FUNCTIONAL RESPIRATORY IMAGING TO EVALUATE PEEP INDUCED BRONCHIAL AND ALVEOLAR RECRUITMENT IN ARDS PATIENTS

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Rationale
Insights in the pathophysiology of ARDS, the most severe form of acute lung injury, mainly point towards alveoli. Recently, airway morphological changes and dysfunction have been demonstrated too. Although it is established that increasing PEEP levels assist in the recruitment of alveoli in ARDS patients to decrease hypoxemia, today no imaging technique was able to easily quantify the diameter of airways or to demonstrate if airways can also be recruited in ventilated ARDS patients. For this purpose, we aimed to use functional respiratory imaging (FRI) as an innovative imaging technique to evaluate whether incremental PEEP levels induced not only alveolar but also bronchial recruitment in ARDS.

Methods
Bedside, a measurement of PEEP-induced lung recruitment is performed via the pressure-volume curve using the Air Liquide eXtend xT ventilator. Static lung compliance values are measured using a low flow inflation generated pressure-volume curve. The lower inflection point is considered as the clinically acceptable minimal PEEP value. Subsequently, 4 distinct PEEP levels are chosen to perform end-expiratory breath hold CT scans: 1) 20 cmH\textsubscript{2}O; 2) median value between 1 and 3; 3) clinically acceptable minimal; 4) 0 cmH\textsubscript{2}O. The 4 sequential CT scans are executed from high to low PEEP levels with a 2-minute stabilization period in between the scans, using volume-controlled ventilation. FRI methods as described by De Backer et al. (Radiology:257(3), 2010) were used to evaluate airway morphology.

Results
Results from 6 patients (range 38 - 78 year old) show that not only alveolar but also bronchial recruitment occurred and were most pronounced in the lower lobes. A nonlinear association between bronchial and alveolar recruitment exists and different coexisting pathologies, such as pulmonary fibrosis (patient 5) or emphysema (patient 3) may explain interpatient variations in this relation.

Conclusions
FRI allows us to assess and predict the recruited lung and airway volume at any pressure level, facilitating an individualized ventilation strategy in ARDS patients. An optimal balance between alveolar recruitment and avoidance of airway overstretching can thus be achieved in mechanically ventilated patients with ARDS.