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| **Title:** | **Demystifying anaesthesia for the critically ill; - new concepts in ARDS.** |
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| **Abstract:** | A majority of patients admitted to the Intensive Care Unit (ICU) require respiratory support. Some of these patients will develop acute respiratory distress syndrome (ARDS) and a few may also require acute surgery. ARDS is frequently associated with multiple organ failure with a mortality rates as high as 70%. It is well understood from animal studies and evidence from large randomised clinical trials that "traditional" methods of ventilation not only cause harm, but contribute to excess mortality. It therefore behoves everyone ventilating patients with ARDS to understand what happens to their lungs when they are ventilated using different strategies.<br>Over 20 years ago, with the availability of CT scanning, it was possible learn about the pathophysiology of ARDS. ARDS could no longer be considered a homogeneous process affecting the all of the lung tissue, but instead a normal but smaller "baby lung" was found to co-exist with basal areas of collapse and consolidation. The paradigm of a "baby" lung provided new insight as to how one should ventilate patients with ARDS. The most important change in clinical practice has been to limit tidal ventilation and permit hypercapnia.<br>More recently it has been found that some or all of the collapsed lung tissue in ARDS can be recruited and then maintained with an appropriate level of positive end expiratory pressure (PEEP).<br>However, there are no well established methods to determine an optimal, patient-specific PEEP or other critical ventilator settings. These fundamental dynamics of these new concepts in ARDS have been recently modelled. The model captures lung units recruited (from a fixed total) at different pressures based on measured pressure-volume (PV) data. Clinical PV data from patients with ARDS at 3 or more PEEP settings is used to validate the model's ability to predict the volume recruitment response to changes in peak inspiratory and expiratory pressures in pressure controlled mode.<br>Data was matched to within 0.1% and 4% over the inflation limb and between 0.3% and 13% over the deflation limb, and correlates well with clinical data and expectations. Predictions of recruited lung volume change with change in PEEP have a median absolute error of 1.87% (IQR: 0.93–4.80%; 90% CI: 0.16–11.98%) for inflation and a median of 5.76% (IQR: 2.71–10.50%; 90% CI: 0.43–17.04%) for deflation, across all data sets and PEEP values (N = 34 predictions).<br><br>**Figure:** Example patient fit and prediction (left) and volume responsiveness of inspiratory (lower) and expiratory (upper) limbs. Asterisk indicates predicted values, lines show the linear trend prediction. Right panel shows an example case for one patient with the linear volume response to changes in PEEP.<br><br>**Summary**: This model enhances our understanding of ARDS, and produces good, clinically relevant predictions of the recruited volume response to changes in ventilation pressure settings. Hence, the model could be used to optimize ventilator management for any individual patient creating a patient-specific approach to ventilation management. |