<0.001	01(5%)	04 (20%)	0.151	0	15(75%)	<0.001
1 hour	2.75±0.71	4.60±1.72	<0.001	01(5%)	0	0.311	0	16 (80%)	<0.001
2 hours	2.90±0.71	2.90±0.64	>0.05	02(10%)	0	0.146	0	02 (10%)	0.146
6 hours	3.20±0.61	4.90±1.48	<0.001	06(30%)	15 (75%)	<0.01	02 (10%)	11 (55%)	<0.001
12 hours	4.20±0.89	5.55±1.50	<0.001	16(80%)	19 (95%)	0.151	07 (35%)	16 (80%)	<0.01
18 hours	4.00±0.91	4.95±1.66	<0.05	13(65%)	15 (75%)	0.490	03 (15%)	11 (55%)	<0.01
24 hours	3.90±1.44	3.80±1.39	>0.05	11(55%)	08 (40%)	0.342	03 (15%)	04 (20%)	0.677

Fig. 1: Consort flow diagram