**Supplement:**

**EIT- image reconstruction:**

The frame rate was set at 20 Hz. To repress cardiac oscillations, a low-pass filter was used. We placed the electrode belt between the 4th and 5th intercostal space as suggested by Karsten et al [[S1](#_ENREF_30)].

Figure 1 shows both analytic options at three different PEEP levels. Analytic option “WIN/LOSS” (picture A,B,C in figure 1) shows cumulated compliance win of 1.4 ml/mbar, color coded blue, in the dorsal area at increasing PEEP levels (PEEP 10-14), while cumulated compliance loss of 0.8 ml/mbar, color coded orange, occurs ventral. Comparing PEEP level 12 to PEEP level 10, compliance win in the dorsal area is 1.6 ml/mbar. Simultaneously, ventral compliance loss is 0.6 ml/mbar.

To identify the amount of overdistension and collapse, the PEEP level with the best compliance for each pixel is selected. If compliance in this pixel declines at a higher PEEP level, the pixel is considered overdistended. If compliance in this pixel declines at a lower PEEP level, it is considered collapsed. Due to the calculation method, this analytic option was only used for adjusting PEEP levels after a minimum of three previous changes and for statistical analyses. Picture D, E and F (figure 1) show the analytic option overdistension (OD), color coded blue, and collapse (CL), color coded white, at the same PEEP levels. Increasing the PEEP level leads to increasing overdistension from 0 % to 15.7 %, while collapse declines from 22.8 % to 1 %. With PEEP reduction to 12, the two parameters converge (OD 5.9 %, CL 7.7 %). PEEP 12 would be chosen as optimal PEEP level.

**Cardiopulmonary monitoring:**

In one instance, placement of an arterial line failed. In this patient, blood pressure was obtained non-invasively and PaO2- values were calculated from SpO2 using a non-linear imputation described in 2016 by Brown et al [[S2](#_ENREF_31)] and prospectively validated in 2017 [[S3](#_ENREF_32)], based on the Ellis inversion [[S4](#_ENREF_33)] of the Severinghaus equation [[S5](#_ENREF_34)].

Oxygenation index (OI) was calculated as a unitless number (FiO2 × mean airway pressure × 100/PaO2).

The ideal body weight was calculated using the following formulae: for children < 60 inches ((height2 )\* 1.65)/1000; for children > 60 inches (male): 50+2.3\*(height-60); for children > 60 inches (female): 45.5+2.3\*(height-60) [[16](#_ENREF_16), S6, S7].

**Statistical analysis:**

To detect the effect of the PEEP titration on the EIT parameters (overdistension and collapse), the respiratory parameters (PEEP, global respiratory system Compliance, ∆P) gas exchange (PaO2, PaCO2, PaO2/FiO2 ratio, oxygenation index) and hemodynamic parameters (heart rate, blood pressure) a linear mixed-effects model with a random effect was used. This model was used to take the repeated measurements in one patient into account. To assess normal distribution, Shapiro–Wilk tests and Kolmogorov–Smirnov tests were performed. A **Wilcoxon matched-pairs signed rank test was used because normal distribution was rejected for global respiratory system compliance.**

**Inclusion and exclusion criteria:**

|  |  |
| --- | --- |
| **Inclusion Criteria** | **Exclusion Criteria** |
| intubated and mechanically ventilated patients:  receiving lung protective ventilation | active hemodynamic instability as evidenced by a more than 50 % change in vasopressor dosing over the preceding 6 hours |
| younger than 18 years of age  with a chest circumference of more than 70 cm | history of prematurity (< 37 weeks p.c.) |
| meeting the Berlin definition [[14](#_ENREF_14)] of ARDS for less than 72 hours | meeting criteria for ALI for more than 72 hours |
| deeply sedated or receiving neuromuscular blocking agents | significant heart disease (no echocardiogram in the past 24 hours demonstrating severe ventricular dysfunction; no known significant mixing lesion, e.g. large VSD) |
| receiving a chest radiograph in the first 12 hours after enrollment  written informed parental consent | recent (< 2 month) history of intrathoracic instrumentation (e.g. cardiac pacemaker, thoracostomy, orthopedic instrumentation) |
|  | presence of an uncuffed tracheal tube |
|  | congenital diaphragmatic hernia |
|  | significant airway obstruction |
|  | restrictive lung disease (other than ARDS) |
|  | pulmonary fibrosis |
|  | cystic fibrosis |
|  | treatment with either inhaled nitric oxide or sildenafil |
|  | severe brain injury requiring intracranial pressure monitor or external ventricular drain |
|  | use of extracorporeal life support |

**Supplemental References**

S1. Karsten J, Stueber T, Voigt N, et al: Influence of different electrode belt positions on electrical impedance tomography imaging of regional ventilation: A prospective observational study. *Crit Care* 2016; 20:3

S2. Brown SM, Grissom CK, Moss M, et al; NIH/NHLBI PETAL Network Collaborators: Nonlinear imputation of Pao2/Fio2 from Spo2/Fio2 among patients with acute respiratory distress syndrome. *Chest* 2016; 150:307–313

S3. Brown SM, Duggal A, Hou PC, et al; National Institutes of Health (NIH)/National Heart, Lung, and Blood Institute (NHLBI) Prevention and Early Treatment of Acute Lung Injury (PETAL) Network: Nonlinear imputation of Pao2/Fio2 from Spo2/Fio2 among mechanically ventilated patients in the ICU: A prospective, observational study. *Crit Care Med* 2017; 45:1317–1324

S4. Ellis RK: Determination of PO2 from saturation. *J Appl Physiol (1985)* 1989; 67:902

S5. Severinghaus JW: Simple, accurate equations for human blood O2 dissociation computations. *J Appl Physiol Respir Environ Exerc Physiol* 1979; 46:599–602

S6. Anderson PO, Knoben JE, Troutman W: Handbook of Clinical Drug Data. New York, McGraw-Hill Professional, 2001

S7. Pai MP, Paloucek FP: The origin of the “ideal” body weight equations. *Ann Pharmacother* 2000; 34:1066–1069