Electrical Impedance Tomography

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Introduction

Employment of technical equipment and devices increased intensely in anaesthesiology and intensive care medicine respectively during the last decades. Regarding mechanical ventilation, which is of outstanding clinical value up to date, lots of modes, parameters and features have been developed and technically implemented in modern respirators [1]. Although the ARDS network encouraged scientific projects concerning concepts of protective artificial respiration during the past ten years, there is still a major deficiency regarding monitoring of ventilation [2]. Up to date, there are just global and very imprecise modalities to monitor injurious impacts of ventilation to lung tissue at bedside. Since CT and MRI scans are associated with high resource consumption, the central method for controlling ventilatory settings and further treatment still is blood gas analysis and predefined algorithms (e.g. according to the ARDS network protocol).

Methods

Electrical Impedance tomography (EIT) is a rather new monitoring modality which has been around for some time. It allows to derive real-time images and video streams of regional ventilation at the bedside. Basis for EIT is the typically circular attachment of electrodes around the human thorax. Predefined changing pairs of electrodes are used to inject alternating current and voltage measurement respectively in order to gain electrical impedance [3]. For impedance distribution reconstruction of the concerned lung cutting, diverse algorithms exist that have various advantages and disadvantages. Dependent on used hardware, number of electrodes and current frequency, up to 40 frames per second can be achieved by repetitive measurements.

Results

Most studies published so far focused on illustrating and measuring (regional) tidal ventilation. That regard, various animal trials have shown that EIT is able to visualize quantitatively variation of tidal volume during respiration. Furthermore, regional tidal volume distribution can be displayed and estimated very precisely [4]. In diverse clinical trials potentialities but also challenges of EIT have been pointed out. Nonetheless, further clinical applications have already been addressed in other studies like perfusion imaging, generating ventilation-perfusion matches, estimating intra-cerebral masses, performing tumour diagnostics and other fields [5,6,7].

References

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