BMC Anesthesiology

RESEARCH

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The analgesic effects of combined bilateral parasternal block and serratus anterior plane block for coronary artery bypass grafting surgery

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Abstract

Background Severe pain occurs after cardiac surgery in the sternum and chest tubes sites. Although analgesia targeting the sternum is often prioritized, the analgesia of the drain site is sometimes overlooked. This study of patients undergoing coronary artery bypass grafting (CABG) aimed to provide optimized analgesia for both the sternum and the chest tubes area by combining parasternal block (PSB) and serratus anterior plane block (SAPB).

Methods Ethics committee approval (E.Kurul-E2-24-6176, 07/02/2024) was received for the study. Then, the trial was registered on www.clinicaltrials.gov (https://clinicaltrials.gov/) under the identifier NCT05427955 on 17/03/2024. Twenty patients between the ages of 18–80, with ASA physical status classification II-III, undergoing coronary artery bypass grafting CABG with sternotomy, were included. While the patients were under general anesthesia, PSB was performed through the second and fourth intercostal spaces, and SAPB was performed over the sixth rib. The primary outcome was VAS (Visual Analog Scale) during the first 12 h after extubation. The secondary outcomes were intraoperative remifentanil consumption and block-related side effects.

Results The average age of the patients was 64 years. Five patients were female, and 15 were male. For the sternum area, only one patient had resting VAS scores of 4, while the VAS scores for resting for the other patients were below 4. For chest tubes area, only two patients had resting VAS scores of 4 or above, while the resting VAS scores for the other patients were below 4. The patients' intraoperative remifentanil consumption averaged 2.05 mg. No side effects related to analgesic protocol were observed in any of the patients.

Conclusions In this preliminary study where PSB and SAPB were combined in patients undergoing CABG, effective analgesia was achieved for the sternum and chest tubes area.

Keywords Acute pain, Cardiac surgery, Drain pain, Chest tube site pain, Parasternal block, Serratus anterior plane block, Sternotomy pain

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Background

Cardiac surgery is most commonly performed via median sternotomy, which often leads to significant postoperative pain [1]. In cardiac surgery, acute pain following sternotomy is particularly evident, especially within the first 2 days postoperatively [2]. Despite treatment with high doses of opioids, most patients report moderate to severe pain during the postoperative period [3, 4]. Several factors contribute to acute post-sternotomy pain, including surgical incision, sternotomy itself, placement of mediastinal and chest tube drains, and potential rib fractures [4]. Inadequate pain control following median sternotomy is associated with activation of the sympathetic nervous system and increased hormonal stress response. This can lead to various adverse postoperative events such as myocardial ischemia, cardiac arrhythmias, pulmonary complications, hypercoagulability and increased rates of delirium. All of these contribute to prolonged hospital stays for patients [1, 5].

Acute post-sternotomy pain can be managed using various methods including thoracic epidural analgesia (TEA), thoracic paravertebral block (TPVB), and intercostal blocks. Additionally, protocols administered via intravenous patient-controlled analgesia (PCA) can also be employed. Moreover, these methods can be combined with multimodal analgesia protocols for enhanced pain management [1]. Neuraxial anesthesia and deep plexus blocks can provide excellent analgesia and reduce the need for systemic analgesics. However, the administration of anticoagulants in cardiac surgery patients increases the risk of epidural hematoma associated with neuraxial procedures [6]. Therefore, the American Society of Regional Anesthesia and Pain Medicine continues to advocate for a conservative approach to neuraxial techniques and other deep blocks such as TPVB [7].

As an alternative, the fascial plane blocks of the chest wall are gaining popularity in procedures requiring sternotomy due to their simplicity and low complication risk. It is expected that the accumulation of local anesthetic (LA) within the fascial plane would block the targeted nerves responsible for surgical incision-related nociception. The spread of LA within the fascial plane is influenced by the injected volume, with higher volumes expected to provide better spread within the targeted plane [8]. Superficial and deep parasternal intercostal plane blocks, interpectoral plane and pectoserratus plane blocks, superficial and deep serratus anterior plane block, and erector spinae plane block are alternative plane blocks used in cardiac surgery [9]. Parasternal block (PSB) targets the anterior cutaneous branches between the T2 to T6 levels, making it a suitable choice for sternotomy incisions. Serratus anterior plane block (SAPB), on the other hand, targets the lateral cutaneous branches of the intercostal nerves approximately between the T2 to T9 levels. SAPB is a suitable choice for procedures involving the lateral chest wall, for example the chest tube area [9–11].

The aim of this study is to observe the postoperative analgesic effectiveness of the combination of PSB and SAPB for patients undergoing coronary artery bypass grafting (CABG) with sternotomy.

Materials and methods

Study design and patients

The study was conducted with a prospective, observational design after obtaining approval from the Ankara Bilkent City Hospital Ethical Committee (E.Kurul-E2-24-6176, 07/02/2024) and written informed consent was obtained from all subjects participating in the trial. The trial was registered on www.clinicaltrials.gov (https://clinicaltrials.gov/) under the identifier NCT05427955 on 17/03/2024.

Patients between the ages of 18 and 80 years, with American Society of Anesthesiologists (ASA) physical status classification II-III, with a body mass index (BMI) between 18 and 30 kg/m^2, undergoing CABG on cardiopulmonary bypass (CPB) with sternotomy, were included in our study.

Patients undergoing combined cardiac surgery procedures, with preoperative requirement for intraaortic balloon pump or high inotropic support, with primary pulmonary hypertension, with ejection fraction < 40%, with infection in the area of the injection site, having re-exploration or ventilation for a prolonged period (> 8 h) were excluded from the study.

A total of 20 patients who agreed to sign the informed consent form (ICF) were included in the study during preoperative anesthesia assessment.

Patients were monitored for general anesthesia according to ASA standards. Anesthesia induction included propofol (1.5-2 $mg.kg^{-1}$), fentanyl (1–2 $\mu g.kg^{-1}$), and rocuronium (0.5-1 $mg.kg^{-1}$) after preoxygenation. Following muscle relaxation, patients were intubated with an appropriately sized endotracheal tube. Subsequently, under general anesthesia and in the supine position, PSB and SAPB were performed under ultrasound (US) (PHILIPS Affiniti 50 color Doppler ultrasound device, Philips L12-5 50-mm linear array transducer) guidance.

The block applications was performed bilaterally. Patients received a total of 50 ml of 0.25% bupivacaine injected from 6 separate points (Fig. 1). This dose (125 mg) is below the upper dose limit according to the product information (2 $mg.kg^{-1}$). Additionally, the block applications were applied to all patients by the same anesthetist who had experience and was certified.

PSB The linear ultrasound probe was placed in the parasagittal midline at the 2nd intercostal space, approximately

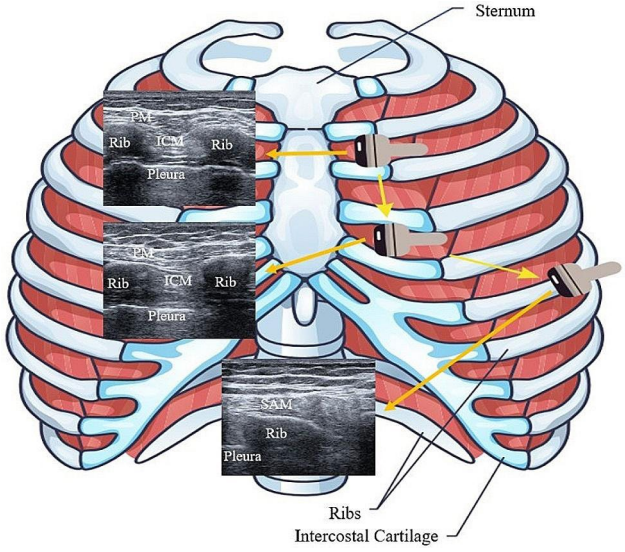

Fig. 1 Anatomical view of the regions where PSB and SAPB will be applied. ICM, intercostal muscle; PSB: parasternal block; PM: pectoralis major; SAM: serratus anterior muscle; SAPB: serratus anterior plane block

2–3 cm lateral to the midline. Subsequently, an US-guided block needle (21-G Pajunk needle) was advanced using an in-plane technique beneath the pectoralis major muscle and above the internal intercostal muscles. Hydrodissection with 2 ml of saline solution was performed in this area. After confirming the accuracy of the placement, 7.5 ml of 0.25% bupivacaine was injected. This procedure was repeated at the 4^{th} intercostal space (Fig. 1).

SAPB The linear ultrasound probe was placed over the 6^{th} rib in the anterior axillary line. After visualizing the muscle structures up to the rib, the needle was advanced using an in-plane technique beneath the serratus anterior muscle, up to the 6^{th} rib. Hydrodissection with 2 ml of saline solution was performed to ensure accurate placement. Subsequently, 10 ml of 0.25% bupivacaine was injected into this area. (Fig. 1).

Following the block applications, the surgical procedure commenced. Anesthesia was maintained using sevoflurane and remifentanil infusion (0.05–0.25 µg. $kg^{-1}.min^{-1}$), with continuous monitoring of the bispectral index to maintain it within the range of 40–50 and according to the alpha wave analysis.

The left internal mammary artery was used in all of our patients. CPB was initiated using a roller-pump, open reservoir, and Nipro® oxygenator with a target flow of 2.2–2.4 $L.min^{-1}$ per m^2 at 36 °C (The Affinity NT Integrated Trillium CVR/Membrane Oxygenator, Medtronic, Minneapolis, MN). After decannulation, the heparin effect was reversed by protamine, the cardiopulmonary bypass was terminated, and the sternum was closed after bleeding control. At the end of the surgery, pleural and mediastinal chest tubes were inserted in all patients. Before transfer to the intensive care unit (ICU), all patients received 1 gram of acetaminophen and 1 $mg.kg^{-1}$ of intravenous tramadol. Subsequently, patients received 4×1 g of acetaminophen in the first 24 h. Rescue analgesics were administered based on pain scores reported in the ICU. If the visual analog scale (VAS) score exceeded 3 in any patient, the initial treatment involved administering tramadol (1 $mg.kg^{-1}$). Following this, morphine (0.05 mg. kg^{-1}) was added as needed.

Patients' age, gender, BMI, operation duration, CPB duration, cross-clamp (CC) duration, and separate VAS scores for sternum and chest tube site during the postoperative period were recorded. In addition, patients' intraoperative remifentanil consumption, extubation time (the time from the end of the surgery to extubation), the occurrence of any severe complications during block application or postoperative follow-up (such as nausea, vomiting, bleeding, pneumothorax, bradycardia, tachycardia, hypotension, delirium), additional analgesic requirements in the postoperative period, monitoring of mean arterial pressure (MAP), heart rate (HR), oxygen saturation (SpO_2), as well as laboratory values such as C-reactive protein (CRP), lactate, Neutrophil/Lymphocyte ratio (NLR) were also recorded.

Statistical analysis

All data obtained and recorded during the study were analyzed using the Jamovi statistical program version 2.3.21.0 (Sydney, Australia). The Shapiro-Wilk test was used to assess whether the data were normally distributed. Normally distributed data were presented as mean±standard deviation (SD), while non-normally distributed or ordinal data were presented as median and quartiles (Q_1-Q_3). Categorical variables were presented as counts and percentages. Wilcoxon test was used to compare preoperative and postoperative dependent group data that did not conform to normal distribution. Statistical significance was considered for p values less than 0.05.

Results

Twenty patients who underwent sternotomy for CABG were included in the study in February and March 2024. The average age and BMI of the patients was 64 years and 28.1 kg/m^2, respectively. Five patients were female, and 15 were male. While the mean surgical duration was 270 min, the CPB duration was 98 min, and the CC duration was 76 min. The patients' mean intraoperative remifentanil consumption 2.05 mg. Patients were extubated on average 330 min after the operation (Table 1).

Patients' VAS scores for resting and coughing at the sternum were evaluated at the 0^{th}, 2^{nd}, 4^{th}, 8^{th}, and 12^{th} hours post-extubation. Only one patient had resting VAS

Table 1 Demographic data, operative times of the patients

Case No	Age (Year)	Gender (F/M)	ASA	BMI kg/m^2	Operation duration	CPB duration	CC duration	Remifentanil consumption (mg)	Extubation Time
1	65	M	3	29.6	270	90	53	1.6	300
2	68	F	3	28.9	260	107	95	1.5	330
3	69	M	3	25.1	270	98	60	1.8	310
4	72	F	3	29.1	240	71	52	2.1	300
5	69	M	3	29.4	310	137	85	2.3	360
6	60	F	3	29	220	66	51	2.1	330
7	74	M	3	24.6	230	86	76	2.2	350
8	62	M	3	24.7	235	96	52	1.7	320
9	69	M	3	28.8	310	109	88	2.4	310
10	59	M	3	29.1	250	108	91	1.9	360
11	64	F	3	27	260	99	78	2.3	320
12	62	M	3	25	280	81	68	2.5	300
13	61	M	3	29.6	220	81	62	1.5	330
14	68	F	3	24	250	66	43	2	380
15	61	M	3	25.3	280	85	56	2	340
16	43	M	3	28.3	270	121	104	1.9	330
17	50	M	3	26.9	290	115	91	2.2	360
18	59	M	3	28	270	112	77	2.1	320
19	73	M	3	27.5	310	139	90	2.2	380
20	74	M	3	29.6	280	125	101	1.6	330
Median (Q_1-Q_3)	64.5 (60–69)	% 25/75	3	28.1 (25–29)	270 (248–280)	98.5 (84–113)	76.5 (55.3–90.3)	2.05 (1.78–2.20)	330 (318–353)

ASA: American Society of Anesthesiologists; BMI: Body mass index; CC: Cross-Clemp; CPB: cardiopulmonary bypass; F: Female; M: Male

scores of 4, while the VAS scores for resting for the other patients were below 4 (Table 2).

Patients' VAS scores for resting and coughing at the chest tube site were evaluated at the 0th, 2nd, 4th, 8th, and 12th hours post-extubation. Only two patients had resting VAS scores of 4 or above, while the resting VAS scores for the other patients were below 4 (Table 3).

Patients' post-extubation MAP, HR, and SpO_2 values remained stable (Table 4).

When evaluated for additional analgesic requirements, only two patients required supplementary analgesia. Furthermore, no side effects related to analgesic protocol were observed in any of the patients (Table 5).

The CRP, lactate, and NLR values of the patients were recorded during both preoperative and postoperative periods (at the 48th hour), and they are presented in Table 5.

Discussion

This prospective observational study suggests that the combination of superficial PSB and deep SAPB may provide effective analgesia in patients with sternotomy and bilateral chest tube insertion. We see the significance of our results in shedding light on prospective randomized trials to be conducted.

Insufficient pain control can lead to increased systemic inflammation and thus to increased early (e.g. respiratory tract infections) and late (e.g. persistent postoperative pain) complications. In this light, multimodal analgesia involving opioid-sparing locoregional analgesia techniques appears particularly promising. The gold standard is thoracic epidural anesthesia or the use of thoracic-paravertebral blocks. There are limitations for both techniques in cardiac surgery, particularly due to the use of anticoagulants with the risk of epidural hematomas. In recent years, it has been thought that US-guided thoracic wall blocks, when used in conjunction with multimodal analgesia, can become an effective component of analgesic management in cardiac surgery [2, 8, 12, 13].

The US-guided PSB is a regional anesthesia technique that targets the anterior branches of the intercostal nerves, which innervate the anterior thoracic wall. In a study, where Pascerella et al. [14] injected 20 ml of 0.5% Ropivacaine for each region, they observed that the PSB provided effective analgesia compared to the control group and significantly reduced extubation time. In our study, VAS scores were found to be quite low, with only two patients experiencing VAS scores of 4 or higher in the early postoperative period, including coughing.

Studies indicate that the two most significant components of pain following cardiac surgery are surgical

Table 2 Postoperative pain scores for sternotomy

Case No	VAS at rest					VAS while coughing				
	0th	2nd	4th	8th	12th	0th	2nd	4th	8th	12th
1	0	0	0	0	0	1	1	1	1	1
2	0	0	0	0	0	1	1	1	1	1
3	2	2	2	2	2	4	4	4	4	3
4	2	1	1	1	1	2	1	1	1	1
5	0	0	0	0	0	1	1	1	1	1
6	2	2	3	3	2	3	3	4	4	3
7	0	0	0	0	0	1	1	1	1	1
8	0	0	0	0	0	1	1	1	1	1
9	1	1	1	1	1	4	3	2	2	2
10	2	2	2	2	2	3	3	3	3	3
11	0	0	2	2	2	1	1	3	3	3
12	0	0	0	0	0	2	2	1	1	1
13	0	0	0	0	0	1	1	1	1	1
14	0	0	2	1	0	2	2	3	2	1
15	3	3	3	3	0	4	4	4	4	2
16	0	0	0	0	0	2	1	1	1	1
17	0	0	0	0	0	1	1	1	1	1
18	4	4	2	2	1	5	5	3	3	2
19	2	2	2	2	2	3	3	3	3	3
20	0	0	0	0	0	1	1	1	1	1
Median (Q_1-Q_3)	0 (0–2)	0 (0–2)	0.5 (0–2)	0.5 (0–2)	0 (0-1.2)	2 (1–3)	1 (1–3)	1 (1–3)	1 (1–3)	1 (1-2.2)

VAS: Visuel analog skala

Table 3 Postoperative pain scores for chest drain

Case No	VAS at rest					VAS while coughing				
	0th	2nd	4th	8th	12th	0th	2nd	4th	8th	12th
1	0	0	0	0	0	1	1	1	1	1
2	2	2	1	2	2	3	3	2	3	3
3	2	2	2	1	1	3	4	3	2	2
4	3	1	1	1	1	4	3	2	2	2
5	1	1	1	1	1	2	2	2	2	2
6	0	0	0	0	0	1	1	1	1	1
7	2	2	1	1	1	3	3	2	2	2
8	1	1	1	1	1	2	2	2	2	2
9	2	2	2	2	2	4	3	3	3	3
10	3	3	3	3	3	4	4	4	4	4
11	2	2	2	2	2	3	3	3	3	3
12	0	0	0	0	0	1	1	1	1	1
13	2	2	2	2	2	4	4	3	3	4
14	0	0	2	1	0	1	2	3	2	2
15	2	2	2	2	0	3	3	4	3	1
16	2	2	3	3	3	3	3	4	4	4
17	4	4	3	3	3	5	5	4	4	4
18	5	4	3	3	2	6	5	4	4	3
19	2	2	2	2	2	3	3	3	3	3
20	2	2	2	2	2	3	3	3	3	3
Median (Q_1-Q_3)	2 (1–2)	2 (1–2)	2 (1–2)	2 (1–2)	1.5 (0.7-2)	3 (2–4)	3 (2-3.2)	3 (2-3.2)	3 (2–3)	2.5 (2–3)

VAS: Visuel analog skala

Table 4 MAP, HR, and SpO_2 values in the post-extubation hours

Case No	MAP					HR					SpO_2				
	0th	2nd	4th	8th	12th	0th	2nd	4th	8th	12th	0th	2nd	4th	8th	12th
1	70	75	76	74	80	108	102	98	96	90	98	97	97	98	98
2	92	88	84	85	82	106	103	107	101	88	98	98	99	99	99
3	78	74	77	82	80	101	104	95	98	95	97	97	97	98	99
4	81	77	75	79	81	98	92	96	91	85	98	100	100	100	100
5	86	88	82	78	77	102	96	91	85	96	96	96	97	98	98
6	75	88	93	90	92	96	92	97	92	95	97	97	97	98	100
7	74	72	78	83	85	94	98	93	87	92	97	97	96	97	97
8	80	88	92	81	87	90	94	88	92	93	96	96	96	96	96
9	71	67	74	81	90	97	91	85	89	95	98	97	97	98	98
10	76	83	84	93	96	103	90	96	92	95	96	96	97	97	98
11	72	84	86	90	81	90	93	90	93	90	95	96	95	95	96
12	88	80	85	87	86	92	95	87	85	97	97	97	97	98	97
13	81	84	78	80	91	78	86	92	94	90	98	98	98	98	98
14	89	83	86	82	87	91	88	94	91	98	98	98	97	96	95
15	84	81	85	91	96	82	84	88	92	90	98	98	98	97	98
16	74	78	77	80	75	103	95	91	88	94	97	97	98	98	98
17	71	73	76	81	74	102	98	93	90	95	98	98	98	99	97
18	74	77	72	76	92	97	96	90	86	92	98	99	99	99	99
19	76	70	74	72	74	95	90	94	91	97	95	96	95	96	97
20	73	75	77	74	82	93	91	87	90	88	96	96	96	95	95
Mean ± SD or Median (Q_1-Q_3)	76 (73–81)	79 (74–84)	78 (76–85)	81 (78–85)	83.5 (80–90)	96.5 (91–102)	93.5 (90–96)	92.5 (89–95)	91 (88–92)	93.5 (90–95)	97 (96–98)	97 (96–98)	97.2 ± 1.2	97.5 ± 1.3	97.7 ± 0.3

MAP: Mean arterial pressure; HR: Hearth rate; SpO_2: Oxygen saturation

Table 5 Patients' additional analgesic requirements, side effect situations, and laboratory values

Case No	AAR (Yes/No)	Side effects (Yes/No)	CRP mg/L		Lactate mmol/L		NLR	
			Pre	Post	Pre	Post	Pre	Post
1	No	No	10.4	253	1.51	1.08	2.68	9.13
2	No	No	0.6	145	0.83	1.02	3.41	3.88
3	No	No	0.5	207	0.90	1.57	2.00	3.36
4	No	No	64.6	284	1.63	1.24	2.69	4.85
5	No	No	17.7	280	0.93	2.17	1.42	23.80
6	No	No	5.9	312	1.09	1.01	1.34	5.12
7	No	No	1.6	141	1.00	4.14	3.80	8.99
8	No	No	6.1	152	1.00	1.74	3.80	11.79
9	No	No	18.8	196	1.06	0.87	3.95	12.57
10	No	No	7.0	161	1.40	1.54	2.16	22.04
11	No	No	3.7	150	0.25	2.89	2.24	10.14
12	No	No	0.6	256	0.50	2.23	4.71	5.81
13	No	No	2.2	287	1.02	1.67	2.18	6.32
14	No	No	1.2	111	0.47	0.91	1.13	6.96
15	No	No	10.0	171	0.74	1.48	2.41	6.40
16	No	No	34.3	349	0.51	0.32	2.27	3.19
17	Yes	No	2.5	211	0.68	0.45	3.02	4.84
18	Yes	No	0.5	184	0.61	0.90	1.65	5.91
19	No	No	1.5	251	1.72	1.11	1.68	5.00
20	No	No	27.9	335	0.73	1.27	1.90	6.22
Median (Q_1-Q_3)	% 10/90	-	4.80 (1.4–12)	209 (159–281)	0.91 (0.66–1.07)	1.25 (0.98–1.69)	2.25 (1.84–3.12)	6.27 (4.96–9.38)
p value*	-	-	**< 0.001**		**0.023**		**< 0.001**	

AAR: Additional analgesic requirements; CRP: C-reactive protein; NLR: Neutrophil/Lymphocyte Ratio

* Wilcoxon test. $p < 0.05$ statistically significant

incision pain and pain at the chest tube drain area [15, 16]. This pain impedes movement, deep breathing, and coughing and therefore has a negative impact on postoperative recovery [17]. An important aim of our work was to cover not only the sternotomy but also the chest drain sites with a combined analgesic blockade technique. Despite the lack of a control group, we interpret the results as promising. While only two patients had VAS scores of 4 or higher while at rest, acceptable levels of VAS scores were observed in all other patients.

Several authors used PSB in cardiac surgery [14, 18, 19]. McDonald et al. [18] first described PSB for cardiac surgery in 2005 in a small, prospective randomized trial comparing block placement techniques. In this study, patients were administered either 54 ml 0.25% levobupivacaine with 1:400,000 epinephrine or 54 ml saline (without epinephrine). Initially, intercostal blocks were placed lateral to the sternal border, with 2 mL administered for each of the 5 interspaces bilaterally (total of 20 ml). Subsequently, a continuous line of the study solution was infiltrated just above the periosteum along the lateral borders of the sternum, with 12 ml per side (total of 24 ml). Finally, 10 ml of the study drug was infiltrated deeply and evenly around the mediastinal tubes. In our study, whereas, low VAS scores were observed with a total of 50 ml of 0.25% bupivacaine (30 ml for PSB, 20 ml for SAPB). This outcome might be attributed to the addition of SAPB to PSB application, which could have prevented both drain-related pain and pain due to retractions in the tissues surrounding the sternum.

In another study where PSB was applied with ropivacaine, researchers found significantly lower intraoperative remifentanil consumption compared to the control group [19]. Although they aimed for hemodynamic-controlled propofol/remifentanil infusion during anesthesia, considering the duration of surgery, it can be said that there were similar remifentanil consumptions to our study. This indicates that preoperative PSB application contributes positively to intraoperative anesthesia and analgesia.

In a study after induction, 10 ml of 0.5% ropivacaine was applied for PSB from 4 points, and at the end of surgery, infiltration analgesia with 20 ml of 0.25% ropivacaine was applied to the drain site [14]. In our study, however, 50 ml of 0.25% bupivacaine, was applied. VAS scores were similarly found to be acceptably low in both studies. Additionally, while the need for additional opioids in the postoperative period was found to be 30% in the aforementioned study, it was 10% in our study. Furthermore, while side effects such as nausea, vomiting,

and delirium were observed in the referenced study, no side effects were observed in our study. Although intraoperative remifentanil consumption was lower compared to our study, the high dose of fentanyl used during the anesthesia induction and the high postoperative opioid requirement in the referenced study may explain this difference. Moreover, the high postoperative opioid requirement suggests that SAPB used for drain pain may be more effective than local infiltration.

In a study where only superficial SAPB block was applied, 40 ml of 0.25% bupivacaine was used. Despite similar operation durations, higher VAS scores were found. In this study, drain pain was not evaluated. The authors mentioned that SAPB may limit drain site pain, but the lower VAS scores in our study suggest that the addition of PSB may provide more effective analgesia by limiting sternal pain as well [11].

To reduce perioperative complications, it is crucial to limit this stress response as much as possible. For this purpose, protocols for Enhanced Recovery After Surgery (ERAS) are implemented in many disciplines, and one of the most important of these is cardiac surgery. In a recent study, it was observed that bilateral erector spinae plane block (ESPB) applied for analgesia significantly limited the increase in CRP and lactate levels [20]. In our study, while lactate levels were similarly low, CRP levels were found lower in this study. This result regarding CRP levels may be associated with the effective implementation of an ERAS protocol in this study.

In another study on pain management in cardiac surgery, the application of bilateral ESPB resulted in NLR levels of 2.96±1.1 in the preoperative period and 17.22±7.3 in the postoperative period [21]. In our study, however, preoperative NLR levels were 2.46, while postoperative levels were 8.57. Based on this, we can infer that PSP and SAPB can be effectively used as components of multimodal analgesia in cardiac surgery.

Anxiety particularly results in serious patient dissatisfaction, especially with multiple injections. Although pre-procedural analgesic and sedative medications are administered for this purpose, anxiety cannot be completely eliminated [22]. In our study, block applications were performed under general anesthesia to mitigate this issue. Furthermore, performing the blocks before surgical incision contributed to preemptive analgesic effects. Another advantage of this approach is that since the procedure is conducted in the supine position, there is no need to provide a specific position for the patient.

Limitations

There are some limitations to our study. Our study was conducted at a single center and with a limited number of patients. Secondly, the absence of a control group has limited the optimal assessment of block effectiveness. Additionally, performing the block application under general anesthesia to mitigate adverse effects such as pain and anxiety in patients has made it impossible to assess the blocks with sensory testing. Finally, the long-term effects of the administered blocks have not been evaluated.

Conclusions

In conclusion, in this preliminary study where PSB and SAPB were used together in patients undergoing CABG, effective analgesia was achieved. When evaluated alongside limited increases in inflammatory parameters, this combination may contribute to multimodal analgesia as an effective analgesic method. We believe that this study will shed light on the evaluation of drain/chest tube pain, which is often overlooked but significantly discomforting for patients, guiding prospective randomized trials to be conducted.

Abbreviations

ASA	American Society of Anesthesiologists
BMI	Body mass index
CABG	Coronary artery bypass grafting
CC	Cross-clamp
CPB	Cardiopulmonary bypass
CRP	C-reactive protein
HR	Hearth rate
ICU	Intensive care unit
LA	Local anesthetic
MAP	Mean arterial pressure
NLR	Neutrophil/Lymphocyte ratio
PCA	Patient-controlled analgesia
PSB	Parasternal block
Q	Quartiles
SAPB	Serratus anterior plane block
SD	Standard deviation
SpO_2	Oxygen saturation
TEA	Thoracic epidural analgesia
TPVB	Thoracic paravertebral block
US	Ultrasound
VAS	Visual analog scale

Acknowledgements

None.

Author contributions

ENZ: Conceptualization, data curation, formal analysis, investigation, methodology, project administration, resources, supervision, visualization, writing–original draft, writing–review & editing. HY: Conceptualization, formal analysis, methodology, project administration, resources, supervision, visualization, writing–original draft. MÇ: Data curation, methodology, supervision, visualization, writing–review & editing. NS: Conceptualization, data curation, formal analysis, investigation, methodology, resources, visualization, writing–original draft, writing–review & editing. ZAD: Conceptualization, formal analysis, methodology, project administration, resources, supervision, visualization, writing–original draft, writing–review & editing.All authors have read, reviewed, and approved the manuscript.

Funding

No Funding Received.

Data availability

The datasets used and/or analysed during the current study available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

The study was conducted with a prospective, observational design after obtaining approval from the Ankara Bilkent City Hospital Ethical Committee (E.Kurul-E2-24-6176, 07/02/2024) and written informed consent was obtained from all subjects participating in the trial. The trial was registered on www.clinicaltrials.gov (https://clinicaltrials.gov/) under the identifier NCT05427955 on 17/03/2024. (principal investigator: Emine Nilgün Zengin, MD). All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration (as revised in 2013) and its later amendments or comparable ethical standards. Informed consent was obtained from all participants and was written in this study.

Informed consent

Patients were informed about the study, and their written consent was obtained.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

Received: 30 April 2024 / Accepted: 25 July 2024
Published online: 05 August 2024

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