Ventilation inhomogeneity- modelling and analysis of inert gas washout curves

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There is a new interest in lung volume measurements during mechanical ventilation since some ventilator manufacturers have recently incorporated this feature in the ventilators. Lung volume measurement with this approach is based on nitrogen washin/washout using fast oxygen and carbon dioxide analyzers and assuming that the nitrogen concentration is equal to 100 percent minus the sum of oxygen- and carbon dioxide concentrations. By plotting the tracer gas concentration, i.e., nitrogen, against the accumulation of tidal volumes washin/washout curves can be constructed and the mixing of alveolar gas, i.e. ventilation inhomogeniety, can be estimated. Knowledge of alveolar gas mixing may be used for diagnosing underlying lung conditions, i.e., obstructive lung disease, as well as for optimizing the ventilator therapy. Many different indices for assessing alveolar gas mixing have been proposed, but none have been widely used during mechanical ventilation, mainly due to lack of easy and accurate methods for tracer gas washin/washout during ventilator treatment (1). The indices existing can be divided in compensated and non-compensated for changes in tidal volumes, dead space and lung volume. Theoretically, the compensated ones should more accurately evaluate the inherent property of the lung function and the changes in gas mixing produced by changes in ventilator settings. However, the different indices, including the compensated ones, are more or less sensitive to the tail of the washout-curve. The indices, which are more sensitive, e.g., pulmonary clearance delay, give very high values in patient with obstructive lung disease, under the condition that washout is continued for a prolonged period (1,2). Based on theoretical considerations and calculations as well on patient studies, we have proposed that the compensated indices; multiple breath alveolar mixing and pulmonary clearance delay have the best properties to be used during mechanical ventilation (1,2,3) .

References

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