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000460

Dynamic MRI shows altered diaphragm movement and configuration due to positive end-expiratory pressure

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Introduction: In mechanically ventilated patients, positive end-expiratory pressure (PEEP) is used to improve gas exchange and respiratory mechanics by preventing alveolar collapse. Recently, it has been demonstrated in rats, that PEEP induces diaphragm remodelling by altering the position and length of the muscle, causing longitudinal atrophy [1]. The effects of PEEP on the human diaphragm during tidal breathing are currently unknown.
Objectives: To study the effects of PEEP on diaphragm movement and configuration during tidal breathing, including velocity of muscle contraction.
Methods: Healthy subjects (n = 17) underwent dynamic magnetic resonance imaging (MRI) in five different planes during tidal breathing under non-invasive ventilation with PEEP. After 30 sec, PEEP was abruptly increased from 2 (baseline) to 5, 10 or 15 cmH_2O (randomized) for 1 minute. The diaphragm dome and zone of apposition (ZOA) were tracked semi-automatically in every MRI frame using a software routine developed in Matlab (see Fig 1). Then, subjects were instrumented with nasogastric catheters to measure diaphragm neuromechanical efficiency (NME) during tidal breathing at different PEEP levels. Parameters were analysed using mixed models.
Results: Diaphragm tracking was successful (Fig 1). Increasing PEEP from 2 to 15 cmH_2O resulted 1) in decreased end-expiratory total diaphragm length (390 (234 - 445) to 351 (295 - 408) mm respectively), mostly due to decreased ZOA length (178 (166 – 190) to 140 (124 - 155) mm respectively), 2) flattening of the diaphragm with an increase of the radius of curvature (R in Fig 1) of 1.4 cm and 1.9 cm for the right and left hemidiaphragm respectively and 3) increased peak contraction velocity (14.2 (13.3 – 15.1) to 15.4 (14.0 – 16.7) mm/s respectively) but unchanged peak relaxation velocity and 4) decreased NME of 48% (37.5 - 56.6%). All mentioned effects were significant ($p < 0.03$) and reported as estimated mean (95% confidence interval).

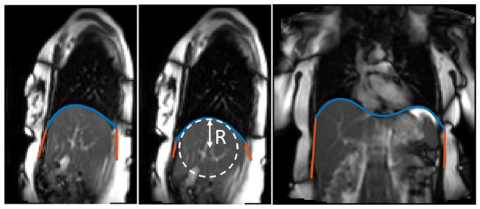

Figure 1 : Automatic tracking of diaphragm dome (blue line) and ZOA (orange line) at end-expiratory lung volume in two different imaging planes, namely sagittal right (left and middle image) and coronal mid (right image). All images were acquired in one subject. Left and middle images show diaphragm configuration at respectively 2 cmH_2O and 15 cmH_2O PEEP. The radius of curvature is shown as the white R in the middle image and was computed by fitting a fourth-degree polynomial through the top of the dome. Note the shortening of the ZOA, caudal displacement and flattening of the dome at 15 cmH_2O PEEP.

Conclusion: PEEP affects diaphragm geometry and function during tidal breathing. These findings suggest that conditions to develop longitudinal atrophy in the human diaphragm are present with the application of PEEP.

Reference(s) and grant ackowledgment(s)
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000483

Can noble metal coating reduce the incidence of ventilator associated pneumonia (VAP): a multicenter double blind randomized pilot study

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Introduction: Ventilator associated pneumonia is still a problem in the intensive care unit (ICU). Noble metal coating of endotracheal tubes reduces the adhesion of bacteria and could reduce the incidence of VAP.
Methods: A controlled prospective randomized, double blind, multicenter study was launched in November 2018 in Liège, Belgium enrolling 324 patients from 8 ICUs from 4 sites of two hospital institutions using endotracheal tubes for ventilated patients from Bactiguard. These tubes with subglottic suctioning had, for half of them, a thin coating of noble metals (gold, silver and palladium) firmly attached to their surfaces, preventing bacteria from adhering and forming biofilm. Coated tubes were indistinguishable from control tubes. Coated and control tubes were coded and remained blinded for all the participants. Patients were followed during ventilation and ICU stay up to 28 days. Tracheal colonization, incidence of VAP, and antibiotic consumption were recorded.
Results: The study ended on 5 March 2020 before the Covid-19 pandemic occurrence in Liège. Data are given as a whole because the code is not yet broken. This will be done before the European convention. Among the 324 patients with a median age of 67.5 (IQR 56,5-74,6), there were 179 men (55.4%). Their mean Charlson score was 2 (IQR 1-4) and the mean saps II score, calculated the day of intubation, was 50.5 ± 17.5. The median length of ventilation through both uncoated and coatedtubes was 5 days (IQR 3-9) totaling 2202 ventilatory days. No bacteria were found in tracheal sputum from 122 patients during ventilation. Persistence of bacteria already present in tracheal sputum the day of intubation was documented in 38 patients and new bacteria were found in 76 patients. No sampling was done in 88 patients, partially because of too short ventilation (n = 26). During ventilation and 2 days after extubation, there were 55 suspected episodes of VAP. The analysis of these episodes based on the presence of new infiltrate on X-ray exam, fever, leucocytosis, increase of the FiO_2 or Peep level, quantitative bacteriological result and CRP change, leads to reject 25 suspicions and classifies the 30 other as confirmed (n = 2), probable (n = 12) or possible (n = 16). The overall incidence of VAP was 13.7/1000 ventilatory days or 9.3/100 patients. Antibiotic from any kind was used during 68.7 % of ventilatory days and 61.7% of ICU days. ICU mortality was 41.9 % and hospital mortality was 50.8%.
Conclusion: This is the first report of a randomized double blind study with Bactiguard tubes which will allow to define the number of patients for a confirmatory larger study.