



Making ventilation visible

PULMOVISTA® 500

The PulmoVista® 500...

The challenge of achieving lung protective ventilation

Although respiratory care has come a long way over the years, complications attributed to inappropriate settings of mechanical ventilation continue to have an adverse impact on patient outcome. Today lung protective ventilation strategies largely rely on physiological parameters which only reflect global lung function. The well known complications of atelectasis and overdistension call for insight into the distribution of ventilation in the ventral and dorsal regions of the lung so that measures can be taken to individually tailor ventilator settings^{1), 2), 3)}. CT and chest x-rays provide regionally specific information but only as a snapshot in time. Determining how different lung regions respond to therapeutic interventions over time is challenging without continuous regional information.

THE VISION – CONTINUOUSLY VISUALIZING VENTILATION

Dräger understands the need for continuous information about regional distribution of ventilation to be available at the bedside. Our search for a suitable solution revealed that the monitoring technique of Electrical Impedance Tomography (EIT) had the potential to address this need.

The progress of development, and results of clinical studies, confirmed that EIT provides the required information in a superior manner^{4), 5), 6)}.

THE METHOD – ELECTRICAL IMPEDANCE TOMOGRAPHY

EIT monitoring involves the application of a small current and measurement of resulting voltages to determine the ventilation related impedance changes that occur in a thoracic cross-section.

Advanced data acquisition techniques and sophisticated reconstruction algorithms are used to generate tomographic images and parameters which enable the assessment of regional distribution of ventilation as well as short-term changes of end-expiratory lung volume within the cross-section. This offers clinicians a new and unique perspective on respiratory care.

¹⁾ Meier T et al., Assessment of regional lung recruitment and derecruitment during a PEEP trial based on electrical impedance tomography. Intensive Care Med 2008; 34: 543-550

²⁾ Putensen C., Electrical impedance tomography guided ventilation therapy, Current Opinion in Critical Care 2007, 13:344-350

³⁾ Kunst P.W. et al., Monitoring of recruitment and derecruitment by electrical impedance tomography in a model of acute lung injury. Crit Care Med 2000; 28: 3891-3895

⁴⁾ Meier T. et al., Assessment of regional lung recruitment and derecruitment during a PEEP trial based on electrical impedance tomography. Intensive Care Med 2008; 34: 543-550

⁵⁾ Lüpschen H. et al., Protective ventilation using electrical impedance tomography, Physiol. Meas. 28 (2007) S247-S260

⁶⁾ Riedl T. et al., Regional and overall ventilation inhomogeneities in preterm and term-born infants, Intensive Care Med (2009) 35:144-151

PulmoVista® 500 offers:

- Continuous information about regional distribution of ventilation, displayed as images, waveforms and parameters
- Trend display of regional distribution of ventilation
- Trend display of changes in end-expiratory lung volume

THE TOOL – PULMOVISTA® 500

PulmoVista 500 is an Electrical Impedance Tomograph which has been specially designed for use in clinical routine. Data is continuously displayed in the form of images, waveforms and parameters. Simply put, PulmoVista 500 lets you visualize the distribution of ventilation.





Regionally specific information

Mechanical ventilation is commonly used as a life saving measure for patients with respiratory complications. However, mechanical ventilation may lead to lung injury and cause inflammatory responses. It is often challenging to set PEEP and tidal volume so that the well known adverse effects of mechanical ventilation are minimized.

Due to the heterogeneous properties of the injured lung, alveolar collapse and overdistension may occur in different parts of the lung. Information about the regional distribution of ventilation is valuable for the management of mechanically ventilated patients^{7), 8), 9)}. PulmoVista 500 has been specifically designed to display and quantify regionally specific changes of air content.

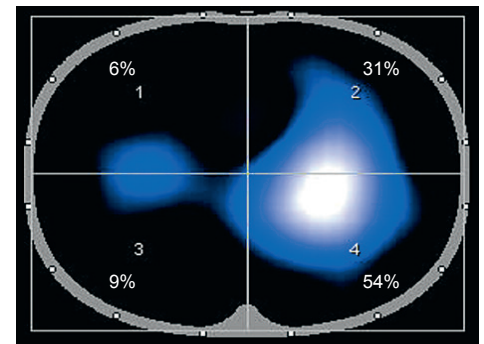
“With EIT the clinician
can follow changes in distribution
of ventilation over time”

(Prof. Dr. med. Dr.-Ing. Steffen Leonhardt, RWTH Aachen University, Aachen, Germany, Sep. 2009)

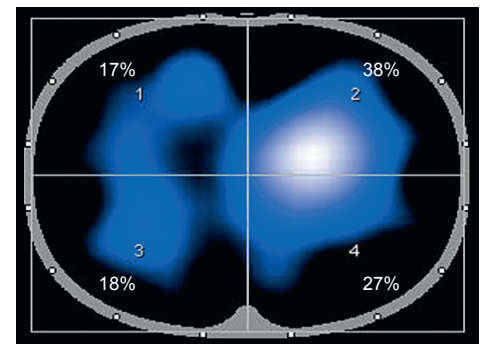
Continuous dynamic bedside imaging

PulmoVista 500 provides continuous real-time dynamic images of ventilation and intrapulmonary air distribution at the bedside. Monitoring is possible for up to 24 hours, enabling a close watch to be kept on critical lung conditions and the effect of therapy changes. Additionally, clever use of trended information provides further insight into patient progress.

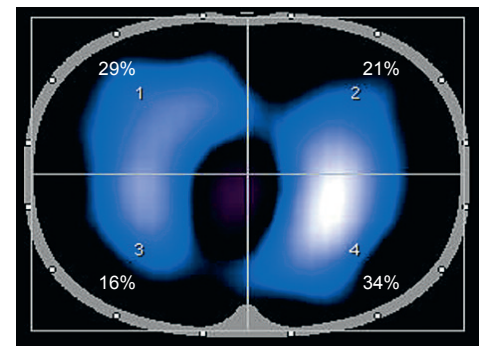
QUANTIFICATION OF DISTRIBUTION OF VENTILATION OVER TIME



Prior to recruitment maneuver



10 mins after recruitment



4 hrs after recruitment

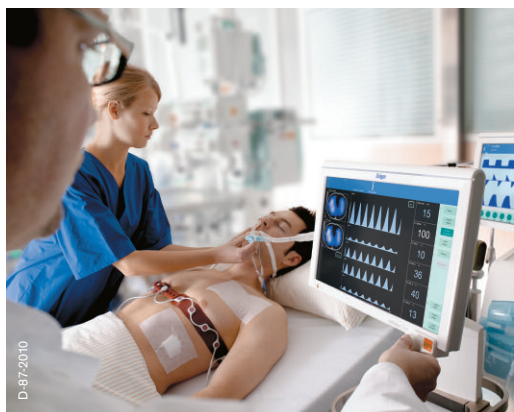
The same tidal volume setting was used pre and post recruitment.

⁷⁾ Erlandson K. et al., Positive end-expiratory pressure optimization using electric impedance tomography in morbidly obese patients during laparoscopic gastric bypass surgery, *Acta Anaesthesiol Scand* 2006; 50: 833–839

⁸⁾ Lindgren S. et al., Regional lung derecruitment after endotracheal suction during volume- or pressure-controlled ventilation: a study using electric impedance tomography, *Intensive Care Med* (2007) 33:172–180

⁹⁾ Odenstedt H. et al., Slow moderate pressure recruitment maneuver minimizes negative circulatory and lung mechanic side effects: evaluation of recruitment maneuvers using electric impedance tomography, *Intensive Care Med* (2005) 31:1706–1714

...a new window to pulmonary function



D-87-2010



D-102-2010



D-28201-2009

Non-invasive tomographic monitoring

The regional ventilation monitoring provided by PulmoVista 500 is non-invasive and without any side-effects. Unlike chest x-rays or CT, there's no ionizing radiation involved. EIT involves minimal preparation so monitoring is established in just a few minutes. Patient preparation only requires the positioning of a flexible non-adhesive belt around the patient's chest. PulmoVista 500 has been designed with the busy ICU environment in mind and does not interfere with the ICU workflow.

“EIT allows continuous quantification of changes of end-expiratory lung volume in the individual patient and at the bedside.”

(Dr. D. Gommers, vice chairman of the Adult Intensive Care Unit at Erasmus Clinical Center in Rotterdam, The Netherlands, Oct. 2009)

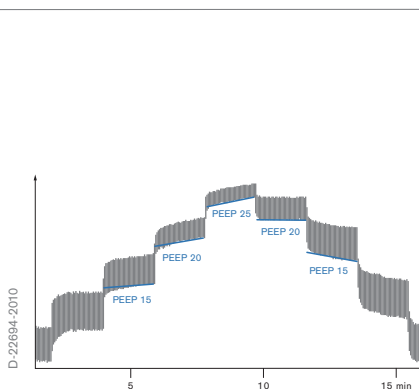
Supporting your everyday work

PulmoVista 500 provides valuable information about the effects of:

- Endotracheal suctioning
- Tidal volume settings
- PEEP settings
- Recruitment maneuvers
- Patient positioning

“As soon as we start using EIT
and get EIT information it will change
our attitude towards ventilation”

(Dr. O. Stenqvist, Dept. of Anesthesia and Intensive Care, Sahlgrenska University Hospital, Göteborg, Sweden, Oct. 2009)



Impedance waveform representing the dorsal lung regions during an experimental PEEP trial: The decremental part shows constant end-expiratory lung impedance at higher PEEP levels indicating a stable end-expiratory lung volume, which has been suggested to be the "optimal PEEP"⁷⁾. At a PEEP of 15 cmH₂O onset of derecruitment results in a negative slope suggesting an inadequate PEEP. Regional information enables detection of the onset of derecruitment earlier than parameters that represent the entire lung¹⁾.

Seeing rather
than assuming –
The PulmoVista® 500

PulmoVista 500 provides new and valuable real-time information. The quantification of regional distribution of ventilation provides a new way of looking at the lung to help treat, or even prevent, atelectasis and overdistension. With insight into end-expiratory lung volume changes PEEP settings can be optimized so that lung regions remain open throughout the breath cycle which may avoid the problems associated with cyclic recruitment.

PulmoVista 500 provides a method to closely monitor the patient's lung condition and to continuously assess the effect of respiratory treatment, thus guiding a strategy of lung protective ventilation.

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93/42/EEC (Medical devices).