LINET RESEARCH

LINET Group

EXECUTIVE SUMMARY

Continuous, Individualized Ventilation Care

With Platform Base Tilt and Electric Impedance Tomography

Multicare

Open Lungs Carefully and Keep Them Open

Pre-Proning and Pre-Recruitment Maneuver Care

ALT – EIT

For patient safety and caregiver confidence

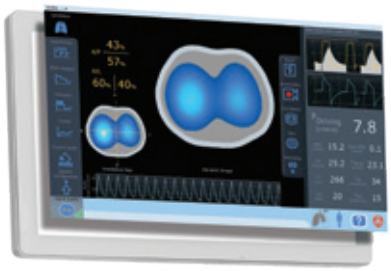
Goals

ALT-EIT helps improve medical care in mechanically ventilated patients.

Typically:

Lung Consolidation	Lung Contusion	Pneumonia	Obesity	ALI/ARDS

Concept



EIT Monitor

Provides continuous, real-time ventilation imaging.

Adjust TILT & PEEP

Comfirm EFFECT

Ventilator

ALT bed

Precise, individualized tilt allows control of ventilation distribution and enhances lung opening.

ALT (Automatic Lateral Therapy)

As an interventional tool, lateral tilting significantly influences the distribution of pleural and trans-pulmonary pressure. Lateral tilt with adequate PEEP can control ventilation distribution (see Tilt Physiology section). ALT can also trigger lung opening at lower pressures compared to current care.[0]

EIT (Electrical Impedance Tomography)

A monitoring tool that provides continuous real-time visualization of patients‘ mechanical ventilation. This is crucial in guiding ALT and ventilator settings.

ALT guided by EIT

Allows precise ventilation management that is:

- Individualized
- Timely
- Continuous
- Targeted
- Careful
- Radiation-free

Concept

Invasive Mechanical Ventilation (IMV) in the USA

IMV represents a high morbidity and mortality group of patients that are associated with significant costs to the healthcare system.

3,109 cases
per 100.000 adults/in 2009 received IMV[3]

20 – 40% of all ICU
admission require IMV[2]

$ 600 – 1500
Hospital cost increment by one IMV day[4]

$ 49.258
Cost per patient receiving mechanical ventilation[1]

$ 47.165
Cost per patient receiving mechanical ventilation with CLRT[1]

$ 2.093
Cost saving per patient after implementation of CLRT[1]

Scope

ALT – EIT Lung Opening

In adequate PEEP

Rotation matters – Application of ALT EIT

SUPINE

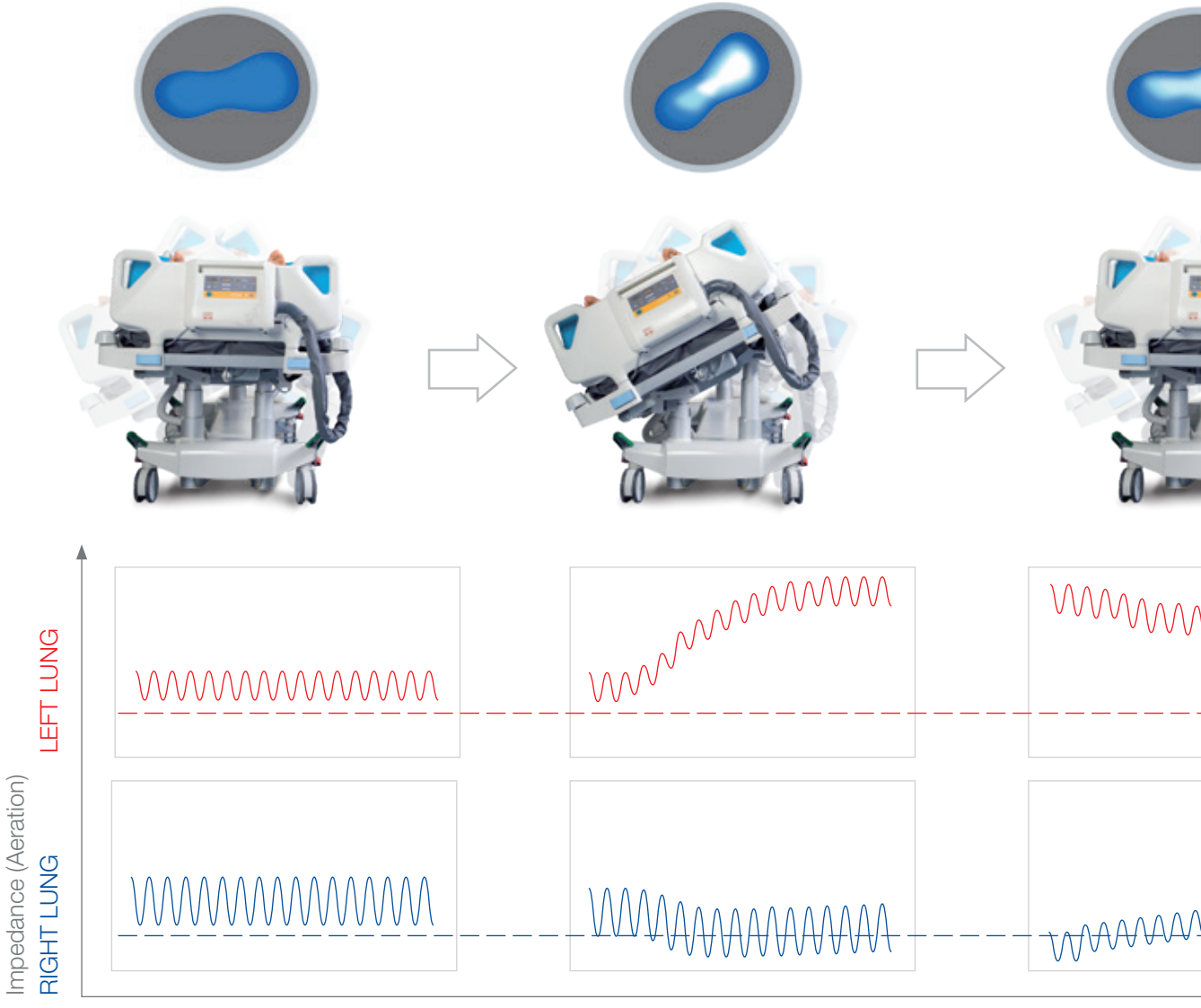
Poorly aerated ALI/ARDS lungs

RIGHT DECUBITUS

Increased aeration in upper lung (left)

SUP

Increased ov

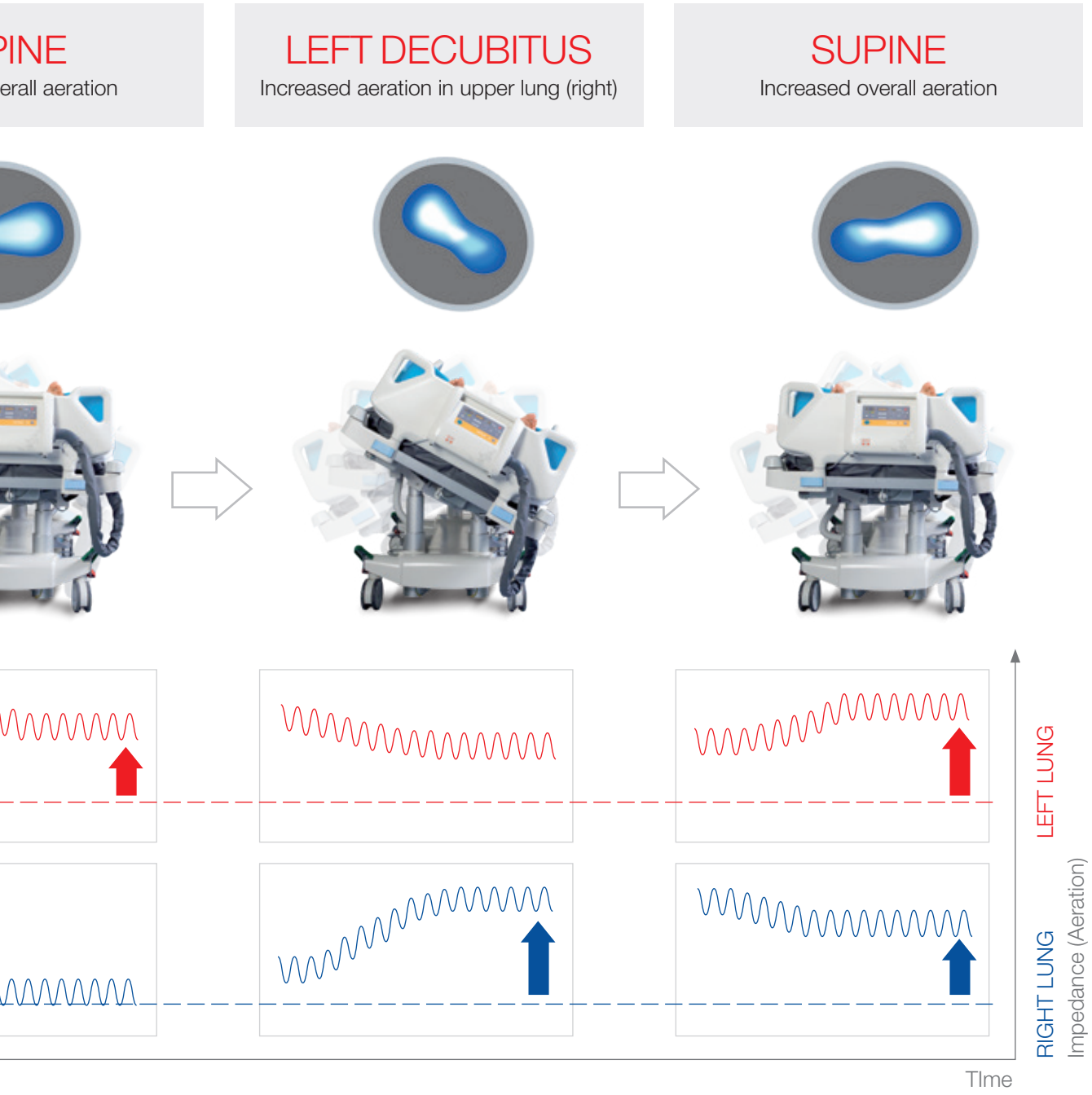


Initial status. The impedance (that reflects aeration) of each lung is provided in a separate graph for clarity – these values may overlap. The oscilation is tidal volume.

The upper lung (left) gains volume due to increased PTP. **Adequate PEEP** is necessary to prevent the lower lung from derecruitment.

After the return to lung may lose so is still recruited re status. Red arrow volume gain.

Rotation matters – Application of ALT EIT

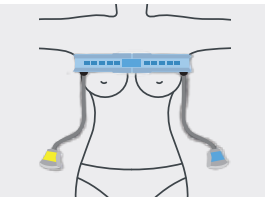


o supine, the
me volume but
lative to initial
v represents

Now the right lung is the upper lung and gains volume due to increased PTP. The blue arrow represents volume gain of the right lung relative to initial status.

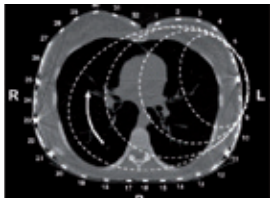
After the return to supine, both lungs may exhibit recruitment. The red and blue arrows represent volume gain.

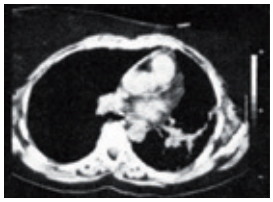
EIT (Electric Impedance Tomography)



A 32-electrode belt is placed around the circumference of the thorax. Electrical current (~5-10mA 30V) is injected through a pair of electrodes and chest impedance is measured by all remaining ones. This is repeated (at 50Hz) for all pairs of electrodes to generate one EIT image.

The EIT is contraindicated in pacemaker/ICD.



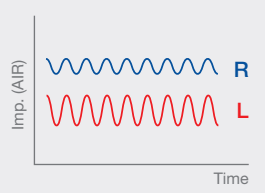


In an analogous principle to CT, a thoracic impedance map is generated.

(This CT presents atalectasis in the left lung).

In an EIT image, the lighter the color the higher the impedance, hence more air.

(This EIT presents less air in the left lung, that may reflect atalectasis).



For any chosen region, the impedance can be displayed graphically over time (The R and L lungs, R has more air).

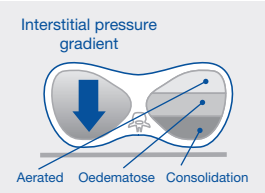
ALT (Automatic Lateral Therapy)

Method of patient lateral tilt developed based on experience with CLRT.

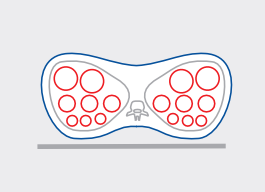
Bed platform based patient rotation with a maximum angle of 60° (30°L/30°R).

Safe patient stabilization system and stable ventilation circuit fixation.

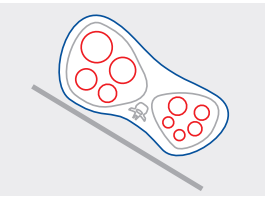
Tilt Physiology



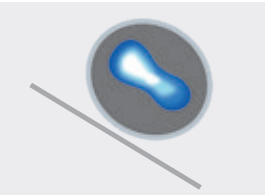
Due to gravity, a vertical gradient of interstitial pressure exists, specifically in oedematous lungs.



Consequently, the alveoli in the lower (dependent) regions are less distended than ventral ones and may even collapse. On the contrary, the upper (nondependent) regions may be overdistended.

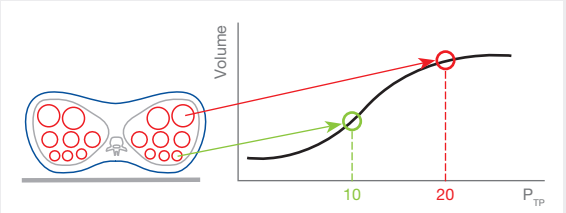


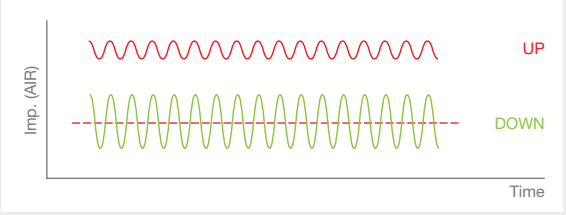
In lateral tilt the same principles apply. Hence the **upper** lung tends to be **more distended**. (illustrated schematically and in EIT image) This distending pressure can serve as an opening maneuver. However, *adequate PEEP must be set* to prevent lower lung from collapse.



NOTE

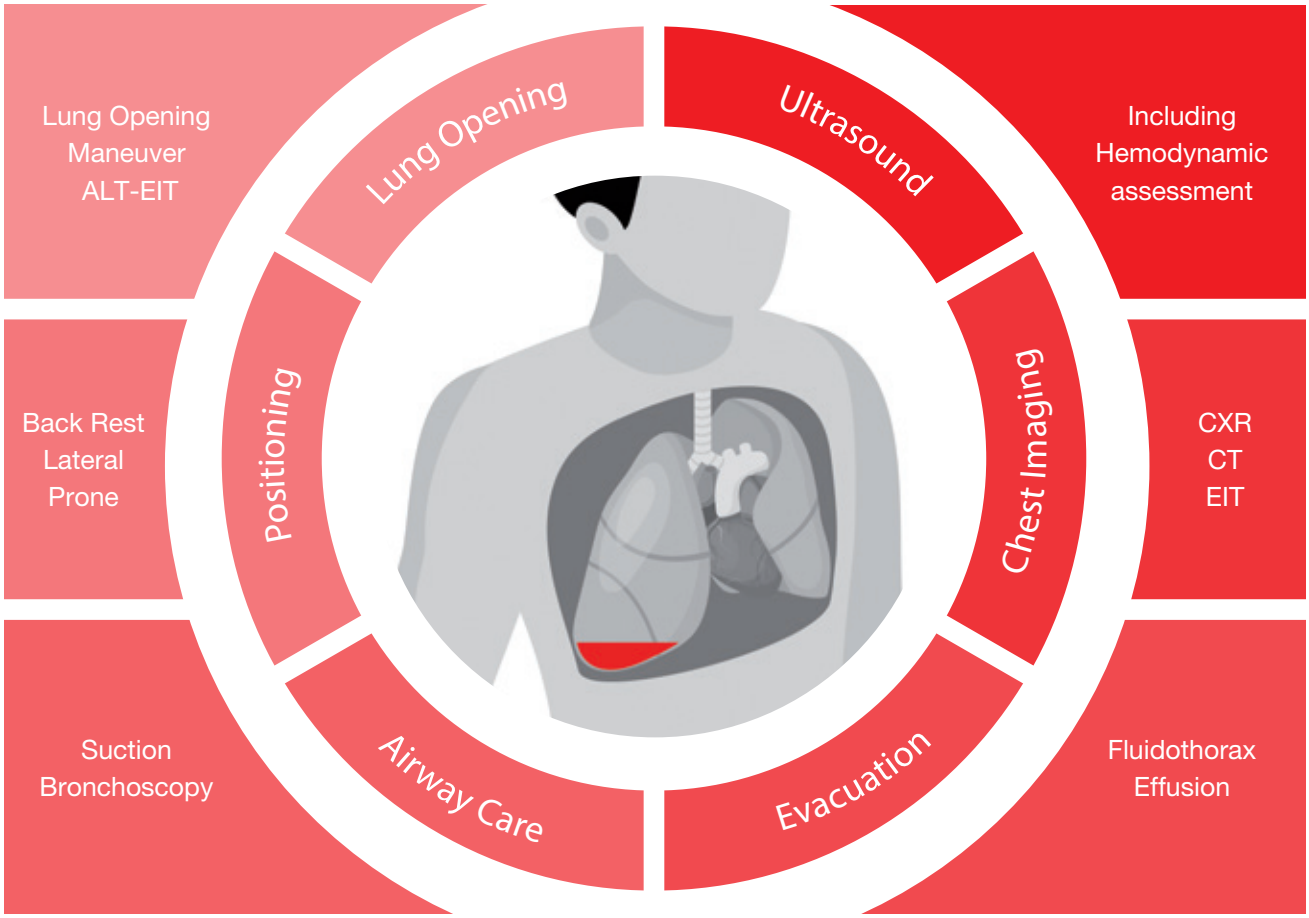
Increased distension does not necessarily implicate increased ventilation. With increased distension (i.e. PTP – trans-pulmonary pressure) compliance regional ventilation decreases. The ultimate example is over-distension with maximal local aeration but almost no local ventilation (red trace "UP" in the graph).





Comprehensive Individualized Care

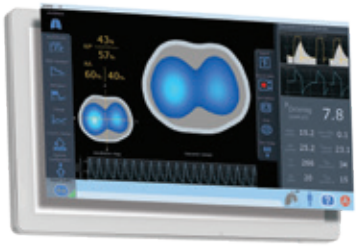
Respiratory failure is always challenging and requires a systemic individualized approach to each patient. Precise differential diagnostics are usually combined with several therapeutic interventions. The combination of lateral lilt and the EIT method can only be effective if it is a component of such complete respiratory care.



References

0. Ongoing study
1. Kang SY, DiStefano MJ, Yehia F, Koszalka MV, Padula WV. Critical Care Beds With Continuous Lateral Rotation Therapy to Prevent Ventilator-Associated Pneumonia and Hospital-Acquired Pressure Injury: A Cost-effectiveness Analysis. J Patient Saf. 2019 Mar 20;. doi: 10.1097/PTS.0000000000000582. [Epub ahead of print] PubMed PMID: 30896557.
2. Critical Care Statistics. Society of Critical Care Medicine [online]. 500 Midway Drive, Mount Prospect, IL 60056 USA: SCCM, 2019 [cit. 2019-09-27]. Available from: https://www.sccm.org/Communications/Critical-Care-Statistics
3. Mehta AB, Syeda SN, Wiener RS, Walkey AJ. Epidemiological trends in invasive mechanical ventilation in the United States: A population-based study. J Crit Care. 2015 Dec;30(6):1217-21. doi: 10.1016/j.jcrc.2015.07.007. Epub 2015 Jul 16. PubMed PMID: 26271686; PubMed Central PMCID: PMC4628853.
4. Mechanical Ventilation in the Intensive Care Unit. THE AMERICAN ASSOCIATION FOR THE SURGERY OF TRAUMA [online]. 633 N Saint Clair St, Suite 2600, Chicago, IL 60611: AAST, 2019 [cit. 2019-09-27]. Available from: http://www.aast.org/GeneralInformation/mechanicalventilation.aspx

ALT guided by EIT



EIT Monitor

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Comfirm EFFECT

ALT bed

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Ventilator

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LINET, spol. s r.o.
Želevčice 5 | 274 01 Slaný | Czech Repblic
tel.: +420 312 576 400 | fax: +420 312 522 668 | e-mail: info@linet.com | www.linet.com

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