

## CLINICAL RESEARCH / KLİNİK ÇALIŞMA

# THE COMPARISON OF SERRATUS ANTERIOR PLANE BLOCK VERSUS INTERCOSTAL BLOCK FOR POSTOPERATIVE ANALGESIA FOLLOWING THORACOTOMY SURGERY

## TORAKOTOMİ OPERASYONLARINDA POSTOPERATİF ANALJEZİ İÇİN YAPILAN SERRATUS ANTERİOR PLAN BLOĞUNUN İTERKOSTAL BLOK İLE KARŞILAŞTIRILMASI

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### ABSTRACT

**Objective:** Pain after thoracotomy is one of the most severe pain experienced by the patients. Intercostal nerve block (IB) is one of the most commonly used methods of pain management after thoracotomy operations. Serratus anterior plane block (SAPB) is a novel block that has been shown to be effective for pain management in thoracic surgery. In this study, we aimed to compare the postoperative visual pain scores (VAS) and analgesic consumption following serratus anterior plane block or intercostal nerve block in patients undergoing thoracic surgery.

**Method:** Patients who underwent thoracotomy operation in our clinic between May 2016 and May 2017 were reviewed retrospectively. Demographic data, postoperative analgesic consumptions and complications were evaluated.

**Results:** Data of 42 patients undergoing thoracotomy operation were obtained. Twenty two patients were performed with IB and 20 patients were performed with SAPB. When the two groups were compared, age, gender, weight, height, duration of operation were similar. VAS scores at postoperative 1<sup>st</sup>, 2<sup>nd</sup>, 4<sup>th</sup>, 6<sup>th</sup>, 12<sup>th</sup> and 24<sup>th</sup> hours were found to be significantly lower in the SAPB group ( $p < 0.001$ ). There was no significant difference in complications in both groups.

**Conclusion:** As a result of this study, SAPB for postoperative analgesia following thoracic surgery was superior to IB.

**KEYWORDS:** Serratus anterior plane block, Thoracotomy, Postoperative pain, Intercostal nerve block

### ÖZ

**Amaç:** Torakotomi sonrası ağrı, hastaların yaşadığı en şiddetli ağrılardan biridir. İnterkostal sinir bloğu (IB) torakotomi operasyonları sonrası görülen ağrı yönetiminde en sık kullanılan yöntemlerden biridir. Serratus anterior plan bloğu (SAPB) yeni tanımlanan ve toraks cerrahisinde etkinliği gösterilmiş bir gövde bloğudur. Bu çalışmada kliniğimizde toraks cerrahisi yapılmış hastalara uygulanan interkostal sinir bloğu (IB) ile SAPB'nin postoperatif vizüel ağrı skorlarını (VAS) ve analjezik tüketimini karşılaştırmayı amaçladık.

**Yöntem:** 2016 Mayıs – 2017 Mayıs arasında kliniğimizde torakotomi operasyonu olmuş hastalar retrospektif olarak incelendi. Hastaların demografik verileri, postoperatif kullanılan analjezik miktarı, postoperatif VAS skorları ve komplikasyonlar kayıtlardan incelendi.

**Bulgular:** Torakotomi operasyonu yapılmış 42 hastanın verilerine ulaşıldı. Yirmi iki hastaya IB ve 20 hastaya SAPB uygulandığı görüldü. Her iki grup karşılaştırıldığında yaş, cinsiyet, kilo, boy, operasyon süresi benzer bulundu. Postoperatif 24 saatlik analjezik kullanımının ve postoperatif 1., 2., 4., 6., 12., 24. saatte VAS skorlarının SAPB grubunda anlamlı olarak az olduğu görüldü. ( $p < 0.001$ ). Her iki grupta komplikasyonlar açısından anlamlı fark görülmedi.

**Sonuç:** Bu çalışma sonucunda toraks cerrahisinde postoperatif analjezi amaçlı uygulanan SAPB IB'ye göre üstün bulunmuştur.

**ANAHTAR KELİMELEER:** Serratus anterior plan bloğu, Torakotomi, Postoperatif ağrı, İnterkostal blok

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## INTRODUCTION

Pain after thoracotomy is one of the most severe pain types experienced by the patients (1). Good pain control after the operation provides comfortable respiration and reduces complications and development of chronic pain (2). There are various analgesia methods for postoperative pain management following thoracotomy. The application of epidural, paravertebral or intercostal nerve blocks and the administration of intrapleural local anesthetic and systemic opioids are shown to be effective methods (3,4).

Intercostal nerve block (IB) has been used frequently in thoracotomy operations and reported to provide safe and effective analgesia (5). On the other hand, the current technique, serratus anterior plane block may also provide benefit for postoperative pain management following thoracotomy. This block was described by Blanco et al in 2013 to provide anesthetic and analgesic blockade of lateral branches of intercostal nerves above and below the serratus anterior muscle (6).

Hence, we aimed to compare serratus anterior plane block (SAPB) with intercostal block (IB) regarding postoperative visual analog scale (VAS) scores for pain and analgesic consumption in patients undergoing thoracotomy operation.

## MATERIAL AND METHOD

This retrospective study approved by local ethics committee (KAEEK 2017/14-18). All procedures were conducted in accordance with the Declaration of Helsinki. Patients who underwent thoracotomy operation in our hospital between May 2016 and May 2017 were examined. The data was retrieved from the records of a total of 49 patients aged 18-75 years, ASA I-III, who had an IB or SAPB for the thoracotomy operation retrospectively. The patients' information was gathered from the patient records and anesthesia block forms.

Four patients with missing data, two without written consent, and one with re-thoracotomy were excluded from the study. A total of 42 patients were allocated into 2 groups. The patients in group IB received intercostal block and intravenous patient controlled analgesia (PCA) with tramadol, whereas the patients in group SAPB received serratus anterior plane block and PCA with tramadol.

All patients received standard general anesthesia protocol as induction with 2-3 mg kg<sup>-1</sup> iv propofol (Propofol, Fresenius-Kabi, Istanbul, Turkey) 1-1.5 mcg kg<sup>-1</sup> fentanyl (Talinat, Vem, Istanbul, Turkey) and 0.6 mg kg<sup>-1</sup> iv rocuronium (Esmeron, MSD, Istanbul, Turkey). Anesthesia was maintained by sevoflurane (Sevorane,

Abbott, Istanbul, Turkey) and in a 50% O<sub>2</sub> -50% air mixture. Standard monitoring of the patients such as heart rate, invasive systolic, diastolic and mean blood pressure, peripheral oxygen saturation and the operating times were recorded. According to the need for single lung ventilation, a double-lumen endotracheal tube in appropriate sizes (35-39 French) was placed with the patient in a supine position. Depending on the side to be operated, the patient was positioned on the left or right side and the surgical procedure was started. At approximately 30 minutes before the end of surgery, dexketoprofen (Arveles, IE Ulagay-Menarini, Turkey) 8 mg IV was administered to all patients. At the end of the operation, intercostal block was performed by the attending surgeon (M.S) or SAPB was performed by the attending anesthesiologist (G.O). All patients were extubated after the operation and transferred to ICU.

### Intercostal nerve block

Before closing the thoracotomy, posterior intercostal block was performed with 4 ml of 0.25% bupivacaine (Marcaine®, Eczacıbaşı, Turkey) to each of 5 levels, comprising the thoracotomy level and 2 above and 2 below with total 20 ml of local anesthetics.

### Serratus anterior plane block

Before the cessation of anesthesia while the patient was still in a lateral position, the entry site on the midaxillary line at the level of the 4<sup>th</sup> and 5<sup>th</sup> ribs was sterilized with povidone iodine. A high-frequency (6-18 MHz) linear ultrasound probe (Esote MyLab Five Genoa, Italy) was sterile covered. The probe was placed between the 4th and 5th ribs in the mid-axillary line and moved to be able to visualize the serratus anterior plane and the intercostal muscles. With a non-stimulating 22 gauge, 50 mm Quincke type needle (Sonoplex, Pajunk, Geisingen, Germany) was introduced with the an in-plane technique. 0.5 ml saline was injected to check the separation of the serratus anterior plane muscle from the overlying fascia. When separation of the fascia was visualized and negative aspiration was made, 30 ml 0.25% bupivacaine (Marcaine®, Eczacıbaşı, Turkey) was injected.

### PCA protocol

All patients received iv PCA (APM II Ambulatory Pump, Abbot Laboratories, San dieago, Ca, USA) which was prepared and received by all patients at the end of the operation. The PCA was set to deliver an infusion of 10 mg tramadol (Contramal®, Abdiibrahim, Turkey) on each demand, at a maximum of 3 times per hour with a 20-min locked period, without continuous delivery.

The data were examined in respect of age, sex, height, weight, ASA, operation type, operating time, the amount of postoperative analgesic consumption, VAS at 1<sup>st</sup>, 2<sup>nd</sup>, 4<sup>th</sup>, 6<sup>th</sup>, 12<sup>th</sup>, 24<sup>th</sup> hours and complications such as atelectasis, nausea, vomiting, hypotension and bradycardia.

VAS scores of the patients in the SAPB group were lower than those of the IB group at each time point (Figure 2). The total analgesic use in the first 24 hours ( $p < 0.05$ ) postoperatively was significantly lower in the SAPB group as  $238.5 \pm 39.5$  mg tramadol compared to  $306 \pm 25.2$  mg tramadol in the IB group ( $p < 0.05$ ) (Figure 3).

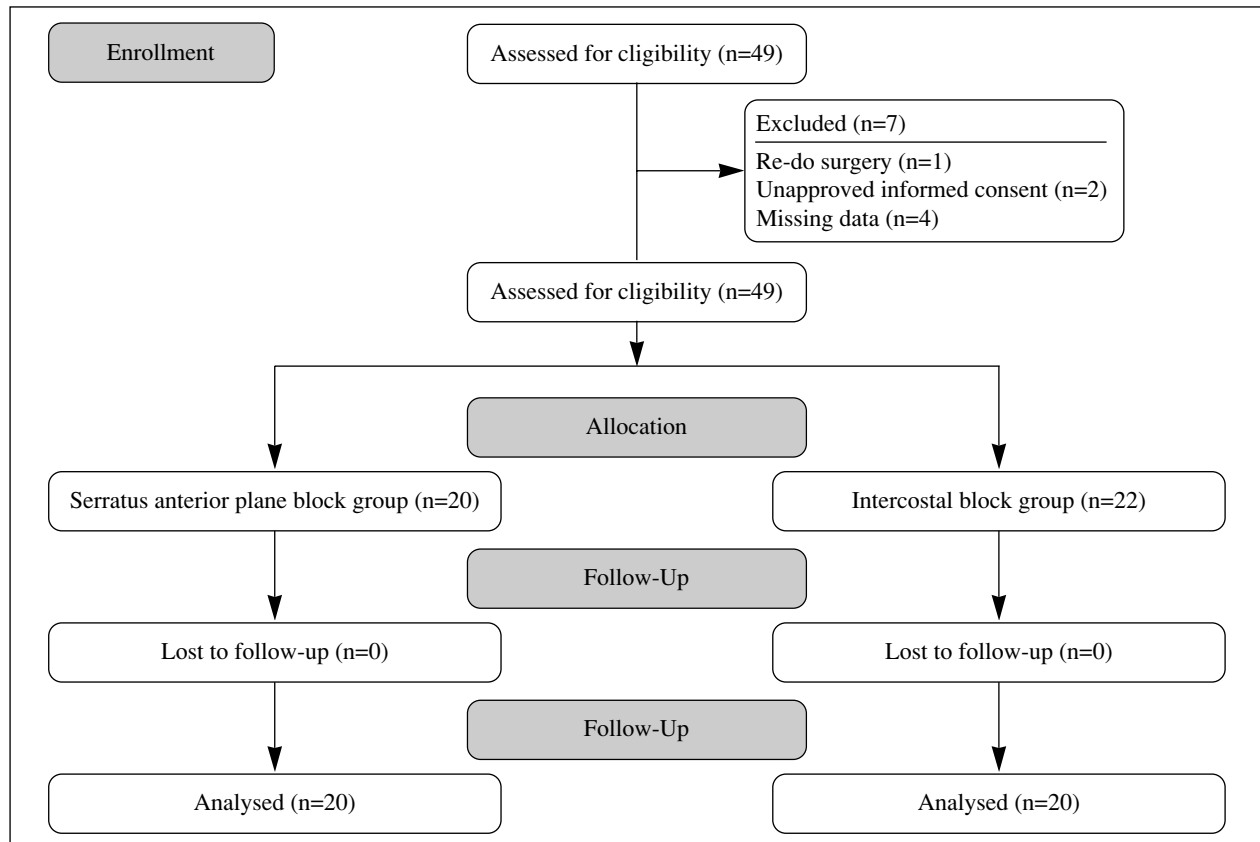


Figure 1. Enrollment of the patients to the study

### Statistical Analysis

Statistical analysis was performed using the SPSS program for Mac, version 17.0 (SPSS, Chicago, IL). Descriptive statistics are presented as mean and standard deviation (SD), and as the number of cases (n) and the corresponding percentage (%) for nominal variables. T tests were performed for normally distributed whereas continuous variables. The Mann-Whitney U test and A chi-square test were used when the parameters didn't meet parametric test requirements. A value of  $p < 0.05$  was considered statistically significant.

### RESULTS

IB was performed in 22 and SAPB was performed in 20 of the 42 patients which were enrolled to the study (Figure 1). There was 22 male and 20 female patients included. No statistically significant difference was determined between two groups regarding age, gender, ASA, height, weight or operating durations (Table I).

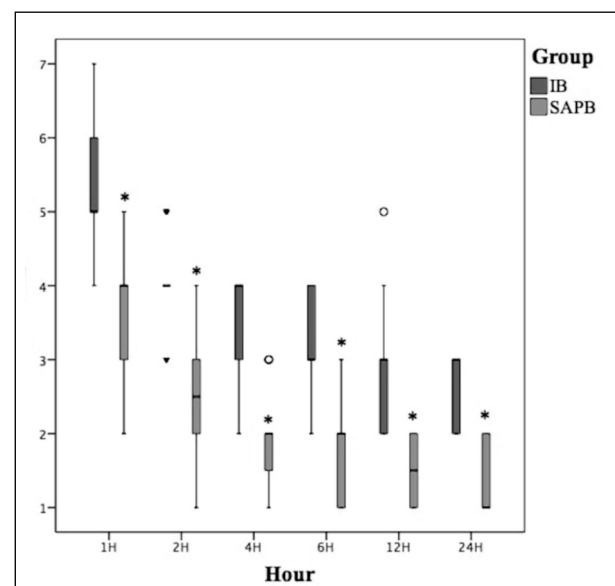


Figure 2. Postoperative VAS scores

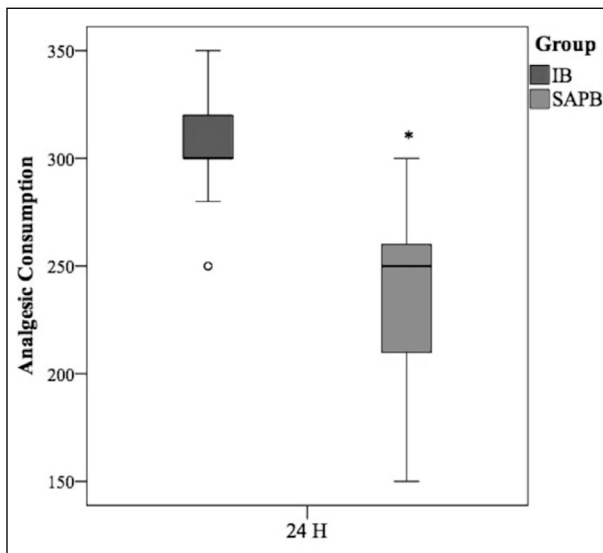


Figure 3. Total analgesic consumption via PCA (tramadol, mg)

Atelectasis, vomiting, nausea, hypotension, and bradycardia were investigated. No significant difference was determined between the groups in respect of complications (Table II).

Table I. Demographic and clinical data

|                             | Group SAPB (n=20) | Group IB (n=22)   | p    |
|-----------------------------|-------------------|-------------------|------|
| Age (years)                 | 48.70 ± 17.06     | 45.73 ± 18.870.62 |      |
| Weight (kg)                 | 68.80 ± 10.35     | 73.00 ± 7.93      | 0.10 |
| Height (cm)                 | 166.75± 6.9       | 168.45 ± 7.70     | 0.40 |
| Sex (M/F)                   | 9/11              | 13/9              | 0.37 |
| ASA (I/II/III)              | 8/9/3             | 8/11/3            | 0.89 |
| Operation time (min)        | 159.5 ± 37.48     | 154.09 ± 40.67    | 0.68 |
| Indications for thoracotomy |                   |                   |      |
| Wedge Resection             | 8                 | 9                 |      |
| Lobectomy                   | 4                 | 8                 |      |
| Hydatid cystectomy          | 6                 | 3                 |      |
| Other                       | 2                 | 2                 |      |

ASA: American Society of Anesthesiologists Physical Status Classification

M: Male, F: Female

SAPB: Serratus Anterior Plane Block, IB: Intercostal Block

Data are presented as Mean ± Standard deviation or ratio

p value < 0.05 is considered as a statistically significant

Table II. Complications

|             | Group SAPB (n=20) | Group IB (n=22) | p    |
|-------------|-------------------|-----------------|------|
| Atelectasis | 5                 | 6               | 0.87 |
| Nausea      | 2                 | 2               | 0.92 |
| Hypotension | 3                 | 4               | 0.78 |
| Bradycardia | 1                 | 1               | 0.94 |

SAPB: Serratus Anterior Plane Block, IB: Intercostal Block

## DISCUSSION

The data obtained in the study demonstrated that the analgesia consumption in the first 24 hours postoperatively and the VAS scores at 1<sup>st</sup>, 2<sup>nd</sup>, 4<sup>th</sup>, 6<sup>th</sup>, 12<sup>th</sup> and 24<sup>th</sup> hours were statistically significantly lower in the SAPB group than in the IB group. IB provides anesthesia in a band along the collateral branch of the intercostal nerve, which runs along the upper side of the rib below (5). It has been claimed that the application of IB along with PCA provides pain control at a level close to that of epidural analgesia (7). IB has been advocated to be safer than epidural block as sympathetic blockade does not develop and side-effects are scarce (8).

SAPB is a novel interfascial plane block technique that provides blockade of the lateral cutaneous branches of the intercostal nerves. The inclusion of the anterolateral and posterior sides of the chest wall in this block allows the possibility of effective pain control in thoracotomy (9). This block has now more widespread use as it can be applied easily under ultrasound guidance. Ökmen et al compared PCA morphine with or without concomitant SAPB for postoperative thoracotomy pain and the VAS

scores and the analgesic consumption levels were lower in the SAPB group (10). Corso et al reported the use of SAPB for intraoperative analgesia in a 10-year-old spontaneously breathing pediatric patient anesthetized with a laryngeal mask airway during a video assisted thoracoscopy (11). There are some other cases in literature reporting SAPB as a newly performed block technique for acute and chronic pain in thoracotomy, rib fractures and esophagus surgery (12-14).

In a prospective, randomized study, SAPB and thoracic epidural anesthesia were compared in patients undergoing a thoracotomy operation and it was reported that the analgesia in the SAPB group was close to that of the epidural block with fewer side-effects and complications observed (15). Two studies comparing SAPB and paravertebral block in breast surgery had controversial conclusions. Gupta et al reported that paravertebral block was superior, but Pérez Herrero et al found SAPB was as effective as paravertebral block in respect of analgesic consumption (16, 17). Furthermore, in the present study, no significant difference was found between the groups in respect of complications such as atelectasis, nausea, vomiting, hypotension and bradycardia and SAPB seemed to be as safe a block as intercostal block in terms of complications.

The approach for SAPB may also contribute to the analgesic effect of the block itself. In a study by Blanco et al, a comparison was made of the techniques of administering local anesthetic to two separate locations of above the serratus plane muscle and below the serratus anterior plane muscle (6). The superior SAPB was reported to be more easily performed than the deep SAPB and to have a longer duration. The dermatome levels of both blocks were similarly covering T2-T9 levels. Piracha et al performed superior SAPB and deep SAPB to 4 cases with post-mastectomy pain and the deep SAPB was reported to be more effective and successful in providing pain relief for the patients (18). In our clinic, and on this study SAPB is performed serratus anterior plane above (superior SAPB) with 30 ml 0.25% bupivacaine.

To the best of our knowledge, this is the first study that compares IB and SAPB performed after thoracotomy for postoperative pain management. However, some limitations do exist. Firstly, the study had a retrospective and non-randomized design. Secondly, dermatome levels the analgesic doses were not recorded continuously. There is a need for further studies to determine the dose and manner of administration of SAPB.

IB and SAPB may be considered practical analgesia options where paravertebral and epidural block are contraindicated or unnecessarily invasive. However, we suggest that SAPB provides a more effective and longer-lasting analgesia than IB following thoracotomy operations.

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