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Assessment of silent spaces at different peep levels by electrical impedance tomography in severe COPD

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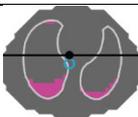
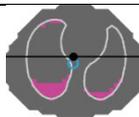
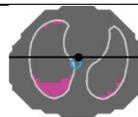
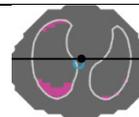
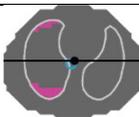
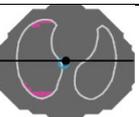
Introduction: Electrical impedance tomography (EIT) is a novel method to monitor regional lung function. For this purpose, 32 surface electrodes are placed around the human thorax. Weak alternating currents are applied via two of these electrodes and the resulting potentials are measured at the remaining electrodes. From the measured voltages, real-time images are calculated which show the distribution of electrical impedance within the body representing functions rather than structures. Using EIT these lungs can be analysed on a regional basis with respect to the following risk factors: collapse, at risk of becoming atelectasis or overdistension. Identifying these lung areas of particular clinical relevance by EIT may help to find the best individual PEEP level for each patient.

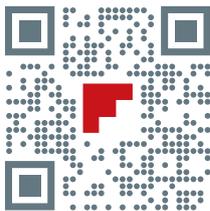
Methods: In five mechanically ventilated COPD patients we performed EIT measurements at PEEP 6, 8, 10, 12, 14, 16 cmH₂O using Swisstom BB² (Swisstom, Landquart, Switzerland). The electrode belt was placed along the sixth intercostal space and based on the measured voltages, tomographic impedance images were calculated. Patient specific regions of interest (ROI) were selected according to the patient's height, weight and gender. Tidal variation of impedance within the ROIs was measured as the difference between the end of inspiration and the beginning of inspiration. Maximal pixel amplitude within the tidal image was divided by 10, which results in 10 different amplitude categories according to which each pixel was then assigned. Thereafter, a virtual line perpendicular to the gravity vector through the geometric focal point of overall ventilation (Centre of Ventilation) was defined for each breath as the "ventilation horizon" (Table 1). All pixels lying below this horizon and belonging to the lowermost category were defined as dependent silent space (DSS). The number of these pixels was counted and expressed as % of all pixels within the ROI. Accordingly, the nondependent silent space (NSS) values describe the percentage of poorly ventilated areas physically located above the ventilation horizon.

Results: Dependent silent space decreases from 15+/-8% (Mean+/-SD) at PEEP 6 to 5+/-5% at PEEP 16. At the same time the nondependent silent space increases slightly from 2+/-2% to 6+/-3%.

Conclusions: We describe the nondependent and dependent silent spaces during a PEEP titration in 5 patients. The location of dependent silent spaces illustrates the recruitment of none or poorly ventilated areas with increasing levels of PEEP even in mechanically ventilated patients with severe COPD.

Table 1: Dependent and non-depended silent spaces for different PEEP level

	PEEP 6	PEEP 8	PEEP 10	PEEP 12	PEEP 14	PEEP 16
Silent spaces and "ventilation horizon"						
DSS [%] (Mean+/-SD)	15+/-9	13+/-7	11+/-4	9+/-3	7+/-4	5+/-5
NSS [%] (Mean+/-SD)	2+/-2	3+/-3	3+/-3	3+/-3	4+/-2	6+/-3



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Unlike traditional tomography, Swisstom's bedside imaging is based on non-radiating principles: Electrical Impedance Tomography (EIT). To date, no comparable devices can show such regional organ function continuously and in real-time at the patient's bedside.

Swisstom creates its competitive edge by passionate leadership in non-invasive tomography with the goal to improve individual lives and therapies.