教育セミナー（ランチョン）

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Electrical impedance tomography for monitoring regional lung ventilation in critically ill patients.
座長:小谷 透(昭和大学病院 集中治療科診療科)
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[LS14]Electrical impedance tomography for monitoring regional lung ventilation in critically ill patients

Inéz Frerichs (University Medical Centre, Schleswig-Holstein, Department of Anaesthesiology and Intensive Care Medicine, Germany)
【 同時通訳付き】

Mechanical ventilation is often a life-saving treatment; nonetheless, its prolonged use in critically ill patients may have harmful effects on the lung tissue and induce the so-called ventilator-associated lung injury. The underlying pathophysiological processes are the volutrama, barotrauma, atelectrauma and ultimately biotrauma. The monitoring of mechanically ventilated patients typically relies on the measurements of airflow and pressure, pulmonary gas exchange parameters and thoracic imaging. However, since the airflow-based measurement of tidal volume (and minute ventilation) often does not include the parallel assessment of functional residual capacity and transpulmonary pressure is also only seldom measured in patients treated in intensive care units, the assessment of pulmonary stress and strain is not possible. However, the excessive stress and strain are the decisive factors promoting the development of lung injury. Moreover, all of the mentioned bio-signals characterise merely the overall lung function and do not allow the assessment of its regional heterogeneity. Regional overdistension and cyclic alveolar opening and closing with their deleterious local effects thus cannot be determined directly at the bedside. Conventional radiological methods like chest radiography, computed tomography or magnetic resonance imaging allow excellent anatomical lung imaging but they are not suitable for regional functional imaging with the measurement of regional lung dynamics. They also do not permit continuous lung monitoring, similar to the increasingly used lung ultrasound. The only currently available imaging method, allowing continuous functional lung imaging at the bedside is electrical impedance tomography (EIT) [1]. EIT is a fully non-invasive and radiation-free imaging modality that can easily be applied in critically ill patients of all age groups, from preterm infants to adult patients. Because of its very high scan rates EIT allows the dynamic assessment of lung ventilation distribution and regional aeration changes but also of lung perfusion. EIT has been successfully applied to determine regional alveolar overdistension, collapse and tidal recruitment [2,3] or regional opening and closing pressures [4]. The continuous availability of such information provides the data necessary for finding protective ventilation settings in each patient. For instance, a decremental positive end-expiratory pressure (PEEP) trial performed under EIT monitoring enables a personalised selection of PEEP that minimises ventilation heterogeneity, overdistension and alveolar cycling. EIT has the potential for becoming a useful tool for optimization of ventilation therapy in critically ill patients with reduced ventilator-associated lung injury.

References:
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[2] Costa et al. Bedside estimation of recruitable alveolar collapse and hyperdistension by electrical

impedance tomography. Intensive Care Med 2009;35:1132-1137.
[3] Kotani et al. Regional overdistension during prone positioning in a patient with acute respiratory failure who was ventilated with a low tidal volume: a case report. J Intensive Care 2018;6:18.
[4] Pulletz et al. Regional lung opening and closing pressures in patients with acute lung injury. J Crit Care 2012;27:323.e11-18.