GE HealthCare

Importance of individualized perioperative PEEP

Postoperative pulmonary complications (PCCs) occur as frequently as cardiac complications during noncardiac related surgeries.[1]

PCCs are associated with increased morbidity and mortality, and using lung-protective ventilation can help reduce the risk of PCCs with the goal of improving patient outcomes.[1]

Achieving therapeutic tidal volumes and positive end-expiratory pressure (PEEP) are vital to lung-protective ventilation, but concrete guidelines for these interventions continue to be of controversy.

Establishing guidelines for patients specifically around PEEP in the operating room has been a challenge. In fact, the only established guidelines state to use 'high' or 'low' PEEP depending on the patient's respiratory status.[2]

A plausible reason for the lack of conclusive guidelines and settings is the need for highly individualized PEEP settings. Although there are no formal guidelines, studies have explored the benefits of individualized PEEP, and consensus-based recommendations have been made by experts around the globe.

This article explores three benefits and highlights the importance of highly individualized PEEP during surgery.

1 Improve pulmonary function postoperatively

A trial involving a small number of patients (*n*=40) compared patients undergoing surgery for abdominal surgery without any prior lung disease. All patients received the same recruitment maneuvers going into surgery and were extubated without any change to PEEP or fractional inspired oxygen tension.[2]

However, during the surgery, the patients were divided into two categories — one group was ventilated with 4 cm H2O PEEP and the other was ventilated with PEEP settings that "resulted in the least collapse and least overdistention." This setting was determined by using electrical impedance tomography.[2]

Within 30-60 minutes of extubation, each patient underwent a chest CT. Those who received personalized PEEP settings showed:[2]

- Lower intraoperative driving pressure
- Better oxygenation
- Equivalent hemodynamics

Furthermore, no pulmonary complications were found postoperatively, and no adverse events were noted associated with the recruitment maneuver.[2]

Rather than relying on static metrics such as predicted body weight or prior respiratory status, dynamic measures using devices like electrical impedance tomography, may provide the best insight on utilizing personalized PEEP settings.[2]

Although this trial was small, it helps highlight a potential way to create guidelines when providing individualized recruitment maneuvers in the OR.

2 Reduce risk of lung injury and postoperative pulmonary complications

High ventilator driving pressure (measured as plateau pressure — PEEP) is a major determinant of lung injury and is associated with PCCs.[3]

Even though this risk is well known, many patients are still treated with high tidal volume ventilation that includes a wide range of PEEP.

A global meeting of experts reviewed questions and conducted a literature search in order to find best practices when it comes to lung protective ventilation. One of the key recommendations includes avoiding de-recruitment without causing over-distention of alveoli intraoperatively, which has the potential to decrease the risk of PCCs.

Furthermore, by reducing high ventilator driving pressure, patients have the potential to:[3]

- Improve perioperative oxygenation
- Improve respiratory mechanics
- Reduce oxidative stress
- Reduce inflammatory response
- Reduce lung injury

This expert panel concluded with a rating of *Strong Recommendation* that PEEP should be individualized to each patient. By doing this, increases in driving pressure are less likely and a lower tidal volume can be maintained.[3] A few examples of when PEEP should be additionally adjusted based on the patient is if the patient is obese, if there is pneumoperitoneum insufflation, or if the patient is in prone or Trendelenburg positions intraoperatively.[3]

Other times PEEP should be set based on individual paraments is after alveolar recruitment maneuvers. Although this recommendation carries a fairly weak quality of evidence, it may reduce alveolar overdistention and/or collapse.[3]

Individualized PEEP may also reduce the risk of progressive alveolar collapse.[3]

3 Supports obese surgical patients

Preserving lung function in obese patients remains a challenge and controversy exists when it comes to best practices and establishing guidelines.

Determining PEEP settings for mechanical ventilation is no different in this group, and this led to a secondary analysis of 90 obese surgical patients. Researchers found patients receiving individualized PEEP had:[4]

- Better oxygenation
- Lower driving pressures
- Redistribution of ventilation toward dependent lung areas

In the study, individualized PEEP included three total recruitment maneuvers and PEEP titration during anesthesia. PEEP settings were individualized by using electrical impedance tomography.[4]

While these are all positive findings, it's noteworthy that an improvement of overall patient outcomes could not be established in the analysis.[4] This means the trial did not produce any results showing a reduction in PCCs in obese patients receiving individualized PEEP versus fixed PEEP.

Summary

- Postoperative pulmonary complications are one of the most common adverse events seen in a surgical setting
- Although formal guidelines have not been created, individualized PEEP settings, often determined by using electrical impedance tomography, can provide several benefits to surgical patients, including improved pulmonary function
- Individualized PEEP can lead to better oxygenation postoperatively and reduce risk of lung injury
- In higher risk patient populations, such as obese surgical candidates, individualized PEEP can result in improvement in lung function postoperatively

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2. Kacmarek, R. & Villar, J. (2018). Lung-protective ventilation in the operating room. *Anesthesiology* 129(6). 1057-1059.
3. Young, C. et al. (2019). Lung-protective ventilation for the surgical patient: international expert panel-based consensus recommendations. *British Journal of Anesthesia*. 123(6) 898-913.
4. Simon, P. et al. (2021). Individualized versus fixed positive end-expiratory pressure for intraoperative mechanical ventilation in obese patients: a secondary analysis. *Anesthesiology*. 134:887-900.

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