Respiration and Airway Management

1123
Expiratory Ventilation Assistance during mandatory ventilation in porcine ARDS improves arterial oxygenation – a randomized controlled animal study

Ventilation,artificial, Lung,adult respiratory distress syndrome

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Background and Goal of Study: Mechanical ventilation aggravates acute respiratory distress syndrome (ARDS). The new ventilation mode Expiratory Ventilation Assistance (EVA) showed an improved oxygenation in lung healthy pigs compared to conventional volume controlled ventilation while utilizing similar inspiratory tracheal pressure (p_{trach}), PEEP and tidal volume (V_T). We hypothesized that EVA improves gas exchange and attenuates ventilator associated lung injury in a porcine model of ARDS.

Materials and Methods: 14 anaesthetised pigs with an oleic acid induced ARDS (initial Horovitz index 100 - 150 mmHg) were randomly allocated to either volume controlled ventilation as control or EVA ventilation with identical ventilation parameters (F_iO_2 0.8, V_T 7 ml/kg body weight, PEEP 9 mbar, respiratory rate adjusted to maintain arterial blood pH > 7.2). P_aO_2, p_aCO_2, p_{trach} and minute volume (MV) were measured every 30 min. After three hours lung tissue was excised and H&E stained for determination of alveolar wall thickness. Statistics were performed with linear mixed model analyses and unpaired t-test's. Data are reported as mean ± SEM.

Results and Discussion: EVA significantly elevated p_aO_2 compared to control group (107 ± 11 vs. 164 ± 21 mmHg, p=0.04). Peak inspiratory p_{trach} was similar in both groups (35 ± 2 vs. 32 ± 2 mbar, p=0.2) whereas mean p_{trach} was significantly elevated in the EVA group (17 ± 1 vs. 19 ± 1 mbar, p=0.02). A comparable p_aCO_2 (control: 54 ± 2, EVA: 57 ± 3 mmHg, p=0.4) was achieved with a significant lower MV in the EVA group (8.7 ± 1.1 vs. 6.1 ± 0.8 l/min, p<0.001). Alveolar walls were thinner in the EVA group (7.8 ± 0.2 vs. 5.5 ± 0.1 µm, p<0.0001).

Conclusion: EVA ventilation stabilizes alveolar walls and hence improves gas exchange in porcine ARDS. This new ventilation technique may yield lung protective effects.

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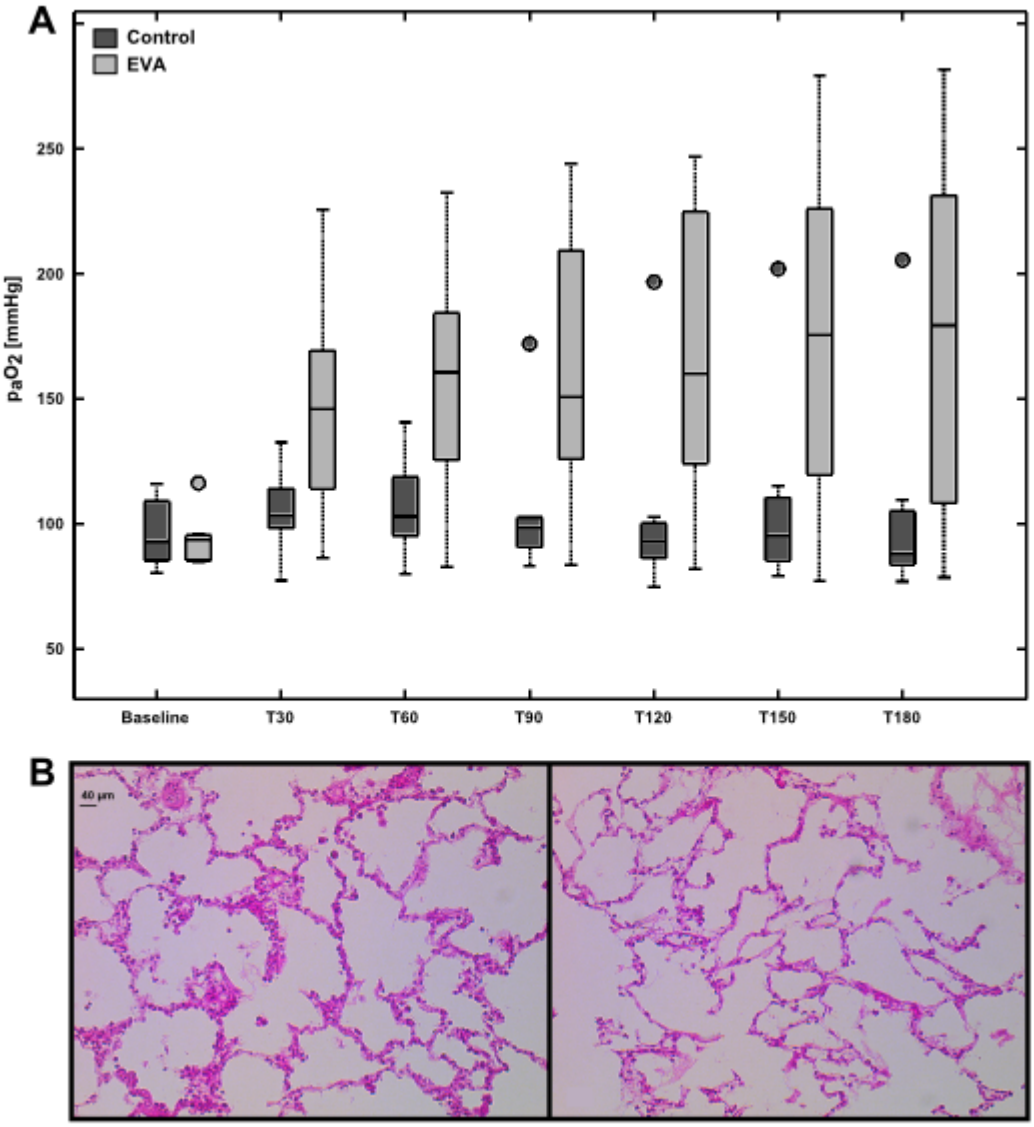

Fig. 1 A: Arterial oxygenation for EVA and control group during the experiment. At baseline, all animals were ventilated with a volume-controlled mode. Box and whisker plots indicate median, interquartile range and full range, outliers are indicated by circles. B: Representative H&E stained tissue samples for control (left) and EVA group (right).