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ORIGINAL ARTICLE

Comparison of intraoperative and post-operative effects of serratus anterior plane block performed with ultrasound and infiltration block in patients undergoing video-assisted thoracoscopic surgery

Video yardımlı torakoskopik cerrahi uygulanan hastalarda ultrasonografi eşliğinde yapılan serratus anterior plane blok ile infiltrasyon blok uygulamasının intraoperatif ve postoperatif etkinliklerinin karşılaştırılması

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Summary

Objectives: We aimed to compare the intraoperative and post-operative analgesic activities of the preventive applied serratus anterior plane (SAP) block and infiltration block in patients undergoing video-assisted thoracoscopic surgery (VATS).
Methods: The study was carried out in 60 patients aged between 18 and 80 who were eligible for elective VATS, with the American Society of Anesthesiologists classification I-II, following ethical committee approval and written informed consent form. Patients were divided into two groups as SAP (group serratus anterior plane block [SAPB]) and group infiltration block after routine monitoring and general anesthesia induction by recording demographic data after randomization. Hemodynamic data of all patients were recorded before, after induction and within intraoperative 30 min period. Patient controlled analgesia (PCA) prepared with morphine was applied to all patients postoperatively. Intraoperative hemodynamic data and opioid consumption of patients, resting time, and coughing visual analog scale, time to first PCA dose, post-operative opioid consumption, rescue analgesic requirement, mobilization times, opioid side effects, and patient and surgical team's satisfaction were evaluated.
Results: Intraoperative hemodynamic data and opioid consumption were similar between the two groups. Post-operative pain scores (0 and 30 min, 1, 2, 4, 8, and 12 h) were lower in the SAPB group ($p<0.005$) and time to use the first PCA ($p=0.002$) was longer in the SAPB group. Post-operative PCA and rescue analgesic requirement were lower in the SAPB group ($p=0.002$, $p=0.00$). It was found that the first mobilization time was shorter in the SAPB group ($p=0.003$), and opioid-related side effects were similar in both groups ($p=0.067$). Patient and surgical team satisfaction was high in the SAPB group ($p=0.004$, $p=0.000$).
Conclusion: As a result, more effective post-operative analgesia was provided with preventively SAPB, compared to infiltration block in patients undergoing VATS.

Keywords: Infiltration block; post-operative analgesia; serratus anterior plan block; video-assisted thoracoscopic surgery.

Özet

Amaç: Bu çalışmada video yardımlı torakoskopik cerrahi (VATS) uygulanacak hastalarda, preventif uygulanan serratus anterior plan (SAP) bloğu ve infiltrasyon bloğunun intraoperatif ve postoperatif analjezik etkinliklerini prospektif ve randomize kontrollü olarak karşılaştırmayı amaçladık.
Gereç ve Yöntem: Etik kurul onayı ve hastalardan alınan yazılı onam sonrası, elektif VATS uygulanacak, Amerikan Anestezistler Derneği (ASA) sınıflaması I-II olan, 18–80 yaş grubu 60 hasta çalışmaya dahil edildi. Hastalar randomizasyonu takiben demografik verileri kaydedilerek rutin monitorizasyon ve genel anestezi indüksiyonu sonrası, SAP (Grup SAPB) ve infiltrasyon blok (Grup İB) yapılan gruplar olarak ikiye ayrıldı. Tüm hastaların hemodinamik verileri indüksiyon öncesi, sonrası ve intraoperatif 30 dakikalık periyotlarda kaydedildi. Postoperatif bütün hastalara morfin ile hazırlanmış hasta kontrollü analjezi (HKA) uygulandı. Hastaların intraoperatif hemodinamik verileri ve opioid tüketimlerini, istirahat ve öksürmekle Vizüel Analog Skala (VAS) skorları, ilk HKA dozu gereksinim zamanı, postoperatif opioid tüketimleri, kurtarıcı analjezik gereksinimleri, mobilizasyon zamanları, opioid yan etkileri, hasta ve cerrahi ekibin memnuniyeti değerlendirildi.
Bulgular: İntraoperatif hemodinamik veriler ve opioid tüketimleri her iki grupta benzer bulundu. SAPB grubunda postoperatif ağrı skorları (0. ve 30. dk, 1. 2. 4. 8. ve 12. sa) daha düşük ($p<0.005$) ve ilk HKA kullanım zamanının daha uzun olduğu saptandı ($p=0.002$). Postoperatif HKA ve kurtarıcı analjezik gereksinimi SAPB grubunda daha düşük bulundu ($p=0.002$, $p=0.00$). İlk mobilizasyon zamanının SAPB grubunda daha kısa olduğu ($p=0.003$), opioide bağlı yan etkilerin her iki grupta benzer olduğu görüldü ($p=0.067$). Hasta ve cerrahi ekip memnuniyeti SAPB grubunda yüksekti ($p=0.004$, $p=0.000$).
Sonuç: Sonuç olarak VATS uygulanan hastalarda preventif uygulanan SAP bloğu ile infiltrasyon bloğuna göre daha etkin postoperatif analjezi sağlanmıştır.

Anahtar sözcükler: İnfiltrasyon bloğu; postoperatif analjezi; serratus anterior plan bloğu; video yardımlı torakoskopik cerrahi (VATS).

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Introduction

Effective treatment of post-operative pain in patients scheduled for thoracic surgery accelerates recovery and decreases the rate of post-operative complications. In this way, early mobilization can be achieved and hospital stay can be shortened by preventing negative consequences of post-operative pain.[1]

Compared to thoracotomy, video-assisted thoracoscopic surgery (VATS) has been reported to provide better pain control, lower costs, early mobilization in post-operative period, and improvement in pulmonary functions.[2]

The success of post-operative rehabilitation applications in patients undergoing thoracic surgery may be enhanced through minimally invasive surgical intervention (VATS) and multimodal pain control. At present, regional anesthesia techniques have come to the fore due to the potential side effects of opioids and nonsteroidal anti-inflammatory drugs (NSAIDs).[3]

Due to potential complications of thoracic epidural analgesia, paravertebral block, (PVB) and regional anesthesia techniques, there is a need for alternative regional methods.

In the present study, we aimed to make a comparison between the serratus anterior plane block performed with USG for preventive analgesia and infiltration block performed on the incision site in patients undergoing elective VATS procedure in terms of intraoperative and post-operative analgesic efficacy, patient-controlled analgesia (PCA) and morphine consumption, and patient and surgeon satisfaction.

Material and Methods

This study was conducted at the Anesthesiology and Reanimation and Thoracic Surgery Clinics of the Uludag University School of Medicine after obtaining written and verbal consents of the patients under the approval (2019-6/23) of Bursa Uludag University School of Medicine Ethics Committee. This prospective randomized study included 60 American Society of Anesthesiologists classification I–II patients who were aged 18–80 years old and scheduled for elective VATS between June 15, 2019, and February 15, 2020. Patients who had allergy to local anesthetics, known or suspected coagulopathy, infection at the injection site, history of thoracic surgery, a severe cardiovascular disease, hepatic or renal failure (glomerular filtration rate <15 ml/min/1.73 m^2), severe neurological or psychiatric disorder, and chronic opioid use were not included in the study.

It was planned to exclude patients who were switched to thoracotomy, whose block application was unsuccessful (local anesthetic distribution was not appropriate; appropriate USG image could not be obtained), and who had problems with the PCA device. All patients were informed of the use of PCA device and of visual analog scale (VAS) to be applied in the post-operative period.

Using the closed envelope method, the patients were separated into two groups to undergo the selected block method for preventive analgesia.

Vascular access was established in the operating room using a 20G cannula. Premedication was achieved with 0.03 mg/kg intravenous (IV) midazolam (Zolamid®, Defarma, Ankara, Turkey). Then, 3 ml/kg/h saline infusion was started. Routine electrocardiogram, non-invasive monitoring of blood pressure, and peripheral oxygen saturation (SpO_2) were performed.

After monitoring, anesthesia was induced with 1 mg/kg lidocaine (Aritmal% 2® Osel, Istanbul, Turkey), 2–3 mg/kg propofol (Propofol 2% Fresenius®, Fresenius Kabi, Bad Hamburg, Germany), 1–2 mcg/kg fentanyl (Talinat®, Vem, Istanbul, Turkey), and 0.6 mg/kg rocuronium (Esmeron®, Merck Sharp and Dohme, New Jersey, USA) and the patients were intubated with either a left-sided or a right-sided double-lumen endobronchial tube (Sher-i-bronch® Teleflex, Pennsylvania, USA) according to the surgical site which is appropriate for the weight and height of the patients. Endotracheal tube placement was confirmed through listening to the respiratory sounds of both sides, end-tidal carbon dioxide monitoring and with fiber-optic bronchoscope, when necessary. The second venous cannula (18G or 16G) was placed and, depending on the position, monitoring of invasive blood pressure was achieved by placing an arterial catheter (20G IV cannula) into the right or left radial artery. The patients were placed in the right or left lateral decubitus position according to the surgical side.

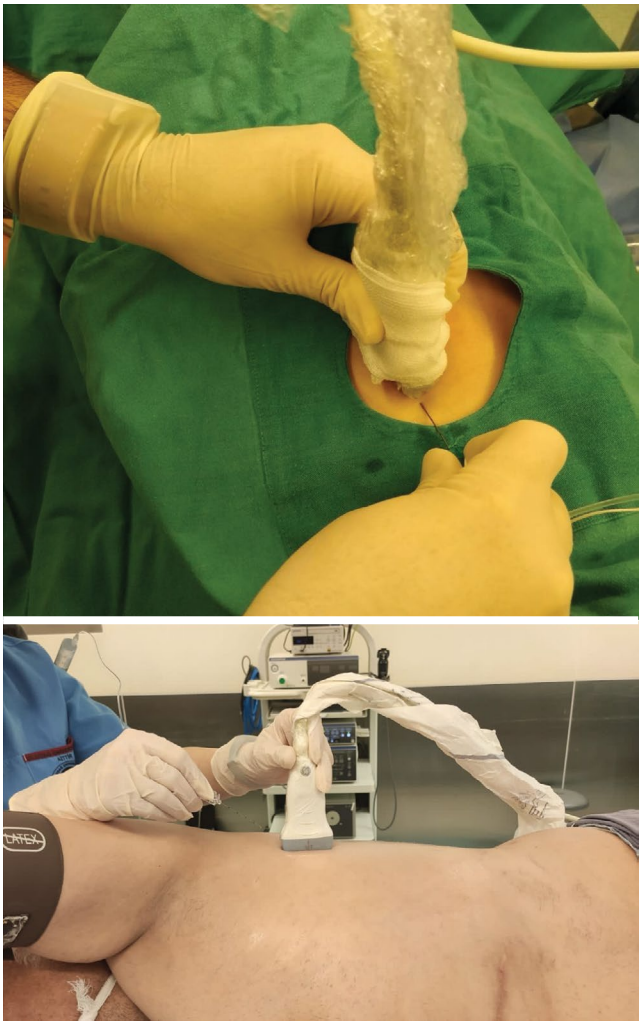

Figure 1. The position of the probe and needle insertion during block application.

Anesthesia was maintained with sevoflurane (Sevorane® Liquid 100%, AbbVie, Queenborough Kent, UK) at a rate of 2 L/min with a minimum alveolar concentration of 1 in a mixture of 50% air + 50% O_2. It was planned to treat hypotension (mean arterial pressure [MAP] <20% of the pre-operative value) with 5 mg ephedrine and bradycardia (HR <40/min) with 0.5 mg atropine.

The blocks were performed with USG (Logiq e®, GE, Boston, USA) by a single anesthesiologist or a surgeon, who were previously experienced in such blocks, before starting surgery.

Serratus anterior plane block (SAPB) group (n=30): While the patient was in the lateral decubitus position, a 10 MHz linear USG probe (the linear probe was covered in a sterile manner after the area to be blocked was cleansed with antiseptic solution) was placed horizontally in the middle axillary line on the

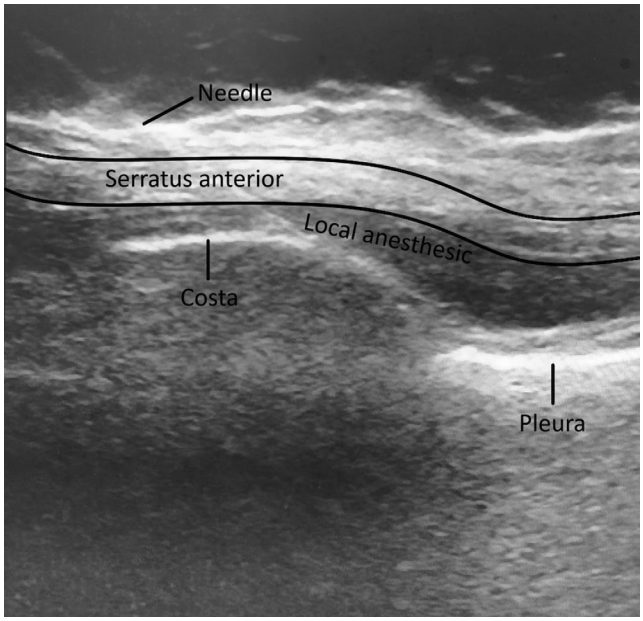

Figure 2. USG image of the serratus anterior plane block.
LA: Local anesthetic.

side where the block would be performed. The serratus anterior, latissimus dorsi, and intercostal muscles were identified at the fourth and fifth intercostal levels. Block needle (50 mm 22 gauge, Stimuplex® Ultra, B. Braun Melsungen AG, Germany) is placed under the serratus anterior muscle at the 1st stage and then advanced between the serratus anterior and the latissimus dorsi in the 2nd stage to be on the same plane with the USG probe (in-plane technique). The prepared bupivacaine 0.25% (Buvasin 0.5%®, Vem, Tekirdağ, Turkey) solution was administered on both sites at a dose of 0.25 mL/kg. It was observed with USG that the local anesthetic solution spreads both between the SAH and the ribs and between the SAH and the latissimus dorsi (Fig. 1, 2).

Infiltration block (IB) group (n=30): While the patients were in the lateral decubitus position, the trocar entry points suitable for the area to be operated and the periphery of ribs that make up the gap were controlled percutaneously through negative aspiration applied in a way that does not to cross the pleura. Bupivacaine 0.25% solution was injected in equal doses of 0.5 mL/kg for each of the three trocar insertion sites, starting from the inner (pleura) to the outer (skin) and surrounding tissues.

Patients' MAP, heart rate (HR), and SpO_2 values were recorded before anesthesia induction and at the 30th, 60th, 90th, and 120th min after induction. In the event that MAP and/or HR increased by 20% or more

at intervals between measurements at every 5 min in the intraoperative period, all such patients were given 0.5–1 mcg/kg IV fentanyl and administrations were recorded.

All patients were given metoclopramide (Primsel®, Osel, Istanbul, Turkey) as anti-emetic prophylaxis for intraoperative nausea and vomiting. All patients were administered 1 g IV paracetamol (Partemol®, And, Tekirdağ, Turkey) after induction and 20 mg IV tenoxicam (Tilcotil® Deva, Tekirdağ, Turkey) 10 min before the end of the operation. At the end of the operation, the patients were given 2 mg/kg sugammadex (Bridion® Merck Sharp DORMA, Istanbul, Turkey) as muscle relaxant antagonist and transported to the recovery unit after extubation.

For post-operative pain control, a PCA device (CADD-Legacy® PCA, Smiths Medical, St. Paul, USA) was used. An IV serum concentration of 1 mg/ml was prepared with 90 ml of saline and 100 mg of morphine hydrochloride (Tramosel®, Haver, Istanbul, Turkey). The PCA device was set to pump with a bolus dose of 2 ml, lockout time of 15 min without basal infusion and loading dose. The patients were transported to the thoracic surgery clinic after their vital signs became stable and the modified Aldrete score was ≥9 (Annex-2). As of the recovery unit, patients were administered a bolus dose of morphine through the PCA device in case VAS ≥4 when asked or on the complaint of the patient. It was planned to administer 50 mg of IV dexketoprofen (Ketavel®, Deva, Istanbul, Turkey) as the first rescue analgesic to patients, who had VAS ≥4 despite PCA, and to give 50 mg of tramadol (Tramosel®, Haver, Istanbul, Turkey) as the second rescue analgesic when VAS ≥4 persisted.

Patients' demographic data, intraoperative hemodynamic data and opioid requirement, VAS score at rest, and cough VAS (CVAS) scores measured in the recovery room (1st min) and at the post-operative 30th min and post-operative 1st, 2nd, 4th, 8th, 12th, and 24th h; the 1st time to use PCA, total morphine consumption, requirement for rescue analgesic, time of the first mobilization, opioid side effects (nausea-vomiting, constipation, respiratory depression, and sedation), and the Likert scale for patient and surgeon satisfaction (1 – not at all satisfied and 5 – very satisfied) were recorded by an anesthesiologist who was blinded to the groups.

Statistical Analysis

We used the descriptive statistics of mean, standard deviation, median, minimum, maximum, frequency, and ratio. The Kolmogorov–Smirnov test was used to measure the distribution of the variables. The independent sample t-test and the Mann–Whitney U-test were employed in the analysis of quantitative independent data. The Chi-square test was used in the analysis of qualitative independent data, and when the Chi-square test conditions were not met, the Fisher's test was used. The SPSS 26.0 program was used for the analyses.

Results

As all operations were performed by the same single surgeon, the surgical approach was the same and three trocar entry openings were created for every patient. No blockade complications were observed in the groups. The distribution of the patients' demographic data is shown in Table 1.

The SAPB and IB groups were similar regarding the MAP measured before induction and at the 1st, 60th, and 90th min after induction (p=0.297, p=0.053, p=0.089, and p=0.0237). MAP value measured at the 30th min after induction was significantly lower in the SAPB group as compared to the IB group (p=0.031) (Table 2).

The intraoperative need for fentanyl was similar in the two groups with 8.3±19.0 mcg in the SAPB group and 15.0±23.3 in the IB group (p=0.226) (Table 3). In the SAPB group, time to need for PCA morphine was longer that the patients in the IB group (p=0.002) (Table 3).

In the SAPB group, the VAS at rest and CVAS scores measured at 0th min, 30th min, 60th min, 2nd h, 8th h, and 12th h were significantly lower than in the IB group (p<0.05). On the other hand, the VAS at rest and CVAS scores at the 24th and 48th h were similar in the SAPB and IB groups (Table 4). Total IV morphine consumption was significantly higher in the SAPB group at the 0th, 30th, and 60th min and the 2nd, 4th, 8th, 12th, 24th, and 48th h as compared to the IB group (p<0.05) (Table 5).

Table 1. Demographic data

	Group SAPB				Group IB				p
	Mean±SD	n	%	Median	Mean±SD	n	%	Median	
Age (year)	53.2±14.5			55.0	52.4±14.3			54.0	0.830[t]
Gender									
Female		16	53.3			16	53.3		1.000χ^2
Male		14	46.7			4	46.7		
BMI (kg/m^2)	26.0±4.5			26.5	28.0±5.9			26.5	0.419[m]
ASA									
1		8	26.7			10	33.3		0.573χ^2
2		22	73.3			20	66.7		
Operation									
Wedge resection		27	90.0			27	90.0		1.000χ^2
Pleural biopsy		3	10.0			3	10.0		

m: Mann–Whitney U-test; χ^2: Chi-square test; t: T-test; BMI: Body mass index; ASA: American Society of Anesthesiologists classification; SAPB: Serratus anterior plane block; IB: Infiltration block; SD: Standard deviation.

Table 2. Comparison of the MAP between groups

MAP (mmHg)	Group SAPB		Group IB		p
	Mean±SD	Median	Mean±SD	Median	
Before induction	104.0±2.7	105.0	100.7±13.7	103.5	0.27[t]
1[st] min after induction	85.8±13.4	86.0	92.1±11.5	92.0	0.03[t]
30[th] min after induction	84.0±12.7	87.5	92.9±18.1	94.0	**0.031**[*t]
60[th] min after induction	82.3±17.8	87.0	89.7±15.4	87.5	0.089[t]
90[th] min after induction	89.5±14.4	85.0	91.6±11.9	93.0	0.237[t]

t: t-test; *: P<0.05 statistically significant; MAP: Mean arterial pressure; SAPB: Serratus anterior plane block; IB: Infiltration block; SD: Standard deviation.

It was observed that 63.3% (n=19) of the SAPB group and 16.7% (n=5) of the IB group did not require additional analgesic. On the other hand, 30% (n=9) of the SAPB group and 50% (n=15) of the control group required NSAIDs. In addition to NSAIDs, 6.7% of the SAPB group (n=2) and 33.3% of the IB group (n=10) needed opioid (p=0.001) (Fig. 3a). The time to first mobilization was shorter in the SAPB group (2.9±0.8 h) than in the IB group (3.5±0.6 h) (p=0.003) (Fig. 3b).

Considering the side effects of opioids, nausea and vomiting were observed in 13.3% (n=4) of the patients in the SAPB group, but none of the patients had constipation, sedation, or respiratory depression. In the IB group, 16.7% (n=5) of the patients had nausea-vomiting, 6.7% (n=2) experienced sedation, 6.7% (n=2) had constipation, and 3.3% (n=1) had respiratory depression. The incidence of opioid side ef-

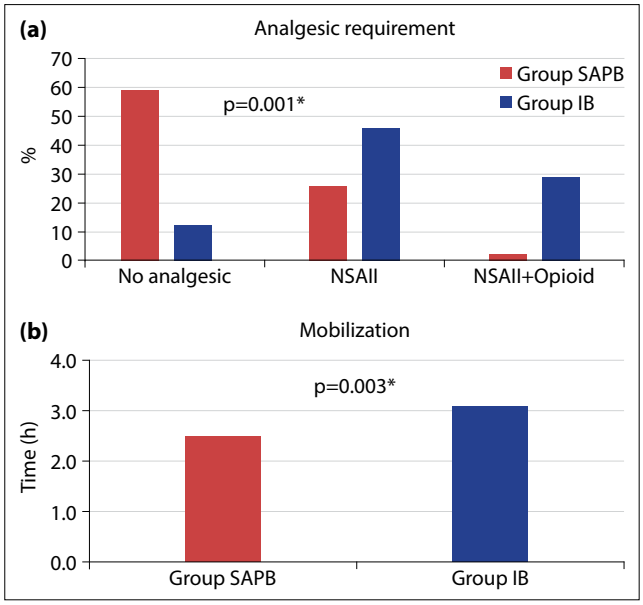

Figure 3. (a, b) Patients' additional analgesic requirements and mobilization times (%, time).
*: P<0.05 statistically significant.

Table 3. Comparison of the groups regarding intraoperative fentanyl consumption and the mean time to require the first PCA

	Group SAPB		Group IB		p
	Mean±SD	Median	Mean±SD	Median	
Intraoperative fentanyl consumption (mcg)	8.3±19.0	0.0	15.0±23.3	0.0	0.226[m]
Post-operative					
The first PCA requirement (min)	160.0±536.8	0.0	7.0±24.5	0.0	**0.002**[*m]

m: Mann–Whitney U-test; χ^2: Chi-square test; *: P<0.05 statistically significant; PCA: Patient-controlled analgesia; SAPB: Serratus anterior plane block; IB: Infiltration block; SD: Standard deviation.

Table 4. Comparison of the groups regarding VAS at rest and cough VAS

	Group SAPB		Group IB		p
	Mean±SD	Median	Mean±SD	Median	
VAS score at rest (0–10)					
0th min	2.0±1.4	2.0	4.5±1.3	5.0	0.000[*m]
30th min	1.9±1.3	2.0	4.1±1.2	4.0	0.000[*m]
60th min	1.9±1.2	2.0	3.6±1.1	4.0	0.000[*m]
2nd h	1.9±1.2	2.0	3.5±1.1	3.0	0.000[*m]
4th h	1.9±1.0	2.0	3.0±0.9	3.0	0.000[*m]
8th h	1.8±1.1	2.0	2.8±0.9	3.0	0.001[*m]
12th h	1.8±1.0	2.0	2.2±0.7	2.0	0.049[*m]
24th h	2.2±1.0	2.0	2.3±0.5	2.0	0.863[m]
48th h	2.0±0.8	2.0	1.8±0.5	2.0	0.258[m]
Cough VAS score (0–10)					
0th min	3.7±1.7	4.0	6.4±1.5	7.0	0.000[*m]
30th min	3.7±1.6	4.0	6.0±1.6	6.0	0.000[*m]
60th min	3.3±1.6	3.0	5.9±1.6	6.0	0.000[*m]
2nd h	3.1±1.6	3.5	5.5±1.1	5.0	0.000[*m]
4th h	3.3±1.3	4.0	5.1±1.3	5.0	0.000[*m]
8th h	3.3±1.2	3.0	5.0±1.0	5.0	0.000[*m]
12th h	3.2±1.2	3.0	4.3±0.9	4.0	0.000[*m]
24th h	3.7±1.2	3.5	4.2±0.8	4.0	0.067[m]
48th h	3.4±1.3	3.5	3.8±0.6	4.0	0.198[m]

m: Mann–Whitney U-test; *: P<0.05 statistically significant; VAS: Visual analog scale; SAPB: Serratus anterior plane block; IB: Infiltration block; SD: Standard deviation.

fects was lower in the SAPB group compared to the IB group, but no significant difference was found between the groups (p=0.067). Patient and surgeon satisfaction scores were higher in the SAPB group compared to the IB group (p=0.004, p=0.000) (Table 6).

Discussion

Besides increasing morbidity and mortality, inadequately treated pain may lead to several clinical and psychological changes including increased cost and decreased quality of life.[4] While thoracic epidural anesthesia/analgesia and PVBs are specified as the gold standard for post-thoracotomy pain control, the optimal post-operative analgesia after VATS has not yet been defined.[5]

In this study, the intraoperative and post-operative effects of SAPB and infiltration block performed for

Table 5. Comparison of SAPB and IB groups for total IV morphine consumption

Post-operative IV morphine (mg)	Group SAPB		Group IB		p
	Mean±SD	Median	Mean±SD	Median	
0th min	1.2±1.2	2.0	1.9±0.7	2.0	0.009*m
30th min	2.4±2.1	2.0	4.4±1.6	4.0	0.000*m
60th min	3.7±2.4	4.0	6.9±2.4	8.0	0.000*m
2nd h	4.8±3.1	4.0	9.4±3.0	10.0	0.000*m
4th h	6.2±3.7	6.0	12.3±3.7	12.0	0.000*m
8th h	7.4±4.3	8.0	15.0±4.0	16.0	0.000*m
12th h	8.7±4.8	8.0	17.7±5.0	19.0	0.000*m
24th h	11.0±5.9	11.0	20.9±5.6	22.0	0.000*m
48th h	11.9±5.4	12.0	22.6±6.5	24.0	0.000*m

m: Mann–Whitney U-test; *: P<0.05 statistically significant; SAPB: Serratus anterior plane block; IB: Infiltration block; SD: Standard deviation.

Table 6. Comparison of the groups regarding patients and surgeon satisfaction scores

Score	Group SAPB		Group IB		p
	Mean±SD	Median	Mean±SD	Median	
Patient satisfaction 1–5	4.1±1.0	4.0	3.3±1.0	3.0	0.004*m
Surgeon satisfaction 1–5	4.2±0.9	4.5	3.3±0.9	3.0	0.000*m

*: P<0.05 statistically significant; SAPB: Serratus anterior plane block; IB: Infiltration block; SD: Standard deviation.

preventive analgesia in patients undergoing VATS under general anesthesia were compared in a prospective, randomized controlled manner.

Similar to the literature,[6,7] we did not find any significant difference between the two groups in intraoperative SpO_2 and HR values. Although MAP values were generally similar between the groups, the MAP measured at 30 min after anesthesia induction was found to be significantly lower in the SAPB group. This result was attributed to the efficacy of SAPB.

Kim et al.[8] divided 90 patients scheduled for VATS, into two groups and applied USG-guided SAPB either with 0.4 mL/kg of ropivacaine 0.375% (SPB group) or saline solution (control group) that there was no significant difference between the groups regarding intraoperative opioid consumption. It was revealed in the prospective, randomized study by Lee et al.[7] investigating intraoperative opioid consumption in patients who underwent thoracoscopic surgery that intraoperative opioid consumption was lower in the USG-guided SAPB group as compared to the control group, and it was concluded that SAPB is a safe and effective regional anesthesia technique for VATS operations. There is no study investigating intraoperative opioid consumption in the literature on infiltration block in patients who underwent thoracic surgery, and we found that intraoperative opioid consumption was similar between the two groups in our study.

In their randomized controlled study comparing SAPB and local anesthetic infiltration, Chen et al.[9] assessed VAS at rest and CVAS scores in the post-operative period and found that both VAS at rest and CVAS scores were lower in the SAPB group compared to the infiltration group. Fiorelli et al.[10] performed infiltration block on 18 patients who underwent bilateral thoracoscopic sympathectomy by injecting lidocaine on the one side and saline on the other side of the same patient, and stated that the VAS scores were significantly lower at the post-operative 4th and 24th h on the side where lidocaine was administered, and that at the 128th h, the scores were still lower but not at significant level.

In this study, VAS and CVAS scores were found to be significantly lower in the SAPB group than in the in-

filtration group during 12 h after surgery. However, VAS and CVAS scores at the 24th and 48th h were similar in the SAPB and IB groups. It was thought that the fact that there was no difference in VAS and CVAS scores at the 24th and 48th h might be related with the half-life of the local anesthetic agent.

In this study, time to use PCA was significantly longer in the SAPB group compared to the infiltration group. Nevertheless, the total amount of morphine consumed was found to be higher in the infiltration group compared to the SAPB group.

Park et al.[11] reported in their prospective, randomized study in which they divided patients undergoing thoracoscopic surgery into two groups as with and without SAPB that the total fentanyl requirement was higher in the control group in the post-operative period except for the 6th and 24th h. It was reported in a prospective, randomized, blind, single-center study in which Ökmen and Ökmen[12] divided 40 patients into two groups to receive SAPB with 20 ml of 0.25% bupivacaine plus IV tramadol through PCA and to receive only IV tramadol through PCA that PCA tramadol consumption at h 6, 12, and 24 was significantly lower the group in which SAPB was performed compared to the other group. Ökmen and Ökmen suggested that SAPB can be an effective treatment option for analgesia after thoracoscopic surgery.

Chen et al.[9] divided 40 patients undergoing thoracoscopic surgery into two groups and applied infiltration block by injecting 0.4 ml/kg of 0.25% ropivacaine in one group while applying SAPB by injecting 15 ml of 0.25% ropivacaine through two trocar entries to the other group. Chen et al.[9] reported that opioid consumption was significantly lower in the SAPB group till the post-operative 8th h, but there was no difference between the groups from 8th to 16th and 16th to 24th h.

Ökmen and Ökmen[12] compared the SAPB with a control group in the prospective study in which they divided 40 patients who underwent VATS into two groups. They administered tramadol by IV PCA in both groups in the post-operative period, and they stated that none of the patients in the SAP group needed additional rescue analgesic, whereas three patients in the other group required additional IV paracetamol, but there was no significant difference between the groups.

Semyonov et al.[13] randomized 104 patients who underwent thoracic surgery into two groups in their prospective, randomized, double-blind and single-center study. While IV opioids and NSAIDs were given to the first group, the other group underwent SAPB in addition to these drugs. They found that the need for rescue analgesic (tramadol) in the post-operative period was less in the SAPB group. The authors reported that SAPB is an effective treatment option for analgesia after thoracic surgery, since it is easy to apply and has a low potential for side effects compared to existing methods. In the present study, we obtained data consistent with the literature and found out that both NSAID and tramadol requirements were lower in the SAPB group compared to the other group.

It is known that mobilization in the early period after thoracic surgery reduces pulmonary complications such as atelectasis and pneumonia, and positively contributes to the healing process.[14] In our study, the time to post-operative mobilization was shorter in the SAPB group than in the infiltration group.

In general, it is seen in the literature that patients who underwent thoracic surgery experience severe pain in the postoperative period and frequently need analgesics during this process, and these analgesics have serious effects on morbidity, especially when the side effects of opioids are considered.

In their retrospective study, Wang et al.[15] divided their 123 patients into three groups as the SAPB, PVB, and control groups and reported that the rates of post-operative nausea and vomiting were lower in the groups who were applied blocks as compared to the control group, without the difference being significant. Furthermore, the rates of sedation and urinary retention were found to be similar in the three groups.

Chen et al.[9] compared SAPB and infiltration analgesia in their prospective study and stated that the rate of post-operative nausea-vomiting was

considerably lower in the SAPB group than in the infiltration group, but the difference was not statistically significant.

Our data are parallel to the information in literature. We monitored patients for potential nausea-vomiting, sedation, and respiratory depression in the post-operative period. Although the incidence of side effects was lower in the SAPB group, there was no significant difference between the groups. We think that this result may be due to the PCA device decreasing side effects by limiting the morphine level administered in a certain time or due to the sample size.

Park et al.[11] compared 89 patients in two groups, USG-guided SAPB group and the control group and indicated higher patient satisfaction in the SAPB group. In this study, both patient satisfaction and surgeon satisfaction were higher in the group applied with SAPB as compared to the IB group.

The first limitation of our study is the absence of a control group. Although the distribution of local anesthetics was clearly seen with USG during SAPB and IB application, the distribution of dermatoma and the efficacy of the block could not be evaluated as the procedures were applied after general anesthesia. Blood levels of the local anesthetics were not measured and that the number of times when patients needed PCA could not be recorded since the PCA device was not able to respond to the patient's analgesic requirement during the lockout time.

Conclusion

Consequently, SAPB is superior to infiltration block in post-operative pain management after thoracoscopic surgery. Moreover, SAPB can be applied as a part of multimodal analgesia as it is a simple and effective block; it reduces the need for postoperative opioids and analgesics, and allows early mobilization. The fact that the patients and the surgical team were highly satisfied about the use of preventive SAPB has encouraged us to work with different protocols on these issues.

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