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Original Article

Effects of pressure-controlled ventilation-volume guaranteed on airway pressure, oxygenation, and postoperative complications in one-lung ventilation: a prospective randomized-controlled study

Cengiz Sahutoglu, Seden Kocabas, Fatma Zekiye Askar

Department of Anesthesiology and Reanimation, Ege University School of Medicine, Izmir, Turkey

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Abstract: The aim of this study was to investigate the effects of pressure-controlled ventilation-volume guaranteed (PCV-VG) and volume-controlled ventilation (VCV) mode on oxygenation, respiratory parameters, and complications in patients with one-lung ventilation (OLV) that underwent lobectomies. A prospective randomized-controlled study was conducted from July 2016 to February 2017. All participants underwent one-lung ventilation and lobectomies. Eighty patients were randomly divided into two groups, group 1 (PCV-VG) and group 2 (VCV). Data including demographic characteristics of the patients, intraoperative mechanical ventilation parameters, intraoperative and postoperative oxygenation parameters, and complications were recorded. Two ventilation modes were compared. The mean age of all patients, of whom 70% (n=56) were male, was 56.5±14.9 (range: 20 to 75) years. PaO_2 values were significantly higher only in PCV-VG modes with two-lung ventilation (P=0.033). However, remaining values including PH, $PaCO_2$, PaO_2, PaO_2/FiO_2, and lactate were similar (P>0.05). Most patients with a significant increase in airway pressure (*Plato pressure* >35 cm H_2O) were in the VCV mechanical ventilation mode. Fiberoptic bronchoscopy was used to confirm tube location (group 1: One patient vs group 2: Ten patients, P=0.007). There were no significant differences in postoperative complication rates between the groups (P>0.05). In conclusion, the use to PCV-VG ventilation mode in one-lung ventilation resulted in a significant decrease in peak airway pressure. However, it did not increase intra- and postoperative oxygenation or reduce complications.

Keywords: One-lung ventilation, lobectomy, volume-controlled ventilation, pressure-controlled ventilation-volume guaranteed, airway pressure, complications

Introduction

Hypoxemia may develop in certain patients. One-lung ventilation (OLV) can be safely implemented to expand the field of vision and facilitate surgical manipulation during lung surgeries. The main cause of hypoxemia is pulmonary shunt due to a single non-ventilated lung [1]. Volume-controlled ventilation (VCV) is often used as a mechanical ventilation mode, when OLV is implemented. Increased airway pressure in ventilated lungs causes blood flow to be directed to the non-ventilated lung and the rate of pulmonary shunts further increases, leading to a deepening of hypoxemia [2]. On the other hand, pressure-controlled ventilation (PCV) mode is used as a preventive ventilation strategy during acute lung injuries (ALI) and acute respiratory distress syndrome (ARDS), preventing uncontrolled increases in alveolar pressure [3]. Several studies comparing PCV with VCV have demonstrated that PCV mode reduces airway pressure and improves partial arterial oxygen pressure (PaO_2), particularly in patients with low preoperative forced vital capacity (FVC) values. In addition, peak inspiratory pressure (PIP) has been shown to decrease, while PaO_2 increases due to decreased inspiratory current in PCV mode during ALI and ARDS. Therefore, PCV mode has been suggested as an alternative ventilation mode to avoid high airway pressure during OLV [4-7]. PCV-VG mode, which combines VCV and PCV modes, is a more novel mode. Attempts have been made to

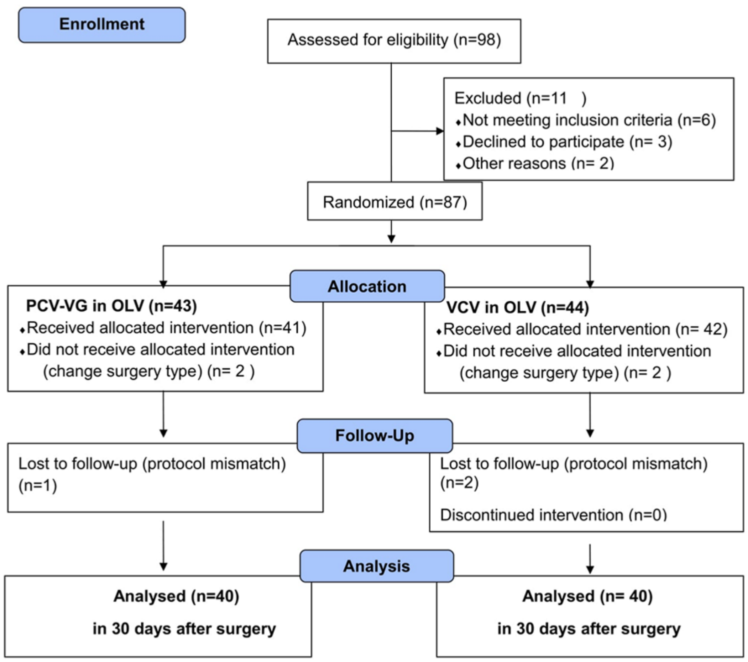

Figure 1. CONSORT diagram showing the flow of patients enrolled in the study. OLV; one-lung ventilation, PCV-VG; pressure-controlled ventilation-volume guaranteed, VCV; volume-controlled ventilation.

provide tidal volume adjusted by the lowest inspiratory pressure with the use of decelerated current [8, 9].

This present study aimed to investigate the effects of PCV-VG mode on oxygenation, need for manipulation, and postoperative complications in patients undergoing OLV, although the null hypothesis states that PCV-VG mode is equally efficacious as VCV.

Materials and methods

Study protocol was approved by the Scientific Ethics Committee (Decision No: 16-7/35). Written informed consent was obtained from each patient. This study was conducted in accordance with the principles of the Declaration of Helsinki.

This prospective randomized-controlled study included a total of 80 patients, aged 18-75 years, undergoing one-lung ventilation and lobectomies between July 2016 and February 2017. Patients were excluded if they had severe renal, cardiac, and hepatic impairment, previous thoracic surgery, and were defined as less than 50% of the predicted values of forced expiratory volume in 1 and forced vital capacity.

Patients were divided into two groups, as group 1 (PCV-VG) and group 2 (VCV), by computer randomization (Excel computer program, Microsoft Inc., Redmond, WA, USA). They were monitored using the same mechanical ventilation mode throughout the operation. Premedication was administered with 5 mg of diazepam at 10.00 PM and at 06.00 AM before the operation. Patients were monitored by electrocardiography, pulse oximetry, invasive radial artery, and central venous catheters. Induction anesthesia included 1 mg/kg of lidocaine, 2-3 mg/kg of propofol, 1-2 µg/kg of fentanyl, and 0.6 mg/kg of rocuronium bromide. All patients were intubated with a left double-lumen tube (females: 35-39 F, males: 39-41 F) and the location was confirmed by auscultation and fiberoptic bronchoscopy. Maintenance anesthesia was provided with desflurane (0.5-1 MAC), remifentanil (0.25-0.5 µg/kg/min), and propofol (1 mg/kg/h), added to oxygen and air mixture as 50% FiO_2. Patients were given mechanical ventilatory support (Datex-Ohmeda Avance Anesthesia Machine, GE Healthcare, Madison WI USA) at a tidal volume of 7 mL/kg predicted body weight with 4 cm H_2O positive end expiratory pressure (PEEP) support to achieve an inspiration/expiration ratio of 1:2 and 50% FiO_2. Patients were then maintained in the lateral position with a central venous catheter inserted into the internal jugular vein of the operation side. During OLV, tidal volumes of patients were reduced to 4 mL/kg and respiratory frequency was increased up to 18-20 (patients were targeted as $ETCO_2$ 35-45 mmHg and oxygen saturation over 92%). Blood pressure, central venous pressure (CVP), arterial blood gas values, compliance, peak inspiratory pressure (PIP), plateau pressure (PP), mean airway pressure (Pmean), baseline, 15^{th} and 60^{th} min OLV, and 15 minutes after two lung ventilation (TLV) following lobectomies were recorded. In addition, postoperative 6^{th} and 24^{th}-hour arterial blood gas analyses were recorded. In cases of intraoperative hypoxemia,

Table 1. Demographic and clinical data of patients (independent-samples t-test and Chi-square test)

	All Patients (n=80)	PCV-VG (n=40)	VCV (n=40)	*p* value
Age (Year)	56.5±14.9	54.6±16.2	58.5±13.4	0.246
Gender (Female/Male)	24/56	11/29	13/27	0.808
BMI (Kg/m^2)	25.9±4.2	25.1±3.7	26.7±4.5	0.086
Additional disease (No/Yes)	26/54	17/23	9/31	0.103
Operation Side (Right/Left)	49/31	26/14	23/17	0.647
Diagnosis (Bronchiectasis/Cancer)	10/70	5/35	5/35	0.999
Cigarette smoking (No/Yes)	24/56	13/27	11/29	0.808
FEV1 (Litres)	2.5±0.7	2.6±0.6	2.46±0.8	0.357
FVC (Litres)	3.5±0.8	3.6±0.7	3.4±0.9	0.326
FEV1/FVC (%)	74.2±10.3	76±11	72.4±9.3	0.124

Abbreviations: BMI; body mass index, BSA; Body surface area, FEV1; forced expiratory volume in the first second, FVC; Force vital capacity, PCV-VG; pressure-controlled ventilation-volume guaranteed mode, VCV; volume-controlled ventilation. Data were presented in mean ± standard deviation and number, n; number of patients.

certain maneuvers were performed for patient optimization including re-adjustment of tidal volume, increasing oxygen ratio, increasing PEEP, oxygen insufflation in non-ventilated lungs, fiberoptic confirmation of location of the intubation tube, and intermittent two-lung ventilation. Recruitment maneuvers (constant airway pressure of 35 cm H_2O to the whole lung for 10 seconds) were performed two times by mechanic ventilators when transitioning from OLV to TLV and at the end of operation. Restrictive fluid therapy was applied during intraoperative and postoperative periods (Based on patient weight, using the 4/2/1 rule to estimate preoperative fluid losses. All patients were applied with 500 mL crystalloid loading during the first hour. Maintenance fluid therapy was titrated as mean arterial blood pressure (MAP) above 65 mmHg (ephedrine was administered to treat refractory hypotension), heart rate (HR) 60-100 bpm, CVP 5-10 mmHg, and urine output above 0.5 mL/kg/h. Postoperative fluid therapy was calculated as 1000 mL/m^2/24 h in the first postoperative day).

Intercostal block (bupivacaine 100 mg), diclofenac 75 mg via intramuscular, paracetamol 1 g intravenous, and tramadol 100 mg intravenous were administered to all patients for analgesia. Maintenance analgesia was provided by patient-controlled analgesia (total tramadol as much as 400 mg as needed) and with diclofenac and paracetamol, as necessary (visual analog scale <4). Sugammadex was used for reversal neuromuscular blockade and all patients were extubated in the operation room.

Data including demographic characteristics, hemodynamic and respiratory parameters, intraoperative mechanical ventilation parameters, intra- and postoperative oxygenation parameters, duration of hospitalization, and intra- and postoperative complications were recorded. Both mechanical ventilatory modes were compared. Postoperative complications were defined as follows. Respiratory complications: pneumonia, re-intubation, tracheotomy, acute respiratory distress syndrome, respiratory failure (requires mechanic ventilation), air leak up 5 days, bronchopleural fistula; Cardiac complications: heart failure, arrhythmias (that *requires treatment),* myocardial infarction; Renal dysfunction: 0.3 mg dL^{-1} increase in creatinine levels compared to baseline values or need for renal replacement treatment or dialysis; Neurological complications: stroke (cerebral hemorrhage, infarct); Gastrointestinal complications: ileus, mesenteric ischemia, hemorrhage; Hematological complications: platelet count of <75000/mm^3 and an elevation of the prothrombin or partial thromboplastin time >1.5 times the control value; Sepsis: presence of infection and concurrent systemic inflammatory response syndrome; Revision: defined as the need for re-operation for any reason.

The primary outcome of this study was to determine the relationship between PCV-VG mechanical ventilation mode and intraoperative/postoperative arterial oxygenation. The secondary outcome was to control whether PCV-VG could decrease intraoperative lung pressure, need for manipulation, and postoperative complications. The anesthesiologist that performed the anesthesia did not take part in the collection of postoperative data.

Statistical analysis

Considering previous studies [7, 10, 11], the sample size was calculated as 80 patients (to

Table 2. Intraoperative blood gas and lactate values of the patients (*Mann-Whitney U-test and independent-samples t-test)*

		PH	$PaCO_2$	PaO_2	PaO_2/FiO_2	Lactate
Baseline	PCV-VG	7.43±0.05	36±5	209±75	411±144	1.18±0.5
	VCV	7.42±0.04	34±4	222±87	421±132	1.20±0.5
OLV15	PCV-VG	7.42±0.05	36±6	93±66	146±90	1.15±0.5
	VCV	7.42±0.04	34±5	100±53	169±88	1.05±0.4
OLV60	PCV-VG	7.42±0.05	35±5	81 (54-238)	131 (54-264)	1.20±0.4
	VCV	7.42±0.04	33±6	92 (52-316)	168 (61-395)	1.25±0.6
TLV	PCV-VG	7.39±0.06	38±5	227 (78-481)*	369±125	1.51±0.8
	VCV	7.39±0.05	35±6	168 (96-384)	332±80	1.75±0.8
Postoperative						
6th h	PCV-VG	7.34±0.05	39±7	116±32	233±63	1.83±0.8
	VCV	7.32±0.05	38±8	118±42	235±85	1.75±0.8
24th h	PCV-VG	7.38±0.04	36±4	109±32	217±64	1.8 (0.9-4)
	VCV	7.38±0.05	34±4	113±38	227±77	1.5 (0.9-3)

Abbreviations: OLV15; 15th-min one-lung ventilation, OLV60; 60th-min one-lung ventilation, TLV; two-lung ventilation after lobectomy, PCV-VG; pressure-controlled ventilation-volume guarantee, VCV; volume-controlled ventilation. Data were presented in mean ± standard deviation or median (min-max). *: P=0.033.

detect a difference of 40±5 in O_2 index during OLV and compare complications). Statistical analysis was performed using SPSS version 21.0 software (IBM Corp., Armonk, NY, USA). Data are expressed as mean ± standard deviation, median, and percentages (%). Normal distribution of data was analyzed using the Kolmogorov-Smirnov test. Chi-squared and Fisher's exact tests were used for categorical variables, whereas independent-samples t-tests and Mann-Whitney U-tests were used for quantitative variables. *P* values of <0.05 are considered statistically significant.

Results

Ninety-eight patients were enrolled in the study, with eighty patients completing it (**Figure 1**). The mean age of all patients, of whom 70% (n=56) were male, was 56.5±14.9 (range: 20 to 75) years. Of these patients, 87.5% and 12.5% underwent lobectomies due to lung tumors and bronchiectasis, respectively. Of these, 40% had more than one systemic disease, while 32.5% did not have any comorbid conditions. Twenty patients had chronic obstructive pulmonary disease, 20 patients had hypertension, 6 patients had coronary artery disease, 3 patients had cerebrovascular disease, 11 patients had diabetes mellitus, 8 patients had multinodular goitre, and 56 patients were smokers (P>0.05). Demographic and baseline characteristics of the patients are shown in **Table 1**. Evaluation of intra- and postoperative first 24-hour blood gases demonstrated that the PaO_2 values were significantly higher with TLV only in the PCV-VG mode. However, remaining values including PH, $PaCO_2$, PaO_2, PaO_2/FiO_2, and lactate were similar (**Table 2**).

PIP, measured from the intraoperative mechanical ventilator in the VCV group and the dynamic compliance in the PCV-VG group, were found to be significantly higher. Mean airway pressure measured on TLV was found to be high in the PCV-VG group, whereas the remaining mean airway pressure measurements and static compliance were found to be similar. Mean arterial pressure, heart rate, and CVP values of the patients were similar throughout the study period in both group 1 and group 2 (P>0.05) (**Table 3**). Total fluid amount (1000 mL (500-1700) vs 1000 mL (550-2300), P=0.088) and urine output (0.97±0.7 mL/kg/h vs 0.88±0.41 mL/kg/h, P=0.528) were similar in both groups.

Half of the patients (18 vs 22, P=0.503) showed an increase in FiO_2 due to decreased oxygen saturation below 92% during the intraoperative period, while insufflation was applied to the independent lung of nine patients (group 1:3 vs group 2:6, P=0.481) due to lack of response to this maneuver. Most patients with a significant increase in airway pressure (PP>35 cm H_2O)

Table 3. Intraoperative airway pressure and compliance values of the patients (*Mann-Whitney U-test and independent-samples t-test)*

		Baseline	OLV15	OLV60	TLV
PIP	PCV-VG	15 (12-26)	19 (14-33)	21±5	18 (14-35)
	VCV	19 (13-35)*	26 (16-45)*	27±6*	22 (16-42)**
PP	PCV-VG	15 (12-26)	19 (14-33)	21±5	18 (14-35)
	VCV	14 (10-28)	21 (11-40)	21.6±5.6	18 (13-35)
Pmean	PCV-VG	9 (7-13)	10.6±1.7	10.8±1.7	10 (8-15)***
	VCV	9 (6-13)	10.8±2.5	10.9±2.5	9 (7-15)
Cdynamic	PCV-VG	47 (28-65)*	23.6±5.8*	23.3±8.3*	33 (17-53)*
	VCV	28 (15-45)	17.3±4.6	17.6±4.9	23 (11-45)
Cstatic	PCV-VG	47 (28-65)	23.6±5.8	23.3±8.3	33 (17-53)
	VCV	45 (19-82)	23.2±7.9	23.7±8.2	32 (14-60)
RR	PCV-VG	12 (12-15)	18 (12-22)	18 (12-22)	14 (10-16)
	VCV	12 (12-18)	16 (12-25)	16 (12-20)	14 (10-20)
TV	PCV-VG	476±65	344±44	348±40	450±53
	VCV	476±68	375±53‡	373±51+	433±64
MAP	PCV-VG	86±16	76±12	82±10	83±13
	VCV	86±15	79±15	80±11	80±13
HR	PCV-VG	91±18	84±15	76±11	74±9
	VCV	90±17	81±12	76±11	75±14
CVP	PCV-VG	8.7±2.3	9.1±3	9.2±3.3	9.7±3.4
	VCV	9.2±3.3	9.5±4	9.6±4.2	10±3.7

Abbreviations: OLV15; 15^{th}-min one-lung ventilation, OLV60; 60^{th}-min one-lung ventilation, TLV; two-lung ventilation after lobectomy, PCV-VG; pressure-controlled ventilation-volume guaranteed mode, VCV; volume-controlled ventilation, PIP; Peak inspiratory pressure (cm H_2O), PP; plateau pressure (cm H_2O), Pmean; mean airway pressure (cm H_2O), C; Compliance (mL/cm H_2O), RR; respiratory rate/min, TV; tidal volume (mL), MAP; mean arterial pressure (mmHg), HR; Heart rate (bpm), CVP; central venous pressure (mmHg). Data were presented in mean ± standard deviation or median (min-max). *P<0.001; **P=0.002; ***P=0.001; ‡=0.006; +=0.017.

were in the VCV mechanical ventilation mode. Fiberoptic bronchoscopy was used to confirm tube location (group 1, n=1 vs group 2, n=10, P=0.007). Despite several interventions, intermittent two-lung ventilation was performed in eight patients with continuous high levels of desaturation or airway pressure (group 1, n=1 vs group 2, n=7; P=0.057).

At least one major complication was reported in 16% of the patients (n=13). Respiratory complications occurring in 12.5% (n=10) of the patients was the most frequent complication. Five of the patients developed a clinical presentation of acute renal failure, while none received dialysis. Only one of the patients (1.3%) died, due to multi-organ failure (**Table 4**).

Discussion

The present study demonstrates that PCV-VG ventilation leads to a significant decrease in PIP. However, it has no effect on intra- and postoperative oxygenation values and does not reduce complications.

Volume control mode is the most common mode of mechanical ventilation, during OLV. Recent publications have shown that PCV mode improves oxygenation during OLV [5, 6, 12]. In PCV mode, decelerated current is used while tidal volume is not constant. Also, pressure is applied and the chest wall is altered according to complications [4-7]. PCV-VG mode, which combines the VCV and PCV modes, is a more novel mode. Attempts have been made to provide the tidal volume adjusted by the lowest inspiratory pressure with the use of decelerated current [2].

In a study on thoracic surgery conducted by Boules et al. [8], including 40 patients, PCV-VG and VCV modes were compared. An increase in PCV-VG mode and PaO_2 values were reported, whereas there was a significant decrease in PIP and Pmean values. PCV-VG mode led to an increase in oxygenation values in 67.5% of the patients during OLV, reportedly due to reduced pulmonary vascular resistance and reduced rates of shunts by PCV-VG mode. Only one of the patients ventilated in the VCV mode was reported to develop hypoxemia. On the other hand, Song et al. [9] compared PCVG and VCV in their study of 27 patients. In their study, PCV-VG increased oxygenation in 63% patients and decreased oxygenation in 33% patients. However, there was no difference between the two modes in terms of oxygenation. PIP values were found to be significantly lower in PCV-VG mode, whereas Pmean values were reported to be higher. Therefore, the dynamic compliance of the PCV-VG group was reported to be higher, whereas static compliance was found to be lower. In another study, Boules et al. [10] compared PCV

Table 4. Distribution of postoperative complications (Chi-squared and Fisher's exact tests)

Complications	All Patients n (%)	PCV-VG n (%)	VCV n (%)	*p* value
At least one complication	13 (16.3)	10 (25)	3 (7.5)	0.066
Respiratory	10 (12.5)	7 (17.5)	3 (7.5)	0.311
Cardiac	1 (1.25)	0 (0)	1 (2.5)	>0.999
Renal	5 (6.25)	4 (10)	1 (2.5)	0.359
Neurological	1 (1.25)	1 (2.5)	0 (0)	>0.999
Gastrointestinal	2 (2.5)	2 (5)	0 (0)	0.494
Hematological	2 (2.5)	1 (2.5)	1 (2.5)	>0.999
Sepsis	2 (2.5)	1 (2.5)	1 (2.5)	>0.999
Revision	1 (1.25)	1 (2.5)	0 (0)	>0.999
Mortality	1 (1.25)	0 (0)	1 (2.5)	>0.999

Some patients had more than one complication. Abbreviations: PCV-VG; pressure-controlled ventilation-volume guarantee, VCV; volume-controlled ventilation, n; number of patients, %; percent.

and PCV-VG modes. The authors found that airway pressure, $ETCO_2$, PaO_2, and oxygenation indexes were similar in both modes. This condition was suggested to be associated with a decelerating flow pattern in both modes. Lin et al. [13] also compared VCV, PCV, and PCV-VG modes in 66 patients older than 65 years. They demonstrated that PIP was significantly lower, whereas PaO_2 was significantly higher in PCV and PCV-VG groups, compared to the VCV group. However, comparison of PCV and PCV-VG modes revealed no significant differences between the groups. This can be attributed to the fact that neuromuscular blockade and sedation levels keep surgical manipulations under control and do not allow sudden changes in lung compliance. In addition, although the patients were over 65-years-old, their lung function was not poor. Therefore, the authors concluded that PCV-VG mode was unable to fulfill the advantages that could automatically compensate for compliance and resistance changes. The authors, however, suggested that PCV-VG mode should be considered as the primary ventilation mode during OLV.

Results of the present study were similar. PCV-VG mode showed an all-time decrease in PIP values and an increase in dynamic compliance. The increase in dynamic compliance in PCV-VG mode was attributed to the decelerated flow applied. Mean airway pressure was also found to be increased significantly in PCV-VG mode only during the TLV period. As a result, an increase in the PaO_2 values was found during this period. Improved oxygenation was also attributed to the moderate increase in the P_{mean} provided by PCV-VG mode. However, oxygenation parameters were found to be similar during the postoperative period, as patients were extubated, since mode application was discontinued.

Assad et al. [14] reported that PCV-VG ventilation mode was superior to VCV in patients undergoing laparoscopic surgery in the trendelenburg position, with low PIP and higher dynamic compliance. However, there were no significant differences in oxygenation rates between the two modes. Therefore, the authors concluded that there was a need for further study investigating the effects of different respiratory modes on patient outcomes, with different patient groups, such as obese patients.

In a prospective cross-over study, Dion et al. [15] compared VCV, PCV, and PCV-VG modes in 20 patients undergoing bariatric surgery. Although PCV and PCV-VG modes were reported to reduce PIP values, no contribution to intraoperative hemodynamics, oxygenation, and anesthetic agent consumption were reported in their study. Comparison of PCV and PCV-VG modes demonstrated no differences in PIP values and all patients were able to be ventilated with PCV and PCV-VG modes without any problems. However, one of the patients ventilated in the VCV mode required modal change. In four patients, it was necessary to reset the inspiratory time to keep PIP at ≤40 cm H_2O.

In the present study, baseline FiO_2 was 50% in all patients. FiO_2 increases were reported to be necessary in half of the patients. Fiberoptic bronchoscopy and intermittent TLV were more likely to be necessary in VCV mode due to excessive increase in airway pressure during OLV. The fact that there was less manipulation in patients ventilated in the PCV-VG mode facilitated the duty of the anesthetist and surgeon.

In recent years, several studies have suggested that PCV ventilation mode is preferred due to the reduction of airway pressure and reduction of oxygenation by reducing shunts [5, 6, 12].

Lin et al. [5] and Tugrul et al. [6] reported that PCV mode developed arterial oxygenation during OLV in patients with older and lower respiratory function tests. Senturk et al. [12] also used PCV + 4 cm H_2O PEEP with VCV + 0 PEEP, suggesting that oxygenation in the PCV + 4 cm H_2O PEEP group improved. In addition, several studies have demonstrated that, although PCV mode during thoracic surgery decreased airway pressure, it did not correct oxygenation [5, 7, 16].

The present study included patients with good respiratory function test results. Only 27.5% of the patients were in the >65-year-old patient group. However, this study did not include morbid obese patients and only 15% of the patients were overweight. There was no relationship between advanced age and overweight and postoperative complications. There were also no significant differences in oxygenation values between the groups. The increase in PaO_2 during TLV was attributed to the moderate increase in P_{mean} due to PCV-VG mode. All patients underwent a minimum of 4 cm H_2O PEEP, which was continued throughout surgery. PEEP was reported to prevent the development of postoperative atelectasis and hypoxemia, resulting in complications similar in the two study groups.

However, there were some limitations to this study. First, patients with poor respiration and a history of serious disease were excluded from the study. Second, a pulmonary artery catheter was introduced. Shut rates and mixed venous saturations were not compared between the groups.

In conclusion, although the use of PCV-VG ventilation during OLV resulted in a significant decrease in peak airway pressure, it did not contribute to intra- and postoperative oxygenation values. It also did not reduce complications. However, less manipulation with intraoperative mechanical ventilation and double-lumen tubing in patients ventilated during PCV-VG mode facilitated the duty of the anesthesiologist. Further large-scale studies are required to confirm these findings and to establish a definite conclusion.

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Ethics Committee approval was received for this study from the Clinical Research Ethical Committee of Ege University School of Medicine. Written informed consent was obtained from patients participating in this study.

Disclosure of conflict of interest

None.

Address correspondence to: Dr. Cengiz Sahutoglu, Department of Anesthesiology and Reanimation, Ege University School of Medicine, Ege Universitesi Tip Fakultesi, Anesteziyoloji ve Reanimasyon AD, Bornova 35100, Izmir, Turkey. Tel: +902323902143; Fax: +902323397687; E-mail: csahutoglu@yahoo.com

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