Bed-side measurement of pulmonary gas exchange

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Pulmonary gas exchange abnormalities are common in the ICU and place the patient at risk of developing hypoxaemia and hypercapnia. The underlying cause of the impaired gas exchange is due to mismatch between ventilation and perfusion ranging from pulmonary shunt, to infinitely high V/Q i.e. alveolar dead space. The Automatic Lung Parameter Estimator (ALPE) is designed for bedside measurement of pulmonary gas exchange [1]. In 2012 a commercial version of this system has been released for use in the ICU.

This presentation reviews the development of the ALPE system resulting in the 2012 commercial version. The technological components are described including a) the general principle of using changes in FIO2 to identify gas exchange abnormalities and b) the current state of mathematical models included in ALPE [2], which allow estimation of pulmonary shunt and parameters describing regions of the lung with low ventilation perfusion (V/Q) ratio and high V/Q ratio.

In addition, potential clinical application of the system will be presented, including clinical examples with special reference to a) Appropriate selection of inspired oxygen fraction [3] and appropriate selection of positive end expiratory pressure (PEEP).

References:

[1] Rees SE, Kjaergaard S, Thorgaard P, Malczynski J, Toft E, Andreassen S. The automatic lung parameter estimator (ALPE) system: non-invasive estimation of pulmonary gas exchange parameters in 10-15 minutes. J.Clin.Monit.Comput. 2002 Jan;17(1):43-52.

[2] Karbing DS, Kjærgaard S, Andreassen S, Espersen K, Rees SE. Minimal model quantification of pulmonary gas exchange in intensive care patients. Med Eng Phys. 2011 Mar;33(2):240-8.

[3] Karbing DS, Allerød C, Thorgaard P, CariusAM, FrilevL, Andreassen S, Kjærgaard S, Rees SE. Prospective evaluation of a decision support system for setting inspired oxygen in intensive care patients. Journal of Critical Care, 2010, 25(3):367-74.