Dräger

Objective: The ***Diagnostic View*** is a convenient bedside tool for automatically assessing PEEP trials by just pressing one single button, in order to directly display and quantify indicators of alveolar collapse, alveolar overdistension and tidal recruitment.

Step 1:   **Perform a PEEP trial** (according to hospital standards)

Example:

Decremental PEEP trial
- Initial recruitment maneuver
- PEEP steps of 2 mbar

RM

PEEP Trial

14 mbar

2 mbar

6 mbar

Step 2:   **Prepare the *PEEP trial analysis* – assignment of "sections"**

1. If the displayed trend data contain a PEEP trial, sections (1) will automatically be assigned to each PEEP step

2. Press button "***PEEP trial analysis***" (2) to conduct the analysis

Conduct analysis

Global | EIP [mbar] | PEEP [mbar]
A:14 B:12 C:10 D:8 E:6

Start analysis — PEEP trial analysis | Customized analysis | 10 min | Refresh

Sections | RVD

Define sections — Automatic | Add section | Remove section

Breaths per section — 5

Reference section for customized analysis — A

If the Medibus parameter *EIP* is not available for the analysis, the PEEP trial must be conducted in pressure controlled ventilation.

If trend data show a PEEP trial, but no sections have been assigned, most likely the section length was set higher than the duration of a PEEP step.

→ Reduce the "Breaths per section" (3) and press "Automatic" (4) to redefine the sections.

Step 3:　Only if needed – Manual adjustment of the "*sections*"

Scenario 1:

If PEEP steps are missed or wrongly assigned in the presence of unstable breathing patterns, sections can manually be added (1), removed (2) or shifted.

Scenario 2:

To assess any PEEP trial other than the latest trial, use the sliders (3) to put the trial of interest into the focus and press "Automatic" (4) to define new sections.

When all sections are properly set:

For both scenarios, just press button "***PEEP trial analysis***" (5) to conduct the analysis.

Before starting the analysis, make sure that every PEEP level has been correctly assigned to a section, as the selected number of spontaneous breaths are averaged. For this reason, sections containing several breaths must be set to areas with constant EELI levels.

Please check our '*Basics – Getting Started Application Guide*' for general description of the '*Diagnostics View*'-Screen and the '*Colour Maps*'.

## Step 4:   Interpreting the results

1. Assessment of Tidal Images during a decremental PEEP trial
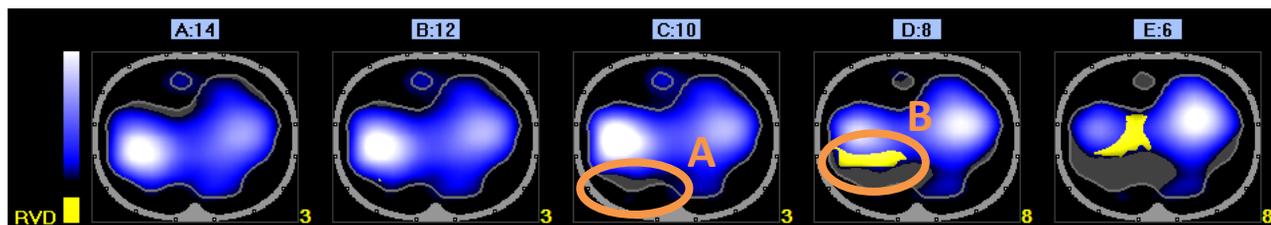
Check for development of grey areas (A) towards lower PEEP levels, which indicate non-ventilated areas that were previously ventilated at higher PEEP levels.

If areas are marked in yellow color (B), touch the corresponding image (in this example, *D:8*) in order to open the page *RVD analysis* (C).

Use this page (C) for detailed assessment of the inspiratory, but also expiratory dynamics. Both large time constants and cyclic opening and closing can cause inspiratory delays.
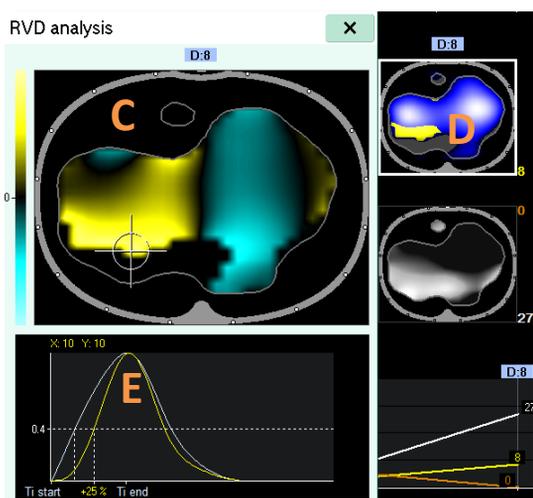
Cyclic opening and closing:
Delayed regions are …

… relative small (D)
… located between well ventilated and non-ventilated areas (D)

The regional waveform (yellow) shows both: late opening and early closing (E) relative to the global waveform (white).
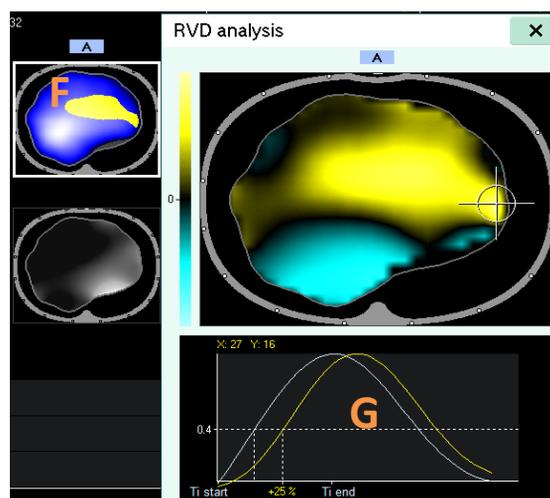
Large time constant:
Delayed regions are …

… relative large (F)
… not located in the dorsal part next to collapse (F)

Both - regional inspiration AND expiration are delayed (G).

The RVD threshold (expressed as % of Ti) can be set on the RVD page. In most of the cases, a threshold of 12% has proven to be an appropriate setting to display significant delays.

If the yellow waveform shows cardiac oscillation, the section length should first be increased. If oscillation is still present, decrease the *Low Pass filter* for RVD stepwise to lower values, until the oscillation is sufficiently suppressed.

When opening page *C*, the crosshair is set to the pixel with the largest delay, however it can be touched and moved within the ventilated area.

Step 4:   Interpreting the results

2. Assessment of images of *Compliance Loss* (*CL*) during a decremental PEEP trial
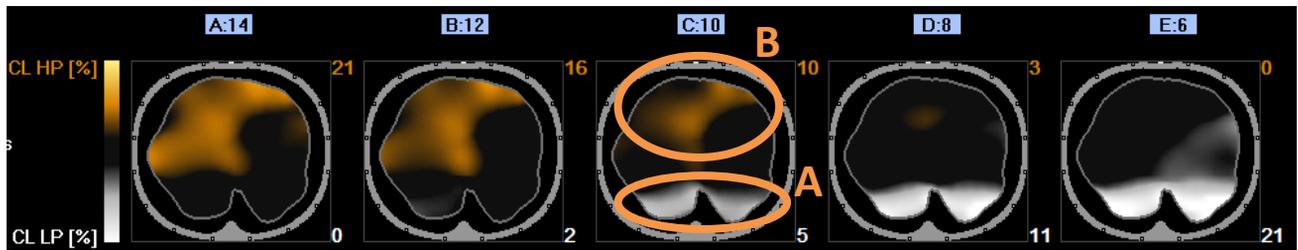
It is self evident that it is mostly impossible to find a PEEP level for all lung regions which is high enough to prevent lung collapse yet low enough to completely avoid overdistension.

This applies especially to patients with severe lung pathologies causing a heterogeneous distribution of both lung volumes and/or ventilation. One of the major causes for the variation of opening pressures is gravity acting on the dependent lung parenchyma.

However, a series of *CL* images can clearly show, at which PEEP level major loss of dorsal compliance due to derecruitment starts: *CL LP*, white (A).

At the same time, this series shows how ventral compliance starts to decrease towards higher PEEP levels: *CL HP,* orange (B).

Due to the novelty of those parameters, clinical data are not yet available for making definite recommendations on acceptable thresholds for *CL LP* and *CL HP*.

However, the following conditions would suggest to select PEEP above the PEEP of a section where

- *CL LP* is **> 5%**

- the corresponding *Tidal Image* shows the absence of dorsal ventilation (grey color)

- RVD is present in the transition between collapsed and ventilated regions

Before increasing the PEEP, lung pathology, cardiac function, blood pressures, blood gases have to be taken into account.

One proposed approach is to select the PEEP based on the best balance between *CL HP* and *CL LP,* i.e. the PEEP level left of the intersection. In this example, a PEEP of 10 would be selected.

Another approach, following the concept of the Open Lung Approach (OLA) could be to only tolerate a minor **CL LP** of e.g. 2%. In this example, a PEEP of 12 would be selected.

Step 4:   Interpreting the results

## 3. Assessment of the diagram and numerical values RVD SD/RVD Ratio, CL HP, CL LP
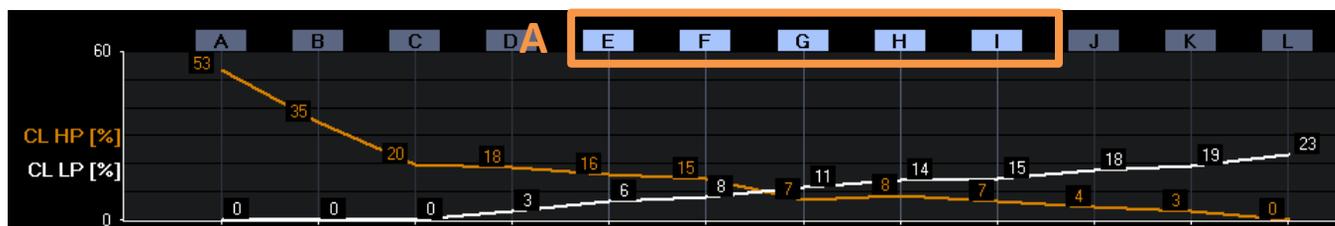
While only 5 images can be displayed at the same time, the **diagram displays the parameters of ALL defined sections** (up to 15). The section labels corresponding to the 5 displayed images are highlighted (*A*).
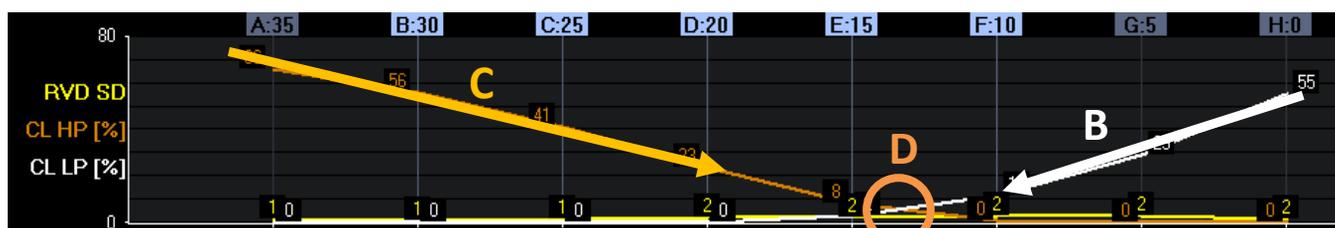
During properly conducted PEEP trials the typical pattern of an **opposing trend of collapse** (*B, white*) **and overdistension** (*C, orange*) **can easily be identified**.
If no opposing trend is displayed the trial should be assessed with care.

A clear **intersection** (*D*) is always present somewhere in the diagram, which especially provides guidance for PEEP selection based on best balance between *CL HP* and *CL LP*.
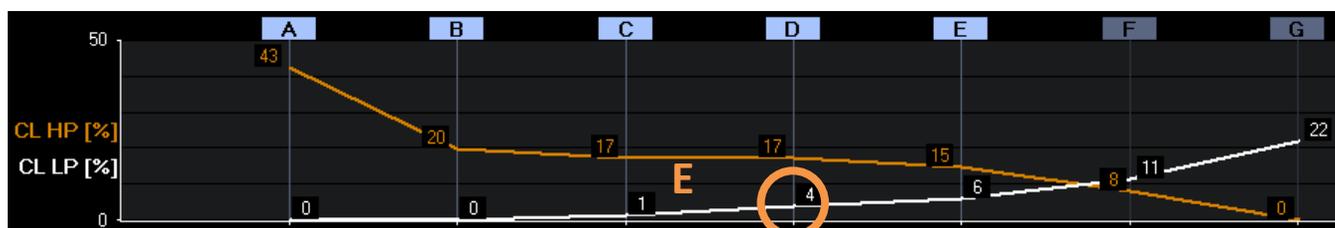

If it is intended to select PEEP according to the **Open Lung Approach** (OLA), the diagram conveniently helps to identify the PEEP where *CL LP* starts to rise (*E*).

If the start and end values for the decremental PEEP trial were properly selected, the point of intersection (*D*) should be rather located in the mid position of the diagram.
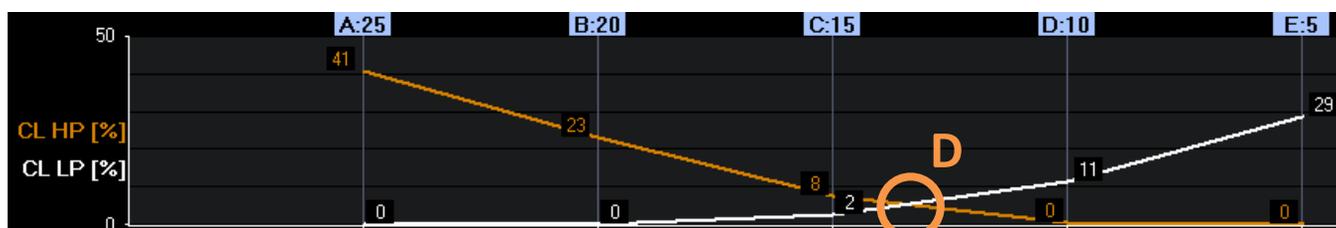
If the point of intersection is located to the very left or very right, the start point, or end point, respectively, of the PEEP trial was not chosen appropriately.
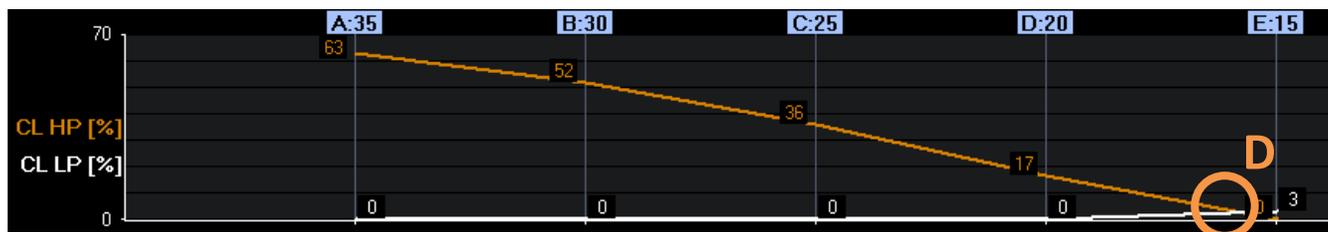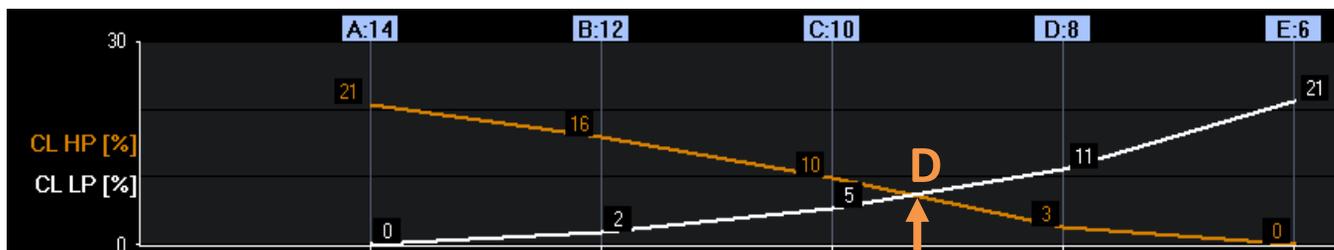

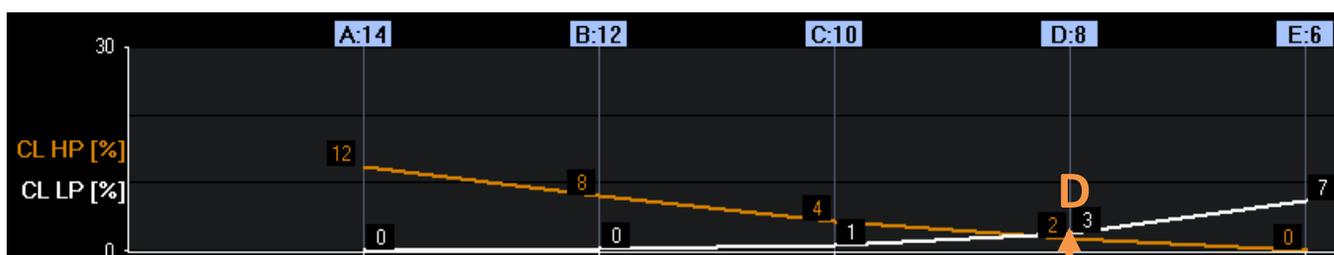**End value of PEEP trial (= lowest PEEP level) was too high**
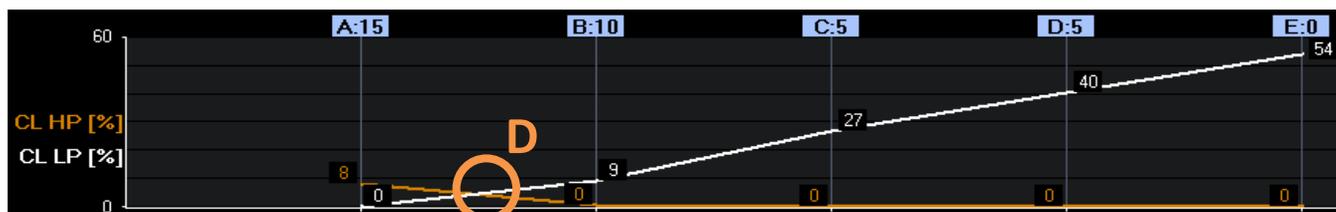
Start value of PEEP trial (= highest PEEP level) was too low
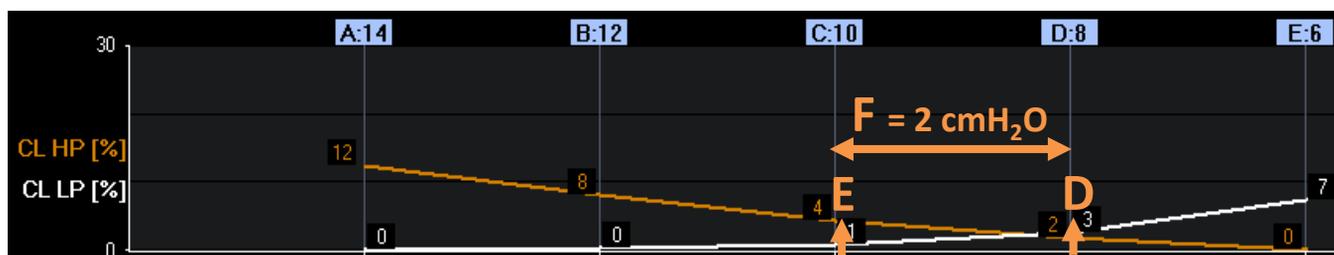

Properly selected start and end values

**Responder to PEEP trials** typically show steep slopes for *CL HP* and *CL LP*

Non-responder to PEEP trials typically show flat slopes for *CL HP* and *CL LP*

The closer the intersection (D) is to zero line, the more homogeneous the lung conditions are typically.

Healthy lung (post-operative patient without pulmonary complications)

The smaller the distance (F) between the point of intersection (D) and the point (E) where CL LP starts to rise, the healthier the lung is.
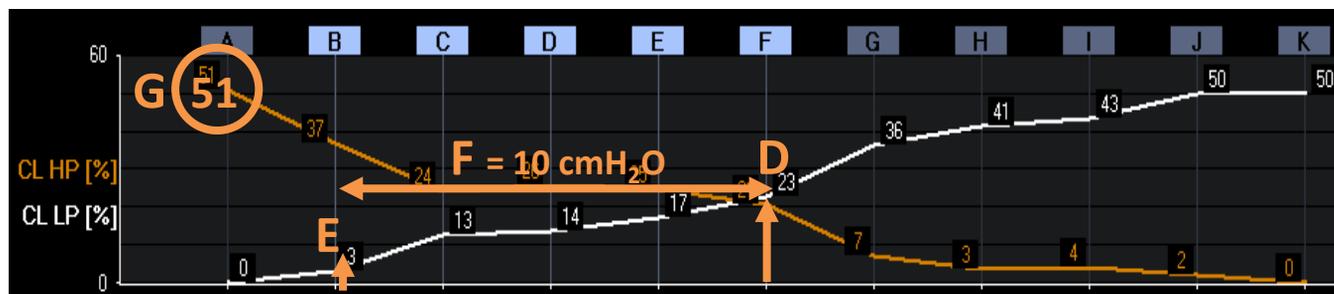
ARDS lung

The higher the maximum CL HP values (G) the more aggressively the trial and the prior RM were conducted.