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Meta-analysis of the effect of individualized PEEP on postoperative pulmonary complications in thoracic surgery

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Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 24 February 2024 and was last updated on 24 February 2024.

INTRODUCTION

Review question / Objective Whether could postoperative pulmonary complications in thoracic surgery benefit from individualized PEEP?

Condition being studied Thoracic surgery is one of the surgical types with the highest incidence of postoperative pulmonary complications (PPCs) after surgery, which seriously affects the prognosis and treatment of patients. One lung ventilation (OLV) is a commonly used ventilation method in thoracic surgery. While providing convenience for surgery, it inevitably causes a certain degree of lung injury. During OLV, the ventilated lungs often suffer from lung volume injury, pulmonary barotrauma, pulmonary atrophy injury, and subsequent release of inflammatory mediators due to inappropriate ventilation parameter settings, which further exacerbate lung injury. In addition, due to gravity, surgical procedures, and hypoxic pulmonary vasoconstriction (HPV), the ventilated lung causes excessive blood flow perfusion, and high concentrations of oxygen can also lead to oxidative stress damage in the ventilated lung. However, collapsed lungs are subjected to multiple impacts such as recurrent lung injury, ischemia-reperfusion injury, and surgical injury.

In recent years, lung protective ventilation strategies have been widely used in general anesthesia surgeries [3,4], and have also been proven to play an important protective role in thoracic surgery [5]. The lung protective ventilation strategy mainly includes low tidal volume, PEEP, and intermittent lung recruitment. However, due to individual differences, fixed PEEP cannot be applied to everyone. Setting PEEP too small can cause atelectasis, leading to hypoxemia. Setting PEEP too high can cause hemodynamic instability, and blood flow to non ventilated lungs can exacerbate pulmonary shunting. Therefore, finding the optimal PEEP is crucial. At present, there is still controversy over the optimal PEEP level and the method of titrating the best PEEP, and there is a lack of high-quality evidence-based medicine evidence on the impact of individualized PEEP on postoperative pulmonary complications in thoracic surgery. This study conducted a meta-analysis of previous literature to evaluate the impact of individualized PEEP on PPCs in thoracic surgery, providing more evidence-based medicine evidence for clinical anesthesiologists to use PEEP reasonably, thereby improving the prognosis and quality of life of thoracic surgery patients.

METHODS

Participant or population The research subjects are adult patients who underwent single lung ventilation in thoracic surgery, with a grade of ≥ 18 years old.

Intervention The intervention measures were individualized PEEP using different titration methods during surgery in the experimental group.

Comparator The control measures were fixed PEEP or no PEEP used during surgery in the control group. Other ventilation strategies were not limited (including tidal volume, ventilation method, inhaled oxygen concentration, etc.).

Study designs to be included RCT.

Eligibility criteria Exclusion criteria(1) Literature types that cannot provide specific data, such as reviews, conference papers, animal experiments, and medical reports; (2) No outcome data, unclear results; ⑶ Repeated publications (4) Preoperative severe pulmonary disease; (5) Individuals who cannot tolerate PEEP titration.

Information sources PubMed, Cochrane Library, Embase, China Knowledge, Wanfang, and Wipro databases.

Main outcome(s) A total of 13 RCTs were included, with a total of 3535 patients, 1775 in the individualized PEEP group and 1760 in the control group. Compared with the control group, the incidence of postoperative pulmonary complications was significantly lower in the individualized PEEP group (OR=0.38,95%CI0.29-0.51,P<0.00001), intraoperative PaO2 was significantly higher (SMD=0.27,95%CI0.12-0.42,P=0.0005), and intraoperative pulmonary compliance was significantly higher (SMD=0.75,95%CI0.67～0.82,P＜0.00001), and intraoperative driving pressure was significantly lower (SMD=-2.17,95%CI-2.42～-1.93,P＜0.00001). There was no statistically significant difference in intraoperative MAP （SMD=0.19,95%CI-1.68～-2.07,P=0.84） and postoperative hospitalization time （SMD=-0.19,95%CI-0.63～0.25,P=0.40） between the two groups.

Quality assessment / Risk of bias analysis Two researchers evaluated the risk of bias of included RCTs using the Cochrane Handbook for Systematic Reviewers (version 5.1.0), RCT risk of bias assessment tool. Evaluation indicators include: l)sequence generation (selection bias); 2) allocation concealment (selection bias): 3) blinding of patients and personnel (performance bias): 4) blinding of outcome assessors (detection bias): 3) incomplete outcome data (attrition bias): 6) elective reporting (reporting bias): 7) other bias. Each indicator contains three levels: low risk.unclear and high risk.

Strategy of data synthesis Perform meta-analysis using RevMan5.4 software, using Ⅰ ² The testing and evaluation method first conducts heterogeneity testing on the included studies, with I2 values of 0-24.9%, 25-49.9%, 50-74.9%, and 75-100% indicating no, low, medium, and high heterogeneity, respectively. When P>0.1 and Ⅰ ²＜ At 50%, it is considered that the heterogeneity among the included studies is low, and a fixed effects model is used for analysis. The Odds Ratio (OR) was selected as the effect indicator for binary data, while the Standardized Mean Difference (SMD) was selected as the effect indicator for continuous data. The combined effect size and its 95% confidence interval (CI) P<0.05 had statistical significance.

Subgroup analysis Subgroup analysis of oxygenation index and lung compliance.

Sensitivity analysis Sensitivity analysis was also conducted to evaluate the effect of the individual study data.

Country(ies) involved China Linyi People's Hospital.

Keywords Positive end-expiratory pressure; postoperative pulmonary complications; lung protective ventilation; one-lung ventilation; Meta-analysis.

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