

## Efficacy of serratus anterior muscle block as a part of multimodal analgesic regimen in patients undergoing modified radical mastectomy

Atin Goel<sup>1</sup>, Sanjeev Palta<sup>2</sup>, Richa Saroa<sup>3\*</sup>, Puja Saxena<sup>4</sup>

Senior Resident<sup>1</sup>, Department of Anaesthesia and Intensive Care, Institute of Liver and Biliary Sciences, New Delhi, India, Professor<sup>2</sup>, Associate Professor<sup>3</sup>, Assistant Professor<sup>4</sup>, Government Medical College and Hospital, Chandigarh, India.

### Background:

The quest for optimal analgesia after modified radical mastectomy has made anaesthesiologist steer its way into the arena of ultrasound guided interfascial blocks. Providing round the clock post-operative analgesia is standard care of treatment provided in our institution to enhance early recovery and prevent morbidity secondary to chronic pain syndromes. We hypothesised that administering serratus anterior muscle (SAM) block as a part of multimodal analgesia would be more efficacious in providing post-operative pain relief than intravenous patient-controlled analgesia (IV- PCA) alone in patients undergoing modified radical mastectomy (MRM).

### Methods:

After obtaining the institutional ethics committee approval and written informed consent, 60 females with American Society of Anaesthesiology (ASA) physical status I and II, aged between 20-80 years, scheduled to undergo MRM under general anaesthesia were randomized to receive post-operative IV-PCA with or without ipsilateral SAM block administered in the study group just after induction. The data was analysed for all quantitative variables and measures of dispersion. Normality of data was ascertained, and appropriate statistical tests were applied.

### Results:

The mean pulse, blood pressure and VAS (at rest and movement) was found to be significantly higher at all time intervals in the group not receiving SAM block. Also, the total morphine dose, rescue analgesic consumption as well incidence of post-operative nausea and vomiting was higher in group that received IV-PCA only in the post-operative period.

### Conclusions:

We conclude that post induction, single shot ultrasound guided ipsilateral serratus anterior muscle block provides effective post-operative analgesia in patients undergoing modified radical mastectomy than IV-PCA alone.

**Keywords:** Modified radical mastectomy; multimodal analgesia; serratus anterior muscle block

### Introduction

Modified Radical Mastectomy (MRM) is considered as the primary therapeutic option in patients of carcinoma breast and may be associated with significant acute pain that has a

propensity to progress to chronic pain syndromes in 25% to 60% of patients, the most common being the post mastectomy syndrome which has a tendency to aggravate emotional and psychological factors among females leading to paraesthesia, phantom breast and intercostobrachial neuralgia in 25-40% of patients.<sup>1,2</sup> Thus, the emphasis has always been laid on provision of adequate and effective perioperative analgesia to avoid the morbidity in post-operative period. Subsequent to introduction of ultrasound in the field of regional anaesthesia, the sonographic vision of an anaesthetist has widened and ability to differentiate aptly between the various structures have given a boost to the

\*Correspondence: Richa Saroa

E mail: [richajayant@rediffmail.com](mailto:richajayant@rediffmail.com)



<https://orcid.org/0000-0002-9836-0121>

Received: 09/03/2020

Accepted: 17/04/2020

DOI: <http://doi.org/10.4038/slja.v28i2.8547>



development of numerous interfascial blocks. Serratus Anterior muscle (SAM) block is an interfascial block where local anaesthetic is deposited in the plane between the latissimus dorsi muscle (LDM) and serratus anterior muscle (SAM). It provides excellent analgesia by virtue of blocking lateral cutaneous branches of the thoracic intercostal nerves (T2–T9).<sup>3,4</sup> In addition it also offers advantage of decreasing vascular injury or haematoma formation, improved quality of sensory blockade, reduction of risk of local anaesthesia toxicity and decreased opioid consumption.<sup>4</sup> SAM block has already been compared with thoracic epidural (TE) and paravertebral block (TPVB) to ascertain its analgesic efficacy in various thoracic surgeries and has been labelled as a safe, economical and lucrative alternative that is devoid of risks associated with both TE and TPVB. We hypothesised that administering SAM block as a part of multimodal analgesia with intravenous patient controlled analgesia (IV- PCA) would be more efficacious in providing post-operative pain relief than IV- PCA alone in patients scheduled to undergo mastectomy surgery under general anaesthesia and would reduce the post-operative cumulative morphine consumption. The pain relief as determined by the total cumulative morphine consumption was the primary outcome while the side effects and complications were observed as the secondary outcomes.

### Method

The present study was a prospective, randomized controlled trial that was conducted after obtaining approval from Institutional Ethics Committee and registration with Clinical trial registry of India.

To detect a difference of 0.8 standard deviation (SD) between the means of morphine consumption of the two groups, it was calculated that 26 patients per group are required for the study to have power of 80% and type I error of 0.05; using a confidence interval of 95%. It was decided to include extra subjects for possible dropouts so finally a total of 60 patients (30 in each group) were enrolled for the present study. Randomization was achieved using computer generated random number table that were secured in a coded opaque sealed envelope.

After written informed consent, 60 females with ASA physical status I and II, between the age 20-80 years, scheduled to undergo MRM under

general anaesthesia were included in the study. Any patient with history of drug allergy, psychiatric illness, substance abuse, severe cardiovascular or respiratory disease, any pre-existing liver disease, metabolic or neurological syndrome, chronic treatment with analgesics, pregnancy, coagulopathy, pre-existing infection at site of block and psychological inability to understand the procedure were excluded from the study.<sup>5</sup>

All the patients underwent a detailed pre anaesthetic evaluation and relevant investigations were performed in all the patients. All the patients were explained about the visual analogue score for pain on the scale of 0-100 (VAS) and categorical scoring system (CSS) for nausea in their own vernacular language in the preoperative period. The patients were also educated about the use of IV- PCA pump regarding the demand-based analgesia. All patients were kept fasting for minimum of 6 hours and were premedicated with oral pantoprazole (40 mg) and alprazolam (0.25 mg), on the night before surgery and in the morning of surgery.

The patients were connected to a multichannel monitor (GE, Healthcare Helsinki, Finland) after they were wheeled in the OR and monitored throughout for electrocardiogram (ECG), non-invasive blood pressure (NIBP), oxygen saturation (SpO<sub>2</sub>), respiratory rate (RR) and end tidal carbon dioxide (etCO<sub>2</sub>). An intravenous cannula, preferably 18G was secured in all patients before the induction of anaesthesia. A standardized intravenous induction was done in all the patients with propofol (2mg/kg), morphine (0.1mg/kg) following adequate preoxygenation and endotracheal intubation was facilitated subsequent to muscle relaxation achieved by non-depolarizing muscle relaxant vecuronium (0.1mg/kg). After securing the endotracheal tube, patients randomized to receive SAM block were administered the same on the side of surgery and were labelled as the study group (Group S). Rest of the patients did not receive the block and were labelled as the control group (Group C). All the blocks were administered by the same anaesthesiologist who was not involved in the collection of data in the post-operative period. After cleaning and draping the chest on the desired side, under aseptic conditions, the sonographic identification of the interfascial plane between latissimus dorsi muscle and

serratus anterior muscle was done using high frequency (5-10 MHz) linear array probe (Sonosite, Inc. Bothell, WA 98021 USA) in the mid axillary line. The in-plane approach was followed to reach the plane where 20 ml of 0.2% ropivacaine was deposited following hydro dissection of the plane with normal saline. Subsequently the surgical procedure was undertaken and at the end of the procedure, the effect of muscle relaxant was antagonized using i.v. glycopyrrolate (10mcg/kg) along with neostigmine (50mcg/kg). Trachea was extubated and patients were transferred to the post anaesthesia care unit (PACU) where the observations were made by an anaesthesiologist who was unaware of the group allocation of the patients. In PACU, all the patients irrespective of their group allocation, were connected to IV-PCA morphine in the strength of 1mg/ml with a bolus of 1 ml and lock out interval of 5 minutes and maximum dose of morphine being 0.2mg/kg body weight in 4 hours. Rescue analgesia with 1 gram paracetamol was administered to patients in both the study groups in case the VAS score > 40 even after maximal permissible dose of morphine over 4 hours. All the patients were monitored in the PACU for at least one hour before being transferred to the ward. They were monitored for haemodynamic variables, viz: heart rate (HR), blood pressure (NIBP), respiratory rate, VAS at rest as well as movement, Categorical Scoring System (CSS) for nausea at regular intervals of 30 mins, 1 hour, 4, 8, 12 and 24 hours. At the end of 24 hours, total cumulative morphine consumption was calculated. Any additional analgesic requirement in the perioperative period was also observed and noted in both the groups. All the recorded information was decoded at the end of the study and was analysed using appropriate statistical tests.

The data was analysed statistically using Statistical Package for Social Sciences (SPSS Inc., Chicago, IL, version 21.0 for Windows). Mean & medians were calculated for all quantitative variables as appropriate and for measures of dispersion standard deviation, standard error or IQR was calculated. Normality of data was checked by measures of Kolmogorov Smirnov tests of normality. If the data was normally distributed independent t-test was applied for comparison of 2 groups. Mann-Whitney U-test was used for statistical analysis of skewed continuous variables or ordered

categorical data. Proportions were compared using Chi square or Fisher's exact test whichever is applicable. Comparison of multiple time related variables within groups were done by repeated measure ANOVA followed by one-way ANOVA and post hoc multiple comparisons. Wilcoxon signed rank test was applied to see statistical difference between times related variables if the data was skewed or scored. All statistical analysis tests were two tailed and P value < 0.05 was taken as significant.

## Results

60 female patients in the age group of 20-80 years with ASA physical status I-II, scheduled to undergo MRM surgery under general anaesthesia were included in the study. The demographic data was comparable and statistically insignificant in both the groups. (Table 1)

**Table 1:** Demographic data

	Group S	Group C	p value
Age (years)	53.57 ± 11.40	53.53 ± 8.25	0.1
Body weight (Kg)	53.30 ± 10.60	52.50 ± 8.17	0.2

(p value >0.05-non-significant)

Preoperative haemodynamics and respiratory rate parameters (mean ± SD) were also comparable in both the groups. (Table 2)

**Table 2:** Preoperative haemodynamics and respiratory parameters (Mean ± SD)

	Group S	Group C	P value
Pulse rate (per minute)	71.27 ± 9.76	74.33 ± 9.50	0.22
SBP (mm Hg)	123.13 ± 13.36	127.80 ± 8.49	0.11
DBP (mm Hg)	77.87 ± 8.56	83.40 ± 8.79	0.17
Respiratory rate (per minute)	14.57 ± 0.94	15.37 ± 0.76	0.1

(p value >0.05 –nonsignificant)

The mean pulse rate as well as blood pressure in the control group was found to be statistically higher at all the time intervals up to 24 hours (p < 0.05) as compared to the group that received SAM block.

The VAS scores at rest and movement (mean ± SD) in the post-operative period were also observed to be significantly higher (p < 0.05) in the control group as compared to the patients in Group S (p < 0.5). (Table 3A and 3B)

**Table 3:** Postoperative Visual Analogue Score for pain

**Table 3a:** VAS at rest

Time	Group S	Group C	p value
30 minutes	13.33 ± 6.74	37.33 ± 5.83	<0.001
1 hour	10.50 ± 5.62	35.33 ± 6.29	<0.001
4 hours	6.67 ± 6.99	32.67 ± 5.21	<0.001
8 hours	6.33 ± 7.98	34.00 ± 7.24	<0.001
12 hours	6.67 ± 7.80	34.33 ± 7.28	<0.001
24 hours	9.83 ± 6.36	33.67 ± 4.90	<0.001

p value <0.05- significant

**Table 3b:** VAS at movement

Time	Group S	Group C	p value
30 minutes	19.00 ± 7.59	42.67 ± 6.40	<0.001
1 hour	17.00 ± 7.38	39.33 ± 6.40	<0.001
4 hours	12.17 ± 6.65	35.33 ± 6.81	<0.001
8 hours	13.50 ± 9.02	37.00 ± 6.51	<0.001
12 hours	15.33 ± 8.40	37.33 ± 7.85	<0.001
24 hours	17.67 ± 7.51	36.67 ± 6.06	<0.001

p value <0.05- significant

The total morphine consumption (mean ± SD) at the end of 24 hours was found to be higher and statistically significant in the control group (10.71 ± 2.91 mg) as compared to group S (0.77 ± 0.73 mg). (Table 4)

**Table 4:** Total morphine and rescue analgesia consumption at the end of 24 hour postoperatively

	Group S	Group C	p value
Total morphine (mg)	0.77 ± 0.73	10.17 ± 2.9	<0.001
Rescue analgesia (grams)	0.00 ± 0.00	0.17 ± 0.38	0.02

p value <0.05-significant

Similarly, the rescue analgesic consumption was also observed to be statistically significant in group C (0.17 ± 0.38 gm) than group S (0 ± 0 gms) over 24 hours. (Table 5)

**Table 5:** Incidence of PONV by CSS

Time	Group S	Group C	p value
30 minutes	0.00 ± 0.00	0.10 ± 0.30	0.08
1 hour	0.07 ± 0.25	0.30 ± 0.47	0.02
4 hours	0.10 ± 0.30	0.20 ± 0.41	0.27
8 hours	0.00 ± 0.00	0.20 ± 0.41	0.01
12 hours	0.10 ± 0.30	0.13 ± 0.35	0.69
24 hours	0.03 ± 0.18	0.33 ± 0.48	<0.001

p value > 0.05 is insignificant at 30 minutes, 4 hours and 12 hours

p value <0.05 is significant at 1 hour, 8 hours and 24 hours

Incidence of PONV as assessed by mean CSS was found to be statistically higher in control group at 1, 8 and 24 hours as compared to group S.

### Discussion

The present study was undertaken as a preliminary experience to ascertain the efficacy of ultrasound guided SAM block in patients undergoing MRM under general anaesthesia and receiving multimodal analgesia in the post-operative period. Provision of effective analgesia is a prerequisite for accelerated recovery in the post-operative period. Post-operative multimodal analgesia is an established method practised at our institute to alleviate pain relief in patients undergoing major surgeries.

In the present study, to reduce the observer bias, all the blocks were performed by an anaesthesiologist who was not involved in the collection of the data in the post-operative period. The data collection in the post-operative period was done by an observer who was unaware of the group allocation of the patient. The application of sterile bandage in the operative site also contributed to concealment of the group of the patient and prevented any observer bias during the collection of data.

During the present study, we observed that patients who were randomized to receive US guided SAM block with 0.2% ropivacaine after induction of anaesthesia, had significantly lower VAS scores both at rest and movement and demonstrated excellent analgesia in the post-operative period up to 24 hours. Also, this group of patients exhibited lower nausea and vomiting in the post-operative period which may be attributed to lesser morphine consumption owing to an effective analgesia that can indirectly be attributed to adequacy of the block administered. It was also observed that SAM block is not associated with any complications and has a shorter learning curve. Also being an interfascial plane block, the distance from pleura could be judged accurately using ultrasound and deposition of the drug was done exactly in desired plane under direct visualization.

Originally described by Blanco T2-T9, SAM block provides effective analgesia to the ipsilateral thorax by virtue of blockade of lateral cutaneous branches of the intercostal nerves (T2-T9). US guided SAM block provides effective analgesia to ipsilateral thorax.<sup>3,4,6,7</sup> SAM block has given comparable results in terms of effective analgesia in patients undergoing MRM surgery when compared to thoracic paravertebral block (TPVB).<sup>8</sup> However TPVB has been shown to require a steep learning curve and has been found to be associated with various complications in the post-operative period. In contrast, ultrasound guided SAM block requires relatively smaller curvature of learning, is easy to perform with minimal complications. Also use of ultrasound has enhanced the capabilities of perioperative physician with respect to both accuracy as well as safety profile of the procedure by enabling real time visualization of needle and effective spread of the local anaesthetic in the interfascial plane.<sup>8,9</sup> The utility of SAM block has also been seen in thoracotomies where drastic decreases in pain scores have been observed in the post-operative period. And therefore, SAM has been labelled as safe and efficacious modality in these patients too.<sup>10,11</sup>

Cumulative morphine consumption has been found to be reduced significantly in patients receiving SAM block after thoracotomies and MRM surgeries where the former has been compared to TPVB and the results of all these studies are consistent to the results derived from the present study where cumulative morphine consumption was found to be significantly less than those who did not receive the block.<sup>8,10,11,12</sup> The opioid sparing effect of SAM block has an inherent advantage of early recovery with lesser side effects attributed to opioids especially, respiratory depression, pruritis, post-operative nausea and vomiting (PONV) that have been always been a matter of concern and may be quite distressing in the post-operative period especially in elderly patients or those associated with multiple co morbidities. All the patients who received the block reported early resumption of their daily activity that included early mobility in bed, ability to sit and do things like dressing up, eating and moving independently. However, we did not utilize any of the available quality of life indices to signify all these positive aspects of the block in the post-operative period and thus this

may be considered as a limitation of the present study.

There are certain other limitation of the present study. The onset time of the block could not be ascertained as the block was performed after the induction of anaesthesia in patients. The administration of the block after induction, whether leads to any reduction of anaesthetic agents also needs to be ascertained. Theoretically, certain subset of patients especially cardiac patients or patients with underlying coexisting diseases, who are not suitable candidates for receiving general anaesthesia may be benefitted by receiving this block in the preoperative period using higher concentrations of local anaesthetics and again it needs to be explored that whether SAM block can be employed as the sole anaesthetic technique in such patients.

The placement of catheter in the interfascial plane for a continuous SAM block would have provided extended analgesia to the patient. However, since the study was designed to record measurements only up to 24 hours, it is difficult to comment whether the efficacy of block extends beyond this time period and further studies need to be undertaken to make this observation. Also, since all the blocks were performed by an experienced anaesthesiologist who has been performing ultrasound guided blocks routinely, it remains uncertain whether the success of the procedure and lack of side effects can be replicated by a novice though the SAM block has a shorter learning curve.

### Conclusion

Therefore, from the results of this study, we conclude that ipsilateral USG SAM block performed on the same side of surgery, is a safe and effective modality to provide effective and adequate post-operative analgesia following MRM surgery in females. It provides inherent advantage of lesser morphine consumption in the post-operative period translating into fewer side effects of opioids when used as a part of multi modal analgesic regimen. The use of ultrasound aids in the performance of the block while increasing its safety profile as well. We recommend the use of ipsilateral USG SAM block in patients undergoing MRM after induction to have added advantage of intraoperative analgesia in addition to excellent post-operative analgesia.

## References

1. Anderson KG, Kehlet H. Persistent pain after breast cancer treatment: a critical review of risk factor and strategies for prevention. *J Pain*. 2011; **12**(7): 725-746  
<https://doi.org/10.1016/j.jpain.2010.12.005>  
PMid:21435953
2. Gartner R, Jensen MB, Nielsen J, Ewertz M, Krohan M, Kehlet H. Prevalence of and factors associated with persistent pain following breast cancer surgery. *JAMA*.2009; **30**: 1985-1992  
<https://doi.org/10.1001/jama.2009.1568>  
PMid:19903919
3. Blanco R, Paras T, McDonnell JG, Galino AP. Serratus plane block: a novel ultrasound guided thoracic wall nerve block. *Anaesth* 2013;**68**:1107-1113  
<https://doi.org/10.1111/anae.12344>  
PMid:23923989
4. Mayes J, Davison E, Panahi P, Eljelani F, Womack J, Varma M. Anatomical evaluation of serratus anterior plane block. An anatomical evaluation of serratus anterior plane block. *Anaesth* 2016;**71**: 1064-1069  
<https://doi.org/10.1111/anae.13549>  
PMid:27440171
5. Kaya M, Oguz G, Senel G, Kadioqlari N. Postoperative analgesia after modified radical mastectomy: the efficacy of interscalene brachial plexus. *J Anaesth* 2013;**27**: 826-827  
<https://doi.org/10.1007/s00540-013-1647-z>  
PMid:23736824
6. Chakraborty A, Khemka R, Datta T. Ultrasound guided truncal blocks: A new frontier in regional anaesthesia. *Indian. J. Anaesth*. 2016;**60**: 703-711  
<https://doi.org/10.4103/0019-5049.191665>  
PMid:27761032 PMCID:PMC5064693
7. Tighe SQ, Kamarkar MK. Serratus plane block: Do we need to learn another technique for thoracic wall blockade. *Anaesth*.2013;**68**: 1103-1106  
<https://doi.org/10.1111/anae.12423>  
PMid:24032664
8. Gupta K, Srikanth K, Girdhar KK, 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**: 381-386  
[https://doi.org/10.4103/ija.IJA\\_62\\_17](https://doi.org/10.4103/ija.IJA_62_17)  
PMid:28584346 PMCID:PMC5444215
9. Helta DF, Rezk KM. Pectoralis serratus interfascial plane block vs thoracic paravertebral block for unilateral radical mastectomy with axillary evacuation. *J Clin Anaesth* 2016;**34**: 91-97  
<https://doi.org/10.1016/j.jclinane.2016.04.003>  
PMid:27687353
10. Okmen K, Okmen BM. The efficacy of serratus anterior plane block in analgesia for thoracotomy: A retrospective study. *J. Anesth*.2017;**31**: 579-585  
<https://doi.org/10.1007/s00540-017-2364-9>  
PMid:28447227
11. Khalil AE, Abdallah NM, Bashandy GM, Kaddah TA. Ultrasound guided serratus anterior plane block versus thoracic epidural analgesia for thoracotomy pain. *J. Cardiothorac Vasc. Anaesth*.2017;**31**:152-158  
<https://doi.org/10.1053/j.jvca.2016.08.023>  
PMid:27939192
12. Abdallah FW, MacLean D, Madjdpour C, Cil T, Bhatia A, Brull BR. Pectoralis and serratus facial plane block each provide early analgesic benefits following ambulatory breast cancer surgery: A retrospective propensity-matched cohort surgery. *Anesth. Analg*.2017;**125**: 294-302  
<https://doi.org/10.1213/ANE.0000000000001975>  
PMid:28328756