

Intraoperative Lung-Protective Ventilation

Intraoperative teaching · CA-2

THE QUESTION

Where the evidence disagrees

This topic was selected because an evidence synthesis beats a textbook on it: the trials disagree, or the guidance has moved recently.

THE EVIDENCE

What each source contributes, and how strong it is

Study design first — a cohort and a randomised trial do not carry the same weight.

Design	Year	Journal	What it found
Meta-analysis	2025	Anesthesiology	High PEEP with recruitment maneuvers may reduce postoperative pulmonary
Guideline	2019	British journal of anaesthesia	Set the ventilator initially to a tidal volume of 6-8 mL/kg predicted body weight
Meta-analysis	2015	Anesthesiology	The dose-response for postoperative pulmonary complications tracks tidal volume, not
Randomised trial	2013	The New England journal of medicine	Lung-protective ventilation cut major pulmonary and extrapulmonary complications
Cohort	2015	BMJ (Clinical research ed.)	In a 69,265-patient registry, a PEEP of 5 cmH2O and a plateau pressure of 16 cmH2O
Review	2025	British journal of anaesthesia	Individualized intraoperative open-lung approach involves recruiting collapsed lung

6 resolved citations behind this deck; every point above traces to one of them.

WHERE THE GUIDANCE SITS

What the guidelines and pooled evidence say

3 findings, each on the slide that follows.

ANESTHESIOLOGY 2025

High PEEP with recruitment maneuvers may reduce postoperative pulmonary

High PEEP with recruitment maneuvers may reduce postoperative pulmonary complications, especially in laparoscopic surgery (OR 0.67 [0.50 to 0.87]).

BRITISH JOURNAL OF ANAESTHESIA 2019

Set the ventilator initially to a tidal volume of 6-8 mL/kg predicted body weight

Set the ventilator initially to a tidal volume of 6-8 mL/kg predicted body weight with PEEP 5 cmH2O, then individualise the PEEP; when recruiting,...

ANESTHESIOLOGY 2015

The dose-response for postoperative pulmonary complications tracks tidal volume, not

The dose-response for postoperative pulmonary complications tracks tidal volume, not PEEP: adding high PEEP to an already low tidal volume gave no...

WHERE THE GUIDANCE SITS

High PEEP with recruitment maneuvers may reduce postoperative pulmonary

Meta-analysis · Anesthesiology

High PEEP with recruitment maneuvers may reduce postoperative pulmonary complications, especially in laparoscopic surgery (OR 0.67 [0.50 to 0.87]).

High Positive End-Expiratory Pressure (PEEP) With Recruitment Maneuvers Versus Low PEEP During General Anesthesia for Surgery: A Bayesian Individual Patient Data Meta-Analysis of Three Randomized Clinical Trials, Anesthesiology 2025 · PMID 39042027

WHERE THE GUIDANCE SITS

Set the ventilator initially to a tidal volume of 6-8 mL/kg predicted body weight

Guideline · British journal of anaesthesia

Set the ventilator initially to a tidal volume of 6-8 mL/kg predicted body weight with PEEP 5 cmH₂O, then individualise the PEEP; when recruiting, use the lowest effective pressure for the shortest effective time.

Lung-Protective Ventilation for the Surgical Patient: International Expert Panel-Based Consensus Recommendations, British journal of anaesthesia 2019 · PMID 31587835

WHERE THE GUIDANCE SITS

The dose-response for postoperative pulmonary complications tracks tidal volume, not

Meta-analysis · Anesthesiology

The dose-response for postoperative pulmonary complications tracks tidal volume, not PEEP: adding high PEEP to an already low tidal volume gave no further reduction.

Protective Versus Conventional Ventilation for Surgery: A Systematic Review and Individual Patient Data Meta-Analysis, Anesthesiology 2015 · PMID 25978326

WHAT THE TRIALS FOUND

Lung-protective ventilation cut major pulmonary and extrapulmonary complications

Randomised trial · The New England journal of medicine

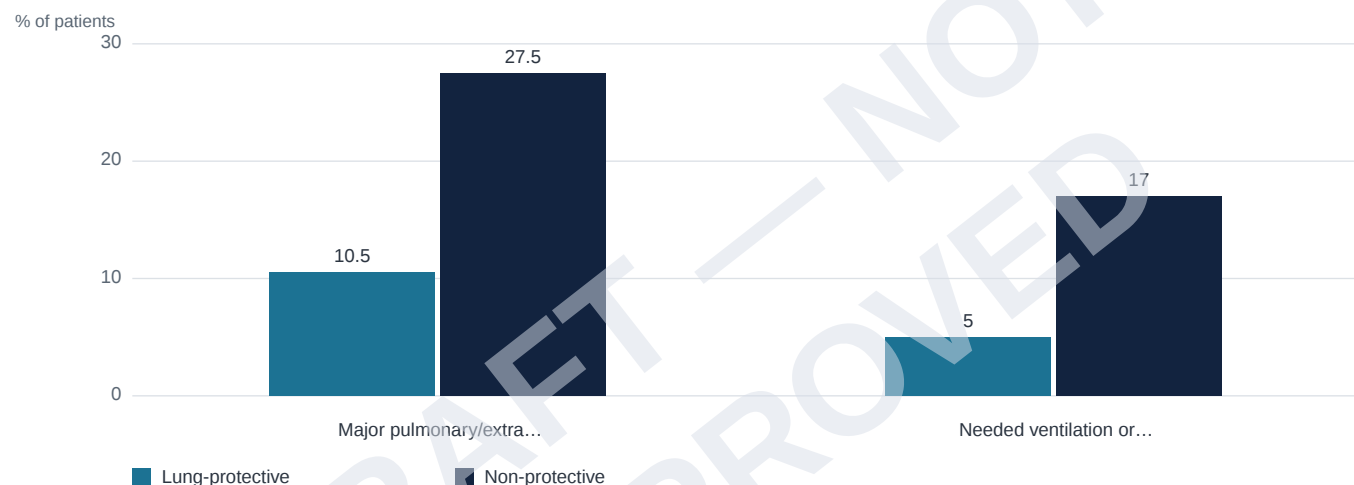
Lung-protective ventilation cut major pulmonary and extrapulmonary complications after major abdominal surgery from 27.5% to 10.5%, and the need for postoperative ventilation or reintubation from 17% to 5%.

A Trial of Intraoperative Low-Tidal-Volume Ventilation in Abdominal Surgery, The New England journal of medicine 2013 · PMID 23902482

THE NUMBERS

IMPROVE: lung-protective ventilation halved complications

400 patients at risk after major abdominal surgery.



The single largest effect in this deck — and it comes from tidal volume, not PEEP.

A Trial of Intraoperative Low-Tidal-Volume Ventilation in Abdominal Surgery, The New England journal of medicine 2013 · PMID 23902482

IN PRACTICE

What the cohorts and reviews add

2 findings, each on the slide that follows.

BMJ (CLINICAL RESEARCH ED.) 2015

In a 69,265-patient registry, a PEEP of 5 cmH₂O and a plateau pressure of 16 cmH₂O

In a 69,265-patient registry, a PEEP of 5 cmH₂O and a plateau pressure of 16 cmH₂O or less were the settings associated with the lowest risk of...

BRITISH JOURNAL OF ANAESTHESIA 2025

Individualized intraoperative open-lung approach involves recruiting collapsed lung

Individualized intraoperative open-lung approach involves recruiting collapsed lung areas and personalizing PEEP to potentially reduce postoperative...

IN PRACTICE

In a 69,265-patient registry, a PEEP of 5 cmH₂O and a plateau pressure of 16 cmH₂O

Cohort · BMJ (Clinical research ed.)

In a 69,265-patient registry, a PEEP of 5 cmH₂O and a plateau pressure of 16 cmH₂O or less were the settings associated

with the lowest risk of postoperative respiratory complications.
Intraoperative Protective Mechanical Ventilation and Risk of Postoperative Respiratory Complications: Hospital Based Registry Study, BMJ (Clinical research ed.) 2015 · PMID 26174419

IN PRACTICE

Individualized intraoperative open-lung approach involves recruiting collapsed lung

Review · *British journal of anaesthesia*

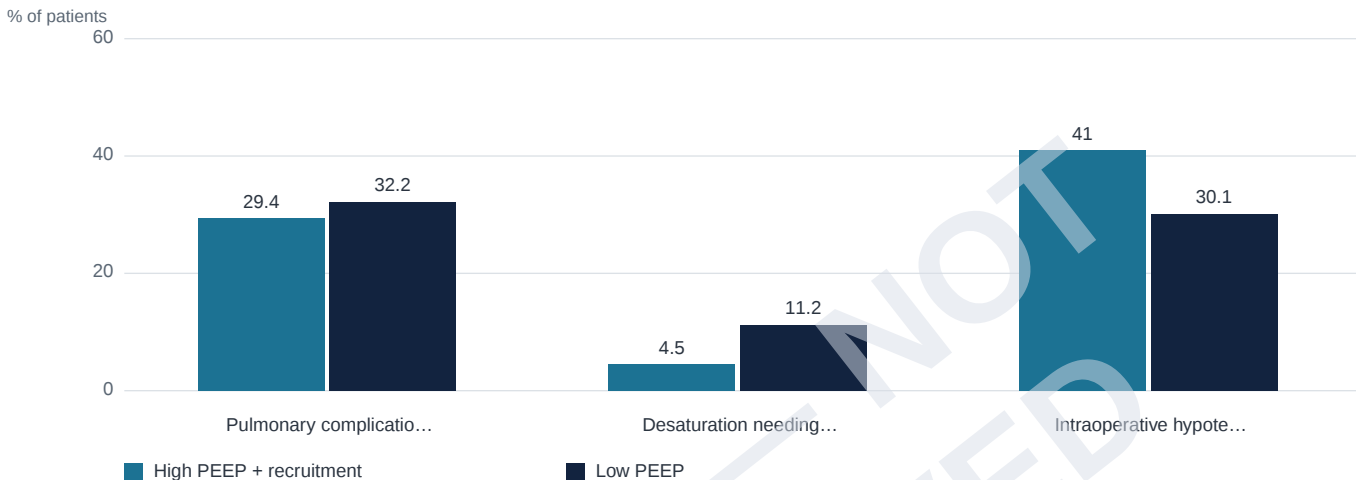
Individualized intraoperative open-lung approach involves recruiting collapsed lung areas and personalizing PEEP to potentially reduce postoperative pulmonary complications compared to strategies tolerating lung collapse.

Improving Lung Protective Mechanical Ventilation: The Individualised Intraoperative Open-Lung Approach, British journal of anaesthesia 2025 · PMID 39880492

THE NUMBERS

High PEEP did not reduce complications, and cost blood pressure

Patient-level meta-analysis of three trials, 3,837 patients.

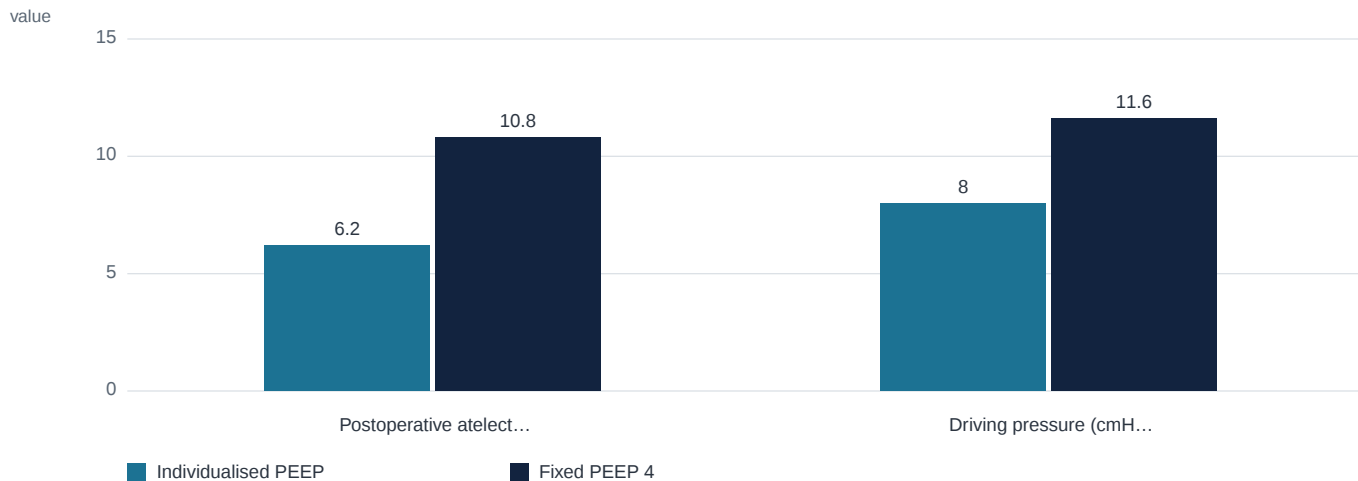


High PEEP buys fewer desaturations and pays in hypotension, without changing the outcome that matters.

THE NUMBERS

One fixed PEEP does not fit

Individually titrated PEEP by electrical impedance tomography, 40 patients.



Titrated PEEP ranged from 6 to 16 cmH₂O with a median of 12 — a fixed 4 left atelectasis behind.

IN THE ROOM

What this changes about the next case

Colour is the strength of the evidence behind each step, not the urgency.

- 1 Set the ventilator initially to a tidal volume of 6-8 mL/kg predicted body weight with PEEP 5 cmH₂O, then individualise the PEEP; when recruiting, use the lowest effective pressure for the shortest effective time.
- 2 High PEEP with recruitment maneuvers may reduce postoperative pulmonary complications, especially in laparoscopic surgery (OR 0.67 [0.50 to 0.87]).
- 3 The dose-response for postoperative pulmonary complications tracks tidal volume, not PEEP: adding high PEEP to an already low tidal volume gave no further reduction.
- 4 Lung-protective ventilation cut major pulmonary and extrapulmonary complications after major abdominal surgery from 27.5% to 10.5%, and the need for postoperative ventilation or reintubation from 17% to 5%.
- 5 In a 69,265-patient registry, a PEEP of 5 cmH₂O and a plateau pressure of 16 cmH₂O or less were the settings associated with the lowest risk of postoperative respiratory complications.

KEY TAKEAWAYS

What to carry into the next case

- High PEEP with recruitment maneuvers may reduce postoperative pulmonary**
Anesthesiology 2025
- Set the ventilator initially to a tidal volume of 6-8 mL/kg predicted body weight**
British journal of anaesthesia 2019
- The dose-response for postoperative pulmonary complications tracks tidal volume, not**
Anesthesiology 2015
- Lung-protective ventilation cut major pulmonary and extrapulmonary complications**
The New England journal of medicine 2013

High PEEP with recruitment maneuvers may reduce postoperative pulmonary

QUESTIONS I'LL ASK YOU IN THE ROOM

1. How does your plan change if the patient is not optimised?

2. What is the physiology behind what we just did?
3. Talk me through the trade-off you made there.
4. What would make you abandon this plan and do something else?

ORAL BOARDS STEM

A 58-year-old with a BMI of 38 is undergoing laparoscopic sleeve gastrectomy in steep reverse Trendelenburg. Peak pressures are 34 cmH₂O after insufflation and the saturation has drifted to 93%.

BOARD QUESTIONS

1. State the initial ventilator settings recommended by international expert consensus on lung-protective ventilation for a surgical patient - tidal volume with its weight basis, and PEEP - what should be done with PEEP after that, and the principle to follow when performing a recruitment manoeuvre.
2. In an individual patient data meta-analysis of protective versus conventional intraoperative ventilation, which ventilator variable did the dose-response for postoperative pulmonary complications track, and what happened when high PEEP was added to an already low tidal volume?
3. In a randomised trial of intraoperative low-tidal-volume, lung-protective ventilation during major abdominal surgery, give the effect on major pulmonary and extrapulmonary complications and on the need for postoperative ventilation or reintubation, with the event rates for each.
4. A Bayesian individual patient data meta-analysis of three randomised trials compared high PEEP with recruitment manoeuvres against low PEEP, reporting an odds ratio of 0.67 (0.50 to 0.87) for postoperative pulmonary complications in laparoscopic surgery. Say how strongly you should state this finding to a resident, and for which surgical setting.

ANSWER KEY

1. **Set an initial tidal volume of 6-8 mL/kg predicted body weight with PEEP 5 cmH₂O, then individualise the PEEP. When recruiting, use the lowest effective pressure for the shortest effective time.**

6-8 mL/kg of predicted body weight with PEEP 5 is a starting point, not the final setting - the PEEP gets individualised from there.

Lung-Protective Ventilation for the Surgical Patient: International Expert Panel-Based Consensus Recommendations, British journal of anaesthesia 2019 · PMID 31587835

2. **The dose-response tracked tidal volume, not PEEP. Adding high PEEP on top of an already low tidal volume gave no further reduction in postoperative pulmonary complications.**

In that pooled data the tidal volume was doing the work - piling PEEP on top of an already low tidal volume added nothing.

Protective Versus Conventional Ventilation for Surgery: A Systematic Review and Individual Patient Data Meta-Analysis, Anesthesiology 2015 · PMID 25978326

3. **Major pulmonary and extrapulmonary complications fell from 27.5% to 10.5%, and the need for postoperative ventilation or reintubation fell from 17% to 5%.**

Those are large absolute differences, and they were shown after major abdominal surgery - that is the population the numbers describe.

A Trial of Intraoperative Low-Tidal-Volume Ventilation in Abdominal Surgery, The New England journal of medicine 2013 · PMID 23902482

4. **State it as a possible rather than an established benefit: high PEEP with recruitment manoeuvres may reduce postoperative pulmonary complications, especially in laparoscopic surgery, where the odds ratio was 0.67 (0.50 to 0.87). The finding is hedged as 'may reduce', and laparoscopic surgery is the setting where it is described.**

Say 'may reduce' - this is pooled trial data with the clearest signal in laparoscopic surgery, not a settled rule for every case.

High Positive End-Expiratory Pressure (PEEP) With Recruitment Maneuvers Versus Low PEEP During General Anesthesia for Surgery: A Bayesian Individual Patient Data Meta-Analysis of Three Randomized Clinical Trials, Anesthesiology 2025 · PMID 39042027

High PEEP with recruitment maneuvers may reduce postoperative pulmonary

SOURCES

- [1] High Positive End-Expiratory Pressure (PEEP) With Recruitment Maneuvers Versus Low PEEP During General Anesthesia for Surgery: A Bayesian Individual Patient Data Meta-Analysis of Three Randomized Clinical Trials, *Anesthesiology* 2025 · PMID 39042027
- [2] Lung-Protective Ventilation for the Surgical Patient: International Expert Panel-Based Consensus Recommendations, *British journal of anaesthesia* 2019 · PMID 31587835
- [3] Protective Versus Conventional Ventilation for Surgery: A Systematic Review and Individual Patient Data Meta-Analysis, *Anesthesiology* 2015 · PMID 25978326
- [4] A Trial of Intraoperative Low-Tidal-Volume Ventilation in Abdominal Surgery, *The New England journal of medicine* 2013 · PMID 23902482
- [5] Intraoperative Protective Mechanical Ventilation and Risk of Postoperative Respiratory Complications: Hospital Based Registry Study, *BMJ (Clinical research ed.)* 2015 · PMID 26174419
- [6] Improving Lung Protective Mechanical Ventilation: The Individualised Intraoperative Open-Lung Approach, *British journal of anaesthesia* 2025 · PMID 39880492