



# Impact of the Ultrasound-Guided Serratus Anterior Plane Block on Post-Mastectomy Pain: A Randomised Clinical Study

Ultrasonografi Eşliğinde Serratus Anterior Plan Bloğun Mastektomi Sonrası Ağrı Üzerine Etkisi: Randomize Klinik Çalışma

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**Objective:** A variety of methods, including neuraxial and regional blocks, have been used to manage post-mastectomy pain. This study evaluates the effect of serratus anterior plane block on acute pain after mastectomy.

**Methods:** A total of 60 patients who were candidates for mastectomy under general anaesthesia were divided in this trial into two groups. After entering the recovery room, the first-experimental-group (SAB) underwent the ultrasound-guided serratus anterior block, but the second-control-group (CTL) received no block intervention. An intravenous patient-controlled analgesia (PCA) device was used to deliver fentanyl in both groups. Using the Visual Analog Scale (VAS), the patients' pain was assessed at intervals of 1, 6, 12 and 24 hours after entering the recovery room. Intravenous acetaminophen was administered as a rescue analgesic if the pain exceeded 3 on the VAS. A total amount of fentanyl consumed, the time to first PCA request, a total amount of acetaminophen consumption and possible adverse effects were evaluated.

**Results:** The pain scores assessed at the time intervals were not significantly different between the two groups ( $p>0.5$ ). The total consumption of fentanyl was significantly lower in the SAB group than in the CTL group ( $p=0.0001$ ). Duration of the time to first PCA request was remarkably longer in the SAB group than in the CTL group ( $p=0.0001$ ). The total amount of acetaminophen consumed was notably higher in the CTL group than in the SAB group ( $p=0.001$ ). None of the patients experienced side effects.

**Conclusion:** Undertaking serratus anterior block following mastectomy can reduce pain scores and lower opioid usage.

**Keywords:** Mastectomy, pain, serratus anterior block, ultrasound

**Amaç:** Mastektomi sonrası ağrıyı yönetmek için nöroaksiyal ve rejyonal blokları içeren çeşitli yöntemler kullanılmıştır. Bu çalışma serratus anterior plan bloğunun mastektomi sonrası akut ağrı üzerindeki etkisini değerlendirmektedir.

**Yöntemler:** Bu çalışmada, genel anestezi altında mastektomi için aday olan toplam 60 hasta iki gruba ayrıldı. Uyanma odasına girdikten sonra, ilk deney grubuna (SAB) ultrasonografi eşliğinde serratus anterior blok uygulandı. Fakat ikinci kontrol grubuna (CTL) herhangi bir blok müdahalesi yapılmadı. Her iki grupta da fentanil vermek için intravenöz hasta-kontrollü analjezi (PCA) cihazı kullanıldı. Hastaların ağrıları Vizüel Analog Skalası (VAS) kullanılarak uyanma odasına girdikten sonraki 1, 6, 12 ve 24 saat aralıklarında değerlendirildi. Ağrı VAS'da 3 değerini aştığında, kurtarma analjeziği olarak intravenöz asetaminofen uygulandı. Toplam tüketilen fentanil miktarı, ilk PCA isteği zamanı, toplam asetaminofen tüketimi miktarı ve olası yan etkiler değerlendirildi.

**Bulgular:** Zaman aralıklarında değerlendirilen ağrı skorları açısından iki grup arasında anlamlı farklılık yoktu ( $p>0,5$ ). Toplam fentanil tüketimi SAB grubunda, CTL grubundan anlamlı derecede daha düşüktü ( $p=0,0001$ ). İlk PCA istemi zamanına kadar geçen süre SAB grubunda, CTL grubuna kıyasla, dikkat çekecek şekilde daha uzundu ( $p=0,0001$ ). Tüketilen toplam asetaminofen miktarı CTL grubunda, SAB grubundan anlamlı derecede daha yüksekti ( $p=0,001$ ). Hastaların hiçbirinde yan etki yaşanmadı.

**Sonuç:** Mastektomiyi takiben serratus anterior blok uygulanması ağrı skorlarını ve opioid kullanımını azaltabilir.

**Anahtar Kelimeler:** Mastektomi, ağrı, serratus anterior blok, ultrasonografi

## Introduction

There are several ways to manage pain after mastectomy (1). Common systemic medications, particularly opioids, have different side effects, such as itching, nausea, vomiting and respiratory depression. Non-steroidal anti-inflammatory drugs are associated with impaired renal function and haemorrhagic disorders (2-6). Despite producing desirable analgesic effect, a thoracic epidural block may result in haemodynamic changes, including hypotension and decreased tidal volume (7). Regional blocks have led to a decreased need for analgesics, maintenance of haemodynamic stability, early ambulation and discharge of patients, and lower hospital costs (8-10). The post-mastectomy pain management can

be performed using regional block techniques, for example, thoracic and intercostal blocks, which may be associated with potential complications of pneumothorax and nerve damage, however (11, 12). In some studies, the serratus anterior block has shown to cause chest wall analgesia lasting for 12 hours following breast surgery. It was also an effective and low-risk method to ameliorate post-thoracotomy acute pain (13-15). The ultrasound-guided serratus anterior block can increase the safety and speed up the procedure (16, 17). Considering limited studies on this technique, the authors decided to investigate the effect of ultrasound-guided serratus anterior block on post-mastectomy acute pain.

## Methods

This study was conducted after obtaining an approval from the ethics committee of the Iran University of Medical Sciences with the reference number IR.IUMS.REC.1395.28929, and registering the trial online on the Iranian Registry of Clinical Trials' website with the registry code IRCT2016011810599N6. Considering the alpha cut-off of 0.05 and power of 80% and ( $d = \mu_1 - \mu_2 = 1.2$ ),  $Z_{\alpha/2}$  is dependent to level of significance which for 5% this is 1.96,  $Z_{\beta}$  is dependent on power and for 80% this is 0.84; so 30 patients in each group was calculated.

$$n = \frac{(Z_{(1-\alpha/2)} + Z_{(1-\beta)})^2 (sd_1^2 + sd_2^2)}{d^2}$$

Having obtained informed written consent, 60 patients who were initially considered candidates for modified radical mastectomy, were assigned in the study. To define the target population, the inclusion criteria were as follows: women, aged 20-60 years, who were candidates for unilateral modified radical mastectomy under general anaesthesia with one

surgeon and who gave informed consent to participate in the study. The exclusion criteria consisted of the American Society of Anesthesiologists' class greater than 3, emergency surgery, coagulation disorders, addiction to narcotics or psychoactive drugs, and mood and psychological disorders.

All patients underwent a general anaesthesia induction with the same anaesthetic protocol, and after entering the recovery room and performing standard monitoring, the patients were divided into two groups based on the block randomisation. They were randomly assigned using a computerised random number table.

The first group received an ultrasound-guided serratus anterior block (SAB) (Micromax, Sonosite, USA) in the lateral decubitus position, managed by the same researcher. The block was performed using a high-frequency linear probe placed in the infra-clavicular region. The probe was then moved latero-caudally towards the mid-axillary line so that the serratus anterior muscle could be observed just as a thin layer on the ribs, at the level of the fifth rib. After identifying the appropriate place, bupivacaine  $0.3 \text{ mL kg}^{-1}$  (Marcaine, AstraZeneca, UK) at a concentration of 0.2% (6 mL normal saline solution was added to 4 mL bupivacaine 0.5% for each 10 mL syringe) was injected in-plane under ultrasound guidance with a sonovisible 21-gauge needle (PAJUNK, Germany) (Figure 1a, b). The control group received no blockade. Further evaluations were carried out by a different investigator who was unaware of the patients' grouping.

For both groups, an intravenous patient-controlled analgesia (PCA) device (Foures SA, France) was programmed to give a loading dose of fentanyl  $7.5 \mu\text{g mL}^{-1}$  (42.5 mL normal saline solution was added to 7.5 mL (375  $\mu\text{g}$ ) fentanyl) followed by bolus injection of 2 mL fentanyl, with a lock-out interval of 15 minutes.



Figure 1. a, b. Sonographic view (a) and probe position for the ultrasound-guided serratus anterior block (b)

Patients' characteristics (age, body mass index, and side of the surgery) were assessed and recorded on the questionnaire. Patients' pain scores were evaluated in the recovery room prior blockade and PCA attachment, and then at 1-, 6-, 12- and 24-hour intervals using a visual analogue scale (VAS) (0 for no pain and 10 for the most severe pain). If the VAS exceeded 3, acetaminophen (Aptel, Unipharma, EU) 1 gr iv in 100 mL of normal saline solution was injected within 15 minutes. The VAS, the fentanyl consumption ( $\mu\text{g}$ ) at 1, 6, 12 and 24 hrs, the initial duration of the PCA attachment (min), the amount of acetaminophen administered (gr) and the potential complications were recorded on the questionnaire.

**Statistical analysis**

The quantitative and qualitative data were expressed as the mean and standard deviation (mean $\pm$ SD) and as percentage, respectively. Quantitative variables were compared using the t-test for those normally distributed or the Mann-Whitney U test in case of abnormal distribution. Qualitative variables were compared using a chi-squared test or Fisher's exact test. The correlation between quantitative variables was examined using Pearson's correlation coefficient. The data collected were analysed using the IBM Statistical Package for the Social Sciences (IBM SPSS Corp.; Armonk, NY, USA) version 21, and the level of significance was set at  $p < 0.05$ .

**Results**

As shown in Table 1, there was no statistically significant difference in patients' characteristics between the two groups ( $p > 0.5$ ). No significant difference was found in the pain scores between the two groups at the time intervals stated ( $p > 0.5$ ). The amount of fentanyl consumed was notably lower in the SAB group than in the CTL group ( $p = 0.0001$ ). The time to first PCA request was remarkably longer in the SAB group than in the CTL group ( $p = 0.0001$ ). The acetaminophen consumption was significantly lower in the SAB group than in the CTL group ( $p = 0.001$ ); none of the participants in group SAB had received acetaminophen. These findings are presented in Table 2. During the intervention and follow-up period, no adverse effects were observed in the patients.

**Discussion**

This study showed that the serratus anterior block relieved post-mastectomy acute pain and reduced the amount of opioid required.

The serratus anterior muscle is located in the antero-lateral side of the chest, extending between the first and ninth ribs. Performing a serratus anterior block causes the lateral cutaneous branches of thoracic intercostal, thoracodorsal and thoracic longus nerves to be anesthetised, resulting in analgesia in the antero-lateral and somewhat posterior aspect of the chest (18-20). In fact, this block selectively affects thoracic nerves (14).

Table 1. Comparison of patients' characteristics in the two groups

	SAB Group	CTL Group	p
Age	49.3 $\pm$ 7.2	50.2 $\pm$ 7.8	0.3
Body mass index	23.5 $\pm$ 3.2	23.8 $\pm$ 2.9	0.4
<b>Side of surgery</b>			
Right	17	19	0.1
Left	13	11	

Table 2. Comparison of patients' pain score, amount of consumed opioid, time to first PCA request, and amount of acetaminophen consumption in the two groups

	Group SAB (n=30)	Group CTL (n=30)	P
<b>VAS scores</b>			
Start point in recovery	5.2 $\pm$ 0.7	5.3 $\pm$ 0.6	0.7
1 hr	2.4 $\pm$ 0.4	2.5 $\pm$ 0.5	0.3
6 hr	2.3 $\pm$ 0.3	2.6 $\pm$ 0.6	0.2
12 hr	2.2 $\pm$ 0.3	2.5 $\pm$ 0.5	0.1
24 hr	2.1 $\pm$ 0.3	2.3 $\pm$ 0.3	0.1
<b>Fentanyl consumption dose (<math>\mu\text{g}</math>)</b>			
1 hr	3.5 $\pm$ 0.2	35.6 $\pm$ 4.5	0.0001
6 hr	9.5 $\pm$ 1.2	224.7 $\pm$ 26.3	0.0001
12 hr	104.2 $\pm$ 21.4	480.6 $\pm$ 26.5	0.0001
Time to first PCA request (min)	323.5 $\pm$ 49.7	16.6 $\pm$ .1	0.0001
Acetaminophen consumption (gr)	0	1.3 $\pm$ 0.4	0.001
Number of patients who needed acetaminophen	0	6	0.001

Employing serratus anterior block to control pain during and after surgery, and even to manage chronic pain, has been considered for several years. However, although the studies conducted were few in number and were mostly case studies, they have confirmed the effectiveness of the block (21, 22).

In their study, Blanco et al, (23) performed the serratus anterior block using levobupivacaine to relieve post-thoracoscopy pain in 2 patients, which led to a desired pain management, and the result obtained was consistent with the present study.

In a morbidly obese patient suffering from rib fractures, Kunhabdulla et al. (24) implemented a serratus anterior block using lidocaine to achieve analgesia during the operation, and then employed continuous infusion of bupivacaine for a week, which resulted in an appropriate analgesic effect. In another study, Madabushi et al. (20) could manage post-thoracotomy acute pain by performing a serratus anterior block with lidocaine. In our study, which was conducted using bupivacaine, a similar result was obtained, and we found less need for an analgesic and longer analgesia after performing SAB.

In a morbidly obese patient considered a candidate for breast surgery, the serratus anterior block with ropivacaine was effective to provide analgesia during the operation (25). The effect of a serratus anterior block accompanied by pectoral block to control chronic pain after mastectomy was examined in a study, which indicated a successful pain management (26). In the current study, only one block was performed and adding more ultrasound-guided blocks in the pectoral region following thoracic surgery may be a good solution for a better analgesia.

Studies on the effects of SAB in chronic pain conditions are rare. In 8 patients suffering from chronic pain syndrome after mastectomy, Zocca et al. (22) investigated the effect of serratus anterior block with bupivacaine and methyl prednisolone, which resulted in a good pain relief even up to 2 weeks in all patients. Serratus anterior plane block is considered to be safe and effective during the S-ICD implantation procedure as well (27).

A study of the effect of ultrasound-guided SAB on managing acute and chronic pain existing in the thoracic area demonstrates that the procedure is easy to perform, is effective in pain management, and has a low number of side effects (20-24).

## Conclusion

Our study had some limitations such as lack of a control group receiving placebo injection; a small sample size; and limited timeframe for patients' assessment. As a few case control studies have examined the effect of SAB on the post-mastectomy pain management, to improve the power of results by this block, larger studies are recommended to be done using other drugs and doses, infusion through a catheter insertion, with even larger multicentric sample sizes. Comparison of the efficacy of this method with other regional blocks on acute and chronic pain management is also recommended.

Based on the results of this study, the serratus anterior block after mastectomy can reduce the need for opiates and is associated with fewer side effects.

**Ethics Committee Approval:** Ethics committee approval was received for this study from the ethics committee of Iran University (IR.IUMS.REC.1395.28929).

**Informed Consent:** Written informed consent was obtained from patients who participated in this study.

**Peer-review:** Externally peer-reviewed.

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