Reviewer's report

Title: Determination of regional respiratory gas flow by electrical impedance tomography in an animal model of mechanical ventilation

Version: 1  Date: 9 November 2013

Reviewer: Eduardo Costa

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I read with great interest the paper by Bodenstein et al. in which the authors investigated the applicability of the EIT to determine respiratory gas flow in mechanically ventilated animals and assessed its correlation with spirometry data. The topic is interesting. However, I have some major concerns.

Major Compulsory Revisions

1) The design is appropriate to validate the global measure of gas flow, but not to validate the regional measures. The title of the manuscript is misleading in that sense. There is no gold standard with which to compare the regional measures. An alternative (and appropriate) design would have involved, for example, inserting a double lumen tube and providing independent lung ventilation.

2) The introduction could be considerably improved, particularly in relation to the relevance of being able to measure gas flow either globally or regionally with EIT.

3) Why did the authors choose the tidal volumes of 15 and 20 ml/kg? It would have been interesting if they also had studied the tidal volumes in the range applied in clinical practice, such as 6 or 8 ml/kg.

4) The correlation of gas flow measured by spirometry to that measured with EIT depends on to what extent the portion of the lung imaged with EIT is representative of the whole lung. The authors appropriately designed the study to assess the conditions that might affect that representativeness, varying for example the PEEP values and the condition of the lung. If the intention of the authors was to induce lung injury, why did they choose to perform only two lung lavages? I am not sure whether those lavages were enough to significantly affect the distribution of aeration of the lungs. It would be important to at least describe in the six pigs that underwent lung lavages their p/f values and their decrease in compliance.

5) Lung ROI: why did the authors use an arbitrary criterion (discarding the last 8 rows of pixels) as opposed to using some of the described techniques to define the lung ROI? Please refer to the work of Zhao et al, for example.

6) What is the rationale of the definition of late inspiratory and expiratory flows? As is apparent in the figure, the authors are calculating an average slope of a clearly nonlinear portion of the flow curve.

7) Why not to compare EIT flow with spirometry flow point by point? This
comparison could have been done using the raw signals and perhaps improved if
time-domain filtering were applied in both, EIT and spirometry signals to eliminate
the cardiac-related oscillations.

8) It was not clear to me how the authors assessed the influence of the
ventilatory settings and of the lung condition on the correlation of spirometry and
EIT. I believe that this assessment would best be performed by two-way
repeated measurements ANOVA or by a mixed-effect linear model.

9) Additionally, I think that analyses of agreement, such as Bland-Altman plots,
should be reported.

10) The second paragraph of the conclusion reads more like a paragraph of
limitations and is not supported by the data. In addition, the limitations of this
work are not clearly stated in the discussion.

Minor Essential Revisions

1) Abstract, second paragraph, lines 1-2.
The following sentence is hard to understand, please consider rewriting: “In a
model of mechanical ventilation n=7 healthy and n=6 pigs before and within one
hour after induction of lung injury by lung lavage were investigated by EIT and
spirometry.”

2) Abstract, third paragraph, lines 6-7. This sentence is not clear: “Diseased and
healthy lungs have a heterogeneous pattern of regional gas flow, depending
partially on lung injury not on ventilator setting.”

3) Background: I don’t think there is enough evidence to state that EIT can be
repeated without a limit.”, especially considering that the electrode belt could lead
to pressure ulcers.

4) Please define ROI at its first appearance in the text.

5) Abstract, fourth paragraph, line 1: typo - there is no comma in “to determine
regional, respiratory gas flow of the lung”.

6) Methods, Experimental preparation, first paragraph, line 5 - typo: laboratory.

7) Page 6: the resolution of the method does not depend on the size of the image
matrix (32x32). Please correct.

8) Please consider replacing the term “independent” lung with “non-dependent”
lung

9) Results and discussion, Flow pattern (ROI analysis), third paragraph. Please
clarify if lavage significantly influenced or not global and regional PIF, PEF and
LEF. “Global and regional PIF, PEF and LEF were not influenced significantly by
modified ventilatory parameters or by early, mild lung lavage […] Lavage
increased PIF significantly in the ventral ROI (p=0.03) and decreased PEF
significantly in the global (p=0.04) and ventral ROI (p=0.03). LEF was mainly hit
in the dorsal ROI (absolute decline, p=0.05)”.

Level of interest: An article whose findings are important to those with closely
related research interests

**Quality of written English:** Not suitable for publication unless extensively edited

**Statistical review:** Yes, and I have assessed the statistics in my report.

**Declaration of competing interests:**
I declare that I have no competing interests