

PUL 03 Review - January 24, 2022

Review PUL 03 Measure Specification by selecting this [link](#)

Feedback from Measure Reviewers

Review of new literature (last review December 2018)

Dr. Joel Kileny

Since the last review of PUL-03 in 2018, it has become well accepted that tidal volume (VT) should be maintained between 4 and 8 ml/kg of PBW, that plateau pressure should be maintained at less than 28 cm H₂O, and that driving pressure should be maintained at less than 15 cm H₂O. While PEEP has been shown to have a positive impact on post-operative pulmonary complications, there are no established guidelines for PEEP (exception: moderate-severe ARDS, in which “high” levels of PEEP are recommended). The take home message is that PEEP continues to be beneficial, but there is no consensus on how much should be used. Ideally, it is unique to each patient, but the method of determining this involves technology not currently available in the US: electrical Impedance Tomography (assesses lung recruitment), invasive esophageal manometry (measures transpulmonary pressure), or measurement of dynamic compliance (time consuming).

1. PROVE Network Investigators for the Clinical Trial Network of the European Society of Anaesthesiology, Hemmes SN, Gama de Abreu M, Pelosi P, Schultz MJ. High versus low positive end-expiratory pressure during general anaesthesia for open abdominal surgery (PROVHILO trial): a multicentre randomised controlled trial. *Lancet*. 2014 Aug 9;384(9942):495-503. doi: 10.1016/S0140-6736(14)60416-5. Epub 2014 Jun 2. PMID: 24894577; PMCID: PMC6682759.

This was a RCT at 30 hospitals involving 900 patients at risk for post-operative pulmonary complications (PPCs) who were planned for open abdominal surgery under GA using lung protective ventilation (8 cc/kg). Enrollment was restricted to individuals who had an intermediate or high risk of PPC according to the ARISCAT score (26-44 Intermediate or >44 High). Patients were allocated to either a high level of PEEP (12 cm H₂O) with recruitment maneuvers (higher PEEP group) or a low level of PEEP (\leq 2

cm H₂O) without recruitment maneuvers (lower PEEP group).

Results: Postoperative pulmonary complications were reported in 174 (40%) of 445 patients in the higher PEEP group vs. 172 (39%) of 449 patients in the lower PEEP group (relative risk 1.01; 95% CI 0.86-1.20; p=0.86). Compared with patients in the lower PEEP group, those in the higher PEEP group developed intraoperative hypotension and needed more vasoactive drugs.

Conclusion: In patients undergoing open abdominal surgery receiving LPV, the use of a high level of PEEP and recruitment maneuvers does not reduce the incidence of postoperative pulmonary complications

Study Limitation: Patients who were morbidly obese or having laparoscopic surgery were not included.

2. Ferrando C et. al on behalf of the Individualized Perioperative Open-Lung Ventilation (iPROVE) Network: Individualised perioperative open-lung approach versus standard protective ventilation in abdominal surgery (iPROVE): A randomized controlled trial. Lancet 2018; 63:193–203

This was a prospective, multicenter RCT trial in 21 teaching hospitals. 1,012 healthy patients were scheduled for laparoscopic and open abdominal surgery over 16 months. Patients were randomly assigned to four arms each evaluating different operative and post-operative ventilatory lung strategies. Lung protective ventilation (LPV) was used in each arm. The primary outcome was a composite of pulmonary and systemic complications during the first 7 postoperative days.

List of Pulmonary complications included the following: aspiration, pneumonitis, atelectasis, bronchospasm, dyspnea, pleural effusion,, hypoxemia, pneumothorax, pneumonia, ARDS, and the need for reintubation.

Arm 1: Open Lung Approach (OLA) and iCPAP- individualized PEEP set to the best respiratory system dynamic compliance (C_{dyn}) after a recruitment maneuver/CPAP if SpO₂ < 96%.

Arm 2: Open Lung Approach (OLA) and CPAP- individualized PEEP set to the best respiratory system dynamic compliance (C_{dyn}) after a recruitment maneuver/CPAP regardless of SpO₂.

Arm 3: Standard Intraoperative Ventilation (STD) + CPAP: LPV + fixed PEEP of 5 cm H₂O without recruitment maneuver/CPAP regardless of SpO₂.

Arm 4: Standard Intraoperative Ventilation (STD) + FM O₂: LPV + fixed PEEP of 5 cm H₂O without recruitment maneuver/supplemental O₂ via face mask.

Results:

Risk of pulmonary and systemic complications did not differ for patients in OLA-iCPAP (110 [46%] of 241, $p=0.25$), OLA-CPAP (111 [47%] of 238, $p=0.35$), or STD-CPAP groups (118 [48%] of 244, $p=0.65$) when compared with patients in the STD-O₂ group (125 [51%] of 244). PEEP in the OLA arms were approximately 10 cm H₂O, while PEEP in the STD arms ranged between 5.4 and 5.6 cm H₂O. Intraoperatively, PEEP was increased in 69 (14%) patients in the standard perioperative ventilation groups because of hypoxemia. None of patients from either of the OLA groups required rescue maneuvers.

Conclusion: In patients who have major abdominal surgery, the different perioperative open lung approaches tested in this study did not reduce the risk of PPCs when compared with standard lung-protective mechanical ventilation.

3.Pereira SM, Tucci MR, Morais CCA, Simoes CM, Tonelotto BFF, Pompeu MS, Kay FU, Pelosi P, Vieira JE, Amato MBP: Individual positive end-expiratory pressure settings optimize intraoperative mechanical ventilation and reduce postoperative atelectasis. ANESTHESIOLOGY 2018; 129:1070–81

Methods: This was a very small single centered physiologic trial involving 40 patients (20 laparoscopic and 20 open abdominal). They were randomized to either PEEP > 4 cm H₂O or electrical impedance tomography (EIT- applied after recruitment maneuvers and targeted at minimizing lung collapse and hyper-distension). Lung protective ventilation (LPV) was utilized in both arms. Patients were extubated without changing selected PEEP or FiO₂ while under anesthesia and were submitted to CT scanner 30-60 minutes post-extubation. Primary outcome of interest was to identify if EIT guided PEEP produced the best compromise between atelectasis and hyper-distension.

Results: EIT-guided PEEP varied markedly across individuals (median, 12 cm H₂O; **range, 6 to 16 cm H₂O**; 95% CI, 10–14). Compared with PEEP of 4 cm H₂O, patients randomized to the EIT-guided strategy had less postoperative atelectasis ($P = 0.017$), lower intraoperative driving pressures ($P < 0.001$), higher intraoperative oxygenation ($P < 0.001$), while presenting equivalent hemodynamics ($P = 0.821$). No other post-operative pulmonary complications were recorded.

Conclusion: PEEP requirements vary widely among patients receiving LPV during abdominal surgery. Individualized PEEP could reduce post-operative atelectasis while improving intraoperative oxygenation and driving pressures.

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Appropriateness of rationale

Dr. Joel Kileny
I believe the rationale is appropriate. PEEP requirements vary widely among patients receiving LPV. While the above studies demonstrate the efficacy of PEEP in patients receiving LPV, the current literature is inconclusive regarding the exact setting of PEEP

Evaluation of inclusion/ exclusion criteria

Dr. Joel Kileny
Inclusion and Exclusions: Nothing needs to be added or removed.

Evaluation of definition of success or flagged cases

Dr. Joel Kileny
I believe the median PEEP of > 2 cm H2O is still appropriate. Because the latest literature advocates for individualized PEEP, there is no reason to increase this threshold.

Other feedback

Dr. Joel Kileny

While it is clear that PEEP is difficult to study, this measure should remain unchanged until there is more evidence.

Recommendation from Dr. Joel Kileny for PUL 03

	Dr. Joel Kileny
Keep as is: no changes at all	<input checked="" type="checkbox"/>
Modify: changes to measure specifications	<input type="checkbox"/>
Retire: eliminate entirely from dashboard and emails	<input type="checkbox"/>

Recommended modifications (if applicable)