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A new way of monitoring mechanical ventilation by measurement of particle flow from the airways in vivo and during ex vivo lung perfusion in DCD lung transplantation

**Background and aim:** The optimal mechanical ventilation in the different phases in the lung transplantation donation after circulatory death (LTX DCD) donation; in vivo, post mortem and during ex vivo lung perfusion (EVLP) are on debate, since different mechanical ventilation settings might affect lung preservation. Measurement of particle flow in exhaled air may allow online assessment of the impact of ventilation before changes in the tissue can be observed. We hypothesized that by analyzing the particle flow and their size distribution we could understand the impact of different ventilation parameters and by that individualise the mechanical ventilation. The exhaled particles collects onto a substrate and for subsequent chemical analysis for biomarkers.

**Method:** We used a customized PExA 2.0 connected onto the outflow of the respirator. The particle flow was analysed from the airways in vivo, post mortem and during EVLP in a porcine model using different ventilation modes; volume controlled ventilation (VCV) and pressure controlled ventilation (PCV) comparing small tidal volumes versus big tidal volumes at different PEEP and after distribution of drugs. The surfactant lipids dipalmitoylphosphatidylcholine (DPPC) and phosphatidylcholine (PC) were collected from the exhaled air and quantified by mass spectrometry.

**Results:** We found that VCV resulted in a significant lower particle flow than PCV in vivo but in ex vivo settings the opposite was found. In both in vivo and ex vivo settings we found that large tidal volume resulted in a larger particle flow than small tidal volumes and that higher PEEP resulted in a lower particle flow from the airways than lower PEEP. In EVLP settings the particle flow was dependant on the flowrate through the lung. We found that DPPC was significantly increased comparing in vivo with EVLP also comparing early phase and late phase in EVLP. We also found a significant change in the particle flow from the airways after infusion of either potassium, norepinephrine, or Niprid in the EVLP circuit.

**Significance:** Here we introduce a new method for measuring particle flow during mechanical ventilation and confirm that these particles can be collected and analyzed. The opening and the closure of the small airways might reflect the particle flow from the airways. We found that different ventilation modes resulted in different particle flow from the airways. We believe this technology will be useful for monitoring mechanical ventilated patients and may be useful for developing strategies to preserve the lung and has a high potential to detect biomarkers.

**Articles**


Ellen Broberg, Snejana Hyllén, Lars Algotsson, Darcy Wagner, Sandra Lindstedt: *Monitoring clinical lung transplantation with airway particle flow during mechanical ventilation. (submitted ICM)*