Continuous, Individualized Ventilation Care
By Platform Base Tilt and Electric Impedance Tomography

Multicare X & Multicare
Open Lungs Carefully and Keep It Open
Pre-Proning and Pre-Recruitment Maneuver Care
ALT – EIT
For patient safety and caregiver confidence

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.

ALT bed
Precise, individualised tilt allows to control ventilation distribution and enhances lung opening.
ALT (Automatic Lateral Therapy)

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 later). 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 setting.

ALT guided by EIT

Allows precise ventilation management that is:

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

Invasive Mechanical Ventilation (IMV) in the USA

IMV represent high morbidity and mortality cohort of patients that are associated with significant cost to healthcare system.

<table>
<thead>
<tr>
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<th>310,9 cases per 100,000 adults/in 2009 received IMV³</th>
<th>20 – 40% of all ICU admission require IMV²</th>
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<tbody>
<tr>
<td>Hospital cost increment by one IMV day⁴</td>
<td>$ 600 – 1500</td>
<td>$ 49.258</td>
</tr>
<tr>
<td>Cost per patient recieving mechanical ventilation¹</td>
<td>$ 47.165</td>
<td>Cost saving per patient after implementation of CLRT¹</td>
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¹ CLRT: Continuous, Individualized Ventilation Care
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)

**SUPINE**
Increased overall aeration

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

Upper lung (left) gains volume due to increased $P_{TP}$. *Adequate PEEP* is necessary to prevent lower lung from derecruitment.

After the return to supine, left lung may lose some volume but is still recruited relative to initial status. Red arrow represents volume gain.
Rotation matters – Application of ALT EIT

During the return to supine, the left lung may lose some volume but is still recruited relative to its initial status. The red arrow represents volume gain.

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. Red and blue arrows represent volume gain.
EIT (Electric Impedance Tomography)

32-electrode belt is placed circumferentially around. 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.

EIT is contraindicated in pacemaker/ICD.

In an analogous principle to CT, thoracic impedance map is generated.
(This CT presents atelectasis in the left lung).

In 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 atelectasis).

For any chosen region, the impedance can be displayed graphically over time (Here R and L lung, R having more air).

NOTE

Increased distension does not necessarily implicate increased ventilation. With increasing distension (i.e. $P_T$ – trans-pulmonary pressure) compliance and thus regional ventilation decrease. Ultimate example is over-distension with maximal local aeration but almost no local ventilation (red trace “UP” in the graph).

Tilt Physiology

Due to gravity, 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 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.

**ALT** (Automatic Lateral Therapy)

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

Bed platform based patient rotation in maximal angle of 60° (30°L/30°R).

Safe patient stabilization system and stable ventilation circuit’s fixation.
Comprehensive Individualized Care

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

References

0. Ongoing study
ALT guided by EIT

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