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Lung-protective ventilation vs conventional ventilation in emergency surgery

Lung-protective ventilation significantly reduces mortality in patients with acute respiratory distress syndrome, but do the advantages of this approach transfer from the intensive care unit to the operating room?

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Introduction

Lung-protective ventilation, defined as the application of low tidal volume ventilation (tidal volumes of 4–8 ml/kg of ideal body weight), positive end-expiratory pressure, recruitment manoeuvres and maintenance of plateau pressure <30 cmH_2O, significantly reduces mortality in patients with acute respiratory distress syndrome (Brower et al, 2000). This landmark trial established lung-protective ventilation as a treatment strategy in critical care, but do the advantages of this approach transfer from the intensive care unit to the operating room?

Lung-protective ventilation reduced postoperative pulmonary complications in elective surgery

Postoperative pulmonary complications are among the most common postoperative complications, and are associated with significant morbidity and mortality. Thirty-day mortality after major surgery complicated by respiratory sequelae can be up to 30% (Khuri et al, 2005). The IMPROVE study set out to answer whether lung-protective ventilation would be advantageous for patients undergoing surgery (Futier et al, 2013). It showed that, in elective major abdominal surgery, lung-protective ventilation was beneficial when compared to traditional ventilation strategies (using tidal volume of 10–15 ml/kg of ideal body weight), primarily via a reduction in major pulmonary and extrapulmonary complications (10.5% vs 27.5%).

An updated meta-analysis of 34 randomised controlled trials drew firmer conclusions (Deng et al, 2020). It concluded that adopting a low tidal volume strategy, with moderate (5–8 cmH_2O), or high (>8 cmH_2O) positive end-expiratory pressure, was associated with fewer postoperative pulmonary complications. However, using a strategy of low tidal volume with low positive end-expiratory pressure (<5 cmH_2O) did not significantly reduce the incidence of postoperative pulmonary complications. Despite these encouraging findings, no significant reduction in short-term mortality was observed.

The benefit of lung-protective ventilation in emergency surgery is unclear

The ALPINE study collected observational data from 568 patients who underwent emergency laparotomies (Watson et al, 2018). Although observational, this study found no association between the use of lung-protective ventilation and postoperative pulmonary complications. Perhaps the urgent nature of cases in this dataset overshadowed any benefit from lung-protective ventilation.

The findings of a meta-analysis comparing low tidal volume vs high tidal volume strategies across elective and emergency major procedures were mixed (Guay et al, 2018). However, their definition of low tidal volume ventilation of <10 ml/kg of predicted body weight may limit interpretation. They observed a significant decrease in postoperative pneumonias (risk ratio 0.45, 95% confidence interval 0.25–0.82) and reduced requirements for non-invasive and invasive ventilation postoperatively (risk ratio 0.31, 95% confidence interval 0.15–0.64), but the data showed neither reduction in 30-day mortality, nor intensive care unit length of stay.

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Conclusions

The benefits of lung-protective ventilation have been demonstrated in prospective trials involving critical care and elective surgical patients. Intraoperative low tidal volume and positive end-expiratory pressure strategies are now endorsed by expert consensus recommendation. It seems congruous that lung-protective ventilation should be beneficial in emergency surgery, but current evidence is lacking. It is feasible that the urgent nature of emergency cases, with altered physiology and non-optimised comorbidities, means the benefits of lung-protective ventilation are attenuated, lost or altogether outweighed. In addition to lung-protective ventilation it seems that complex interactions between age, intraoperative FiO_2 and positive inspiratory pressure also have some role, which could explain why lung-protective ventilation strategies alone have failed to demonstrate benefit in the emergency surgical patient.

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