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Analysis of the effectiveness of intrapleural analgesia after minimally invasive coronary artery bypass grafting on a beating heart

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Abstract

Purpose: To determine the effectiveness of intrapleural analgesia (IPA) for pain relief after minimally invasive coronary artery bypass surgery on a beating heart.

Methods: We prospectively studied 35 patients who underwent coronary artery bypass grafting on a beating heart through a mini thoracotomy access on the left. Patients were divided into two groups: group I received IPA with a catheter (n=16) and group II patients were not introduced intrapleural analgesia (n=19). Postoperative pain was assessed according to the visual analogue scale (VAS), consumption of analgesics, extubation time, arterial blood gas parameters. Adequacy of respiration and lung ventilation were estimated by electrical impedance tomography.

Results: Extubation time after surgery did not differ in both groups. Arterial oxygen partial pressure was higher ($p<0.05$) in the first group (160.82±46.98) compared to the second group (111.42±49.26). Regarding the EIT in the quadrant mode, distribution of tidal volume was better in the first group ($p<0.05$) in the 2nd, 3rd quadrant and in the layer mode, the second layer of the first group showed better results compared to the same layer of the second group. After extubation, average pain score according to VAS was four points for the first group and six points for the second group. On the 1st and 2nd day pain scores were the same in both groups. Postoperative analgesia by promedol was required only for 1 patient (6.25%) from the first group, and 14 patients from the second group (73.7%). Additionally, tramadol was administered to 43.5% (7 patients) of the first group and 26.3% (5 patients) of the second group.

Conclusion: IPA can be used as one of the effective treatments for postoperative pain in minimally invasive coronary artery bypass surgeries. IPA promotes less use of opioids. An improvement in respiration was observed with reduction in postoperative pain.

Keywords: postoperative pain, intrapleural, analgesia, electrical impedance tomography.

Introduction

Lately, minimally invasive procedures in cardiac surgery (MICS) are gaining popularity and this poses certain challenges for anesthesiology practice [1]. Minimally invasive direct coronary artery bypass (MIDCAB) being commonly applied subtype of MICS where revascularization takes place through conjunction of the left internal thoracic artery (ITA) and left anterior descending artery, nowadays are implemented worldwide more often [2]. The mini-thoracotomy approach for these surgeries may require more personalized pain management techniques to minimize postoperative pain. The relief of postoperative pain after MIDCAB is necessary to ensure a complete and rapid recovery [3]. Management of pain after minimally invasive procedures remains a major challenge, and the pursuit of an optimal pain control strategy still continues.

Poorly controlled pain can lead to limited chest expansion, ineffective cough, hypoxia, atelectasis, and eventually respiratory failure and pneumonia. Besides, poor analgesia delays early extubation, one of the factors that decreases number of days spent in hospital, as well as overall morbidity and mortality [4]. Opioids have traditionally been the cornerstone of pain management, but all current guidelines recommend minimizing their use due to numerous side effects the most prominent of which are CNS and respiratory depression [5,6]. Despite these new recommendations, evidence to support a single pain management strategy is limited. Multimodal pain management strategies being a part of Enhanced Recovery after Surgery programs (ERAS) to reduce postoperative morbidity and mortality associated with poorly controlled pain after thoracotomy [7, 8], occupies a special place in addressing multifactorial pathophysiology of thoracotomy pain.

Multimodal analgesia involves the use of two or more anesthetics and analgesics that have different mechanisms of action and allows achievement of adequate pain relief with a minimum side effect [3, 4, 6, 9]. For this purpose, systemic and regional methods are applied. In modern practice, there are several methods of pain relief after thoracotomy one of them being intrapleural analgesia (IPA). Although in guidelines accepted in 2016 intrapleural analgesia is not recommended as a single technique for post operative management after thoracic surgeries [10], non-inferiority of the procedure was not supported and application of IPA is regarded as a part of multimodal analgesia under the supervision of the signs for a possible local anesthetic systemic toxicity, cardiac and CNS toxicities being the most detrimental [11].

The review on thoracic regional anesthesia conducted by Joshi et al. evaluated the sole efficacy of IPA versus other thoracic regional anesthesia techniques such as epidural analgesia (EA) and thoracic paravertebral block (PVB) based on three studies [12]. In the first study, Bachmann-Mennenga et al. deduced inferiority of IPA based on the conclusion that seven out of ten patients receiving IPA required additional opioids for pain management compared to other groups receiving EA or PVB [9]. Wedad et al. found out superiority of paravertebral block compared to the EA or IPA [13] and the last study included in the review analyzed thirty-two patients in each group [14] and did not distinguish any difference in pain scores along with morphine consumption in patients receiving EA or IPA accordingly. In the earlier review conducted by Karmakar and Ho application of IPA was shown to be preferable when other thoracic blocks including epidural and paravertebral are non-advisory. Effectiveness of IPA versus epidural anesthesia (EA) was contradictory in several studies [15]. The first study mentioned in review demonstrated superiority of IPA versus EA provided with the same local anesthetic amount and analgesia duration in terms of substantial decrease in mean blood pressure in case of epidural anesthesia [16] which is an intolerable outcome for minimally invasive heart surgeries performed without cardiopulmonary bypass. In contrast, the second study showed higher effectiveness of EA compared to IPA in terms of better values of negative inspiratory pressure and tidal volume with reduced number of consumed opioids, although with higher extent of induced hypotension in case of EA [17]. The last study conducted by Short et al. presented equal effectiveness of IPA and systemic opioid approach supporting better outcomes after applying IPA to avoid circulatory depression in case of epidural anesthesia and respiratory depression in case of opioid usage [18]. It should be again noted that the studies conducted in both reviews were limited by the amount of the patients involved and study design applied making the statistical evidence relatively indecisive. Application of the cross over design would include a crucial parameter such as drug metabolism consideration to equilibrate the duration of the analgesic effect.

Recently IPA were gaining popularity again. According to the review on multimodal anesthesia management techniques during minimally invasive cardiac surgeries conducted in 2021 [3], IPA provides deeper analgesic effect due to ability to be continuously delivered, although correct placement of the catheter is vital. Another recent review comparing the benefits of EA to IPA demonstrated superiority IPA by resulting in the [19] less value of Visual pain score in patients receiving IPA compared to EA group with other respiratory and hemodynamics parameters being similar [19]. Ishikawa et al. applied IPA and EA after thoracoscopic surgery showing that delivery of IPA analgesia did not require additional analgesic management compared to EA group [20].

IPA has been used in practice for a long time, but summarizing all available literature, there is little research on IPA effectiveness in MIDCAB grafting surgeries. In our practice, in search of effective methods of analgesia after MIDCAB grafting, we started to apply IPA and compare its analgesic effect with the control group. The primary goal of the study is to assess IPA analgesic effect in terms of hemodynamics, respiratory parameters and data from arterial blood gases in both groups. The secondary goal is to assess IPA analgesia by comparing visual analogue scale scores in control and treatment groups.

Materials and methods

We prospectively studied 35 cardiac patients who underwent off-pump coronary artery bypass (OPCAB) through a mini-thoracotomy access on the left (5th ICS thoracotomy). Approval from the ethical committee was obtained before the start of the study. Selected patients initially did not have respiratory distress and their division was randomized in two groups. The first group consisted of patients receiving intrapleural analgesia (n=16) and the second group represented patients free from intrapleural analgesia (n=19). Division on groups was carried out randomly by physicians not involved in the study. Sample size was gathered according to the available spots for MIDCAB surgery during the time of prospective study. Participants were preoperatively examined in a standard manner, preanesthetic evaluation was performed and informed consent on application of intrapleural anaesthesia as well as on the participation in the study was received. All patients underwent multi-component general anesthesia with double-lumen endotracheal tube (one lung ventilation: left bronchus intubation) of an appropriate size depending on patient's height and weight. Position control and fixation of the endotracheal tube were performed under fiberoptic bronchoscopy control. Intraoperatively invasive monitoring of systolic blood pressure, diastolic blood pressure, central venous pressure (CVP), continuous electrocardiographic (ECG) monitoring, blood saturation (SpO2), capnography (etCO2), ABGs (initial and final), temperature, Activated Clotting Time (ACT) were recorded.

Technique for inserting an intrapleural catheter. After induction into anesthesia and tracheal intubation, the patients of the first group underwent the installation of an intrapleural catheter. In the right lateral recumbent position, at the level of the 6th ICS on the left along the scapular line (between the posterior axillary and paravertebral lines), the pleural cavity was punctured with a Tuohy needle connected to a syringe of 3-4 ml of saline and a 0.9% sodium chloride system through a three-way valve with the purpose of pneumothorax prevention. After puncture of the pleural cavity, an epidural catheter was installed with the side holes 5-8 cm deep from the tip of the needle, then the needle was removed, the catheter was fixed to the skin with adhesive tape and marked [21]. Patency check was performed by injection of 5 ml 0.9% sodium chloride saline. The left half of the patient's chest was elevated with a roller placed under the left scapula. Re-examination of endotracheal tube positioning was checked under fiberoptic bronchoscopy control after changing patient's position. After the start of the surgery, one-lung ventilation was performed during the main stage, with the left lung being turned off under strict monitoring of vital signs.

Estimated dosage of heparin for coagulation was 150 units/kg administered as a bolus. Target activated clotting time was 200 seconds. Upon completion of the aorto-coronary bypass, inactivation of heparin was performed with protamine. Towards the end of the surgery, reintubation was performed with a conventional endotracheal tube according to patient's height and weight. Following the surgery, patients were hospitalized in ICU. Initial data was recorded: age, gender, body mass index (BMI), diagnosis and comorbidities, ASA classification. In the postoperative period, the following parameters were recorded: systolic and diastolic blood pressure, pulse rate, blood saturation, extubation time. Postoperative pain intensity was assessed using a visual analogue scale (VAS) from 0 to 10 points (0 – no pain, 10 – the most severe pain). Postoperatively, degree of pain was monitored continuously and assessed three times by the same employee: after extubation, at 08:00 am on the 1st day and at the same time on the 2nd day postoperatively, and the assessment was carried out by nurses and physicians not involved in the study. The parameters of ABGs were assessed on the first two days postoperatively. The amount of opioid and non-opioid analgesics used after surgery as long as the frequency of administration was recorded. Also, the length of stay (LOS) in ICU, the duration of inpatient treatment was recorded. In the first group (n=16), bupivacaine 0.25% 20 ml was injected into the intrapleural catheter as an analgesia postoperatively before extubation. After injection, the pleural cavity drainage was closed, the patient the patient was placed horizontally for 15 minutes, after which the pleural cavity drainage was opened. If the patients from the first group experienced pain, an additional dose of analgesic was administered in the amount of 0.25% 20 ml. All patients underwent analgesia with trimeperidine and tramadol after assessing the pain syndrome according to VAS which value should be more or equal to four. To assess the adequacy of breathing after extubation and on the first day postoperatively, electrical impedance tomography (Dräger PulmoVista® 500) of the lungs was performed at the level of the 4th-5th intercostal space. Electrical impedance tomography (EIT) was performed in two modes with the division of the estimated level of lung fields into "layers" and "quadrants". On the screen, the picture of the examined area (slice) of the lungs in the "layers" mode is divided into 4 layers from the sternum to the spine, in the "quadrants" mode, the examined area of the lung slice is divided into 4 quadrants: the anterior right – 1st quadrant, the anterior left – 2nd quadrant, back right – 3rd quadrant and back left – 4th quadrant.

The study did not include patients who underwent repeated thoracotomy due to bleeding, as long as patients who underwent sternotomy. Statistical processing of the obtained data was carried out in STATA program according to nonparametric descriptive methodology, applying Mann-Whitney U test.

Results

The compared groups did not differ in terms of diagnosis and comorbidities. According to the general characteristics of the group (Table 1), there was no variability in sex and age. Also, the risk of ASA stratification, the duration of ICU hospitalization and the duration of inpatient treatment did not differ between the groups.

In the first group, ten patients had BMI over 30, while in the second group, there were only 4 people with such BMI. Though, statistical significance was not revealed. All patients underwent multicomponent anesthesia, induction with propofol following maintenance anesthesia with sevoflurane. Difference in drug dosages during anesthesia was not observed. The average duration of anesthesia was 195 minutes, the duration did not differ significantly between groups. The amount of fentanyl used in the first group was 700 mcg and 800 mcg in the second group (p>0.05).

Intraoperative hemodynamic data are presented in the following Table 3. According to the analysis, significant differences in SBP, DBP and HR in the groups was not noted.

According to the analysis of hemodynamic parameters after surgery, the first day and the second day showed a difference (p<0.05) in heart rate. The mean value for the first group was statistically significantly lower (80±10.7) than the mean value for the second group (90.1±12.13). However, no difference was noted in SBP, DBP and HR between those days.

The duration of mechanical ventilation (median (IQR) minutes) in the postoperative period for the first and the second group was 232.5 (187.5-340) minutes and 230 (170-280) minutes accordingly, that is, the extubation time for the groups was the same (p> 0.05).

Analyzing data on arterial blood gases in the postoperative period, the following data were obtained. A significant difference (p < 0.05) was revealed in the partial pressure of oxygen in arterial blood, which was higher in the first group (160.82±46.98) compared to the second group (111.42±49.26). Considering the level of partial pressure of carbon dioxide there was a hypercapnic trend for the latter group where IPA was not implemented.

Glucose level from ABGs parameter, being an indirect sign of the body's stress response on the first two days postoperatively, did not show any difference between the groups. Overall, patients in both groups showed the average glucose value higher than normal due to stress response to surgery. The analysis of the results of electrical impedance tomography (EIT) which was

Table 1 Basic Data by groups

Patient's Data	All (N=35)	Group I (N=16)	Group II (N=19)	p-value
Age, mean (SD±)		60.1 (8.83)	61.56 (8.98)	0,632
BMI, n(%)				0,153
<18.5	0	0	0	
18.5 < 25	9 (25.71)	5 (55.56)	4 (44.44)	
25 < 30	12 (34.29)	4 (33.33)	8 (66.67)	
30 <	14 (40)	10 (71.43)	4 (28.57)	
Gender, n(%)				0,929
Female	9 (25.71)	5 (55.56)	4 (44.44)	
Male	26 (74.29)	14 (53.85)	12 (46.15)	
LOS in ICU n(IQR)	2 (1-2)	2 (1-3)	2 (2-2)	0,552
LOS inpatient (IQR)	10 (8-13)	10 (8-15)	10 (8-12)	0,806
3rd grade	9 (25.71)	5 (55.56)	4 (44.44)	
4th grade	26 (74.29)	14 (53.85)	12 (46.15)	

BMI – body mass index, ICU – Intensive Care Unit

Table 2 Duration of anesthesia and amount of fentanyl used during anesthesia

	All (N=35)	Group I (N=16)	Group II (N=19)	p-value
Duration of anesthesia (min) median(IQR)	195 (165-240)	192.5 (177.5-207.5)	195 (155-280)	0,816
Fentanyl used (ampoules), mean(SD±)	8 (6-8)	7 (5-8)	8 (7-9)	0,174

Table 3 Hemodynamic parameters

	All (N=35)	Group I (N=16)	Group II (N=19)	p-value
Hemodynamic parameters during anesthesia				
SBP mmHg., mean(SD±)	122.28 (14.22)	125.5 (12.43)	119.58 (15.38)	0,225
DBP mmHg., mean(SD±)	66.06 (9.21)	65.5 (9.97)	66.53 (8.76)	0,748
HR per min, mean(SD±)	75.57 (15.01)	72.75 (12.22)	77.95 (16.97)	0,314
Hemodynamic parameters during anesthesia 1st day postoperatively				
SBP mmHg., mean(SD±)	121.88 (12.43)	123.06 (10.74)	120.89 (13.91)	0,614
DBP mmHg., mean(SD±)	65.31 (9.78)	63.5 (10.19)	66.84 (9.41)	0,321
HR per min, mean(SD±)	85.48 (12.2)	80 (10.07)	90.1 (12.13)	0,01
Hemodynamic parameters during anesthesia 2nd day postoperatively				
SBP mmHg., mean(SD±)	124.69 (13.64)	124.07 (12.86)	125.16 (14.52)	0,825
DBP mmHg., mean(SD±)	70.42 (8.19)	67.5 (5.85)	72.58 (9.11)	0,07
HR per min,, mean(SD±)	87.64 (9.92)	84.57 (6.86)	89.89 (11.33)	0,129

SBP – systolic blood pressure, DBP – diastolic blood pressure. HR – heart rate.

Table 4 ABGs parameters postoperatively

	Group I (N=16)	Group II (N=19)	p-value
ABGs parameters after extubation			
pH, median(IQR)	7.38 (7.34-7.39)	7.36(7.3-7.38)	0,178
p02 mmHg, mean(SD±)	160.82 (46.98)	111.42 (49.26)	0,004
pCO2 mmHg, median(IQR)	37.15 (33.4-41.2)	40.5 (37.4-47.7)	0,016
Lactat mmol/L, median(IQR)	1.2 (0.92-1.65)	1.2 (1.03-1.4)	0,855
BE mmol/L, mean(SD±)	-3.07 (2)	-3.61 (2.61)	0,507
Glucose mmol/l, median(IQR)	7.8 (6.6-8.8)	7.8 (6.7-8.4)	0,89
ABGs parameters 1st day postoperatively			
pH, median(IQR)	7.39 (7.37-7.42)	7.37 (7.34-7.4)	0,078
p02 mmHg, mean(SD±)	99.26 (25.58)	99.01 (33.89)	0,981
pCO2 mmHg, median(IQR)	35.95 (35.15-39.7)	40.8 (34.6-43.8)	0,111
Lactat mmol/L, median(IQR)	1.41 (1.05-1.67)	1.46 (1.13-2.1)	0,529
BE mmol/L, mean(SD±)	15.44 (7.96)	12.95 (7.41)	0,345
Glucose mmol/l, median(IQR)	8.25 (7.2-8.7)	8.25 (7.1-8.7)	0,835
ABGs parameters 2nd day postoperatively			
pH, median(IQR)	7.4 (7.39-7.44)	7.4 (7.38-7.41)	0,239
p02 mmHg, mean(SD±)	94.78 (21.58)	85.96 (20.12)	0,256
pCO2 mmHg, median(IQR)	36.8 (34.4-40.2)	39 (36.4-41.4)	0,243
Lactat mmol/L, median(IQR)	1.04 (0.93-1.35)	1.04 (1-1.5)	0,607
BE mmol/L, mean(SD±)	-0.9 (2.5)	-1.14 (2.1)	0,776
Glucose mmol/l, median(IQR)	7 (6.7-8.5)	7.3 (6.2-8.5)	0,48

Table 5 Results of EIT of the lungs after surgery

	Group I (N=16)	Group II (N=19)	p-value
EIT results, day 1			
RI 1st quadrant, mean(SD±)	16.07 (9.25)	22.5 (10.92)	0,095
RI 2nd quadrant, mean(SD±)	34.36 (5.51)	28.58 (8.49)	0,037
RI 3rd quadrant, mean(SD±)	37.07 (6.85)	29.7 (5.79)	0,003
RI 4th quadrant, mean(SD±)	12.78 (8)	17.35 (7.82)	0,12
RI 1st layer, mean(SD±)	28.21 (11.36)	23.94 (12.01)	0,327
RI 2nd layer, mean(SD±)	29.53 (11.72)	20.36 (6.84)	0,015
RI 3rd layer, mean(SD±)	29.5 (8.42)	31.11 (8.59)	0,602
RI 4th layer, mean(SD±)	20.93 (8.81)	16.23 (8.15)	0,134
EIT results, day 2			
RI 1st quadrant, mean(SD±)	16.8 (7.86)	22.37 (10.75)	0,103
RI 2nd quadrant, mean(SD±)	33.8 (10.94)	30.68 (8.87)	0,365
RI 3rd quadrant, mean(SD±)	34.67 (7.94)	34.89 (8.91)	0,938
RI 4th quadrant, mean(SD±)	12.06 (6.25)	12.84 (6.37)	0,724
RI 1st layer, mean(SD±)	32.27 (8.19)	27.74 (11.13)	0,197
RI 2nd layer, mean(SD±)	26.53 (13.06)	15.6 (8.55)	0,008
RI 3rd layer, mean(SD±)	32.27 (7.97)	31.42 (11.96)	0,815
RI 4th layer, mean(SD±)	16.4 (8.27)	15.74 (8.92)	0,825

RI – region of interest, EIT – electrical impedance tomography.

carried out to study the adequacy of breathing postoperatively showed the results represented in the Table 5. In the quadrant mode 2nd and 3rd field of study as well as the 2nd slice in the layer mode showed larger values ($p<0.05$) in comparison to the second group demonstrating better respiratory dynamics after IPA implementation.

EIT in the quadrant mode performed on the second day post surgically showed no differences in both groups, but in the layer's mode, a difference was found with a large value on the 2nd layer (26.53 ± 13.06) of the first group compared to the second group (15.6± 8.55) where intrapleural blockade has not been performed.

Table 6 Postoperative VAS pain scores and pain relief

Pain assessment	Group I(N=16)	Group II (N=19)	p-value
VAS after extubation, median(IQR)	4 (3-5)	6 (5-7)	
VAS Day 1, median(IQR)	3 (3-3)	3 (3-4)	
VAS Day 2, median(IQR)	2 (2-2)	2 (2-3)	
Analgesia, n (%)			
Bupivacaine in IP catheter 2-fold injection.	12 (75)	0	
Number of patients received Trimeperidine 20mg IM (%)	1 (6.25)	14 (73.7)	
Number of patients received Tramadol IM			0,012
Tramadol 100 mg/day	1 (6.25)	10 (52.6)	
Tramadol 200 mg/day	8 (50)	4 (21.05)	
Tramadol 300 mg/day	7 (43.75)	5 (26,3)	

VAS is a visual analogue scale. IP – intrapleural.

An important point of the study was the assessment of pain relief. All patients underwent analgesia with trimeperidine and tramadol, if necessary, after assessment of pain by VAS. The first group (n=16) after surgery in the ICU before extubation was additionally injected with bupivacaine through intrapleural catheter, with subsequent intubation per need. The results of the analysis of postoperative pain relief are presented in Table 6.

According to VAS, the intensity of pain after extubation was less in the first group and averaged four points (in the second group, the average score was six). Dynamically, pain scores according to VAS on the first two days were the same in both groups. In the first group, bupivacaine was administered twice in 75% (12) patients, i.e. before extubation and in dynamics after an average of 8 hours. In the remaining quarter of the first group, bupivacaine was not administered repeatedly. Postoperative analgesia with additional trimeperidine application was necessary for one patient in the former group (6.25%) and for fourteen patients from the latter group (73.7%). Pain relief with a single tramadol dose was required for one (6.25%) patient from the first group and ten (52.6%) patients from the second group. Double administration of tramadol during the day was observed in eight (50%) and four (21.05%) patients, while injection of tramadol three times per day was required in seven (43.5%) and five (26.3%) of patients from the former and latter groups accordingly. Significant difference (p = 0.012) in the frequency of prescribed tramadol was observed.

Discussion

Pain after cardiothoracic surgery is an indication for multimodal analgesia. There are different methods of regional analgesia and anesthesia, which can reduce surgical stress and postoperative pain [2, 8]. Analyzing existing literature, there are very few studies related to intrapleural blockade during MICS on a beating heart. In our study, we used the method of an intrapleural analgesia. Bupivacaine was administered as the local anesthetic for pain relief due to its long duration of action, and the dosage was chosen after a review of the literature describing the use of 0.25% bupivacaine as a sufficient dose.

The literature describes the effectiveness of intrapleural blockade with 8 ml of 0.25% bupivacaine in contrast to thoracic epidural anesthesia in MIDCAB [22] according to VAS values, but in this study a lower dose was used, and it required repeated administration of IPA over time. In our study, the use of bupivacaine at a dose of 20 ml of 0.25% showed an improvement in oxygenation and ventilation on the first day after surgery according to EIT findings and ABGs parameters. Although one lung ventilation technique by itself poses higher risk for the atelectasis formation, possible atelectasis formation is expected to be equally distributed in both groups since one lung ventilation was performed in both groups. The only difference is the administration of intrapleural analgesia resulting in different density measurements by EIT. Thus, application of IPA revealed a more adequate distribution of the volume of ventilation on the side of surgical intervention and less tachycardia compared to the control group.

Cogan J et al. from the Montreal Heart Institute reports the effectiveness of intrapleural administration of bupivacaine in drainage tubes inserted into the pleural space which they widely use. But this technique requires application of more careful aseptic techniques with each injection. The intrapleural catheterization we use is established before surgery and the rules of care are the same as for central venous catheters, and there is no risk of depressurization of pleural drains [23].

With intrapleural analgesia, opioid analgesics were used significantly less, confirming the data of other authors [3, 4, 5, 22, 23]. Comparatively, the second group consumed more trimeperidine. But fifty per cent of patients in the first group required repeated administration of tramadol. Significant differences in VAS were not observed between the groups. Recently, several authors report the benefit of opioid-free analgesia in cardiac surgery patients [24]. Also, Carlos et al supports the effectiveness and decreased need for opioids in intercostal block compared with other methods, but this technique requires additional tools such as an ultrasound device for navigating intercostal block [25].

Halide Ogus et al found benefits of intrapleural analgesia over placebo in patients with COPD after CABG sternotomy. Intrapleural analgesia improved lung function parameters, provided a good level of pain relief, and allowed rapid mobilization which led to decrease in postoperative respiratory complications [26]. According to the results of our study, with intrapleural blockade, there are better indicators of oxygenation in arterial blood gas parameters and more adequate distribution of tidal volume in the lung fields according to EIT.

Conclusion

IPA can be used as one of the effective methods for postoperative pain management. IPA promotes less opioid use, and there has been an improvement in respiration with a reduction in postoperative pain. IPA is safe and one of the effective methods of postoperative analgesia in MIDCAB.

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