Evaluation of Centre of Ventilation (CoV) during three different ventilation conditions

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Evaluation of Centre of Ventilation (CoV) during three different ventilation conditions

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Abstract: The EIT-based Centre of Ventilation (CoV) within the lungs was evaluated at baseline and 10 minutes after applying three ventilation conditions: (1) zero end-expiratory pressure (ZEEP), (2) 5 cmH_2O of PEEP without a recruitment maneuvre (RM) and (3) after a RM. A significant dorsal shift of the CoV was seen for the RM, but not for the other two conditions.

1 Introduction

During anaesthesia, functional residual capacity decreases resulting in atelectasis formation in the dependent parts of the lungs. Several ventilation modes have been used to avoid or counteract this lung collapse. However, monitoring the effectiveness of different ventilation modes and settings is still challenging. The CoV has been used to evaluate the distribution of ventilation within the lungs of anaesthetised subjects [1].
The aim of this study was to investigate in healthy dogs the shift in the CoV under changing ventilation conditions.

2 Methods

The lungs of nine healthy Beagle dogs positioned in dorsal recumbency were ventilated during three subsequent anaesthesias (sevoflurane in oxygen 100%) using volume-controlled ventilation at 10 ml kg^{-1}, zero end-expiratory pressure (ZEEP) and a respiratory rate adjusted to maintain PE'CO_2 between 4.7 and 5.3 kPa. After 35 minutes, baseline EIT images were recorded using a belt around the thorax caudal to the apex of the heart (T_1). Dogs then underwent in randomised order either continued ventilation at ZEEP (control group), ventilation with positive end-expiratory pressure of 5cmH_20 (PEEP) alone or after a recruitment manoeuvre (RM) performed by increasing PEEP stepwise to 15 cmH_2O and peak inspiratory pressure to 40 cmH_2O and by maintaining them there for 10 breaths [2]. Measurements were repeated after 10 minutes (T_2). The ventilation-related relative impedance changes (ΔZ) from the start to the end of inspiration were calculated, see Figure 1. Then the geometric CoV was determined. T_1 was compared to T_2 using Student´s paired t-test.

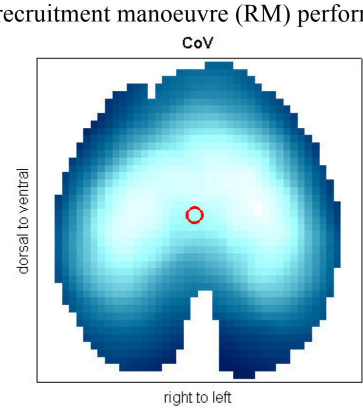

Figure 2: EIT ventilation image of a dog with CoV (red circle). Bright colours mark areas with high and dark colours areas with low impedance changes, which relate directly to the amount of regional ventilation. The CoV is calculated from the tidal image (end minus start of inspiration).

3 Results

Only after the RM a significant dorsal shift of the CoV was found (P = 0.0118), while such a redistribution of ventilation was observed neither during ZEEP nor PEEP (Figure 2).

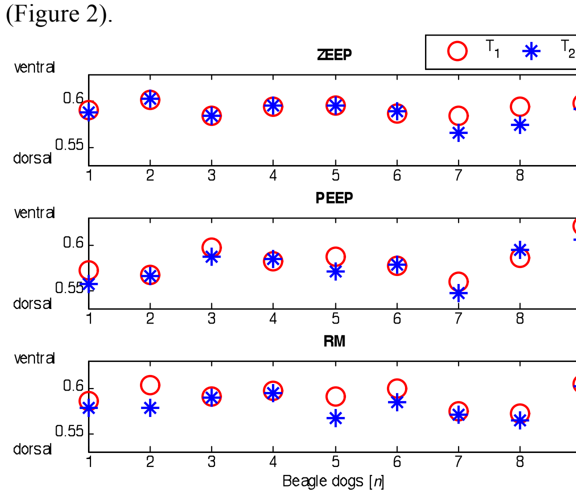

Figure 2: CoV before (T_1) and after (T_2) applying three different ventilation modes to the lungs of healthy dogs. ZEEP = zero end-expiratory pressure, PEEP = positive end-expiratory pressure, RM = recruitment manoeuvre combined with PEEP.

4 Conclusions

While the combination of RM and PEEP caused a significant dorsal shift of the CoV from baseline ventilation at ZEEP even in healthy lungs and during short term ventilation, PEEP did not show the same effect.

References

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