Assessment of tidal recruitment during inhalation by electrical impedance tomography and dynamic computed tomography - feasibility study in porcine model lavage injury

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Background and goal of study

Tidal recruitment of atelectasis is a known contributor to ventilator induced lung injury, but its detection remains a challenge.
The most promising technology therefor seems to be electrical impedance tomography (EIT). Our aim was to find a correlate for tidal recruitment by EIT during ongoing respiration compared to dynamic computed tomography (dCT).

Materials and methods

With animal committee approval, 7 mechanically ventilated pigs were studied in healthy and after lung lavage during a pressure ramp maneuver (elisa 800, SALVIA medical, Germany): 0 to 50 mbar (5 mbar/sec).
EIT (PioneerSet, Swisstom, Switzerland) and dCT (Emotion 16, Siemens AG, Germany) were recorded simultaneously and time synchronized. To identify tidal recruitment, we extended the previously described static center of ventilation (CoV) method [1] by computing it dynamically over the inspirational phase (dCoV in EIT). For direct comparison, the center of gravity (dCoG) was post-processed by dCT.

Results and discussion

Both EIT and dCT showed significantly more tidal movement of dCoV and dCoG after lung lavage ($p<.05$, fig.1A). This within-breath shifting towards dependent lung regions during inhalation ($p<.01$, fig.1B) could be attributed to a decrease of atelectatic lung volume as detected by dCT.
The changes in ventilation distribution by tidal recruitment could be followed by the indirect measures of dCoV and dCoG (fig.2) with a high linear correlation (marginal $R^2 = .83$, fig.3).
We performed the measurements during a time-expanded pressure ramp maneuver to capture enough data points with the dCT. The presented dCoV, because of EIT's high temporal resolution, should be appropriate for monitoring tidal recruitment during ongoing tidal ventilation without the need for specific maneuvers.

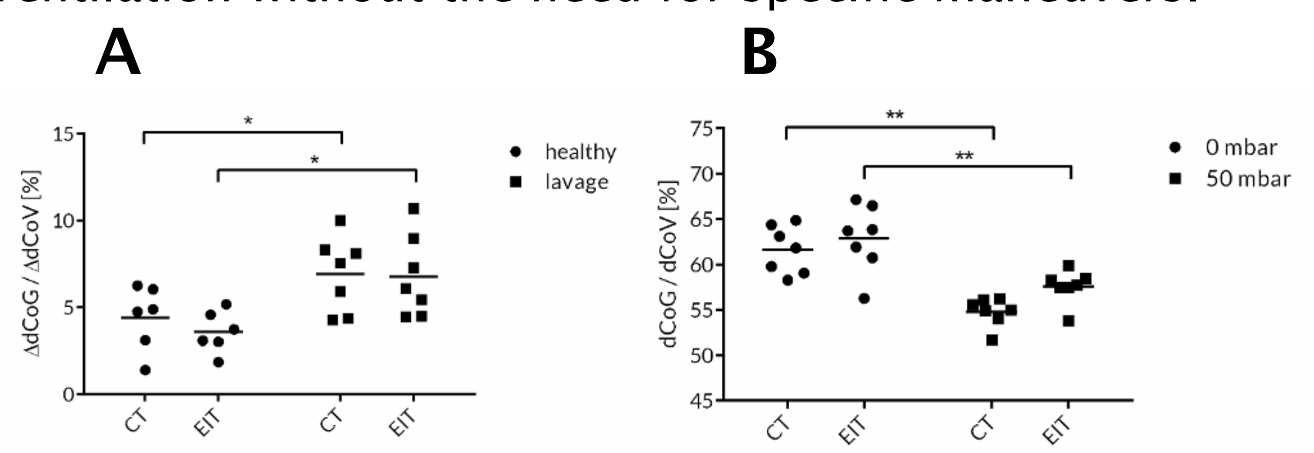

Figure 1. A) Amount of tidal movement of ventilation distribution in dCT and EIT before and after lavage B) dCoG/dCoV at 0 and 50 mbar after lavage. *p<.05 **p<.01

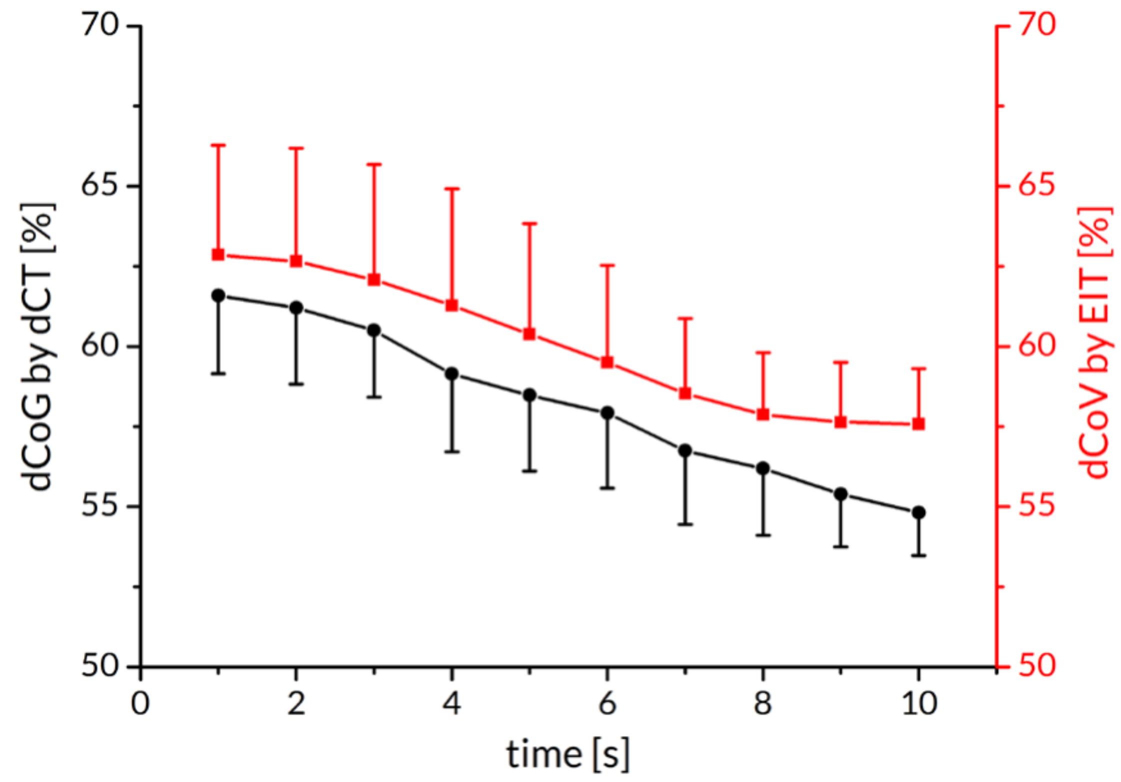

Figure 2. Temporal dynamics of dCoG and dCoV during inhalation after lung lavage.

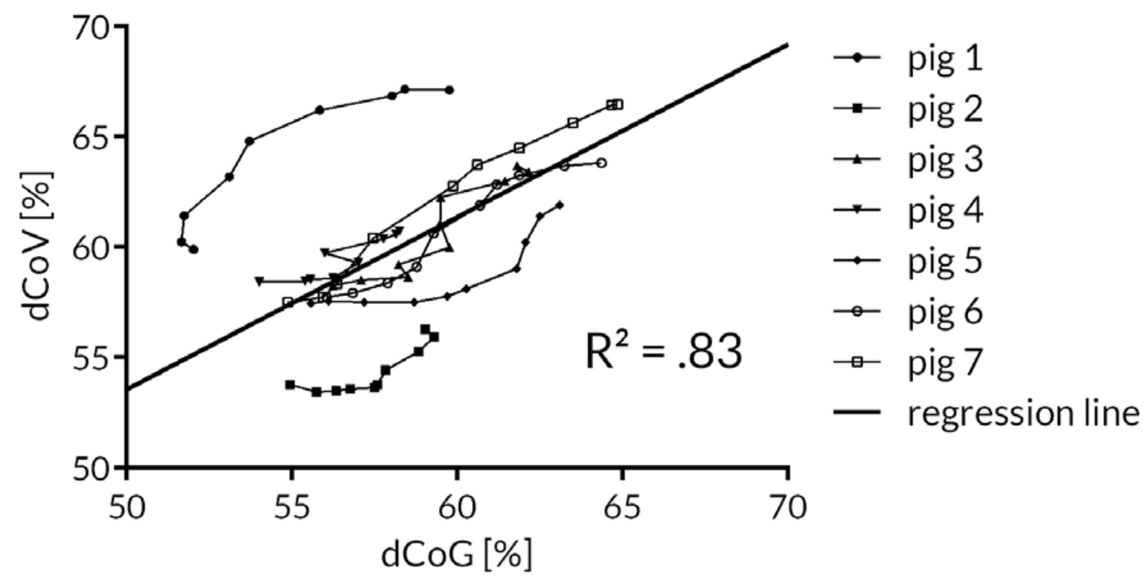

Figure 3. Correlation between dCoG and dCoV after lung lavage

Conclusion

Our data provides first evidence that tidal recruitment can be estimated by the EIT dCoV method.

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Reference

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