Expiratory flow control and Ventilator induced lung injury

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Argomento: VENTILAZIONE

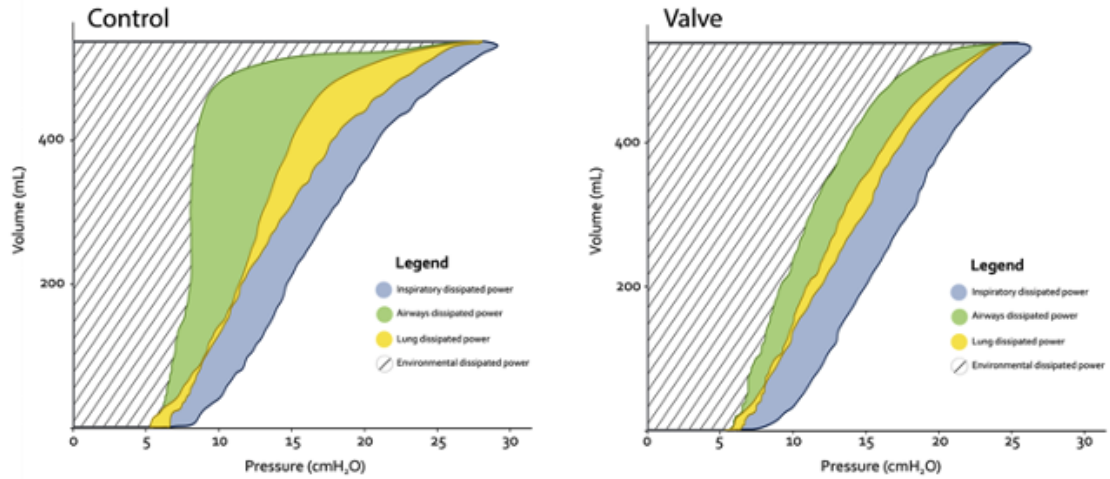
***Introduction*:** Mechanical power is a summary variable, putatively cause of Ventilator Induced Lung Injury (VILI). Out of the total power delivered, part of it is dissipated to win the inspiratory resistances, while the remaining amount is stored in the lung as elastic energy. This energy is released during expiration, but its distribution between respiratory system and environment is influenced by the flow pattern. We investigated whether expiratory flow control could reduce the energy dissipated into the lung parenchyma and consequently Ventilator Induced Lung Injury.

Methods: We studied 22 female piglets (29±2kg). The animals were randomized in two groups: a control (n=11) and a valve (n=11), where expiratory flow was controlled through a computer driven valve. Both groups were ventilated prone for 48h with similar mechanical power (~ 9J/min). Electric Impedance Tomography was continuously measured. Measurements were taken at baseline, 0.5h and every 6h. Lung weight, wet to dry ratios and histology were evaluated.

Results: Total mechanical power was similar in the control and valve groups (8.49±0.92 and 8.44±0.56 J/min respectively, p=0.88) as well as the fraction dissipated during inspiration (16.1±3.5% and 16.9±5.6%). The amount of energy dissipated within the respiratory system was remarkably different (2.9±0.6, control, vs 1.16±0.4 J/min, valve, p <0.001). Out of this energy, the amount dissipated into the lung parenchyma was 1.45±0.5 vs 0.73±0.16 J/min (p=0.008). The decrease of electrical impedance (sign of lung damage) was significantly greater in the control group (p=0.02), primarily in dorsal lung regions. Respiratory mechanics, gas exchange, hemodynamics, total lung weigh, wet to dry ratios and histology were similar among groups.

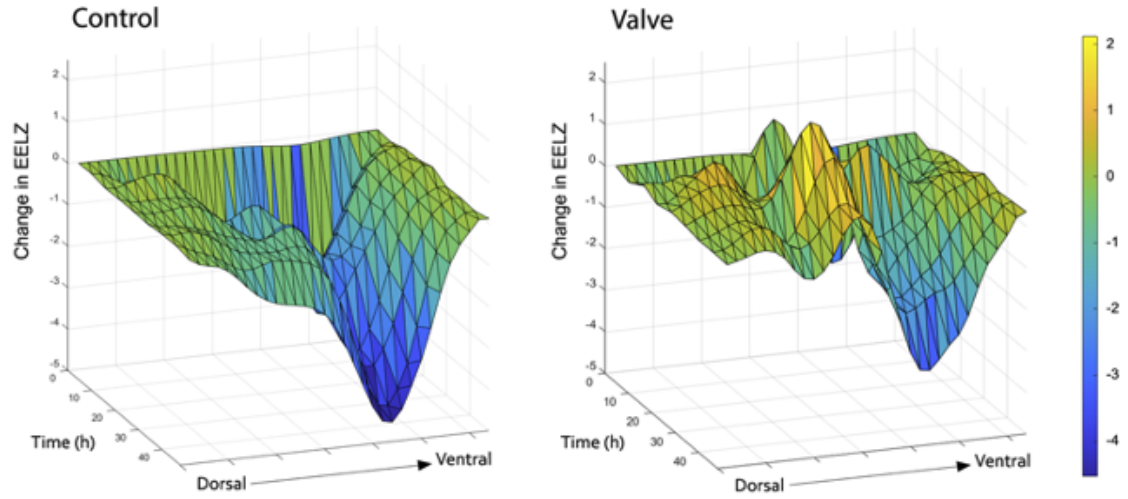
Conclusions: expiratory flow control causes different energy distribution. At least in these experimental conditions, the lower amount of energy dissipated into the lung parenchyma in the valve group was insufficient to significantly decrease the lung damage vs control.

PANEL A



Panel A: a visual model of energy dissipation distribution in the two experimental groups. As shown, the amount of energy dissipated to overcome inspiratory resistance was similar in the two groups (blue area), while the expiratory phase was remarkably different (see text for details)

PANEL B



PANEL B: a tridimensional view of end-expiratory lung impedance (EELZ) change over time in the two groups. As shown, in the control group (panel A), the EELZ remained similar in the dorsal regions (green color) but sharply decreased with time in the most ventral ones (dependent regions, blue color). In contrast, in the valve group (panel B), the EELZ increased with time in the dorsal regions while it decreased in the ventral ones, albeit less than in controls. The two figures were built averaging all the impedance measured in the two groups.