

A comparison of EIT lung perfusion measures

Symon Stowe¹, Alistair Boyle¹, Michaël Sage², Mathieu Nadeau², Jean-Paul Praud², Étienne Fortin-Pellerin², Andy Adler¹

¹Carleton University, Ottawa, Canada, andy.adler@carleton.ca

²Université de Sherbrooke, Canada

Abstract: Several different techniques have been proposed to measure the distribution of perfusion in the lung using EIT: using a bolus of hypertonic saline, or frequency filtering the EIT images at the cardiac rate. We compare these techniques in newborn lambs. The preliminary results from two animals show a common trend between bolus injection and frequency analysis measures of perfusion.

1 Introduction

The “holy grail” of EIT-based lung function assessment is measurement of both ventilation and perfusion distribution. While EIT measures of ventilation are reasonably well validated, multiple different measures of perfusion are used and their relationship is poorly understood [1]. True EIT-perfusion measures can be made with a vascular injection of a conductivity contrasting (hypertonic NaCl) fluid, but this is invasive, must be infrequent to avoid hypernatremia, and can affect the EIT signal over time [2]. The second approach uses cardiac-frequency filtering of the time-series EIT images. This shows what has been called “pulsatility”, and is affected by cardiac-related movement and is not sensitive to the continuous blood flow in the capillaries.

Our goal is to compare images from these techniques

to determine whether the distribution of perfusion and its trends are consistent between bolus- and filtering-derived functional images. Data with a large change in ventilation status due to the introduction of total liquid ventilation (TLV) were used [3].

2 Methods & Results

Newborn lambs were anesthetized and ventilated in a supine position. 16-electrode, EIT data were acquired at 4.7 frames/s using the Sigmatome II EIT device [4], and the experimental protocol of Fig. 1 used. P_B was measured by a injection of a 7.9% saline solution during an apnoea. P_A and P_V were measured during apnoea and ventilation.

Results show a relationship between images in overall shape and distribution of pulsatility images through the stages of the protocol, from gas ventilation (baseline), through TLV filling, stable (5 minutes) and 2h post filling.

References

- [1] D Nguyen, *et al*, *Physiol Meas* 33:695–706, 2012
- [2] J Yap, *et al*, *Parenteral and Enteral Nutrition* 41:641–646, 2017
- [3] M Sage *et al*, *PloS one*, 13:e0191885, 2018.
- [4] N Robitaille *et al*, *Physiol Meas*, 30:S57–S71, 2009.

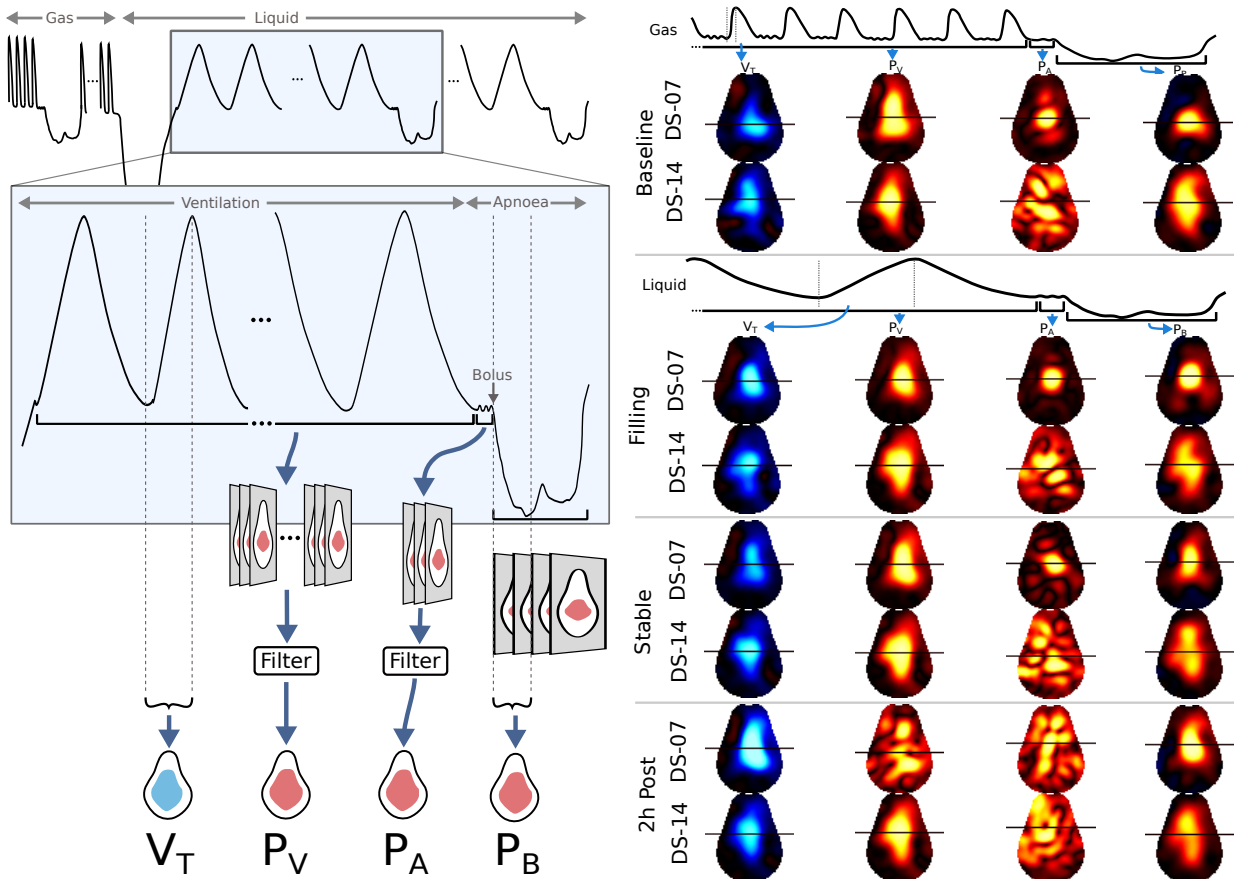


Figure 1: Protocol (left) and Images (right) in two lambs. P_V : pulsatility (perfusion) image during ventilation, from frequency filtering EIT data during ventilation; P_A : pulsatility (perfusion) image during apnoea, from frequency filtering EIT data during apnoea; P_B : perfusion image from bolus, calculated between bolus measures and an apnoea reference measure; and V_T : tidal ventilation image.