Respiratory mechanic assessment of Asymmetrical Acute Respiratory Distress Syndrome with Electrical Impedance Tomography.

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Background: ARDS is a heterogeneous syndrome involving different phenotypes with distinct clinical and outcome characteristics. Low flow pressure volume (PV) curve reflects the global behavior of the lungs and can be misleading in ARDS. With Electrical Impedance Tomography (EIT) it is possible to measure the distribution of ventilation in each lung in order to describe asymmetrical lung injury. Moreover, each lung respiratory mechanic and PV curve can be assessed with an EIT derived method. In the present study, we hypothesized that some ARDS patients may have asymmetrical injury where EIT would provide different information from those obtained from global P-V curves.

Methods: French Ethical Committee (20/42, CPP Est IV) and registered (NCT04386720).

We recorded the low flow PV curve without PEEP of the ventilator and the EIT derived PV curves of each lung. A difference of tidal ventilation of at least 20% between the 2 lungs was considered as asymmetrical ARDS. We compared respiratory mechanic between the 2 lungs in patients with asymmetrical ARDS.

Results: We analyzed 26 patients, 18 patients had asymmetrical lung injury (Figure), the most injured lung received 28.5 ± 8.0 % of the tidal ventilation, its compliance was significantly lower than the less injured lung: 11.9 ± 7.8 vs 28.8 ± 14.3 ml.cmH_2O^{-1} $p<0.0001$ respectively. Thirteen patients had an airway opening pressure >4cmH_2O; Global PV curve AOP was 6.6 ± 3.4 cmH_2O, similar to the less injured lung with 6.6 ± 3.3 cmH_2O, whereas the most injured lung had a significantly higher AOP of 10 ± 3.9, p=0.003. The PEEP recruited volume V_{REC} was significantly lower in the most injured lung: 67 [43-123] vs 120 [57-225] ml, p=0.015. The compliance of the recruited lung (C_{rec}) in the most injured lung was not different from the less injured 22.0 [5.6-32.3] vs 24.0 [11.8-41.0] ml.cmH_2O^{-1} respectively, p=0.460.

Conclusion: EIT can show asymmetrical ARDS and assess respiratory mechanic of each lung. Personalizing ventilator management in asymmetrical lung injury entails assessing each lung-

specific risk of VILI with repeated opening and collapse of the more injured lung and overdistension in the less injured lung. A specific compromise between PEEP and V_T in asymmetrical ARDS could attenuate the risk of VILI.