

The use of Automatic Lateral Therapy (ALT) guided by Electrical Impedance Tomography (EIT) for Continuous and Individualized Ventilatory Support

The article for the popularization of the novel method

Introduction and background:

The physiological and clinical effects of prone position on ARDS have been studied for many years. In 2013 was demonstrated that the early application of prolonged prone-positioning sessions significantly decreased mortality of patients with severe ARDS. Nowadays, prone position has become increasingly recommended in patients with severe ARDS.

The effects of lateral position, another potentially beneficial kind of body positioning, remain largely unknown. Patient rotation is generally used for prevention of pressure injuries and for airways and pulmonary hygiene. Some data suggest that patient rotation may be used also as a strategy for prevention of ventilator-associated pneumonia. There is pressing a need of a better understanding of the respiratory and cardiovascular effects of lateral tilt.

After seven years of comprehensive foundational research on the effects of regional changes of lung mechanics in different body positions, we would like to share the new findings and open the discussion platform about continuous individualization of ventilatory care based on targeted patient's repositioning guided by real-time and personalized monitoring by Electrical Impedance Tomography.

A timely titrated proper level of PEEP, which is a key global mechanical ventilation parameter, is a decisive factor to keep the sick lung open. But symmetrical lung diseases are less common than asymmetrical ones. Consequently, application of global mechanical ventilation parameters like PEEP on lungs with different regional mechanics may lead to critical complications and less protective and efficacious ventilatory support.

Method:

Continuous monitoring of Global and Left/Right lung plethysmography (ventilation over time) by EIT displays around-the-clock regional (L/R) Tidal Volume (V_T) and Functional Residual Capacity (FRC) distributions. By changing the patient position (e.g. by the bed LINET Multicare that is equipped by platform-based rotation) we can timely and effectively influence regional lung mechanics and, consequently, optimize regional V_T and FRC (left and right lungs). The EIT monitoring accurately shows, in real-time, the regional increase of the ventilation in the dependent lung ($L_{dep} \uparrow V_T$) and the increase of the air volume (FRC) in the nondependent lung ($L_{n-dep} \uparrow FRC$). These regional/selective beneficial effects, in combination with a proper level of PEEP, afford a gentle, safe and simultaneous recruitment of nondependent lung units as well as a reduction of overdistension in dependent ones.

Conclusion:

The real-time monitoring of regional lung behaviour by EIT, the titration of optimum PEEP, and the personalization of body position by ALT, afford an easy understanding and application of a close loop system for timely individualization and optimization of protective mechanical ventilation.



Figure 1: Scheme of Close Loop system to individualize mechanical ventilation



Figure 2: Application of the method in clinical practice (Illustrative image)