

# Crosstalk Lunge -> Herz

„Herz-Lungen-Interaktionen“

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# Objectives

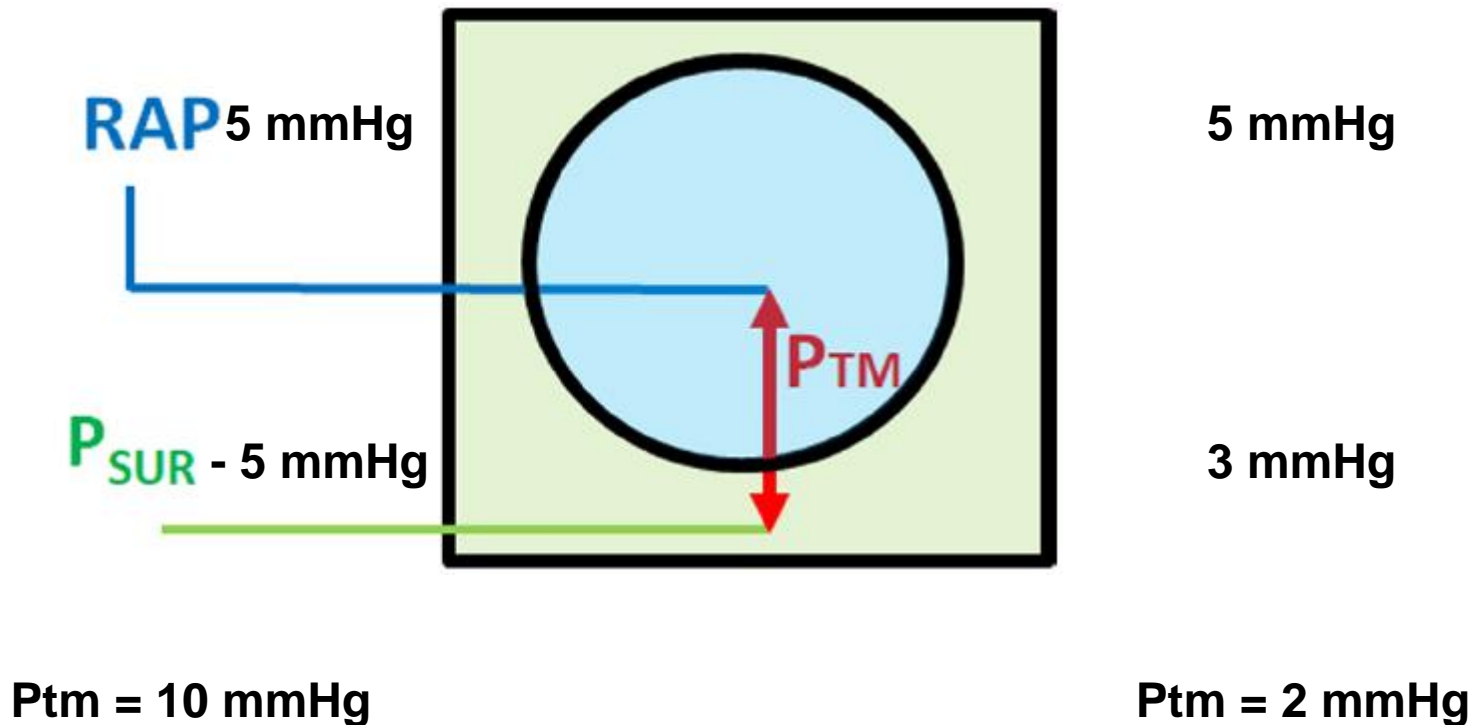
- Basics of
  - Pressure measurement
  - Cardiac function
  - Pulmonary circulation
- Preload effects
- Afterload effects
- Heart-Heart-Crosstalk
- Clinical consequences

# Basic principles I: pressure reference

## Heart and Lung in the thorax: transmural pressure

Spontaneous breathing

Positive pressure ventilation

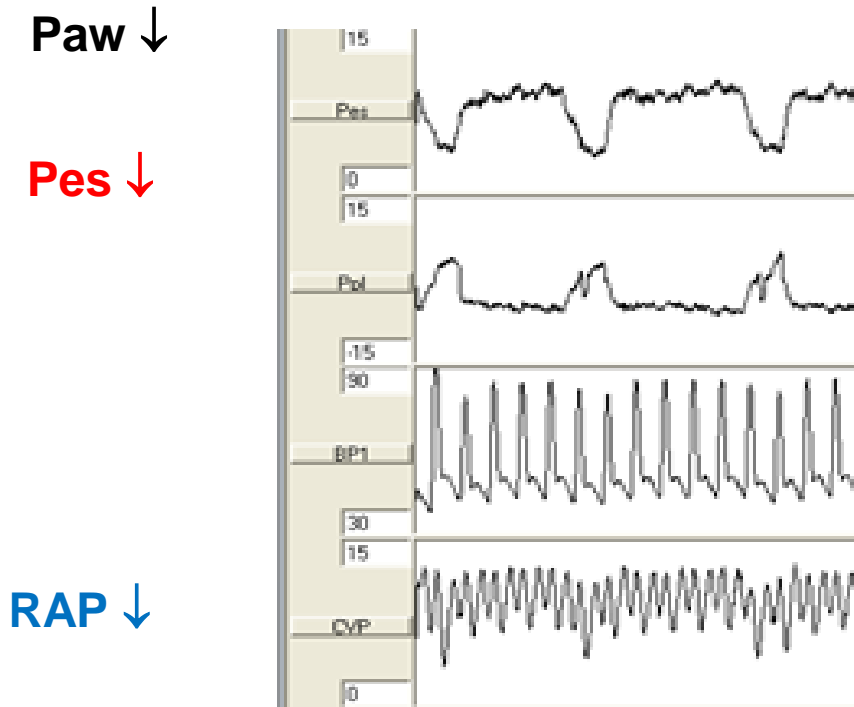


Grübler et al. Swiss Med Weekly 2017

# Basic principles I: examples

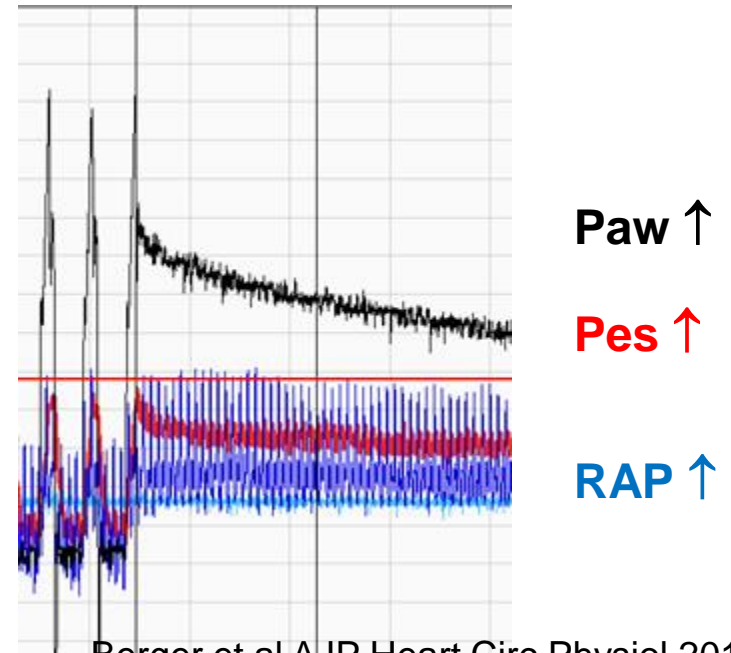
What happens to transmural pressures?

## Spontaneous breathing



Berger et al Crit Care 2014

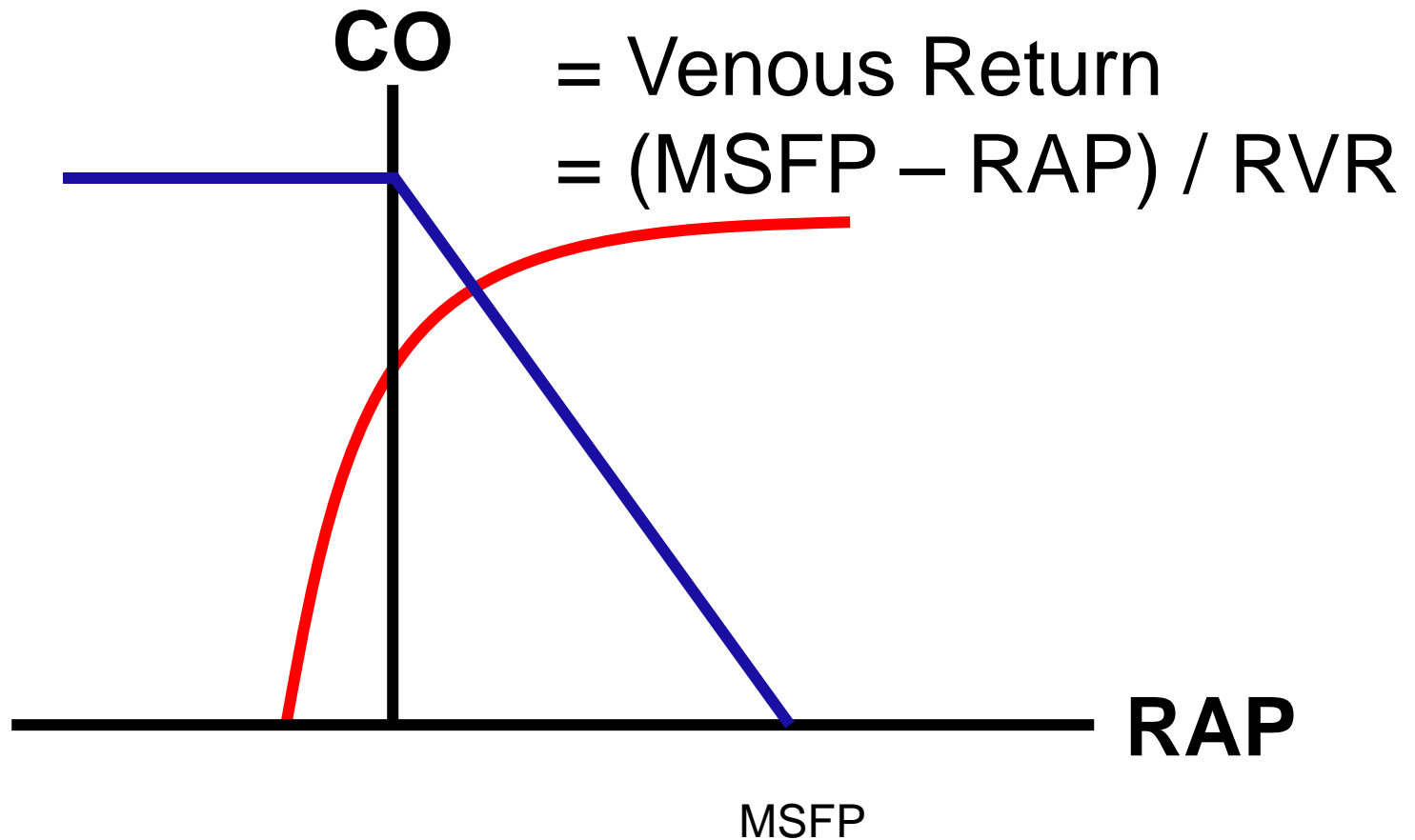
## Positive pressure ventilation



Berger et al AJP Heart Circ Physiol 2016

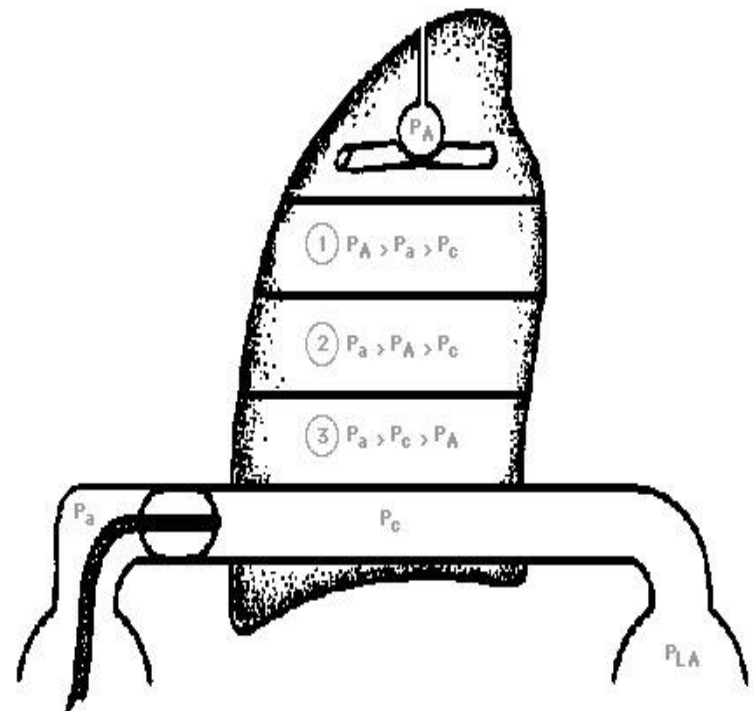
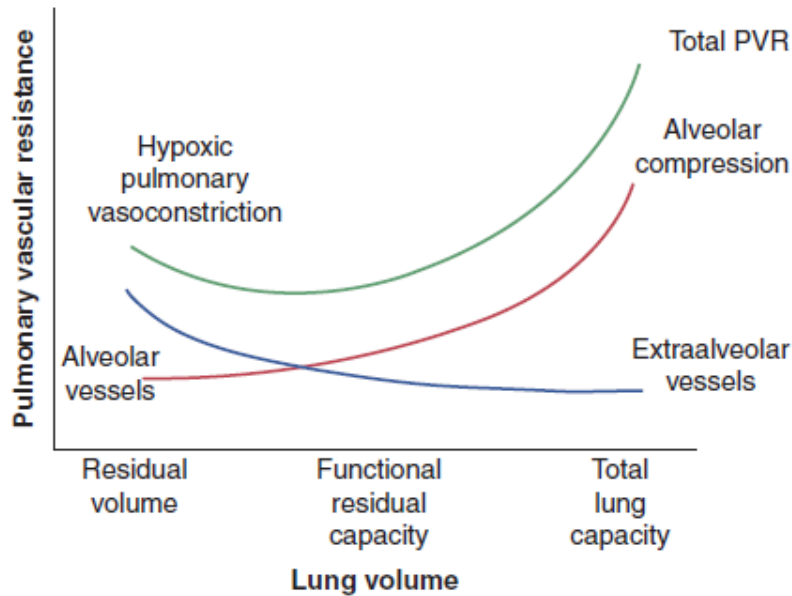
## Basic principles II: Cardiac function curve

The heart can only pump what it gets



# The pulmonary circulation

High flow, low pressures, high compliance

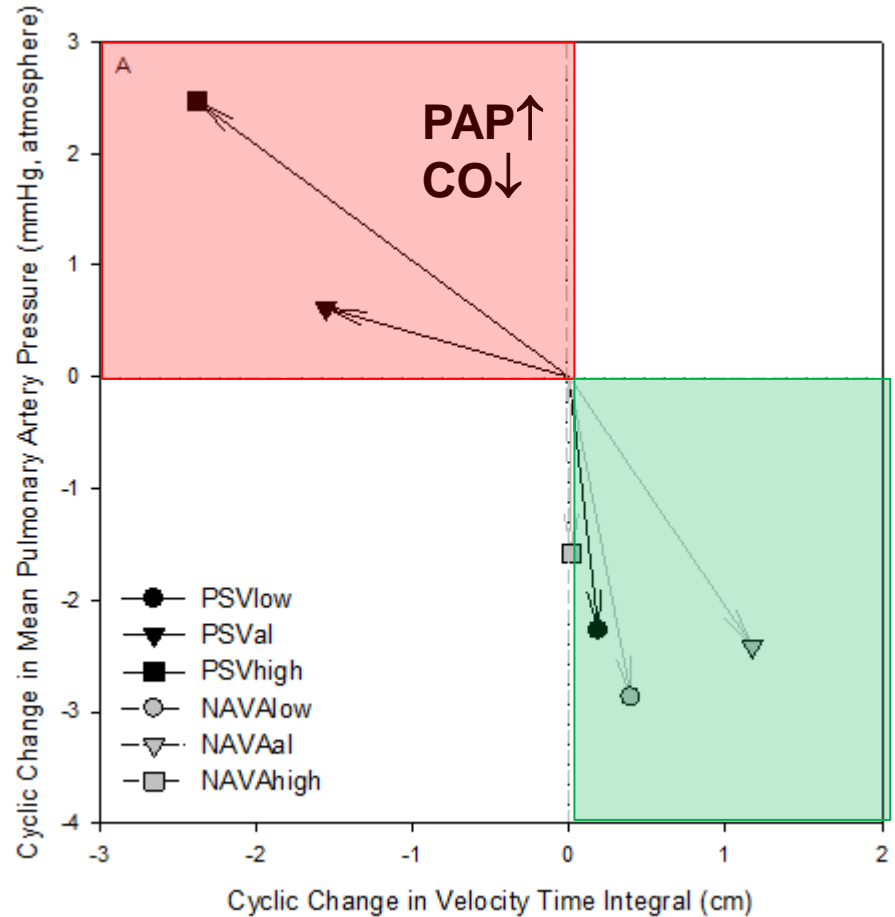
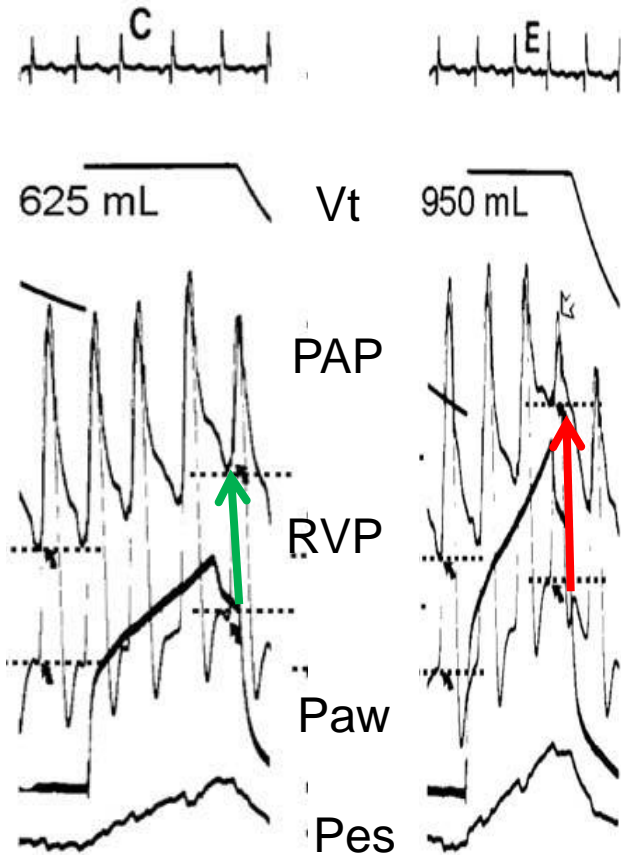


- Mechanical effects
- Recruitment effects -> afterload
- Effects of gas exchange -> HPV, Hypercapnia

Gomez, in Tobin, Mechanical ventilation

# The right ventricle: afterload effects

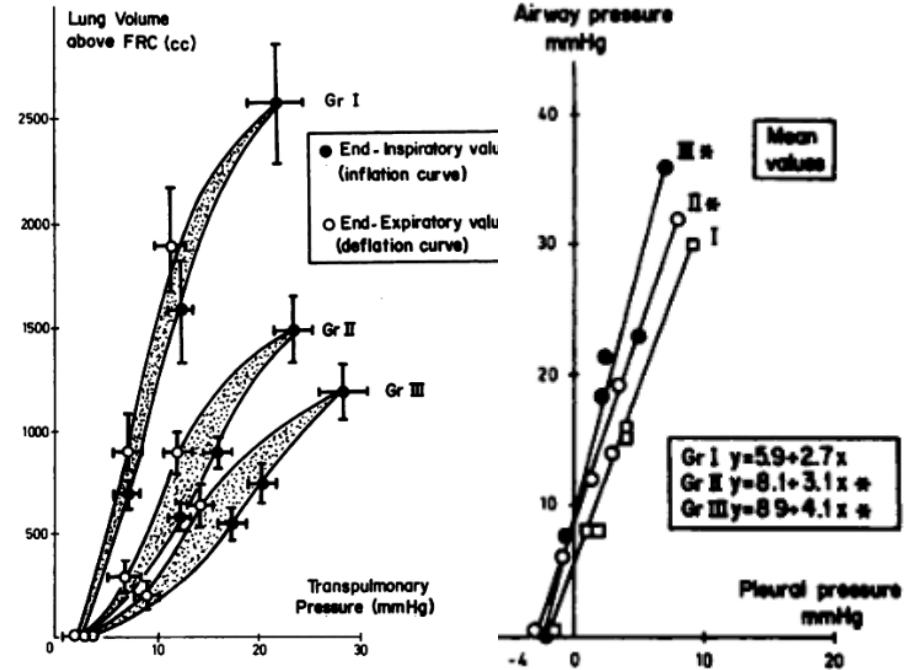
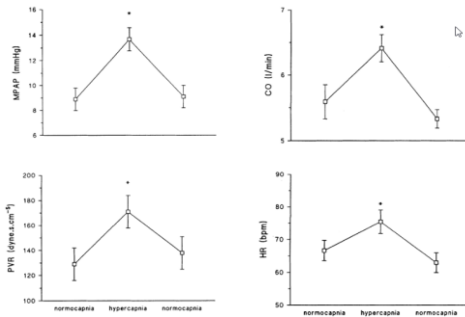
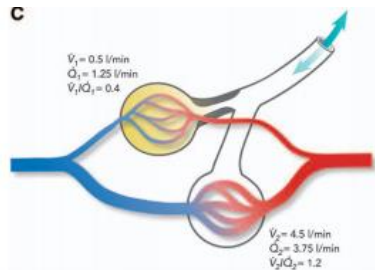
## High flow, low pressures



Jardin, Intensive Care Medicine (2003) 29:1426–1434

Berger et al Crit Care 2014

# Lunge diseases modulate afterload effects



Hypoxic and hypercapnic pulmonary vasoconstriction

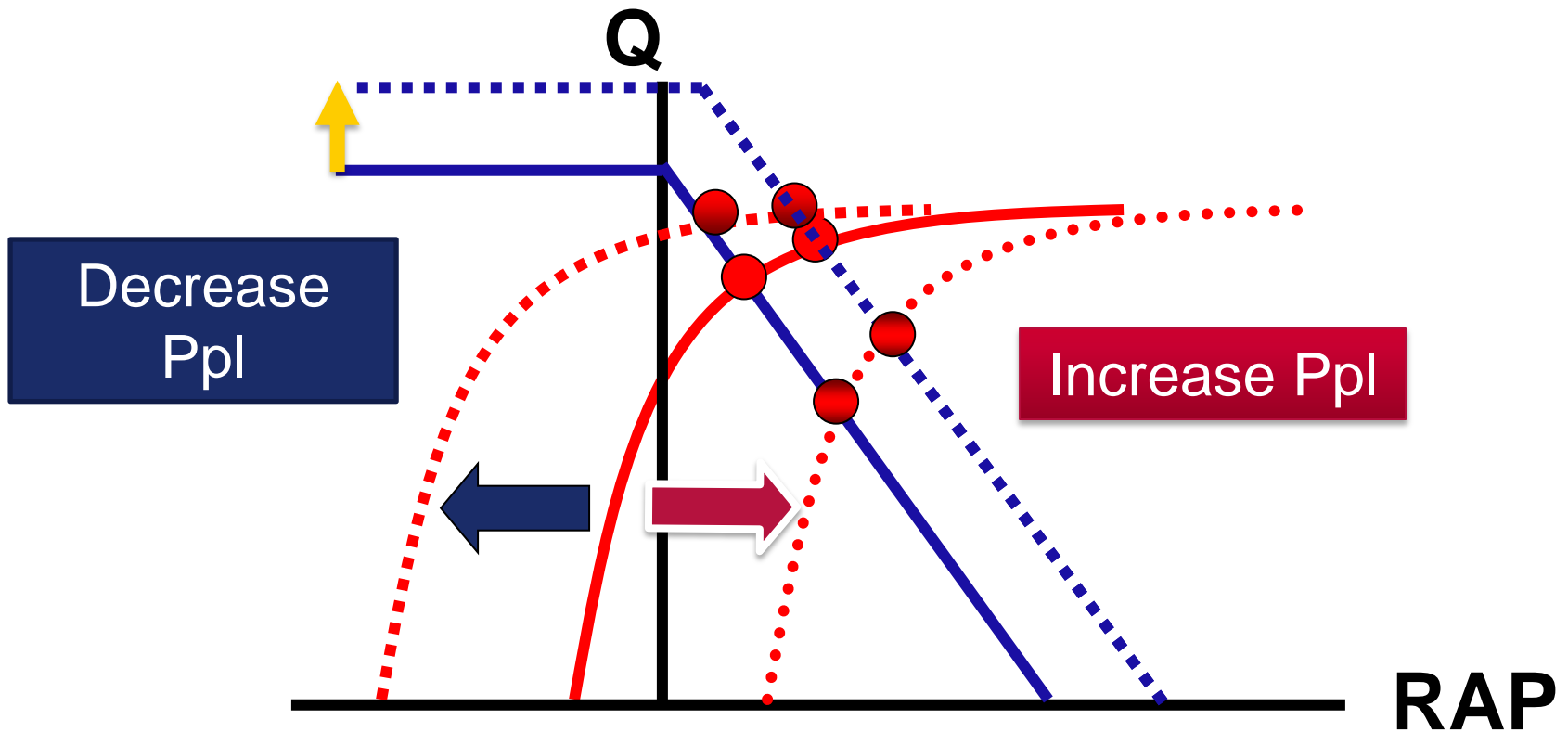
Lumb Anesthesiology 2015 and Kiely, Chest 1996

Decreased compliance

Jardin, Chest 1985



# RV Preload effects: Interaction with venous return



Courtesy of Sheldon Magder

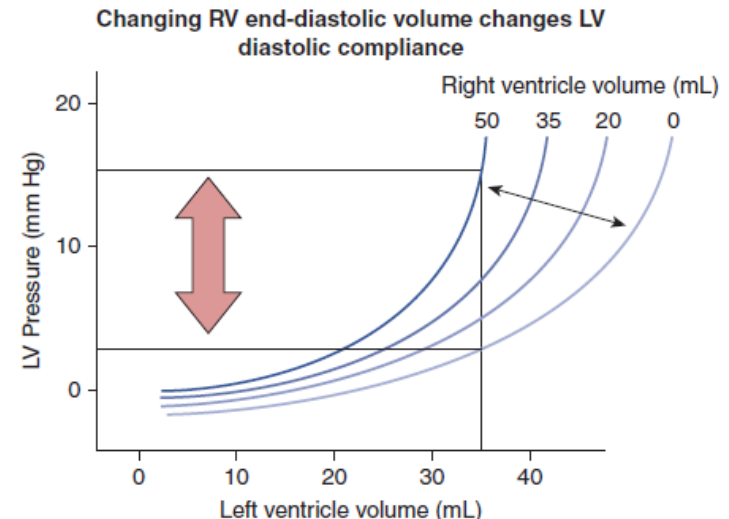
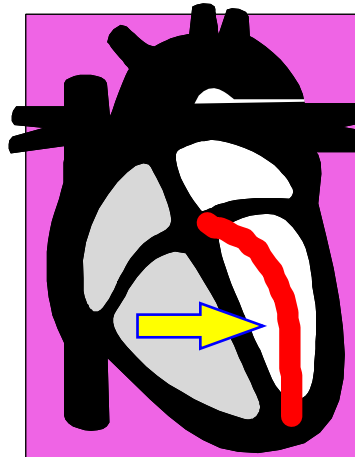
# Heart-Heart- Interaction: Ventricular interdependence

The left heart can only be as good as the right heart

## • The two pumps

- pump in series
- but work in parallel

- mutual dependence on preload
- Mechanical interdependence

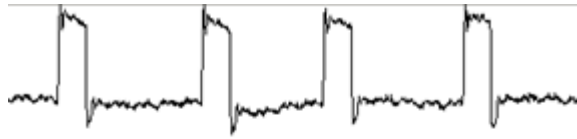


Taylor et al. *Am J Physiol* .  
1967;213:711–718

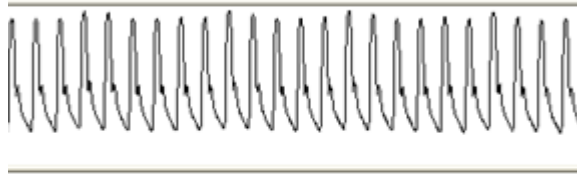
# So, where can I see that?

Depends on what you monitor...

Ppl



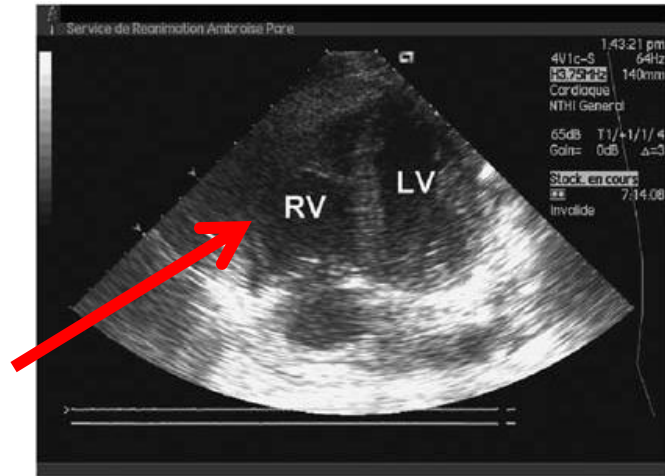
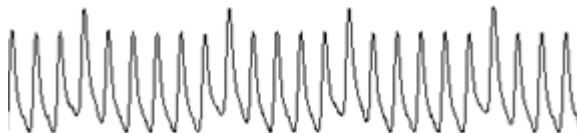
ABP



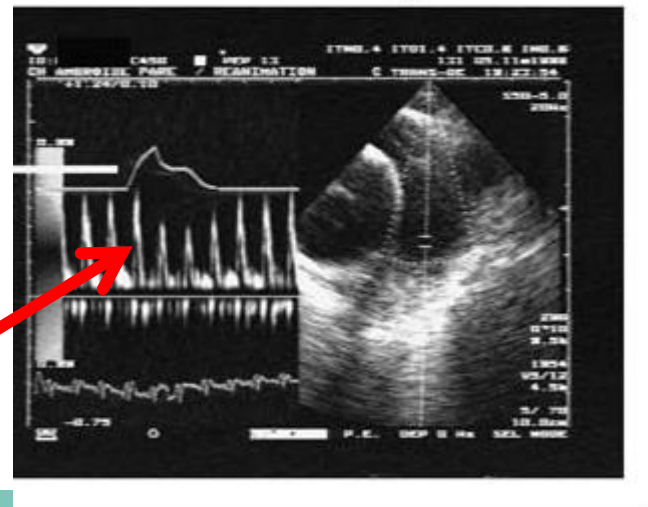
CVP



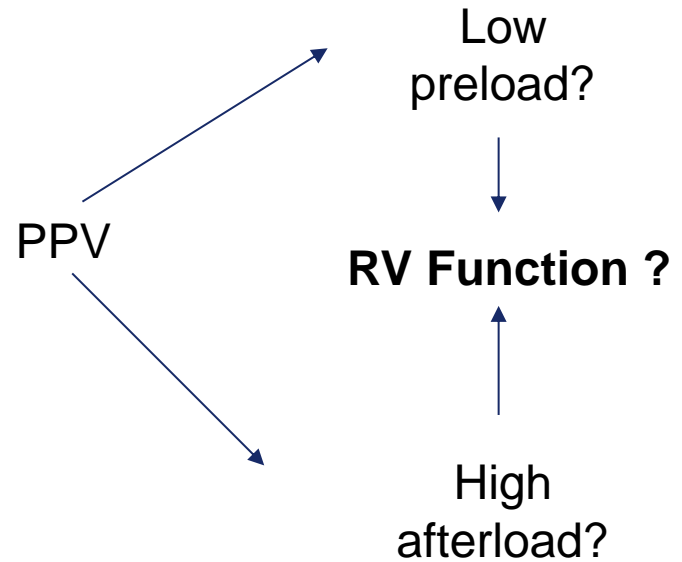
PAP



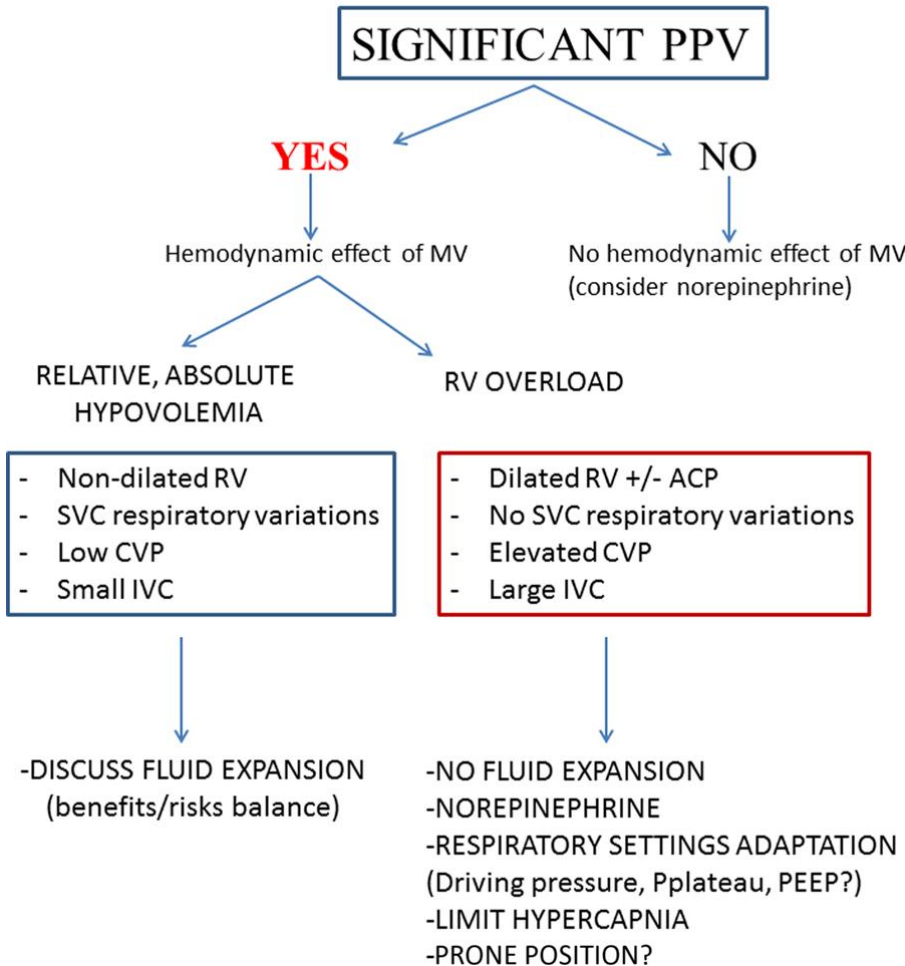
PEEP 13 cmH<sub>2</sub>O



# Pulse Pressure Variation: Be careful!



# Rules of thumb for heart lung interactions



## • Is there a problem?

- Hemodynamic compromise?

50% of ICU patients are NOT volume responsive!

## Summary

- Heart Lung Interactions are normal
- Volume responsiveness is normal, non-responsiveness is pathological
- The effect of MV on the pulmonary circulation is variable
  - Balance between mechanical factors, recruitment and HPV
- The right ventricle is the center of attention
  - Afterload increase, preload decrease
  - «Bottleneck»
  - Deleterious interaction with LV if dilated

# Literatur

<http://www.heart-lung.org>

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- **Boufferache K et al.** Acute respiratory distress syndrome, mechanical ventilation, and right ventricular function. *Curr Opin Crit Care* 2011; 17: 30
- **Grübler M et al.** Basic Concepts of Heart-Lung-Interactions during Mechanical Ventilation. *Swiss Med Weekly* 2017; 147: w14491