ISSN 2307-8960 (online)

# World Journal of *Clinical Cases*

*World J Clin Cases* 2022 November 26; 10(33): 12066-12461

Published by Baishideng Publishing Group Inc

World Journal of Clinical Cases

Contents

Thrice Monthly Volume 10 Number 33 November 26, 2022

## MINIREVIEWS



## ORIGINAL ARTICLE

### Clinical and Translational Research



### Retrospective Study

*World Journal of Clinical Cases*

**Thrice Monthly Volume 10 Number 33 November 26, 2022**

## Contents

*World Journal of Clinical Cases*

**Thrice Monthly Volume 10 Number 33 November 26, 2022**

## Contents

*World Journal of Clinical Cases*

**Thrice Monthly Volume 10 Number 33 November 26, 2022**

## Contents

*World Journal of Clinical Cases*

Thrice Monthly Volume 10 Number 33 November 26, 2022

## Contents




**NAME OF JOURNAL**
*World Journal of Clinical Cases*

**ISSN**
ISSN 2307-8960 (online)

**LAUNCH DATE**
April 16, 2013

**FREQUENCY**
Thrice Monthly

**EDITORS-IN-CHIEF**
Bao-Gan Peng, Jerzy Tadeusz Chudek, George Kontogeorgos, Maurizio Serati, Ja Hyeon Ku

**EDITORIAL BOARD MEMBERS**
https://www.wjgnet.com/2307-8960/editorialboard.htm

**PUBLICATION DATE**
November 26, 2022

**COPYRIGHT**
© 2022 Baishideng Publishing Group Inc

**INSTRUCTIONS TO AUTHORS**
https://www.wjgnet.com/bpg/gerinfo/204

**GUIDELINES FOR ETHICS DOCUMENTS**
https://www.wjgnet.com/bpg/GerInfo/287

**GUIDELINES FOR NON-NATIVE SPEAKERS OF ENGLISH**
https://www.wjgnet.com/bpg/gerinfo/240

**PUBLICATION ETHICS**
https://www.wjgnet.com/bpg/GerInfo/288

**PUBLICATION MISCONDUCT**
https://www.wjgnet.com/bpg/gerinfo/208

**ARTICLE PROCESSING CHARGE**
https://www.wjgnet.com/bpg/gerinfo/242

**STEPS FOR SUBMITTING MANUSCRIPTS**
https://www.wjgnet.com/bpg/GerInfo/239

**ONLINE SUBMISSION**
https://www.f6publishing.com




E-mail: bpgoffice@wjgnet.com https://www.wjgnet.com

World Journal of Clinical Cases

Submit a Manuscript: https://www.f6publishing.com

*World J Clin Cases* 2022 November 26; 10(33): 12146-12155

DOI: 10.12998/wjcc.v10.i33.12146

ISSN 2307-8960 (online)

ORIGINAL ARTICLE

Retrospective Study

# Different positive end expiratory pressure and tidal volume controls on lung protection and inflammatory factors during surgical anesthesia

Yu Wang, Yi Yang, Ding-Mu Wang, Jie Li, Quan-Tang Bao, Bei-Bei Wang, Shu-Jun Zhu, Lu Zou

**Specialty type:** Anesthesiology

**Provenance and peer review:** Unsolicited article; Externally peer reviewed.

**Peer-review model:** Single blind

**Peer-review report's scientific quality classification**

Grade A (Excellent): 0
Grade B (Very good): B
Grade C (Good): C
Grade D (Fair): 0
Grade E (Poor): 0

**P-Reviewer:** Kleinschmidt S, Germany; Terceno M, Spain

**Received:** June 22, 2022
**Peer-review started:** June 22, 2022
**First decision:** July 13, 2022
**Revised:** July 27, 2022
**Accepted:** October 20, 2022
**Article in press:** October 20, 2022
**Published online:** November 26, 2022

**Yu Wang, Ding-Mu Wang, Quan-Tang Bao, Bei-Bei Wang, Shu-Jun Zhu,** Department of Anesthesia, Xinghua City People's Hospital, Xinghua 225700, Jiangsu Province, China

**Yi Yang,** Department of Anesthesiology, Suzhou High-Tech Zone People's Hospital, Suzhou 215011, Jiangsu Province, China

**Jie Li,** Naval Medical Center, Naval Medical University, PLA, Shanghai 200433, China

**Lu Zou,** Department of Anesthesiology, Changzhou Hospital of Traditional Chinese Medicine, Changzhou 213000, Jiangsu Province, China

**Corresponding author:** Lu Zou, MD, Associate Chief Physician, Chief Doctor, Department of Anesthesiology, Changzhou Hospital of Traditional Chinese Medicine, No. 25 Heping North Road, Tianning District, Changzhou 213000, Jiangsu Province, China.
baobao01013812@163.com

## Abstract

### *BACKGROUND*

Mechanical ventilation can lead to the severe impairment of the metabolic pathway of alveolar surfactants, inactivating alveolar surfactants and significantly reducing lung-chest compliance. The cardiopulmonary function of elderly patients usually reduced to a certain extent, and there are lung complications after surgical anesthesia, just like lung barotrauma caused by mechanical ventilation, atelectasis and postoperative hypoxemia.

### *AIM*

To investigate the effects of different positive end expiratory pressures (PEEPs) and tidal volumes (VTs) on respiratory function, the degree of the inflammatory response and hemodynamic indexes in patients undergoing surgery under general anesthesia.

### *METHODS*

A total of 120 patients undergoing surgery for gastric or colon cancer under general anesthesia in Xinghua People's Hospital from January 2017 to January 2021 were randomly divided into Group A and Group B, with 60 cases in each group. The ventilation mode in Group A was VT (6.0 mL/kg) + PEEP (5.0 $cmH_2$

O), while that in Group B was VT (6.0 mL/kg) + PEEP (8.0 $cmH_2O$). Blood gas parameters, respiratory mechanical parameters, inflammatory response indicators, hemodynamic indicators and related complications were compared between the two groups.

***RESULTS***

There were no significant differences in $PaCO_2$, $PaO_2$, oxygen or the examined indexes at T0 between group A and group B ($P > 0.05$). The measured $PaO_2$ value of patients in group A at T3 was higher than that in group B, and the difference was significant ($P < 0.05$). There were no significant differences in peak airway pressure ($P_{peak}$), mean airway pressure or dynamic pulmonary compliance (Cdyn) at T0 between group A and group B ($P > 0.05$). The measured $P_{peak}$ value of patients in group A at T1 was higher than that in group B, and the difference was significant ($P < 0.05$). The measured Cdyn value at T1 and T2 was greater than that in group B ($P < 0.05$). Before surgery, there were no significant differences in tumor necrosis factor-α (TNF-α), interleukin (IL)-6 or IL-10 between group A and group B ($P > 0.05$). After 4 h, the measured values of TNF-α and IL-6 in group A were lower than those in group B, and the differences were significant ($P < 0.05$). The IL-10 Level in group A was higher than that in group B ($P < 0.05$). At T0, there were no significant differences in cardiac output, cardiac index (CI), stroke volume index (SVI) or mean arterial pressure between group A and group B ($P > 0.05$). The measured values of CI and SVI at T2 in patients in group A were higher than those in group B, and the differences were significant ($P < 0.05$).

***CONCLUSION***

For patients undergoing surgery for gastric or colon cancer under general anesthesia, the VT (6.0 mL/kg) + PEEP (5.0 $cmH_2O$) regimen was more effective than the VT (6.0 mL/kg) + PEEP (8.0 $cmH_2O$) regimen in protecting the lung function and ventilatory function of patients, and it had better effects on maintaining hemodynamic stability and reducing inflammatory reactions.

**Key Words:** General anesthesia; Positive end expiratory pressure; Tidal volume; Respiratory function; Inflammatory reactions; Hemodynamics



**Core Tip:** A retrospective study proved that for patients undergoing surgery for gastric or colon cancer under general anesthesia, the tidal volume (VT) (6.0 mL/kg) + positive end expiratory pressure (PEEP) (5.0 $cmH_2O$) regimen is better than the VT (6.0 mL/kg) + PEEP (8.0 $cmH_2O$) regimen Can more effectively protect the patient's lung function and ventilation function.

**Citation:** Wang Y, Yang Y, Wang DM, Li J, Bao QT, Wang BB, Zhu SJ, Zou L. Different positive end expiratory pressure and tidal volume controls on lung protection and inflammatory factors during surgical anesthesia. *World J Clin Cases* 2022; 10(33): 12146-12155

**URL:** https://www.wjgnet.com/2307-8960/full/v10/i33/12146.htm

**DOI:** https://dx.doi.org/10.12998/wjcc.v10.i33.12146

## INTRODUCTION

Elderly patients often present more complications because they exhibit a variety of pathologies during the perioperative period, such as decreased respiratory function and increased heterogeneity of lung tissue[1]. They are also prone to the development of lung injury, including barotrauma, atelectasis, postoperative hypoxemia and other complications during general anesthesia[2,3]. In addition, pulmonary complications are one of the main complications in elderly patients after general anesthesia [4]. Mechanical ventilation, as an important measure for respiratory support treatment and general anesthesia for surgery, has been used for a long time in clinical practice[5,6]. Some studies have proposed the use of low volume tidal (VT) (6–8 mL/kg) combined with a certain level of positive end expiratory pressure (PEEP) and allowing $PaCO_2$ to rise to a certain extent as a lung protection strategy, which can improve lung compliance and oxygenation function[7,8]. For example, applying VT supplemented with appropriate PEEP for mechanical ventilation during esophageal cancer surgery can reduce the systemic inflammatory response, improve lung function and shorten the time to extubation, indicating a certain improvement in the prognosis of patients[9]. A large number of studies confirmed that during mechanical ventilation, the alveolar epithelium was stimulated by mechanical traction and

released a variety of inflammatory cytokines, such as tumor necrosis factor-α (TNF-α), interleukin-6 (IL-6) and IL-10, which promoted the activation of macrophages and neutrophils. These cells not only produced a large amount of collagenase and elastase but also release a large amount of active oxygen. These substances can directly or indirectly destroy alveolar epithelial cells or even vascular endothelial cells, leading to lung tissue damage[7,10,11].

Reducing lung complications after surgery for gastric cancer or colon cancer under general anesthesia is an urgent problem to be solved. Research has shown[12] that PEEP can improve the oxygenation function of the lung to a certain extent and improve the ventilation effect. PEEP has been widely used in the treatment of acute lung injury and has achieved good clinical effects[3,13]. In this study, elderly patients (aged 60–81) undergoing abdominal tumor surgery under general anesthesia were taken as the research subjects, and the clinical effects of different ventilation modes were explored from a new perspective through comparisons among different groups to provide a theoretical and experimental basis for the safe implementation of mechanical ventilation in elderly patients.

## MATERIALS AND METHODS

### Material

A total of 120 patients undergoing surgery for gastric cancer or colon cancer under general anesthesia in our Hospital from January 2017 to January 2021 were selected and randomly divided into Group A and Group B, with 60 cases in each group according to random numbers. Inclusion criteria: (1) The patient had surgical treatment for gastric cancer or colon cancer under general anesthesia; (2) American Association of Anesthesiologists[14] classification: grades I–III; (3) The age of the patient was 60–81 years old; and (4) Presurgical lung function and heart function were tested, and the patient could tolerate the surgery. The exclusion criteria were as follows: (1) Concomitant bronchial asthma; (2) Pulmonary infection, tuberculosis and pulmonary fibrosis; (3) A history of congenital heart disease, severe arrhythmia and myocardial infarction; (4) A history of cerebrovascular disease in the past six months; (5) Allergic history; and (6) Other serious complications or complications.

Patients and their families received appropriate communication, and an informed consent form was signed by each patient before enrollment in this study. This study was implemented based on the protocols of the Medical Ethics Committee of our hospital.

### Pharmaceutical instrument

Anesthetic drugs were given as follows: Midazolam: 10 mg/2 mL, Jiangsu Enhua Pharmaceutical Co., Ltd.; Propofol injection: 20 mL 200 mg, AstraZeneca Pharmaceutical Co., Ltd.; Intravenous neostigmine: 1 mL: 0.5 mg × 10 PCs, Henan Runhong Pharmaceutical Co., Ltd.; Etomidate fat emulsion 20 mg/10 mL, Jiangsu Enhua Pharmaceutical Co., Ltd.; Sevoflurane 250 mL/bottle, Maronite Pharmaceutical Co., Ltd.; Vecuronium bromide powder batch number: 1104012, 4 mg, manufacturer: Hainan Starr Pharmaceutical Co., Ltd.; and Fentanyl: 50 μg/1 mL, Yichang Renfu Pharmaceutical Co., Ltd.

### Instrument reagent

ELISA kits were purchased from Beijing Dakota Biotechnology Co., Ltd.; a microplate reader was used (model ELX-800) manufacturer: Burt Co., Ltd., USA; OMEDA 7100 (Shanghai Lixin Industry Co., Ltd.), an anesthesia machine was used, and Philips ECG Monitor (Philips Medical Instruments, the Netherlands) was used.

### Anesthesia and ventilation methods

Surgical anesthesiologists were all doctors in the same group. Food and water was withheld from patients for more than 8 h before the operation. The venous channel was opened after entering the room, and ECG monitoring was conducted. An intravenous injection of 0.02 mg/kg midazolam was performed, and a right femoral artery puncture was performed under local anesthesia. Anesthesia was performed with an induced oxygen flow of 5 L/min, midazolam 0.01–0.03 mg/kg, propofol 2 mg/kg, and vecuronium 0.15 mg/kg. Intubation was performed successfully and the rats were mounted on the anesthesia machine. The ventilation mode in group A was VT (6.0 mL/kg) + PEEP (5.0 $cmH_2O$), while that in group B was VT (6.0 mL/kg) + PEEP (8.0 $cmH_2O$). End-expiratory carbon dioxide was maintained at 35–45 mmHg (1 mmHg = 0.133 kPa) during the operation, with a maximum airway pressure peak of no more than 25 $cmH_2O$. Before the operation, intravenous fentanyl at 2 μg/kg and propofol at 3 mg/ (kg·h) were administered to maintain anesthesia, remifentanil was administered at 0.05-1.00 μg/ (kg·min), and intermittent vecuronium bromide injections and inhaled sevoflurane at a 0.5-1.2 minimum alveolar concentration were given. Inhalation anesthesia was stopped 20 min before the end of the operation, with an oxygen flow rate of 5 L/min and intravenous fentanyl at 0.5–1.0 μg/kg. Spontaneous breathing resumed after surgery.

### Observation index

The blood gas parameters, respiratory mechanical parameters, inflammatory response indicators, hemodynamic indicators and related complications of the two groups at different times [before anesthesia induction (T0), 10 min mechanical ventilation (T1), 60 min mechanical ventilation (T2), and after catheter removal (T3)] were compared.

The blood gas parameters mainly included arterial partial pressure of carbon dioxide ($PaCO_2$), arterial partial pressure of oxygen ($PaO_2$), oxygen and index. The respiratory mechanical parameters mainly included peak airway pressure ($P_{peak}$), mean airway pressure ($P_{mean}$), and dynamic pulmonary compliance (Cdyn).

Inflammatory response indicators included serum TNF-α, IL-6, and IL-10.

Hemodynamic indicators mainly included the patient's cardiac output (CO), cardiac index (CI), stroke volume index (SVI), and mean arterial pressure (MAP).

At different times during the operation, 3 mL of venous blood was collected and centrifuged at 3000 r/min for 15 min. Serum was separated, and the levels of TNF-α, IL-6 and IL-10 were detected by ELISA.

During the operation, a multifunctional monitor was used to record the $P_{peak}$, Cdyn, $P_{mean}$, MAP, CO, SVI, and CI. Arterial blood was drawn for blood gas analysis, $PaO_2$ and $PaCO_2$ were recorded, and the oxygenation index (OI) was calculated, where OI= $PaO_2/FiO_2$.

### Statistical analysis

In this study, the measurement values of $P_{peak}$, $P_{mean}$ and Cdyn were all in line with the approximate normal distribution or normal distribution through the normal distribution test, expressed as mean ± SD, and the measurement data were analyzed by the *t* test and an analysis of variance in SPPS software. The $\chi^2$ test was used to analyze adverse reactions. The significance level was set at $\alpha = 0.05$.

## RESULTS

### Comparison of general data between two groups

There were no significant differences in baseline data, such as age, height, weight, and sex composition, between group A and group B ($P > 0.05$, Table 1).

### Comparison of operation indexes between two groups

There were no significant differences in operation time, anesthesia time, total fluid replacement or urine volume between group A and group B ($P > 0.05$, Table 2).

### Comparison of blood gas index between two groups

There were no significant differences in $PaCO_2$, $PaO_2$, oxygen or index at T0 between group A and group B ($P > 0.05$). The measured $PaO_2$ value of patients in group A at T3 was higher than that in group B, and the difference was significant ($P < 0.05$, Table 3).

### Comparison of airway compliance between two groups

Compared with group A and group B at T0, there was no significant difference ($P > 0.05$). The measured value of $P_{peak}$ in group A was higher than that in group B at T1 ($P < 0.05$), and the measured value of Cdyn at T1 and T2 was higher than that in group B ($P < 0.05$) (Table 4).

### Comparison of serum inflammatory factor levels before and after the operation between the two groups

Before surgery, there were no significant differences in TNF-α, IL-6 or IL-10 between group A and group B ($P > 0.05$). After 4 h, the measured values of TNF-α and IL-6 in group A were lower than those in group B, and the differences were significant ($P < 0.05$). The IL-10 Level in group A was higher than that in group B ($P < 0.05$) (Table 5).

### Comparison of hemodynamic indexes before and after operation between the two groups

At T0, there were no significant differences in CO, CI, SVI or MAP between group A and group B ($P > 0.05$). The measured values of CI and SVI at T2 in group A were higher than those in group B, and the differences were significant ($P < 0.05$) (Table 6).

### Comparison of complication rate between two groups

The incidence of surgical complications in group A and group B was statistically analyzed, and there were no significant differences between the two groups ($P > 0.05$, Table 7).

**Table 1 Comparison of general data of the two groups of patients (mean ± SD)**

| Index | Group A (*n* = 60) | Group B (*n* = 60) | $t/\chi^2$ value | *P* value |
|---|---|---|---|---|
| Age (yr) | 69.6 ± 5.3 | 70.3 ± 5.7 | -0.697 | 0.487 |
| Height (cm) | 165.0 ± 6.1 | 163.9 ± 5.5 | 1.037 | 0.302 |
| Body weight (kg) | 125.1 ± 9.7 | 126.4 ± 7.5 | -0.821 | 0.413 |
| SBP (mmHg) | 129.5 ± 7.6 | 128.0 ± 8.2 | 1.039 | 0.301 |
| DBP (mmHg) | 75.2 ± 6.9 | 76.8 ± 7.7 | -1.199 | 0.233 |
| HR (beats/min) | 76.4 ± 8.1 | 75.0 ± 7.0 | 1.013 | 0.313 |
| Sex, *n* (%) | | | 0.862 | 0.353 |
| Male | 33 (55.00) | 38 (63.33) | | |
| Female | 27 (45.00) | 22 (36.67) | | |
| hypertension, *n* (%) | | | 1.269 | 0.260 |
| Yes | 26 (43.33) | 20 (33.33) | | |
| No | 34 (56.67) | 40 (66.67) | | |
| Diabetes, *n* (%) | | | 1.713 | 0.191 |
| Yes | 11 (18.33) | 6 (10.00) | | |
| No | 49 (81.67) | 54 (90.00) | | |
| ASA stage, *n* (%) | | | 2.874 | 0.238 |
| I stage | 15 (25.00) | 10 (16.67) | | |
| II stage | 35 (58.33) | 33 (55.00) | | |
| III stage | 10 (16.67) | 17 (28.33) | | |

SBP: Systolic blood pressure; DBP: Diastolic blood pressure; HR: Heart rate; ASA: American Society of Anesthesiologists.

**Table 2 Comparison of surgical indicators between the two groups (mean ± SD)**

| Group | Operation time (min) | Anesthesia time (min) | Total rehydration (mL) | Urine volume (mL) |
|---|---|---|---|---|
| Group A (*n* = 60) | 216.3 ± 20.5 | 233.8 ± 19.5 | 2568.1 ± 208.4 | 398.5 ± 58.1 |
| Group B (*n* = 60) | 212.0 ± 22.7 | 229.5 ± 22.8 | 2590.4 ± 211.7 | 410.3 ± 63.5 |
| *t* value | 1.089 | 1.110 | -0.581 | -1.062 |
| *P* value | 0.278 | 0.269 | 0.562 | 0.290 |

**Table 3 Comparison of surgical indicators between the two groups (mean ± SD)**

| Group | Operation time (min) | Anesthesia time (min) | Total rehydration (mL) | Urine volume (mL) |
|---|---|---|---|---|
| Group A (*n* = 60) | 216.3 ± 20.5 | 233.8 ± 19.5 | 2568.1 ± 208.4 | 398.5 ± 58.1 |
| Group B (*n* = 60) | 212.0 ± 22.7 | 229.5 ± 22.8 | 2590.4 ± 211.7 | 410.3 ± 63.5 |
| *t* value | 1.089 | 1.110 | -0.581 | -1.062 |
| *P* value | 0.278 | 0.269 | 0.562 | 0.290 |

## DISCUSSION

In elderly patients, the alveoli are more likely to collapse during general anesthesia, causing atelectasis and leading to lung injury and hypoxemia. Small tidal volume combined with PEEP has been widely used in the clinical treatment of acute lung injury and has achieved good clinical results. However, with the increase in PEEP, the venous return flow may be decreased, and the arterial vascular resistance will be increased, which may affect cardiac output and increase the risk of lung injury, especially for elderly

**Table 4 Comparison of airway compliance indexes between the two groups (mean ± SD)**

| Group | T0 | T1 | T2 | T3 |
|---|---|---|---|---|
| $P_{peak}$ ($cmH_2O$) | | | | |
| Group A ($n$ = 60) | 15.36 ± 2.44 | 20.06 ± 1.98 | 21.58 ± 2.74 | 17.41 ± 2.80 |
| Group B ($n$ = 60) | 16.11 ± 2.70 | 18.62 ± 2.70 | 20.67 ± 2.68 | 18.15 ± 2.76 |
| $t$ value | -1.596 | 3.331 | 1.839 | -1.458 |
| $P$ value | 0.113 | 0.001 | 0.068 | 0.148 |
| $P_{mean}$ ($cmH_2O$) | | | | |
| Group A ($n$ = 60) | 8.51 ± 1.84 | 10.33 ± 1.96 | 11.36 ± 2.24 | 10.71 ± 2.54 |
| Group B ($n$ = 60) | 8.93 ± 2.00 | 9.81 ± 2.71 | 10.95 ± 2.46 | 10.40 ± 2.75 |
| $t$ value | -1.197 | 1.204 | 0.955 | 0.641 |
| $P$ value | 0.234 | 0.231 | 0.342 | 0.522 |
| Cdyn ($cmH_2O$) | | | | |
| Group A ($n$ = 60) | 38.64 ± 3.11 | 30.52 ± 3.04 | 29.64 ± 3.11 | 33.75 ± 3.58 |
| Group B ($n$ = 60) | 39.33 ± 4.05 | 28.64 ± 3.58 | 28.11 ± 2.90 | 32.68 ± 2.83 |
| $t$ value | -1.047 | 3.101 | 2.787 | 1.816 |
| $P$ value | 0.297 | 0.002 | 0.006 | 0.072 |

$P_{peak}$: Peak airway pressure; $P_{mean}$: Mean airway pressure; Cdyn: Dynamic pulmonary compliance.

**Table 5 Comparison of serum inflammatory factor levels before and after operation between the two groups (mean ± SD)**

| Group | TNF-α (ng/mL) | | IL-6 (pg/mL) | | IL-10 (pg/mL) | |
|---|---|---|---|---|---|---|
| | Preoperative | 4 h after operation | Preoperative | 4 h after operation | Preoperative | 4 h after operation |
| Group A ($n$ = 60) | 43.26 ± 6.80 | 76.65 ± 8.77 | 47.14 ± 5.50 | 56.94 ± 7.30 | 34.62 ± 5.10 | 29.51 ± 4.75 |
| Group B ($n$ = 60) | 45.10 ± 6.55 | 89.28 ± 12.64 | 45.03 ± 6.28 | 69.71 ± 10.38 | 36.36 ± 6.15 | 25.83 ± 5.08 |
| $t$ value | -1.510 | -6.359 | 1.958 | -7.795 | -1.687 | 4.099 |
| $P$ value | 0.134 | 0.000 | 0.053 | 0.000 | 0.094 | 0.000 |

TNF-α: Tumor necrosis factor-α; IL: Interleukin.

patients under general anesthesia[15-17].

In this study, patients undergoing gastric or colon cancer surgery under general anesthesia were given different kinds of ventilation. The ventilation mode in group A was VT (6.0 mL/kg) + PEEP (5.0 $cmH_2O$), and that in group B was VT (6.0 mL/kg) + PEEP (8.0 cmH2O). The results of this study showed that there were no significant differences in $PaCO_2$, $PaO_2$, oxygen or index at T0 between group A and group B ($P$ > 0.05). The measured $PaO_2$ value of patients in group A at T3 was higher than that in group B, and the difference was significant. This study found that a small tidal volume of 6 mL/kg combined with PEEP 5 $cmH_2O$ and 8 $cmH_2O$ could improve alveolar oxygenation function. To a certain extent, $PaO_2$ increased with increasing PEEP, improving the oxygenation and ventilation function of the lung. The unventilated alveolar dead spaces would reopen, and the number would increase, leading to the corresponding enhancement of alveolar oxygenation function. PEEP is conducive to the exchange of external gas and alveolar gas, as well as the release of carbon dioxide and the entry of oxygen into the alveolar space, thus improving the oxygenation and ventilation function of the lung in elderly patients.

$P_{peak}$, $P_{mean}$ and Cdyn are three commonly used respiratory mechanical indicators that can reflect lung compliance, airway resistance and alveolar pressure[18,19]. The results of this study showed that there were no significant differences in $P_{peak}$, $P_{mean}$ and Cdyn at T0 between the patients in group A and group B ($P$ > 0.05). The $P_{peak}$ measured value of patients in group A at T1 was higher than that in group B, and the difference was significant ($P$ < 0.05). The Cdyn measured value at T1 and T2 was greater than that in group B. In Group B, the 6 mL/kg tidal volume in combination with PEEP at 5 $cmH_2O$ mode had a lower change in airway pressure and a lower $P_{peak}$ and thus had less adverse effect on lung compliance,

**Table 6 Comparison of hemodynamic indexes between two groups of patients before and after operation (mean ± SD)**

| Group | T0 | T1 | T2 | T3 |
|---|---|---|---|---|
| CO (L/min) | | | | |
| Group A ($n$ = 60) | 4.81 ± 0.85 | 4.43 ± 0.80 | 4.36 ± 0.75 | 4.51 ± 0.83 |
| Group B ($n$ = 60) | 4.95 ± 0.90 | 4.30 ± 0.78 | 4.13 ± 0.80 | 4.37 ± 0.86 |
| $t$ value | -0.876 | 0.901 | 1.625 | 0.907 |
| $P$ value | 0.383 | 0.369 | 0.107 | 0.366 |
| CI [L/(min·m$^2$)] | | | | |
| Group A ($n$ = 60) | 4.11 ± 0.40 | 3.83 ± 0.46 | 3.51 ± 0.42 | 3.68 ± 0.40 |
| Group B ($n$ = 60) | 4.26 ± 0.44 | 3.90 ± 0.50 | 3.30 ± 0.39 | 3.53 ± 0.44 |
| $t$ value | -1.954 | -0.798 | 2.838 | 1.954 |
| $P$ value | 0.053 | 0.426 | 0.005 | 0.053 |
| SVI (mL/m$^2$) | | | | |
| Group A ($n$ = 60) | 47.52 ± 4.63 | 44.03 ± 3.75 | 43.85 ± 3.11 | 45.08 ± 4.09 |
| Group B ($n$ = 60) | 48.36 ± 4.90 | 43.41 ± 4.03 | 41.66 ± 3.57 | 44.13 ± 4.37 |
| $t$ value | -0.965 | 0.872 | 3.583 | 1.229 |
| $P$ value | 0.336 | 0.385 | 0.000 | 0.221 |
| MAP (mmHg) | | | | |
| Group A ($n$ = 60) | 97.63 ± 4.15 | 88.16 ± 5.20 | 87.11 ± 4.64 | 102.84 ± 5.00 |
| Group B ($n$ = 60) | 98.90 ± 4.68 | 86.85 ± 4.96 | 86.08 ± 5.03 | 104.07 ± 4.86 |
| $t$ value | -1.573 | 1.412 | 1.166 | -1.366 |
| $P$ value | 0.118 | 0.161 | 0.246 | 0.174 |

CO: Cardiac output; CI: Cardiac index; SVI: Stroke volume index; MAP: Mean arterial pressure.

**Table 7 Comparison of the complication rate between the two groups**

| Group | Lung infection | Atelectasis | Other | Complication rate (%) |
|---|---|---|---|---|
| Group A ($n$ = 60) | 2 | 0 | 1 | 3 (5.00) |
| Group B ($n$ = 60) | 3 | 1 | 3 | 7 (11.67) |
| $\chi^2$ value | | | | 1.745 |
| $P$ value | | | | 0.186 |

suggesting an improved lung protection and more advantages especially in patients with low lung compliance. In this study, it was also found that the measured Cdyn value at T1 and T2 was greater than that in group B, which might be due to the decrease in lung compliance caused by the increase in long-term airway pressure in patients during the operation mode. The mode in group B was conducive to the protection of the lung, and it could avoid lung injury caused by high tidal volume. The lung functions of different patients are different, and the PEEP that causes the reopening of collapsed alveoli is also different. When setting the PEEP, we need to evaluate its clinical effect and the impact of adverse consequences on patients and then make the corresponding parameter settings to achieve the best effect and minimize adverse reactions. When the PEEP exceeds a certain range, the probability of lung injury will increase. However, further research is needed.

The results of this study showed that the CI and SVI measured values of patients in group A at T2 were higher than those in group B, and the differences were significant. A tidal volume of 6 mL/kg combined with a PEEP of 5 cm$H_2O$ improved intrathoracic and right atrial pressure, reduced left ventricular transmural systolic blood pressure and pressure gradient, reduced intrathoracic blood volume and extravascular lung water, and improved hemodynamics. Setting appropriate PEEP could improve cardiac function and alleviate pulmonary edema. In this study, a tidal volume of 6 mL/kg combined with a PEEP of 5 cm$H_2O$ ventilation mode was more conducive to the stability of body

hemodynamics.

With the clinical benefits of low tidal volume combined with an appropriate level of PEEP-based lung protective ventilation strategy in patients undergoing mechanical ventilation during major surgery, anesthesiologists began to explore and find lung protective ventilation strategies that could be applied during mechanical ventilation during general anesthesia. Studies have shown that a small tidal volume combined with an appropriate level of PEEP ventilation can inhibit the release of inflammatory cytokines. There are few reports regarding the effects of different mechanical ventilation modes on inflammatory cytokines in elderly patients undergoing gastric or colon cancer surgery under general anesthesia. Once inflammatory factors are out of balance, they will lead to serious adverse consequences. IL-10 is an anti-inflammatory and immunosuppressive factor that inhibits the release of proinflammatory mediators such as IL-6 and TNF-α[20]. The results of this study showed that at 4 h after surgery, the measured values of TNF-α and IL-6 in group A were lower than those in group B, and the differences were significant ($P < 0.05$). The IL-10 Level in group A was higher than that in group B ($P < 0.05$). The results of blood gas indicators showed that the use of a tidal volume of 6 mL/kg combined with the PEEP 5 $cmH_2O$ mode of mechanical ventilation in elderly patients with gastric or colon cancer under general anesthesia had less impact on inflammatory factors and blood gas indicators in elderly patients, and the incidence of postoperative lung injury was also low.

Clinically, it has been concluded in recent years that the ventilation mode of low VT, a certain level of PEEP and permissive hypercapnia is mainly used for the treatment of acute lung injury, acute respiratory distress syndrome and other causes leading to respiratory failure. This study focused on the effects of different mechanical ventilation modes on the prognosis of elderly patients with gastric cancer and gastric or colon cancer.

## CONCLUSION

In summary, the VT (6.0 mL/kg) + PEEP (5.0 $cmH_2O$) scheme is more effective than the VT (6.0 mL/kg) + PEEP (8.0 $cmH_2O$) scheme in protecting the lung function and ventilatory function of patients undergoing surgery for gastric cancer or colon cancer under general anesthesia, and it has better effects on maintaining hemodynamic stability and reducing inflammatory reactions.

## ARTICLE HIGHLIGHTS

### *Research background*

Mechanical ventilation can lead to the severe impairment of the metabolic pathway of alveolar surfactants, inactivating alveolar surfactants and significantly reducing lung-chest compliance. The cardiopulmonary function of elderly patients usually reduced to a certain extent, and there are lung complications after surgical anesthesia, just like lung barotrauma caused by mechanical ventilation, atelectasis and postoperative hypoxemia.

### *Research motivation*

This study investigated the effects of different positive end expiratory pressures (PEEPs) and tidal volumes (VTs) on respiratory function, the degree of the inflammatory response and hemodynamic indexes in patients undergoing surgery under general anesthesia.

### *Research objectives*

This research aimed to explore the effects of different PEEP and VT control on lung protection and inflammatory factors during surgical anesthesia

### *Research methods*

A total of 120 patients undergoing surgery for gastric or colon cancer under general anesthesia in Xinghua People's Hospital from January 2017 to January 2021 were included.

### *Research results*

There were no significant differences in $PaCO_2$, $PaO_2$, oxygen or the examined indexes at T0 between group A and group B. The measured $PaO_2$ value of patients in group A at T3 was higher than that in group B, and the difference was significant. The measured peak airway pressure value of patients in group A at T1 was higher than that in group B, and the difference was significant. The measured dynamic pulmonary compliance value at T1 and T2 was greater than that in group B).

### *Research conclusions*

For patients undergoing surgery for gastric or colon cancer under general anesthesia, the VT (6.0

mL/kg) + PEEP (5.0 $cmH_2O$) regimen was more effective than the VT (6.0 mL/kg) + PEEP (8.0 $cmH_2O$) regimen in protecting the lung function and ventilatory function of patients, and it had better effects on maintaining hemodynamic stability and reducing inflammatory reactions.

### *Research perspectives*

For patients undergoing gastric or colon cancer surgery under general anesthesia, the VT (6.0 mL/kg) + PEEP (5.0 $cmH_2O$) regimen is more valuable in clinical promotion than the VT (6.0 mL/kg) + PEEP (8.0 $cmH_2O$) regimen.

## FOOTNOTES

**Author contributions:** Wang Y and Yang Y have the same contribution to this article and should be regarded as the co-first author; Wang Y, Yang Y and Wang DM design the experiment; Li J drafted the work, Bao QT, Wang BB and Zhu SJ collected the data; Yang Y, Zou L and Wang Y analysed and interpreted data, Wang Y, Yang Y, Wang DM and Li J wrote the article.

**Institutional review board statement:** This study was approved by the Medical Ethics Committee of Xinghua City People's Hospital.

**Informed consent statement:** Patients were not required to give informed consent to the study because the analysis used anonymous clinical data that were obtained after each patient agreed to treatment by written consent.

**Conflict-of-interest statement:** The authors declared that there is no conflict of interest between them.

**Data sharing statement:** No additional data are available.



**Country/Territory of origin:** China

**ORCID number:** Yu Wang 0000-0003-2262-882X; Yi Yang 0000-0002-7937-9951; Ding-Mu Wang 0000-0003-0361-4713; Jie Li 0000-0002-6396-1007; Quan-Tang Bao 0000-0002-9376-1962; Bei-Bei Wang 0000-0002-9965-9344; Shu-Jun Zhu 0000-0001-7147-0016; Lu Zou 0000-0002-4176-5443.

**S-Editor:** Wang JL
**L-Editor:** A
**P-Editor:** Wang JL

## REFERENCES

1 **Aceto P**, Perilli V, Luca E, Schipa C, Calabrese C, Fortunato G, Marusco I, Lai C, Sollazzi L. Predictive power of modified frailty index score for pulmonary complications after major abdominal surgery in the elderly: a single centre prospective cohort study. *Eur Rev Med Pharmacol Sci* 2021; **25**: 3798-3802 [PMID: 34109588 DOI: 10.26355/eurrev_202105_25947]
2 **You AH**, Song Y, Kim DH, Suh J, Baek JW, Han DW. Effects of positive end-expiratory pressure on intraocular pressure and optic nerve sheath diameter in robot-assisted laparoscopic radical prostatectomy: A randomized, clinical trial. *Medicine (Baltimore)* 2019; **98**: e15051 [PMID: 30946349 DOI: 10.1097/MD.0000000000015051]
3 **Turbil E**, Terzi N, Cour M, Argaud L, Einav S, Guérin C. Positive end-expiratory pressure-induced recruited lung volume measured by volume-pressure curves in acute respiratory distress syndrome: a physiologic systematic review and meta-analysis. *Intensive Care Med* 2020; **46**: 2212-2225 [PMID: 32915255 DOI: 10.1007/s00134-020-06226-9]
4 **Généreux V**, Chassé M, Girard F, Massicotte N, Chartrand-Lefebvre C, Girard M. Effects of positive end-expiratory pressure/recruitment manoeuvres compared with zero end-expiratory pressure on atelectasis during open gynaecological surgery as assessed by ultrasonography: a randomised controlled trial. *Br J Anaesth* 2020; **124**: 101-109 [PMID: 31733807 DOI: 10.1016/j.bja.2019.09.040]
5 **Frutos-Vivar F**, Peñuelas O, Muriel A, Mancebo J, García-Jiménez A, de Pablo R, Valledor M, Ferrer M, León M, Quiroga JM, Temprano S, Vallverdú I, Fernández R, Gordo F, Anzueto A, Esteban A. Mechanical ventilation in Spain, 1998-2016: changes in the disconnection of mechanical ventilation. *Med Intensiva (Engl Ed)* 2021 [PMID: 34092422 DOI: 10.1016/j.medin.2021.04.005]
6 **Forrest IS**, Jaladanki SK, Paranjpe I, Glicksberg BS, Nadkarni GN, Do R. Non-invasive ventilation versus mechanical ventilation in hypoxemic patients with COVID-19. *Infection* 2021; **49**: 989-997 [PMID: 34089483 DOI: 10.1007/s15010-021-01633-6]

7 **Mazzinari G**, Diaz-Cambronero O, Alonso-Iñigo JM, Garcia-Gregorio N, Ayas-Montero B, Ibañez JL, Serpa Neto A, Ball L, Gama de Abreu M, Pelosi P, Maupoey J, Argente Navarro MP, Schultz MJ. Intraabdominal Pressure Targeted Positive End-expiratory Pressure during Laparoscopic Surgery: An Open-label, Nonrandomized, Crossover, Clinical Trial. *Anesthesiology* 2020; **132**: 667-677 [PMID: 32011334 DOI: 10.1097/ALN.0000000000003146]

8 **Collino F**, Rapetti F, Vasques F, Maiolo G, Tonetti T, Romitti F, Niewenhuys J, Behnemann T, Camporota L, Hahn G, Reupke V, Holke K, Herrmann P, Duscio E, Cipulli F, Moerer O, Marini JJ, Quintel M, Gattinoni L. Positive End-expiratory Pressure and Mechanical Power. *Anesthesiology* 2019; **130**: 119-130 [PMID: 30277932 DOI: 10.1097/ALN.0000000000002458]

9 **Kiss T**, Bluth T, Braune A, Huhle R, Denz A, Herzog M, Herold J, Vivona L, Millone M, Bergamaschi A, Andreeff M, Scharffenberg M, Wittenstein J, Vidal Melo MF, Koch T, Rocco PRM, Pelosi P, Kotzerke J, Gama de Abreu M. Effects of Positive End-Expiratory Pressure and Spontaneous Breathing Activity on Regional Lung Inflammation in Experimental Acute Respiratory Distress Syndrome. *Crit Care Med* 2019; **47**: e358-e365 [PMID: 30676338 DOI: 10.1097/CCM.0000000000003649]

10 **Hol L**, Nijbroek SGLH, Schultz MJ. Perioperative Lung Protection: Clinical Implications. *Anesth Analg* 2020; **131**: 1721-1729 [PMID: 33186160 DOI: 10.1213/ANE.0000000000005187]

11 **Scaramuzzo G**, Spadaro S, Dalla Corte F, Waldmann AD, Böhm SH, Ragazzi R, Marangoni E, Grasselli G, Pesenti A, Volta CA, Mauri T. Personalized Positive End-Expiratory Pressure in Acute Respiratory Distress Syndrome: Comparison Between Optimal Distribution of Regional Ventilation and Positive Transpulmonary Pressure. *Crit Care Med* 2020; **48**: 1148-1156 [PMID: 32697485 DOI: 10.1097/CCM.0000000000004439]

12 **Yoshida T**, Grieco DL, Brochard L, Fujino Y. Patient self-inflicted lung injury and positive end-expiratory pressure for safe spontaneous breathing. *Curr Opin Crit Care* 2020; **26**: 59-65 [PMID: 31815775 DOI: 10.1097/MCC.0000000000000691]

13 **Priebe HJ**. Effect of intraoperative PEEP and recruitment manoeuvres on postoperative lung aeration. Comment on Br J Anaesth 2020; 124: 101-109. *Br J Anaesth* 2020; **125**: e234-e235 [PMID: 32354413 DOI: 10.1016/j.bja.2020.03.023]

14 **Spadaro S**, Caramori G, Rizzuto C, Mojoli F, Zani G, Ragazzi R, Valpiani G, Dalla Corte F, Marangoni E, Volta CA. Expiratory Flow Limitation as a Risk Factor for Pulmonary Complications After Major Abdominal Surgery. *Anesth Analg* 2017; **124**: 524-530 [PMID: 27537927 DOI: 10.1213/ANE.0000000000001424]

15 **Amaral BLR**, de Figueiredo AB, Lorena DM, Oliveira ACO, Carvalho NC, Volpe MS. Effects of ventilation mode and manual chest compression on flow bias during the positive end- and zero end-expiratory pressure manoeuvre in mechanically ventilated patients: a randomised crossover trial. *Physiotherapy* 2020; **106**: 145-153 [PMID: 30979507 DOI: 10.1016/j.physio.2018.12.007]

16 **Lee JH**, Ji SH, Lee HC, Jang YE, Kim EH, Kim HS, Kim JT. Evaluation of the intratidal compliance profile at different PEEP levels in children with healthy lungs: a prospective, crossover study. *Br J Anaesth* 2020; **125**: 818-825 [PMID: 32682552 DOI: 10.1016/j.bja.2020.06.046]

17 **Ilia S**, Geromarkaki E, Briassoulis P, Bourmpaki P, Tavladaki T, Miliaraki M, Briassoulis G. Effects of increasing PEEP on lung stress and strain in children with and without ARDS. *Intensive Care Med* 2019; **45**: 1315-1317 [PMID: 31214743 DOI: 10.1007/s00134-019-05667-1]

18 **Shono A**, Katayama N, Fujihara T, Böhm SH, Waldmann AD, Ugata K, Nikai T, Saito Y. Positive End-expiratory Pressure and Distribution of Ventilation in Pneumoperitoneum Combined with Steep Trendelenburg Position. *Anesthesiology* 2020; **132**: 476-490 [PMID: 31770148 DOI: 10.1097/ALN.0000000000003062]

19 **Mini G**, Ray BR, Anand RK, Muthiah T, Baidya DK, Rewari V, Sahni P, Maitra S. Effect of driving pressure-guided positive end-expiratory pressure (PEEP) titration on postoperative lung atelectasis in adult patients undergoing elective major abdominal surgery: A randomized controlled trial. *Surgery* 2021; **170**: 277-283 [PMID: 33771357 DOI: 10.1016/j.surg.2021.01.047]

20 **Reinius H**, Borges JB, Engström J, Ahlgren O, Lennmyr F, Larsson A, Fredén F. Optimal PEEP during one-lung ventilation with capnothorax: An experimental study. *Acta Anaesthesiol Scand* 2019; **63**: 222-231 [PMID: 30132806 DOI: 10.1111/aas.13247]

Published by **Baishideng Publishing Group Inc**
7041 Koll Center Parkway, Suite 160, Pleasanton, CA 94566, USA
**Telephone:** +1-925-3991568
**E-mail:** bpgoffice@wjgnet.com
**Help Desk:** https://www.f6publishing.com/helpdesk
https://www.wjgnet.com