



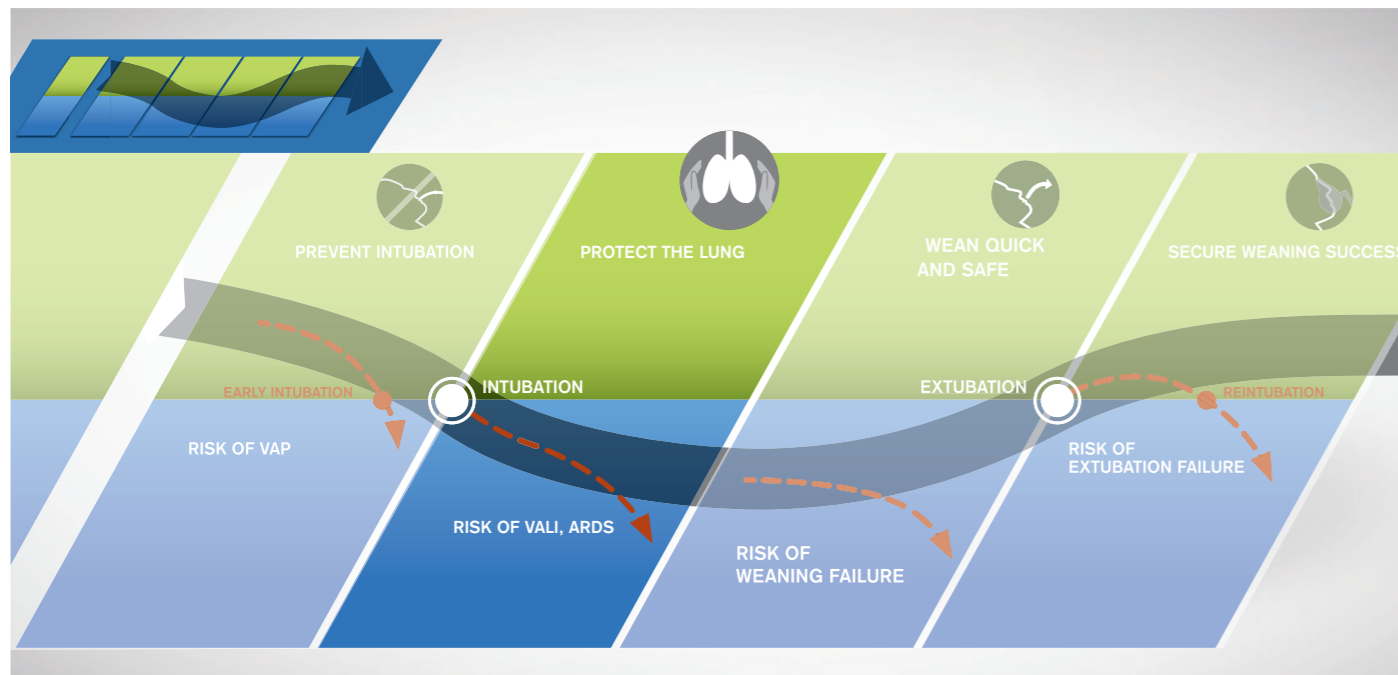
# Automatic lung recruitment maneuver with Low Flow PV Loop

With the Low Flow Pressure Volume (PV) Loop maneuver, a quasi-static PV loop can be recorded during inspiration and expiration. This could help to identify inflection points of the lung to find optimal PEEP and/or tidal volume and/or inspiratory pressure settings.

“Decreases in  $\Delta P$  owing to changes in ventilator settings were strongly associated with increased survival.”<sup>1</sup>

“In ARDS, the percentage of potentially recruitable lung is extremely variable and is strongly associated with the response to PEEP.”<sup>2</sup>

**Stabilize the patient and protect the lung as second step of the Respiration Pathway**



**MECHANICAL VENTILATION**

As non-invasive as possible, as invasive as necessary. Along the Respiration Pathway a variance and diversity of treatment tools clearly improve the clinical decision-making.

The **Low Flow PV Loop** maneuver can help to identify inflection points of the lung to find optimal PEEP and/or VT resp. Pinsp settings.

**Low Flow PV Loop**

The Low Flow PV Loop in the Evita family serves as an automatic lung recruitment maneuver. By slowly filling and emptying the lung with a low, constant flow, only the elastic properties of the respiratory system are recorded. The virtually quasi-static pressure volume loop displays a good correlation with the static

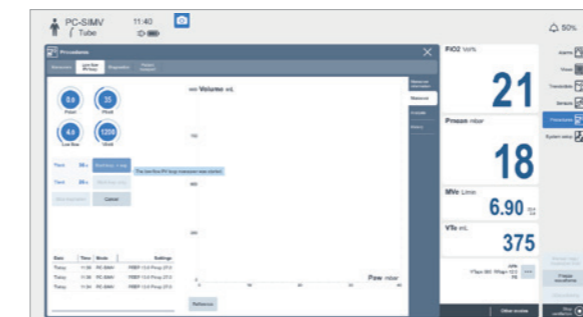
Super Syringe method – conveniently carried out with the same equipment at the bedside. The loop can be recorded for inspiration or for inspiration and expiration. You can choose between inspiration-only low-flow inflation and a maneuver which comprises both inflation and deflation.

**TO BE SET (TO MAINTAIN COMPLETE CONTROL OVER THE ENTIRE PROCEDURE) :**

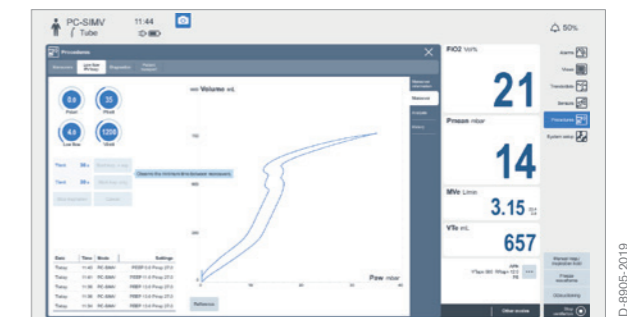
- Start pressure
- Maximum pressure
- Flow rate down to 2 l/min
- Maximum volume

By setting the flow that is delivered during the inflation and also controlled during the deflation at a sufficiently low level, the resistive pressure component can be neglected and virtually

only the elastic properties are recorded. The initial pressure of the maneuver can be set between the current PEEP setting and zero.



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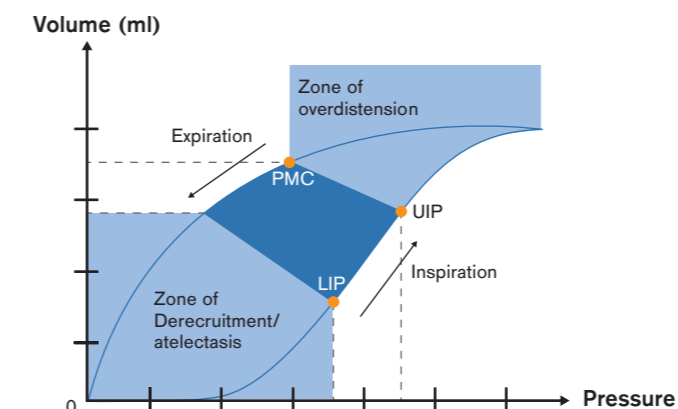
**TO BE TAKEN INTO ACCOUNT:**

- No initiation in spontaneous ventilation modes due to required appropriate patient passivity
- Leakages should be avoided

- Set the type of humidification correctly
- For low-flow deflation down to lower pressures, the PEEP level can be reduced prior to the maneuver.

Because the low-flow PV loop also acts as a lung recruitment maneuver, in order to maintain the positive effect of such re-

cruitment, it is necessary to apply at least the PEEP level that prevailed prior to the maneuver.



D-1374-2019

UIP Upper Inflection Point  
LIP Lower Inflection Point  
PMC Point of Maximum Curvature

1 Amato et al., 'Driving Pressure and Survival in the Acute Respiratory Distress Syndrome', N. Engl. J. Med., vol. 372, Feb. 2015  
2 Gattinoni et al., 'Lung recruitment in patients with the acute respiratory distress syndrome', N. Engl. J. Med., vol. 354, Apr. 2006

## ANALYSIS

Two cursors can be moved over the PV loop in order to determine the lower inflection point (LIP) or the upper inflection point (UIP) on the inspiratory limb or the point of maximum curvature (PMC) on the expiratory limb. This can also be used to calculate the static compliance between the two cursor positions.

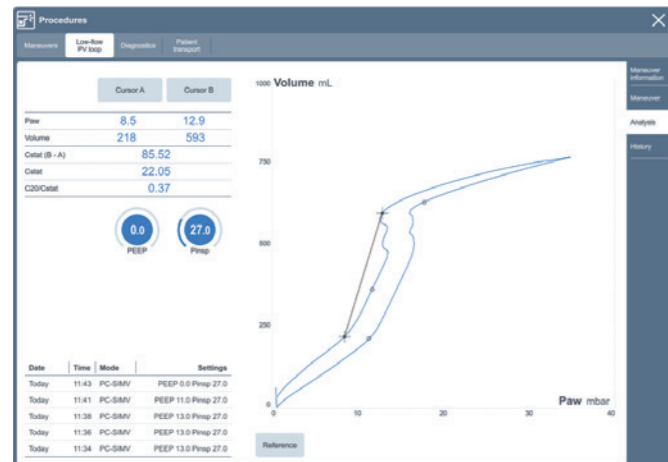
To assist with understanding the volume history of the lung, the ventilation mode, the PEEP setting and the inspiratory pressure or tidal volume setting at the start of the maneuver are recorded and displayed together with the loop. PV loops initiated from higher PEEP levels with high inspiratory pressures look different from PV loops initiated from lower PEEP levels or smaller inspiratory pressures. This needs to be taken into account when

comparing low-flow PV loops which have been recorded at different times.

### The analysis of the PV loop may be helpful to:

- choose the right PEEP level to avoid cyclic recruitment and de-recruitment.
- adjust inspiratory pressure or tidal volume to avoid overstretching of alveoli.

While setting these directly on the maneuver page, graphical help lines and the displayed inflection points illustrate how the new setting fits to the lung properties recorded earlier.



Analysis screen after exemplary maneuver

## VOLUME HISTORY

Up to ten loops can be stored as reference and individually measured with the cursors. As the ventilation settings prior to the start of the maneuver influence the PV loop's shape, the major

settings at the start of the maneuver are recorded to serve as indication of the "volume history" of the lung.

## Improved outcomes have been shown with Low Flow PV Loop maneuver

**“The Low Flow PV Loop in the Evita can be used to optimize ventilator settings.”**

Takeuchi M et al., Set Positive End-expiratory Pressure during Protective Ventilation Affects Lung Injury. *Anesthesiology*, V 97, No 3, 2002 Sep

**“The hysteresis of the PV curve can be used to assess the recruitability of the lung.”**

Demory D et al., Recruitability of the lung estimated by the pressure volume curve hysteresis in ARDS patients., *Intensive Care Med.* 2008 Nov

**“The quasi-static measurement of the PV curve is a simple method, easy to interpret, for objective adjustment of the ventilatory parameters in ARDS patients as the lung injury evolves.”**

Pestaña D et al., Adjusting positive end-expiratory pressure and tidal volume in acute respiratory distress syndrome according to the pressure-volume curve., *Acta Anaesthesiol Scand.* 2003 Mar

**LOW FLOW PV LOOP IS AVAILABLE FOR THE FOLLOWING DRÄGER VENTILATORS:**

- Evita® V800
- Evita® V600
- Evita® Infinity® V500
- Evita® V300



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Dräger Evita® V800

Not all products or features are for sale in all countries or are only available as an option.

**TECHNICAL DATA**

**Low Flow PV Loop**

Low Flow Setting	2 to 15 l/min
Pstart	0 to PEEP
Vlimit	0 to 2.0 l
Plimit	0 to 80 mbar/cmH <sub>2</sub> O

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