Research Article (Araştırma Makalesi)

Cardiopulmonary Bypass and Perioperative Mechanical Ventilation Strategy: National Turkey Study

Kardiyopulmoner Baypas ve Perioperatif Mekanik Ventilasyon Stratejisi: Ulusal Türkiye Çalışması

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Özet

Amaç: Bu çalışma, kardiyopulmoner baypas (KPB) uygulanan durumlarda Türkiye'deki anestezi uzmanlarının perioperatif mekanik ventilasyon stratejilerini tanımlamayı amaçlamaktadır.

Gereç ve Yöntemler: Anesteziyoloji ve Reanimasyon uzmanlarından oluşan iki derneğin üyelerine e-posta yoluyla iki kez anket soruları gönderildi. Sorular, KPB cerrahisinde preoperatif, intraoperatif ve postoperatif dönemlerde anestezi uygulamaları ve mekanik ventilasyon stratejilerini belirlemek için üç bölüme ayrılmıştır.

Bulgular: Ankete 269 anestezi uzmanı katıldı. Katılımcıların 105'i (%40.2) hastanelerindeki yoğun bakım ünitesi yatak sayısının 20'nin üzerinde olduğunu belirtti. KPB süreci dışında tidal volüm hesaplanmasında 6 ml/kg (%42.5) katsayısının kullanımı tercih edilmektedir. Ameliyat boyunca düşük (0-5 cmH_2O) pozitif ekspiryum sonu basıncı (PEEP) tercih eden katılımcı sayısı %41.1 idi. Katılımcıların %40.8'i "hemodinamik olarak stabil ve obez hastalarda" 5-10 cmH_2O PEEP tercih etmektedir. KPB sürecinde katılımcıların %38.3'ü mekanik ventilatörü kapatmaktadır, %24.4'ü hastayı mekanik ventilatörden ayırmayı tercih etmektedir. Anestezi uzmanlarının %35.8'i rekruitment manevralarını tercih ederken, %38.9'u tercih etmemiştir. Katılımcıların %51'inin hipoksemi/hiperkapnisi olan hastalarda non-invaziv ventilasyonu tercih ettiği ve %55.1'inin tüm hastalara ekstübasyon sonrası pulmoner rehabilitasyon uyguladığı sonucuna varıldı.

Sonuç: Çalışmamız, Türkiye'de KPB cerrahisinde çoğu anestezi uzmanının izlediği mekanik ventilasyon stratejilerinin benzer olduğunu göstermiştir.

Anahtar Kelimeler: Anestezi uzmanları, Kardiyopulmoner Baypas, Kardiyak Cerrahi, Kılavuzlar, Mekanik Ventilasyon.

Abstract

Objective: This study aims to describe anesthesiologists' perioperative mechanical ventilation strategies in cases where cardiopulmonary bypass (CPB) is performed in Turkey.

Material and Methods: Survey questions were sent twice via e-mail to members of the two associations consisting of specialists in Anesthesiology and Reanimation. The questions were divided into three parts to determine anesthesia applications and mechanical ventilation strategies in the preoperative, intraoperative, and postoperative periods of CPB.

Results: The questionnaire was provided with the participation of 269 anesthesiologists. 105 (40.2%) participants stated that the number of intensive care unit beds in their hospital was over 20. A 6 ml/kg (42.5%) coefficient is preferred in calculating tidal volume outside the CPB process. The number of participants who preferred low (0-5 cmH_2O) positive end-expiratory pressure (PEEP) throughout the surgery was 41.1%. 40.8% of the participants prefer 5-10 cmH_2O PEEP in "hemodynamically stable and obese patients". During the CPB process, 38.3% of the participants turned off the mechanical ventilator, and 24.4 % preferred to wean the patient from the mechanical ventilator. While 35.8 % of anesthesia specialists preferred recruitment maneuvers, 38.9% did not. It was concluded that 51% of the participants preferred non-invasive ventilation in patients with hypoxemia/hypercapnia, and 55.1% applied pulmonary rehabilitation after extubation to all patients.

Conclusion: Our study showed that the mechanical ventilation strategies followed by most anesthesiologists in CPB in Turkey are similar.

Keywords: Anesthesiologists, Cardiopulmonary Bypass, Cardiac Surgery, Guidelines, Mechanical Ventilation.

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INTRODUCTION

The incidence of postoperative pulmonary complications (PPC) in cardiac surgeries is relatively high, with a rate of 55%. In addition to increased morbidity and mortality, PPC increases costs with it. PPCs such as atelectasis, pneumonia, pneumothorax, bronchospasm, and aspiration pneumonia may occur in the perioperative period due to the systemic inflammatory response caused by the use of cardiopulmonary bypass (CPB) and impaired mechanical ventilation (1).

There is no definitive ventilation strategy in on-pump cardiac surgery. To improve pulmonary outcomes, protective mechanical ventilation strategies are being developed by using different techniques such as positive end-expiratory pressure (PEEP), tidal volume levels, and recruitment maneuvers (2). It is thought that complications such as pneumonia and atelectasis are reduced with preoperative and postoperative pulmonary rehabilitation (3).

The study's primary aim is to investigate the mechanical ventilation strategies applied by anesthesiologists in Turkey in on-pump cardiac surgeries in the perioperative period of CPB-applied cases. The secondary goal is to analyze preoperative patient evaluation and postoperative extubation strategies.

MATERIALS AND METHODS

The study is planned as cross-sectional and descriptive. Surveys were sent to the members of the Turkish Anesthesiology and Reanimation Association (TARD) and Thoracic and Cardiovascular Anesthesia and Intensive Care Association (GKDAYBD), which includes Anesthesiology and Reanimation specialists, via e-mail twice, on 02.07.2019 and 10.07.2019, to ensure maximum participation. While TARD covers all anesthesiologists, GKDAYBD is an association of anesthetists primarily interested in thoracic and cardiovascular surgery. Anesthesiologists can be members of both associations. In the e-mail sent, the researcher's name, contact information, and the study's aims were specified. Informed written consent was not required. There were no exclusion criteria. However, anesthetists performing on-pump cardiac surgery in their hospitals were asked to complete the surveys. The study was prepared following the survey reporting list. The questions in the survey were divided into three parts preoperative, intraoperative (also evaluated during CPB and non-CPB), and postoperative period of cardiopulmonary bypass. A total of 35 multiple-choice questions were asked in the study. Before the questions were sent to the anesthesiologists via e-mail, three separate anesthesiology and reanimation specialists were asked, and it was tested that the survey would take 3-4 minutes on average. Participants were asked to answer questions directly and anonymously. The online survey was submitted using Google Forms Survey.

Survey link: https://docs.google.com/forms/d/e/1FAIpQLScucfb12-adsXBsqSDbm-AJA1YPHtjC4YnjKBZ1aQhZo507dw/viewform

Statistical Analysis

Ratio (%) and frequency (n) parameters were used to express categorical variables statistically. Data were evaluated with IBM SPSS version 22 (IBM SPSS for Windows version 22, IBM Corporation, Armonk, New York, United States). Sampling methods were used to determine the sample size of the study. It was determined that n:278 individuals should be included in the study, considering the 95% confidence interval for a population of approximately 1000 individuals and a population distribution ratio of 0.50 for a sampling error of 0.05.

RESULTS

Anesthesiologists were contacted via e-mail, and 269 answered the survey. 130 (48.3%) participants were in the 40-49 age range, and 145 (53.9%) were women. It was observed that 118 (43.8%) worked in a training and research hospital, and 182 (68.2%) received specialty training in a university hospital. 105 (40.2%) of the participants stated that the number of beds in the intensive care unit in their hospitals is over 20. While 123 (46.3%) participants stated that the physician in charge of the postoperative intensive care unit was a cardiovascular surgeon, the number of participants who stated that the responsible physician was an anesthesiology and reanimation specialist was 120 (45.2%). Among the hospitals where the participants worked, there were 184 (68.4%) anesthesiologists involved in continuous cardiac surgery anesthesia. Additionally, 68 (35.5%) physicians had 5-10 years of experience. Furthermore, 86 (32.5%) participants reported receiving less than 200 cases of CPB surgery annually, whereas 14 participants mentioned receiving more than 2000 cases of CPB surgery annually **(Table 1)**.

Except for the CPB period in cardiac surgery;

While the number of participants who recorded the actual weight and estimated weight inputs of the patients to the mechanical ventilator during the surgery was 138 (52.6%) and 77 (29.3%), respectively, 26 (9.8%) participants preferred the body mass index value. 113 (42.5%) participants prefer 6 ml/kg at most for tidal

Table 1. Sociodemographic characteristics and cardiac anesthesia-intensive care capacities of hospitals (n=269)

		n	%
Age	20-29	14	5.2
	30-39	95	35.3
	40-49	130	48.3
	50-60	30	11.2
Sex	Male	124	46.1
	Female	145	53.9
Employed institution	State Hospital	26	9.7
	Training and Research Hospital	118	43.8
	Private Hospital	28	10.4
	University Hospital	97	36.1
Specialization hospital	Training and Research Hospital	85	31.8
	University Hospital	182	68.2
Number of postoperative	> 20	105	40.2
intensive care unit beds	0-6	54	20.7
	6-10	38	14.6
	10-20	64	24.5
Physician in charge of the postoperative intensive care unit	Anesthesiology and Reanimation Specialist	120	45.2
	Cardiovascular Surgery Specialist	123	46.3
	Intensive Care Specialist	15	5.7
	Other	7	2.8
Is the anesthesiologist continually interested in cardiac surgery anesthesia?	Yes	184	68.4
	No	85	31.6
If Yes to the previous question, how many years has the anesthesiologist been interested in cardiac surgery anesthesia?	0-5 Years	55	28.6
	10-20 Years	45	23.4
	Above 20 Years	24	12.5
	5-10 Years	68	35.5
Number of cardiopulmonary bypass cases received annually	<200	86	32.5
	201-400	78	29.4
	401-1000	49	18.5
	1001-1500	29	10.9
	1501-2000	9	3.4
	>2000	14	5.3

n: patient number of patients, %: percentage value.

volume in the mechanical ventilator. 109 (41.1%) participants preferred 0-5 cmH_2O pressure for the PEEP value applied throughout the surgery in hemodynamically stable patients. In hemodynamically stable and obese (BMI>30) patients, the PEEP value applied during surgery was recorded as the response of 108 (40.8%) participants, in the range of 5-10 cmH_2O at most. In hemodynamically unstable patients, PEEP applied during surgery was mainly in the range of 0-5 cmH_2O and was preferred by 146 (55.1%) participants **(Table 2)**.

During the CPB period in cardiac surgery;

To the question of applied tidal volume, 102 (38.3%) participants stated that they turned off the mechanical ventilator, 65 (24.4%) weaned the patient from the mechanical ventilator, and 47 (17.7%) ventilated the patient with <3 ml/kg. For the applied PEEP pressure, 167 (64%) participants responded as 0 cmH_2O. For the applied lung recruitment maneuvers, 100 (38.9%) participants stated that they "did not apply". Ninety-two of the participants (35.8%) stated that

Table 2. Preoperative anesthesia preparation features (n=269)

		n	%
In which situation is blood gas analysis requested?	Patients with abnormal clinical findings	73	27,4
	Always	143	53.8
	In COPD patients	24	9.0
	In patients with low SPO2	18	6.8
	Other	8	3.0
In which situation are lung function tests requested?	Patients with abnormal clinical findings	60	22.7
	Always	135	50.9
	In COPD patients	55	20.8
	In patients with low SPO2	7	2.6
	Other	8	3.0
In which situation is a chest X-ray requested?	Patients with abnormal clinical findings	5	1.9
	Always	255	95.8
	In COPD patients	4	1.5
	Other	2	0.8
In which situation is echocardiography requested?	Patients with abnormal clinical findings	29	10.9
	Always	230	86.1
	In patients with low SPO2	2	0.7
	Other	6	2.3
Is preoperative pulmonary rehabilitation applied?	Patients with abnormal clinical findings	68	25.4
	Always	53	19.8
	Other	60	22.5
	In COPD patients	68	25.4
	In patients with low SPO2	18	6.7
Additional consultations	Other	15	4
requested from the	Endocrinology	75	19.8
anesthesia clinic	Infectious diseases	65	17.1
(Multiple options can be ticked)	Chest Diseases	14	3.6
	Cardiology	210	55.5

n: patient number of patients, %: percentage value, COPD: Chronic Obstructive Pulmonary Disease, SPO2: Oxygen Saturation

they applied the recruitment maneuver to all patients, 26 (10.1%) to high-risk patients, 17 (6.6%) to patients with low saturation, and 6 (2.4%) to obese patients **(Table 3)**.

Table 3. Anesthesia-mechanical ventilation methods applied during the CBP period and throughout the surgery, except the CBP period.

		n	%
Mechanical ventilator body weight input during surgery (Excluding the pumping period)	BMI	26	9.8
	Actual weight	138	52.6
	Other	21	8.3
	Estimated weight	77	29.3
Mechanical ventilator applied during surgery tidal volume input (Excluding cardiopulmonary bypass)	< 5 ml/kg	11	4.1
	> 9 ml/kg	4	1.5
	5 ml/kg	18	6.8
	6 ml/kg	113	42.5
	7 ml/kg	70	26.3
	8 ml/kg	50	18.8
PEEP applied during surgery in hemodynamically stable patients (Excluding cardiopulmonary bypass)	0	17	6.4
	0- 5 cmH_2O	109	41.1
	5 cmH_2O	103	38.9
	5-10 cmH_2O	36	13.6
PEEP applied during surgery in hemodynamically stable obese patients (BMI>30) (Excluding cardiopulmonary bypass)	> 10 cmH_2O	3	1.1
	0	9	3.4
	0- 5 cmH_2O	65	24.5
	5 cmH_2O	80	30.2
	5-10 cmH_2O	108	40.8
PEEP applied during surgery in hemodynamically unstable patients (Excluding cardiopulmonary bypass)	0	50	18.9
	0- 5 cmH_2O	146	55.1
	5 cmH_2O	51	19.2
	5-10 cmH_2O	18	6.8
Tidal volume applied during pumping period	<3 ml/kg	47	17.7
	> 5 ml/kg	25	9.4
	3-5 ml/kg	27	10.2
	Weaning the patient	65	24.4
	Mechanical ventilator off	102	38.3
PEEP applied during cardiopulmonary bypass (cmH_2O)	0	167	64.0
	0- 5 cmH_2O	56	21.5
	5 cmH_2O	30	11.5
	5-10 cmH_2O	8	3.1
Lung recruitment maneuvers applied during cardiopulmonary bypass	All patients	92	35.8
	Other	16	6.2
	Obese patients (BMI>30)	6	2.4
	Patients with low SPO_2	17	6.6
	Not applying	100	38.9
	High-risk patients	26	10.1

Table 3. ***Continue***

		n	%
Anesthesia method used during the operation	Opioid	6	2.3
	Propofol	2	0.8
	Sevoflurane	26	9.9
	Sevoflurane+Opioid	183	69.8
	TIVA (Opioid+Propofol+Aritmal)	45	17.2
Amount of manually applied lung recruitment pressure during the operation	Manually, the pressure was held at 20-30 cmH_2O	106	40.6
	Manually, the pressure was held at 30 cmH_2O	53	20.3
	Manually, the pressure was held at 30-40 cmH_2O	69	26.4
	Manually, the pressure was held at <20 cmH_2O	26	10.0
	Manually, the pressure was held at > 40 cmH_2O	7	2.7
Tele-inspiratory pressureduring the operation	Tele-inspiratory pressure 20- 30 cmH_2O	126	49.8
	Tele-inspiratory pressure 30 cmH_2O	36	14.2
	Tele-inspiratory pressure 30-40 cmH_2O	16	6.3
	Tele-inspiratory pressure <20 cmH_2O	75	29.6
Lung recruitment maneuvers	All patients	127	47.7
during the operation	Patients with low SPO_2	10	3.8
	When exiting the pump	30	11.3
	Only obese patients (>30 BMI)	24	9.0
	Not applying	44	16.5
	High-risk patients	31	11.7
Duration of lung recruitment pressure	< 10 sec	73	28.6
	10-30 sec	139	54.5
	31-60 sec	37	14.6
	60 sec	6	2.4
Frequency of lung recruitment maneuvers	After CPB	14	8.4
	Once every 10 min	10	6.0
	Once every 20 min	18	10.8
	Once every 30 min	30	18.1
	Every hour	46	27.7
	End of the case	12	7.2
	Other	36	21.8

n: patient number of patients, %: percentage value. BMI: Body mass index, TIVA: Total intravenous anesthesia, CPB: Cardiopulmonary bypass, PEEP: positive end-expiratory pressure, SPO2: Oxygen Saturation

During the operation in cardiac surgery;

When the anesthesia methods preferred by the participants were questioned, the preferences mainly were observed as Sevoflurane+opioid (69.8%). The pulmonary recruitment pressure applied manually during the operation was chosen by 106 (40.6%) of the participants, and the peak inspiratory pressure chosen by 126 (49.8%) was 20-30 cmH_2O. 127 (47.7%) participants stated that they "applied recruitment maneuvers to all patients" during the operation. While this pressure was applied between 10-30 seconds at most by 139 participants, 46 (27.7%) participants chose the maximum application interval as every hour **(Table 3)**.

170 (63.9%) of the participants reported that they received a request from the cardiovascular surgeon regarding the application of a mechanical ventilator, and it was observed that 118 (69.4%) of these requests were "to wean the patient from the mechanical ventilator". 116 (43.6%) of the anesthetists reported that the surgical team had "poor knowledge" about perioperative mechanical ventilator applications. 155 (61.5%) of the participants performed endotracheal aspiration before extubation, 210 (79.5%) stated that patients were not extubated in the operating room, 123 (51%) preferred non-invasive ventilation to patients with hypoxemia/hypercapnia, and 141 (55.1%) reported that all patients always received pulmonary rehabilitation after extubation **(Table 4)**.

Table 4. Knowledge of intraoperative mechanical ventilation of the surgical team and postoperative approaches

		n	%
Does the cardiovascular surgery team have a request regarding mechanical ventilator application during CPB?	Yes	170	63.9
	No	96	36.1
If yes to previous question, type of request?	Wean the patient	118	69.4
	Turn off the Mechanical Ventilator	39	22.9
	Apply only PEEP	1	0.6
	Apply only Tidal Volume	2	1.2
	Apply Tidal Volume and PEEP (TV≤3-5 Ml/kg, PEEP≤5)	10	5.9
How is the knowledge level of the surgical team about mechanical ventilator applications during CPB according to you?	Ignorant and needs training	29	10.9
	Very good	10	3.8
	Good	27	10.2
	Intermediate	84	31.6
	Poor	116	43.6
Is endotracheal aspiration performed before extubation?	Yes	155	61.5
	Yes, following lung recruitment maneuvers	43	17.1
	Not done by us	5	2.0
	Not done	49	19.4
Is extubation performed in the operation room?	Rarely	43	16.3
	Often	11	4.2
	Not done	210	79.5
Is non-invasive ventilation performed after extubation?	Always for all patients	28	11.6
	When needed	2	0.8
	Patients with Hypoxemia/Hypercapnia	123	51.0
	Patients with a history of COPD	31	12.9
	Not followed by us	1	0.4
	Patients in the high-risk group	56	23.2
Is pulmonary rehabilitation performed after extubation?	Always for all patients	141	55.1
	Patients with a history of COPD	30	11.7
	Not followed by us	1	0.4
	not done	21	8.2
	Patients in the high-risk group	63	24.6

n: patient number of patients, %: percentage value, CPB: Cardiopulmonary bypass, TV:Tidal Volume
PEEP: positive end-expiratory pressure, COPD: Chronic Obstructive Pulmonary Disease

DISCUSSION

According to our nationwide survey study: Anesthesiologists prefer low tidal volumes and PEEP preference in the range of 0-5 cmH_2O in hemodynamically stable or unstable patients, high PEEP preference in the range of 6-10 cmH_2O in obese patient groups, and protective ventilation strategies in which recruitment maneuvers are applied are at the forefront. In the study, in which anesthetists from different hospitals and with different experiences participated, it was seen that the basic criteria for mechanical ventilation followed by most of the anesthesiologists were similar. It has also been determined that there is no fixed protocol for mechanical ventilation strategies in cardiac surgery in Turkey.

The high "always" response rate for chest X-ray, blood gas analysis, pulmonary function tests, and echocardiography follows the pre-anesthesia evaluation criteria in cardiac surgery in the preoperative evaluation. The FEV1 value, which shows the volume of gas expelled from the lungs in the first second of forced expiration in the pulmonary function test, helps estimate the risk of postoperative pulmonary complications. Again, by interpreting arterial blood gas, an idea about the gas exchange, which shows the oxygen-carbon dioxide balance in the body, is provided (4). Preoperative echocardiography detects left ventricular thrombus or left-right ventricular function in patients with suspected severe left ventricular dysfunction or recent myocardial infarction. Especially when right ventricular dysfunction is detected, it can be decided to delay coronary artery bypass graft (CABG) for up to 4 weeks and wait for a recovery in the right ventricle (5). It was observed that the most requested consultation by the anesthesia outpatient clinic before cardiac surgery in Turkey was from the cardiology clinic. It has been reported that requesting cardiology consultation legally protects anesthetists in case of complications that may develop and provides benefits in the official determination of the risk of surgery (6).

In a meta-analysis comparing ventilation and CPAP, independent of the PEEP value applied during CPB, it was reported that both methods did not differ in PPC, and CPAP application only improved postoperative oxygenation (7). In the MECANO study, it was reported that no difference was observed between the groups in terms of reintubation, respiratory failure, and hospital mortality when the group not ventilated during pump was compared with the ventilation group administered under 3 ml/kg tidal volume and 5 cmH_2O PEEP (8). In the PROVECS study, both groups compared were ventilated with low tidal volumes before and after CPB (6-8 ml/kg, based on estimated body weight); While the open lung protective strategy was applied by applying recruitment maneuver and perioperative high PEEP (8 cmH_2O) in the experimental group during the CPB process, the recruitment maneuver was not applied in the control group during the CPB. It was ventilated with low PEEP pressure (2 cmH_2O) and low-pressure CPAP (2 cmH_2O). There was no difference between the groups in terms of PPC incidence. The study reported that working with open lungs with an open thorax may cause difficulties for surgeons, and hemodynamic instability that may occur may cause difficulties for anesthetists (9). In support of both studies, it was observed that most anesthetists in Turkey followed the patient with the mechanical ventilator turned off, without applying PEEP, and without recruitment maneuvers during CPB; that is, they did not prefer the open lung method. Except for the CPB period, it was noted that the low tidal volume (6-8 ml/kg) range was more frequently preferred. It was also noted that while 0-5 cmH_2O PEEP pressure was preferred in the hemodynamically stable or unstable patient group, higher PEEP (5-10 cmH_2O) was preferred in the obese patient group. Although the modern intraoperative lung-protective ventilation strategy (low PEEP and low tidal volume) is based on data obtained from abdominal surgeries, it has been reported that it may reduce PPC for cardiac procedures (10). It is recommended to consider a coefficient of 6-8 ml/kg for tidal volumes. Except for the CPB period, it has been reported that recruitment maneuvers are beneficial to reducing inflammatory cytokines in the period following intubation and to open closed alveoli that occur due to surgery during the operation and even in the intensive care unit and can be applied as long as the patient's hemodynamics remains stable (11). According to the survey, the highest rates for this maneuver are that anesthesiologists in Turkey apply recruitment to each patient for 10-30 seconds every hour.

In cardiac surgery, it is aimed to extubate the patient as early as possible in the postoperative period. According to the quality criteria supporting early extubation, the patient should be extubated within 6-24 hours postoperatively (12). However, thanks to the renewed CPB techniques and low-dose anesthesia applications, this interval was reduced to 1-24 hours, and even extubation was tried in the operating room under the name of "ultra-fast extubation" and was

found successful. Appropriate patients without severe cardiorespiratory pathologies should be selected for rapid extubation (13). In Turkey, however, the operating room is rarely preferred for extubation timing. Wu et al., in their meta-analysis on the prophylactic use of non-invasive mechanical ventilation (NIMV) in the postoperative period of cardiac surgery, stated that NIMV might contribute to early discharge even if it does not reduce pulmonary complications (14), while Olper et al. stated that this approach would reduce reintubation (15). NIMV was administered to all patients only by 28 (11.6%) participants in our study. One hundred twenty-three participants (51%) apply NIMV in the patient group with hypoxemia and hypercapnia after extubation. In cardiac surgeries, postoperative pulmonary physiotherapy applications (such as deep breathing, chest vibration, and cough-triggering maneuvers) prevent complications such as non-extractable secretion, pneumonia, and atelectasis. It has also been reported that physical therapy in the preoperative period reduces respiratory complications, especially in patients in the medium-high-risk group. Pulmonary physiotherapy after cardiac surgery in meta-analyses; although it cannot be as routine and valuable as thoracic surgeries because of the additional costs and its benefit has not been proven, pulmonary rehabilitation is included in our country (3). It is generally applied to patients with COPD or abnormal clinical findings in the preoperative period, when needed, and routinely at a high rate in the post-extubation period.

Most anesthetists dealing with cardiac surgery in Turkey prefer ventilation with tidal volumes as low as 6 ml/kg during cardiac surgery (except during the CPB period). During the CPB period, ventilation is often stopped. Our study found that anesthesiologists' cardiac surgical anesthesia management procedures differed. However, it has also been determined that there is no protocol regarding mechanical ventilation strategies in cardiac surgery in Turkey. New studies are necessary to determine optimal applications and obtain clear guidelines for mechanical ventilation strategies in cardiac surgery.

Ethic: Ethics committee approval (protocol no: 2019/06-08) was obtained from Kahramanmaras Sutçu Imam University, Faculty of Medicine Clinical Research Ethics Committee on 03.04.2019. Helsinki declaration principles were followed and an informed consent form was taken from the participants.

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