Protective mechanical ventilation

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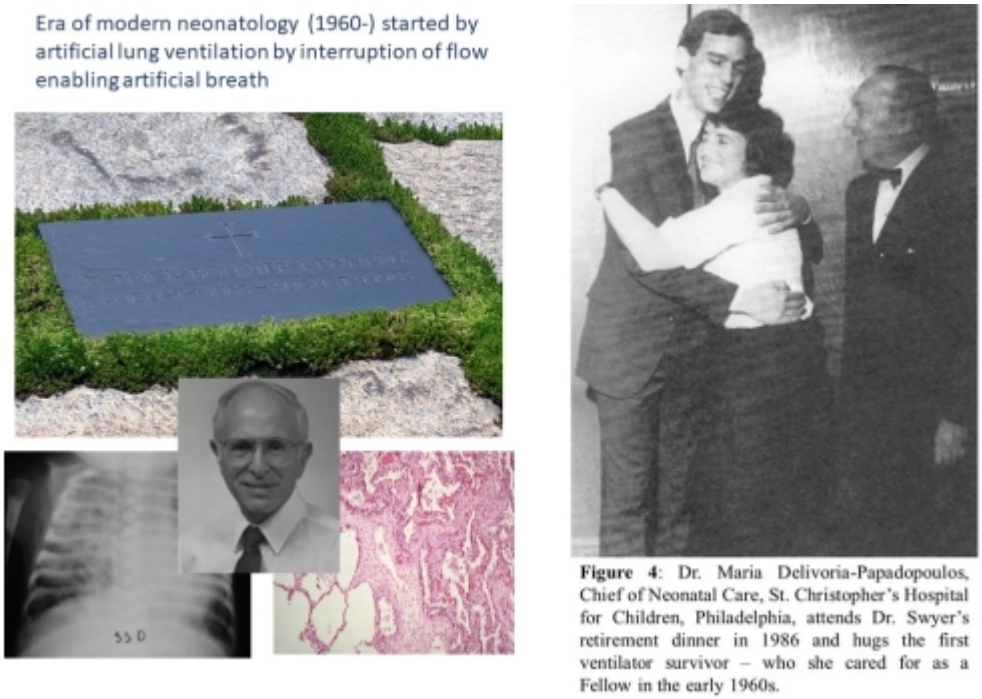
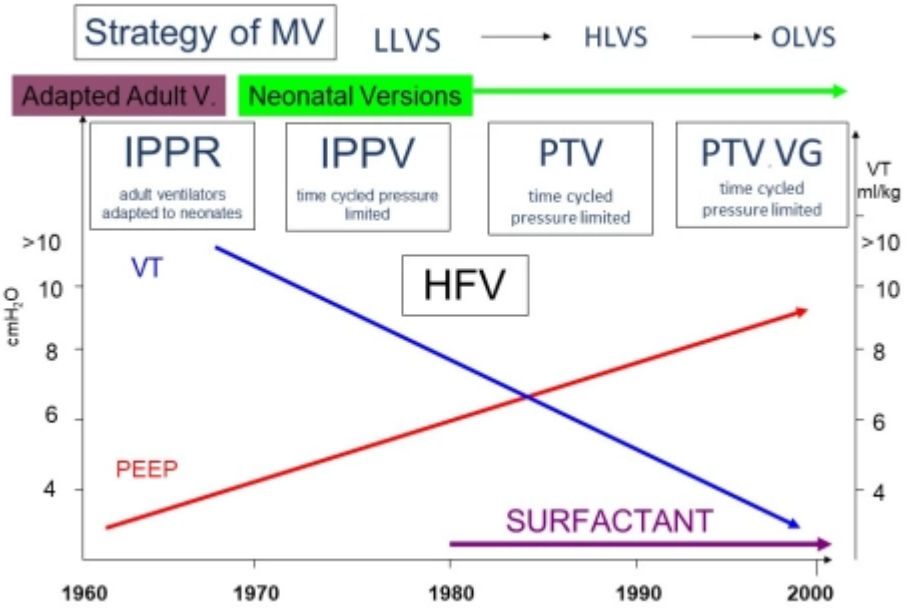
CZECH REPUBLIC
DEVELOPMENT COOPERATION

Protective mechanical ventilation

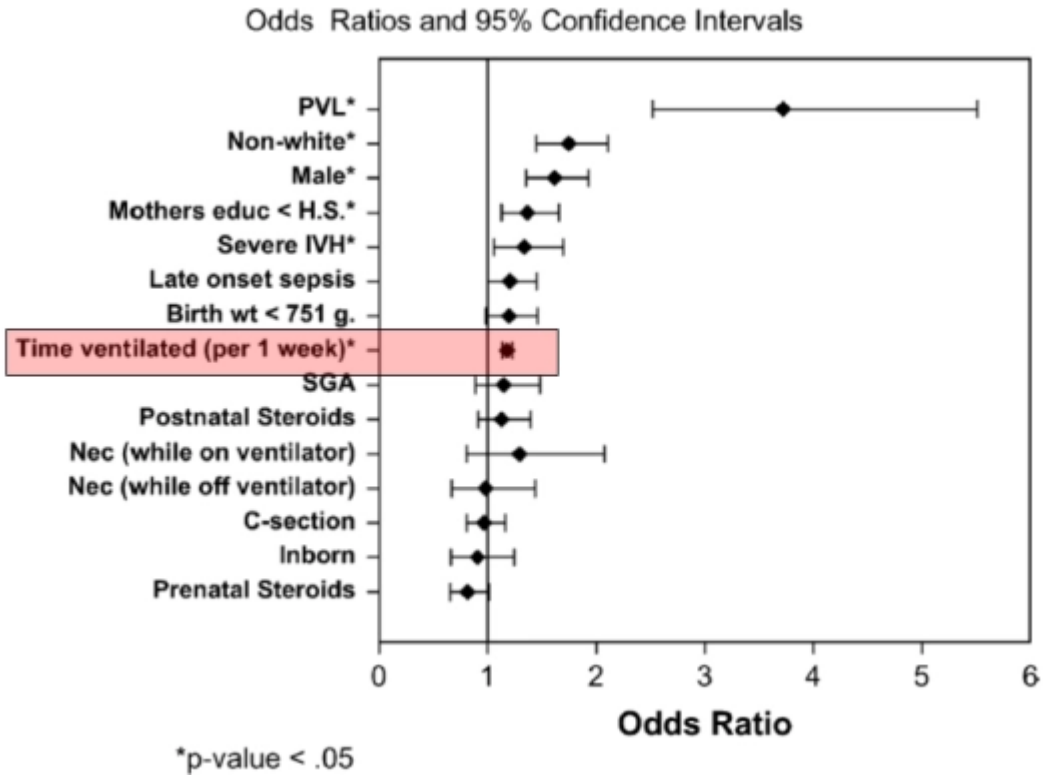


Neonatology



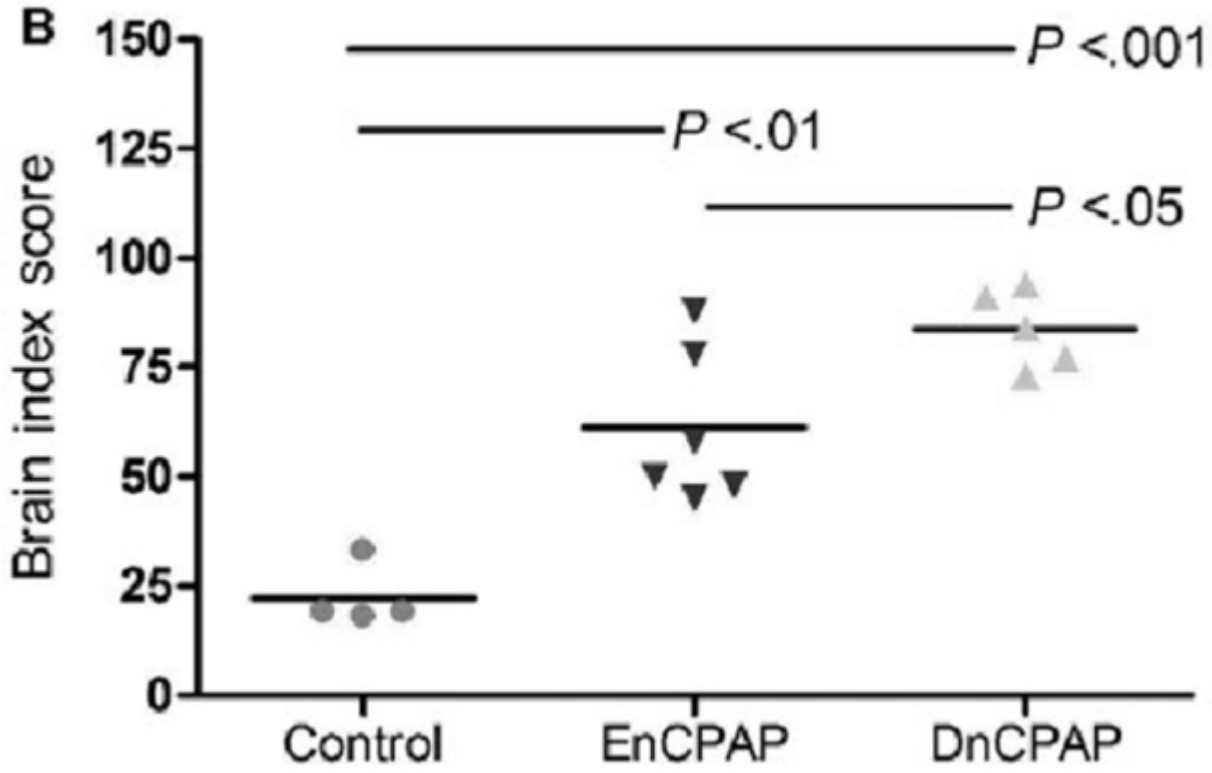
Strategy

Mechanical ventilation in newborns
Risk of neurodevelopmental impairment



Ventilation

Mechanical Ventilation and Brain Injury Risks after 1 or 5 days of ventilation

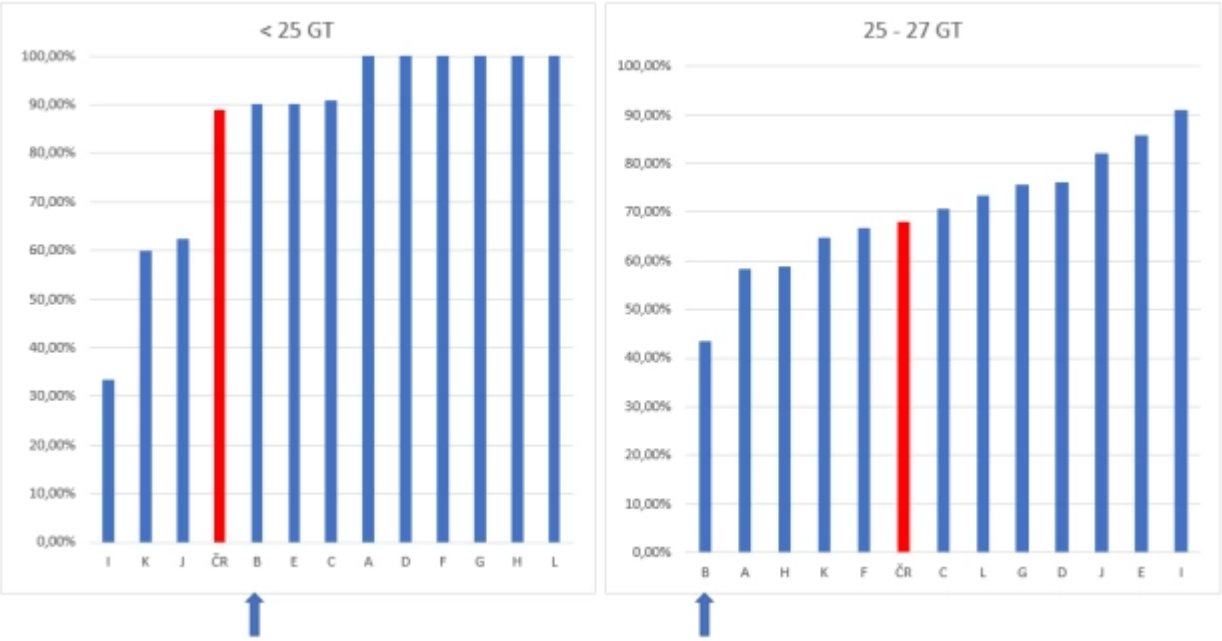


"There is a lower risk of BPD development, if infants do not require artificial invasive ventilation"

Association between mechanical ventilation and lung injury (VALI)

However there is still more than 50% of ELGA infants, who require mechanical ventilation.

Need for Mechanical Ventilation
12 PCIP in 2017



Traumas Contribute To Ventilator Induced Lung Injury- VILI

- Barotrauma 1973
- Volutrauma 1988
- Atelectrauma 1997

Oxygen toxicity

- **Ergotrauma 2016**

Ergotrauma
Absorption of mechanical energy exceeding a compensation ability of lung tissue

- Tpt = K x ΔV/V0
- Tpt...transpulmonary pressure
- K...specific lung compliance
- ΔV...change of lung volume
- V0... initial lung volume
  Specific lung compliance = pressure needed for two time FRC achievement

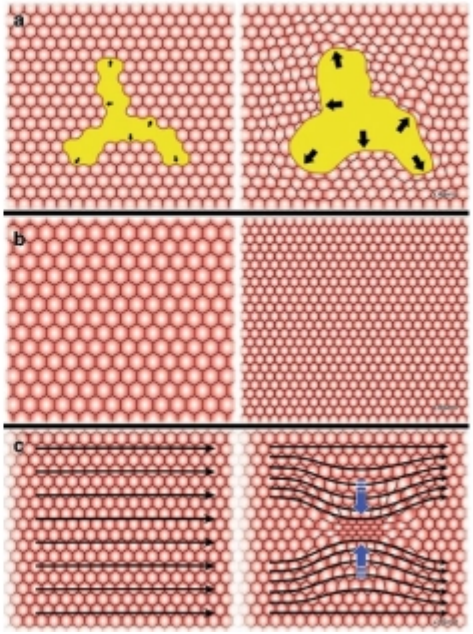
VENTILATOR INDUCED LUNG INJURY -VILI

3 main mechanisms:

OVERDISTENSION
- high volume/pressure

RECOREX
repeated collapse and reexpansion

Heterogeneous ventilation
Overdistended alveoli collapse the nearby ones



Protein influx into alveoli

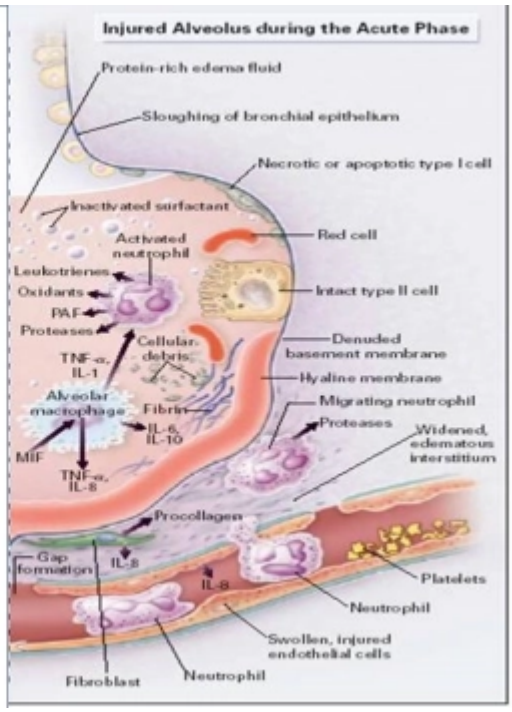
Activation of macrophages –cytokines
Activation of neutrophiles – proteases, leukotrienes

Inactivation of surfactant

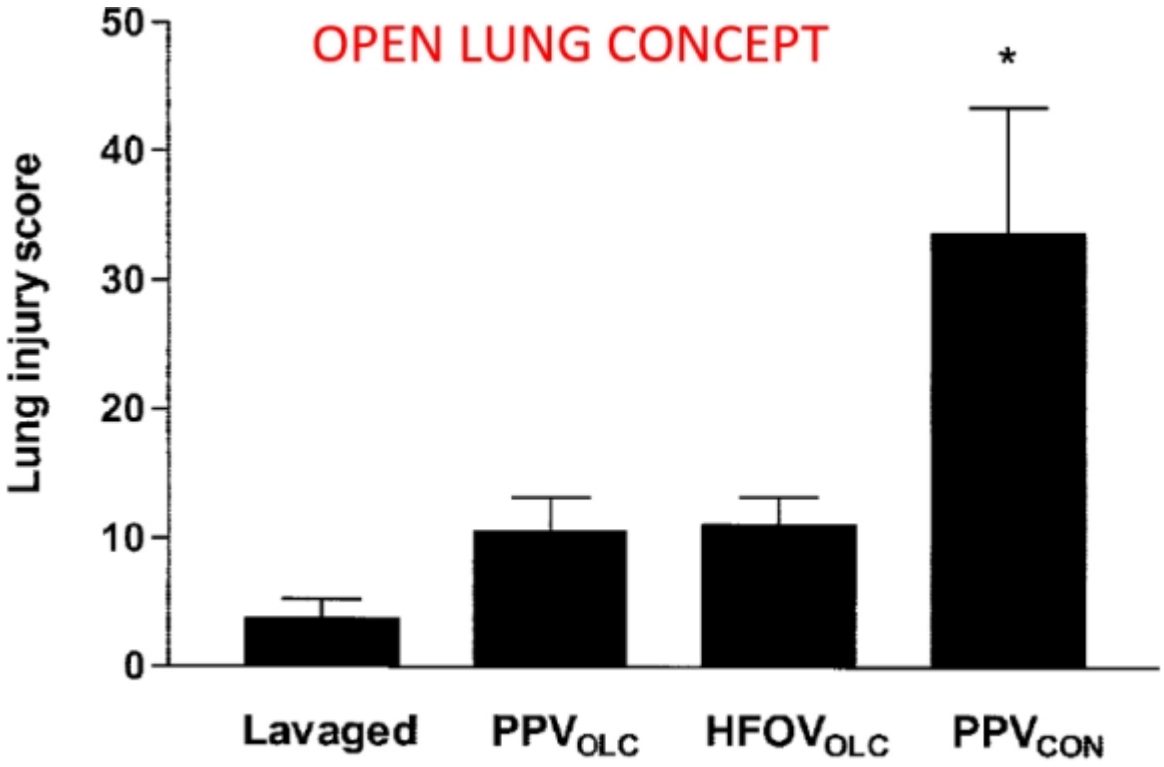
Disruption of epithelium and endothelium

WORSENING of GAS EXCHANGE
ESCALATES VENTILATOR PARAMETRES

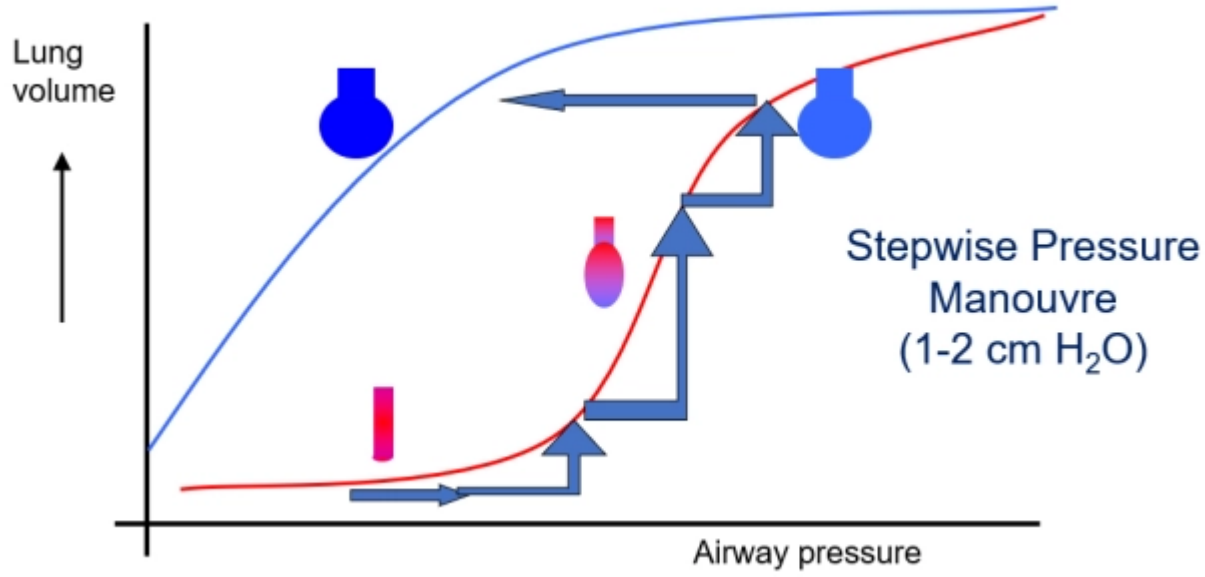
VICIOUS CIRCLE



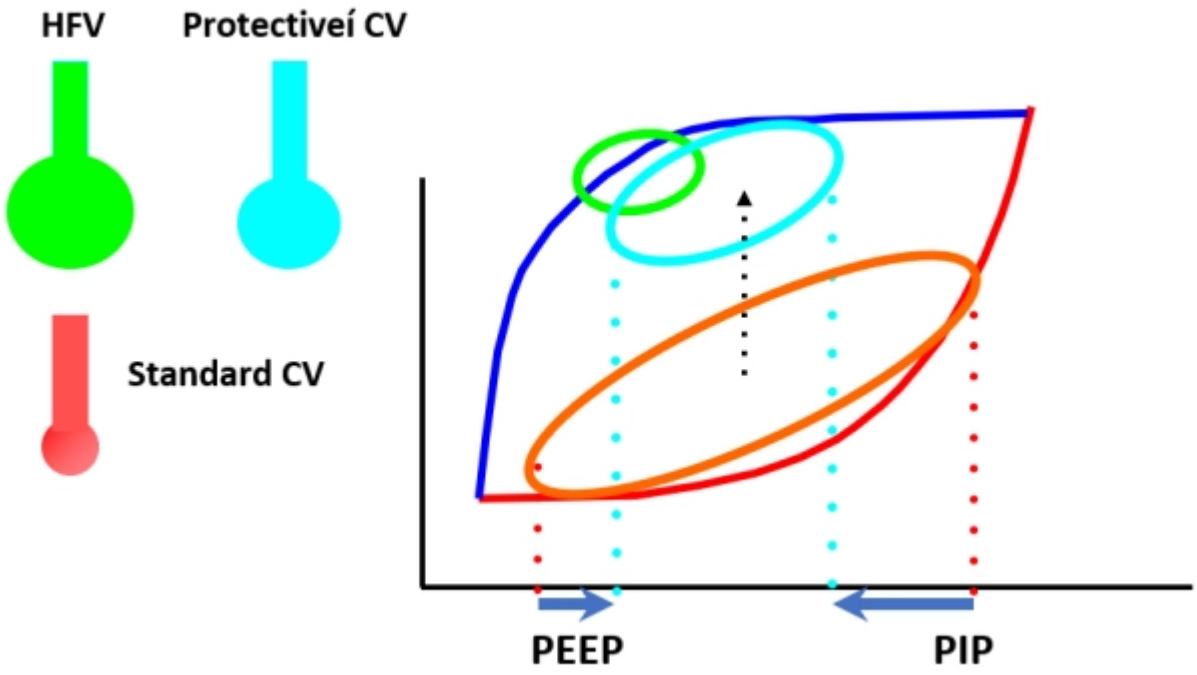
PREVENTION Of LUNG INJURY
„Keeping the lung open“



Recruitment and Stabilization



Approximation Of Protective CV and HFV



Strategy OPTIMUM LUNG VOLUME with minimal V/Q imbalance

HFOV

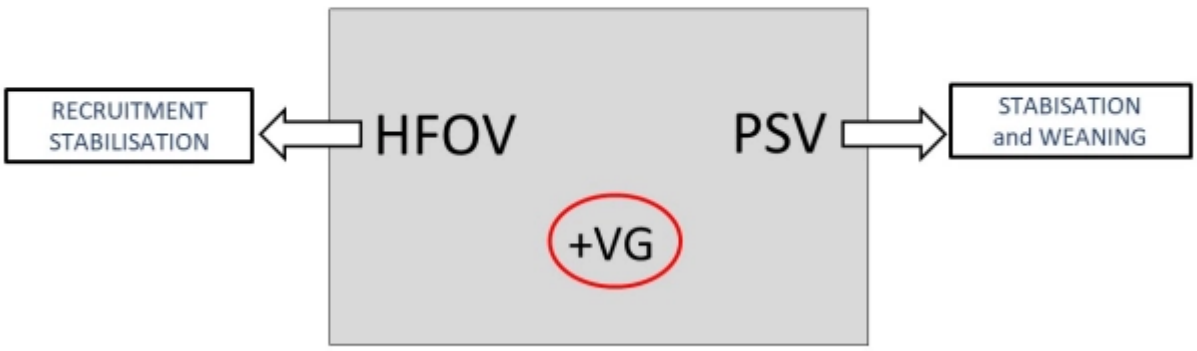
HFJV

AC (SIPPV)

PSV

SIMV

VG



Keep in your mind!

Characteristic of lung disease

- Homogeneous, IRDS
- Heterogeneous, disperse, focal
- Acute or chronic

Biophysical properties of lung

- Compliance, Crs = ΔV/ ΔP
- Resistance, R = (P1-P2)/V
- Time Constant, TC = C x R

Phase of MV related to lung

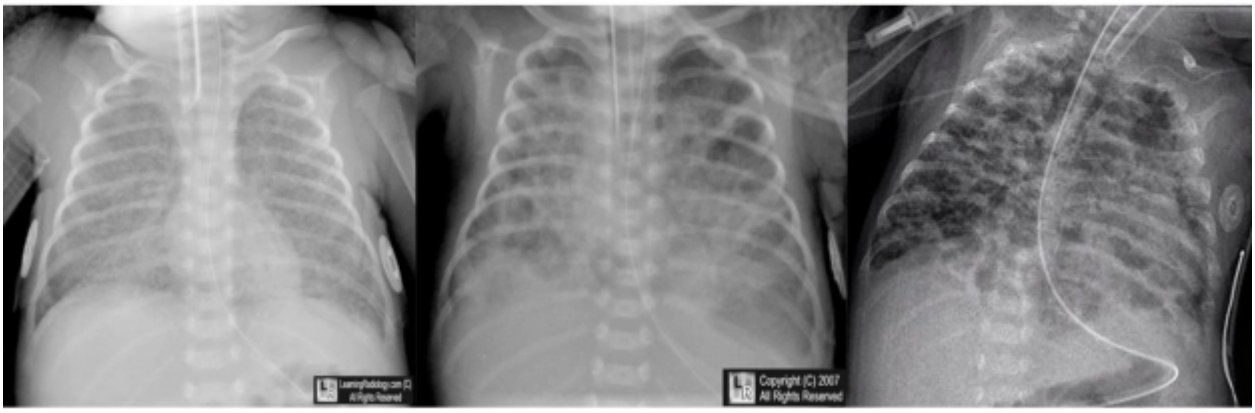
- Recruitment
- Stabilisation
- Weaning and extubation

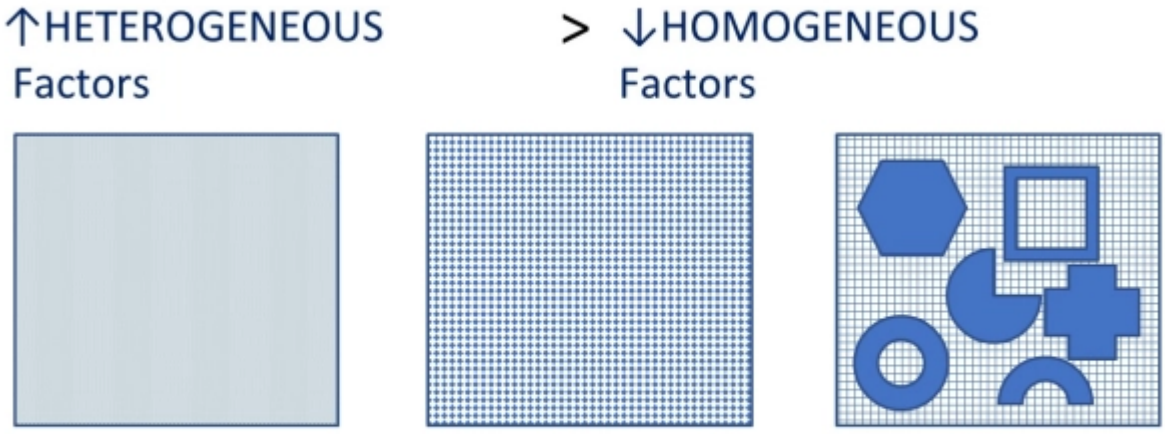
Postulates of “KNOWLEDGES“ to minimise iatrogenic lung injury:

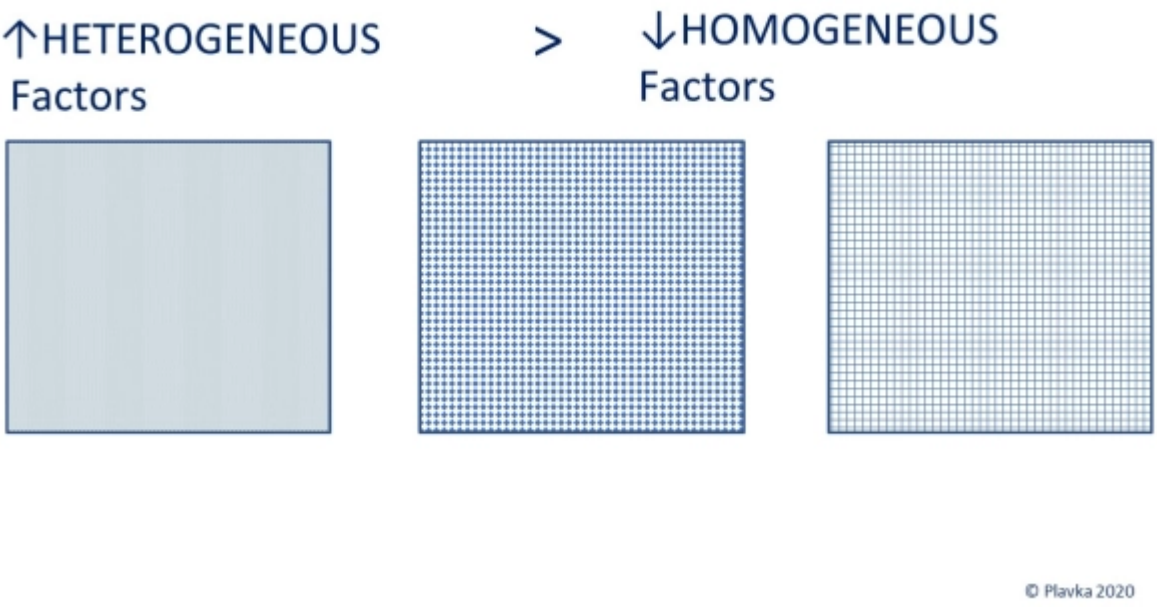
- **ALL TOGETHER**

1. Biophysical properties of lung (dg. and pathophysiology of lung)

2. Phase of lung disease (recruitment-stabilization-weaning)
3. Specifics of ventilatory devices and modes







Basics of „LUNG HOMOGENIZATION“

- Adequate alveolar distension during the whole of respiratory cycles
- Respecting of *time constants* in different lung compartments
- Positioning

Ventilatory parameters related to homogenization of lung:

In favor of...:

- ↑MAwP/FiO2
- ↑Frequency (Hf)
- ↓ VT

Against...:

- ↓ MAwP/FiO2
- ↑ Frequency IMV
- ↑ VT

Adverse effect of high intrathoracic (intrapulmonary pressure):

- Dopamin 2-5 ug/kg/min
- Dobutamin 10-20ug/kg/min
- Volumexpansion

Prone position during ventilators support

1. **Increases the elasticity of thorax**
2. **Homogenize distribution of lung liquid content**
3. **Facilitate recruitment of dorsal regions of lung** (dependent regions)

Improvement

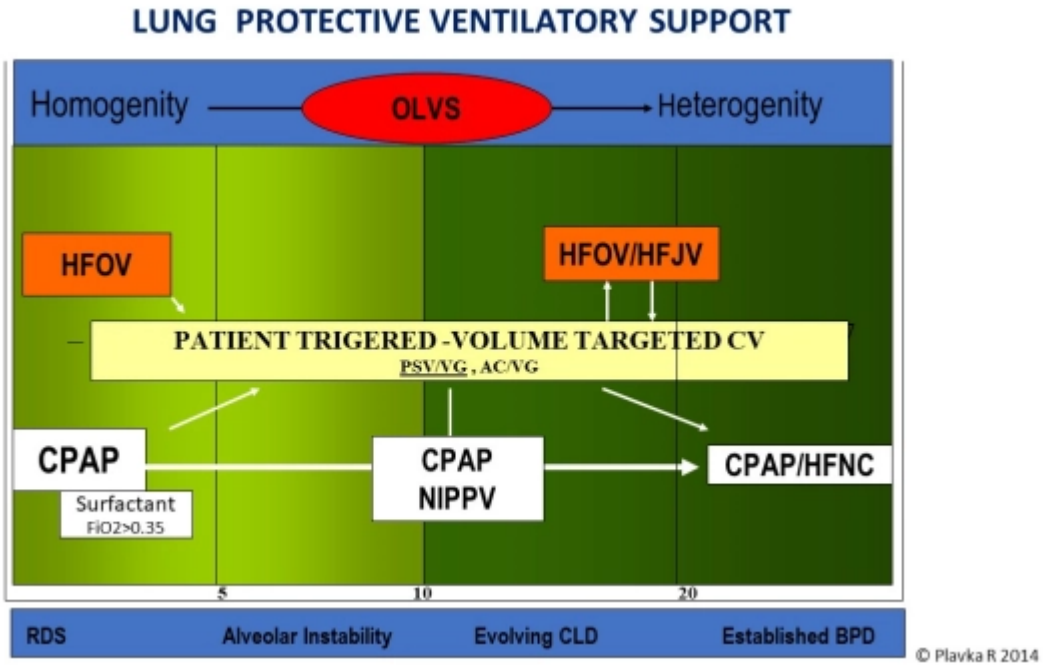
- V/Q proportion
- Distribution and exchange of gases
- Mobilisation of secretion

TRIAS of SUCCESS:
STRATEGY – VENTILATORY MODE - MANAGEMENT

STRATEGY „OPTIMUM LUNG VOLUME“

With adequate distribution of VTs to stabilized alveoli (PEEP a MAwP) during the all whole respiratory cycles
IS A KEY
Appropriate choice of ventilatory mode related to the current lung pathology makes management easier may attenuates negative effects of MV.

MODE IS A MEDIATOR
Only educated and well skilled doctors familiar with device can provide successful management
MANAGEMENT IS A PROCESS!



Ventilatory

Back Up

Keep always in your mind!

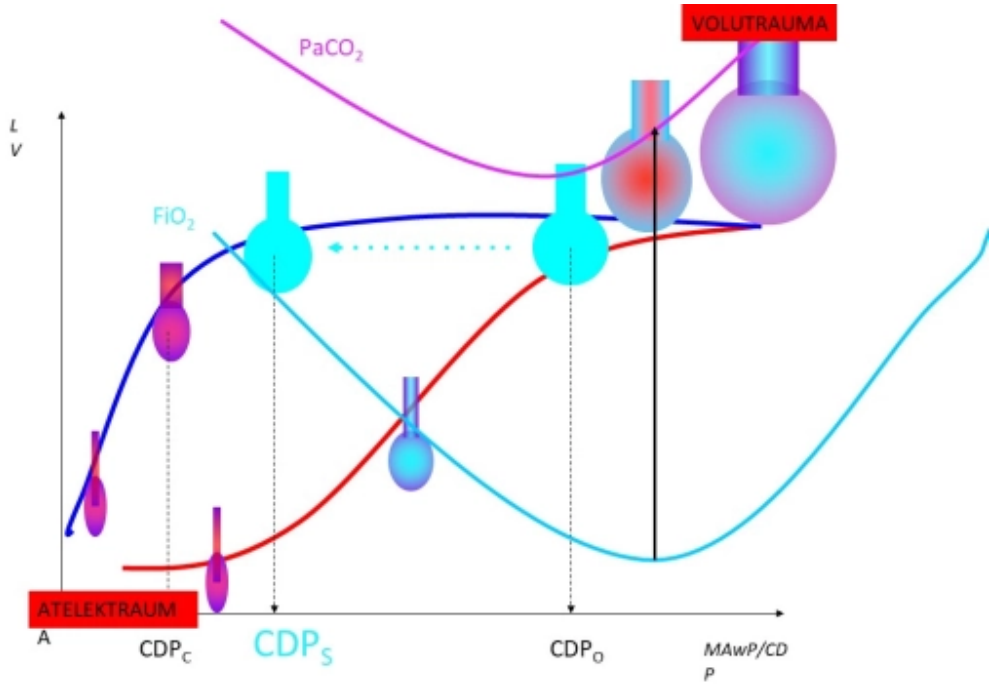
Mechanisms VALI/VILI

- Excessive VT and Low EEP EEP
- High FiO2
- Low lung volume and very uneven distribution of gas

Phases of MV

- Recruitment
- Stabilisation

- Weaning and Extubation



Trauma