COVID-19 pneumonia
Time course, monitoring and treatment

2020

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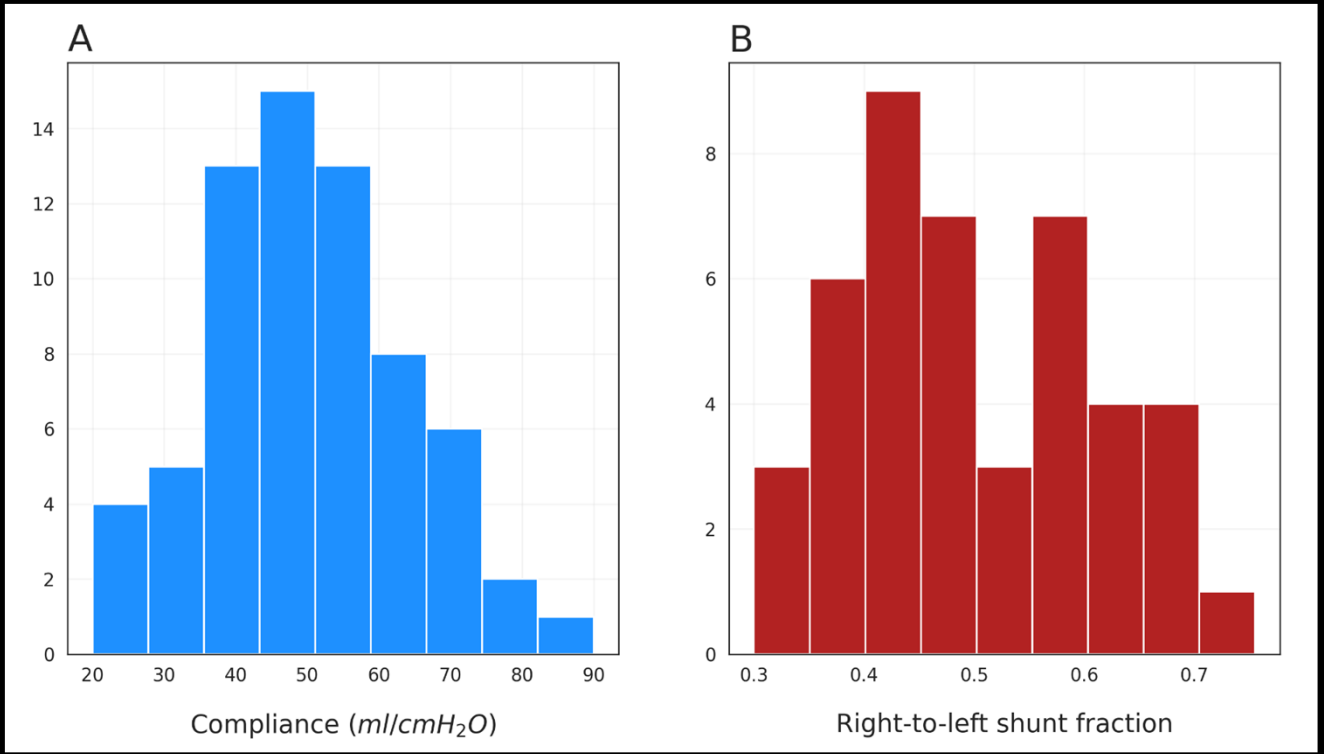
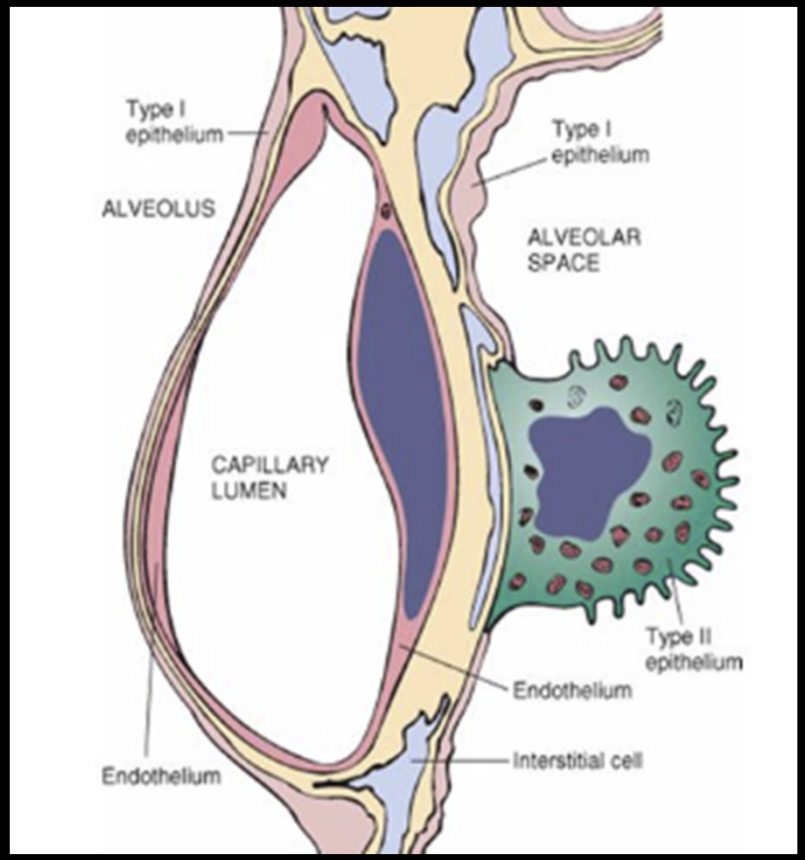
The main findings



Covid-19 Does Not Lead to a "Typical" Acute Respiratory Distress Syndrome

L. Gattinoni et al, AJRCCM 2020



VIRUS

↓

Epithelial – endothelial receptor

↓

Inflammation

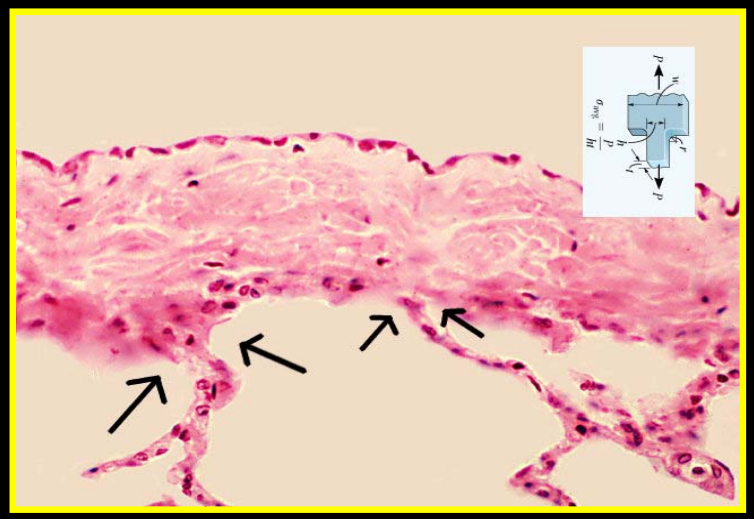
↓

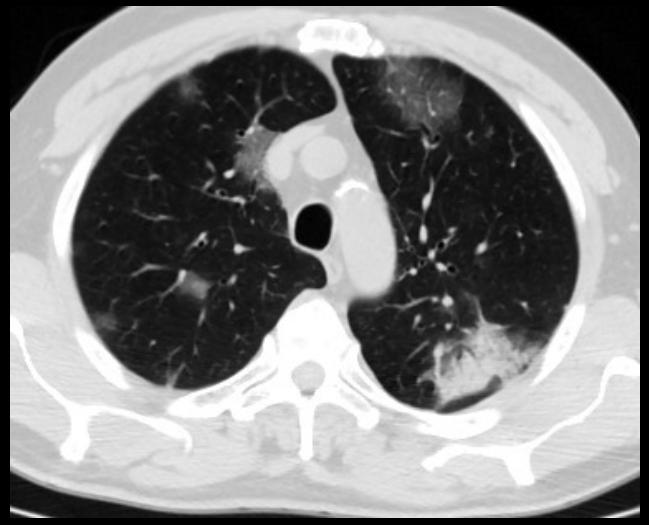
Interstial edema

↓

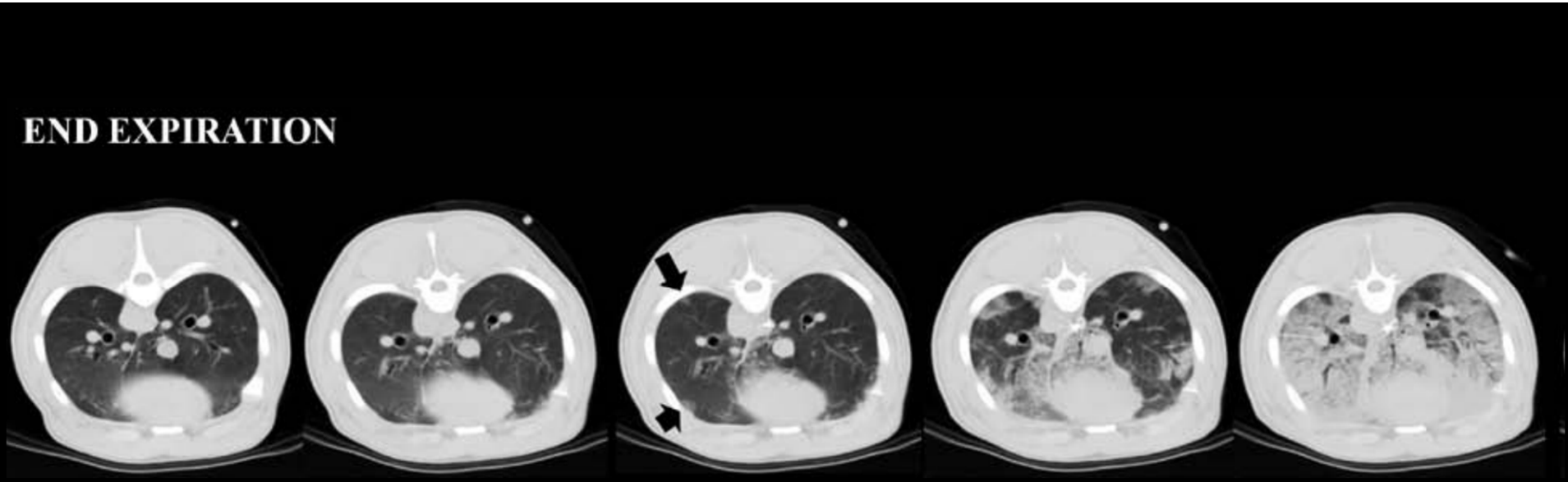
Where?

Inflammation + focused stress





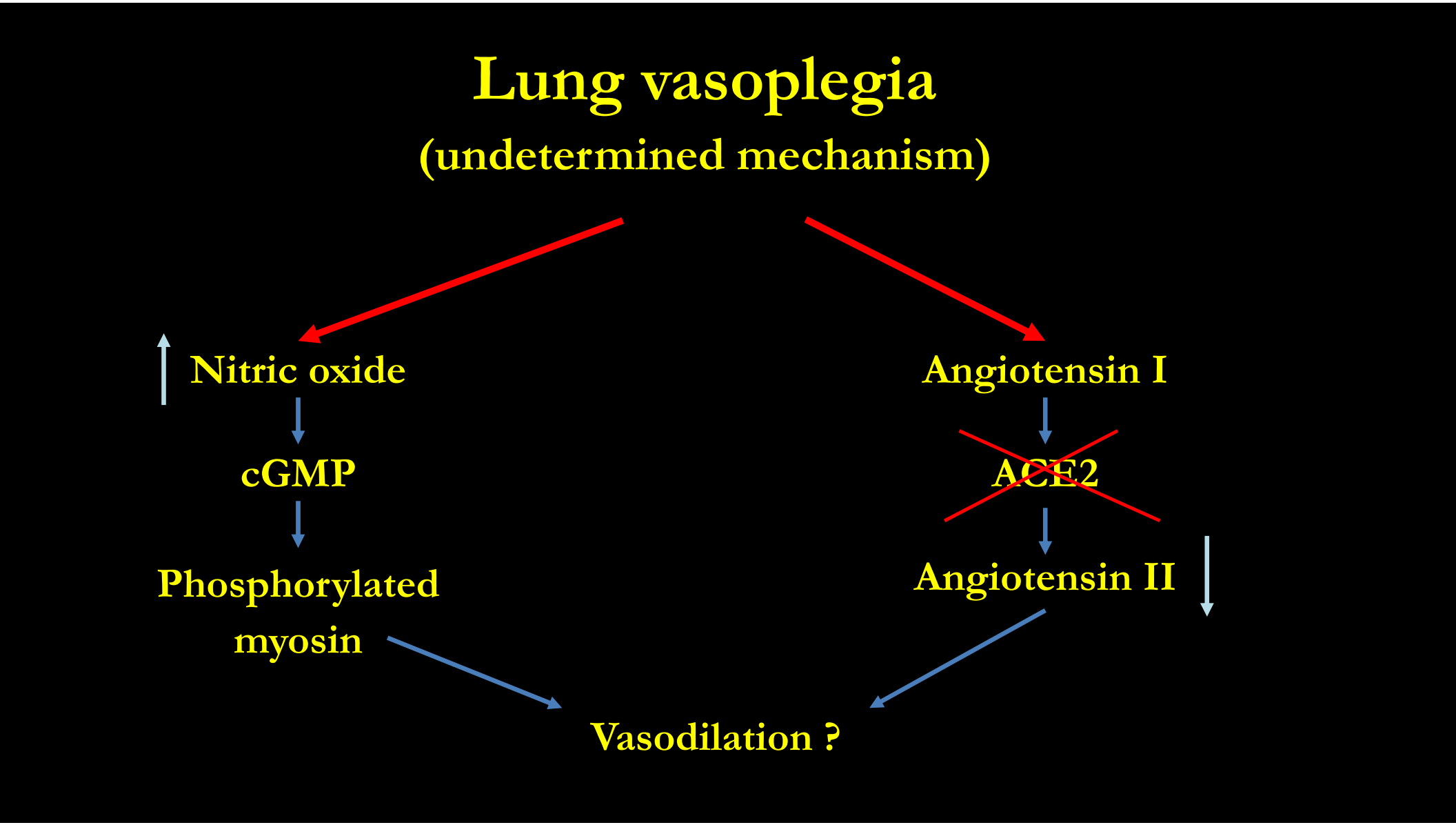
Peripheral densities



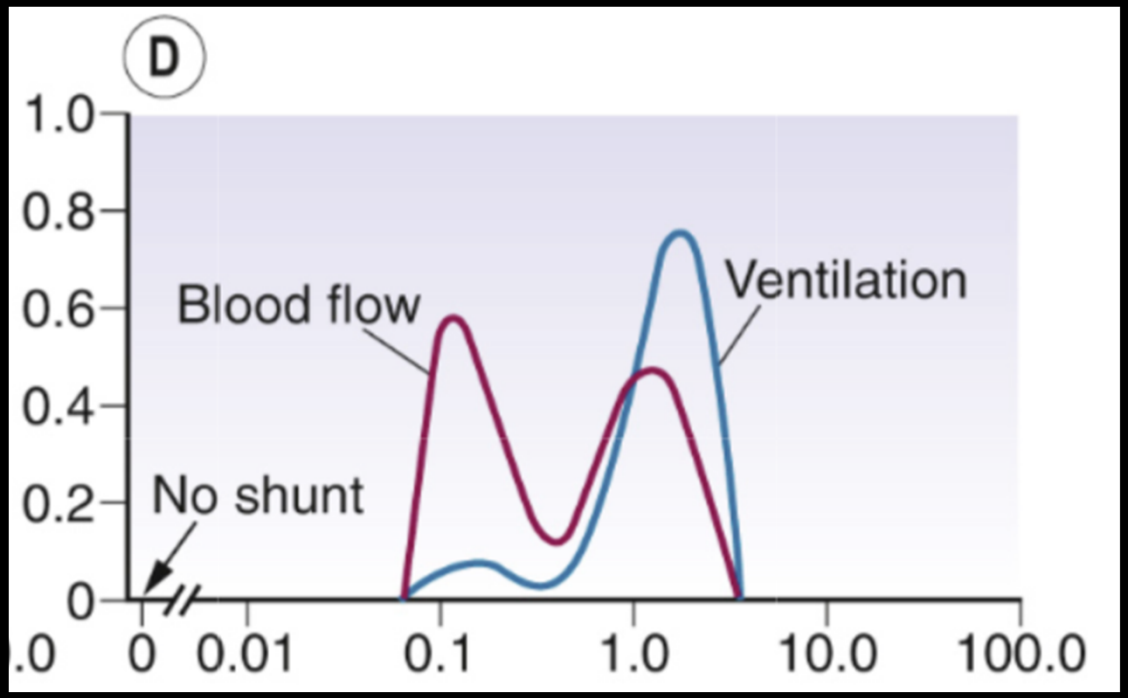
Time course of VILI development

In 40 hours

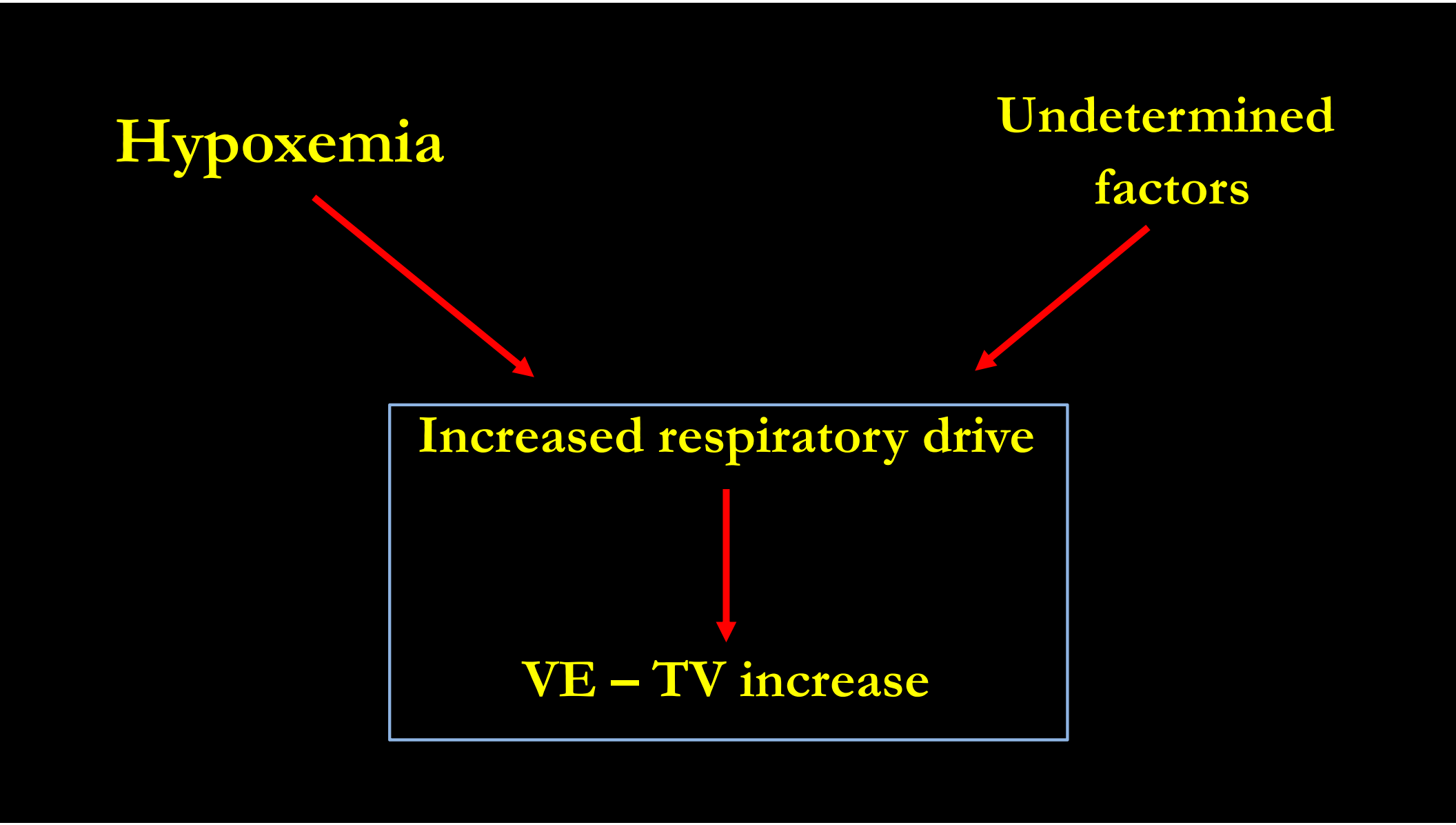
Lung Inhomogeneities and Time Course of Ventilator induced Mechanical Injuries
Cressoni et al,
Anesthesiology 2015

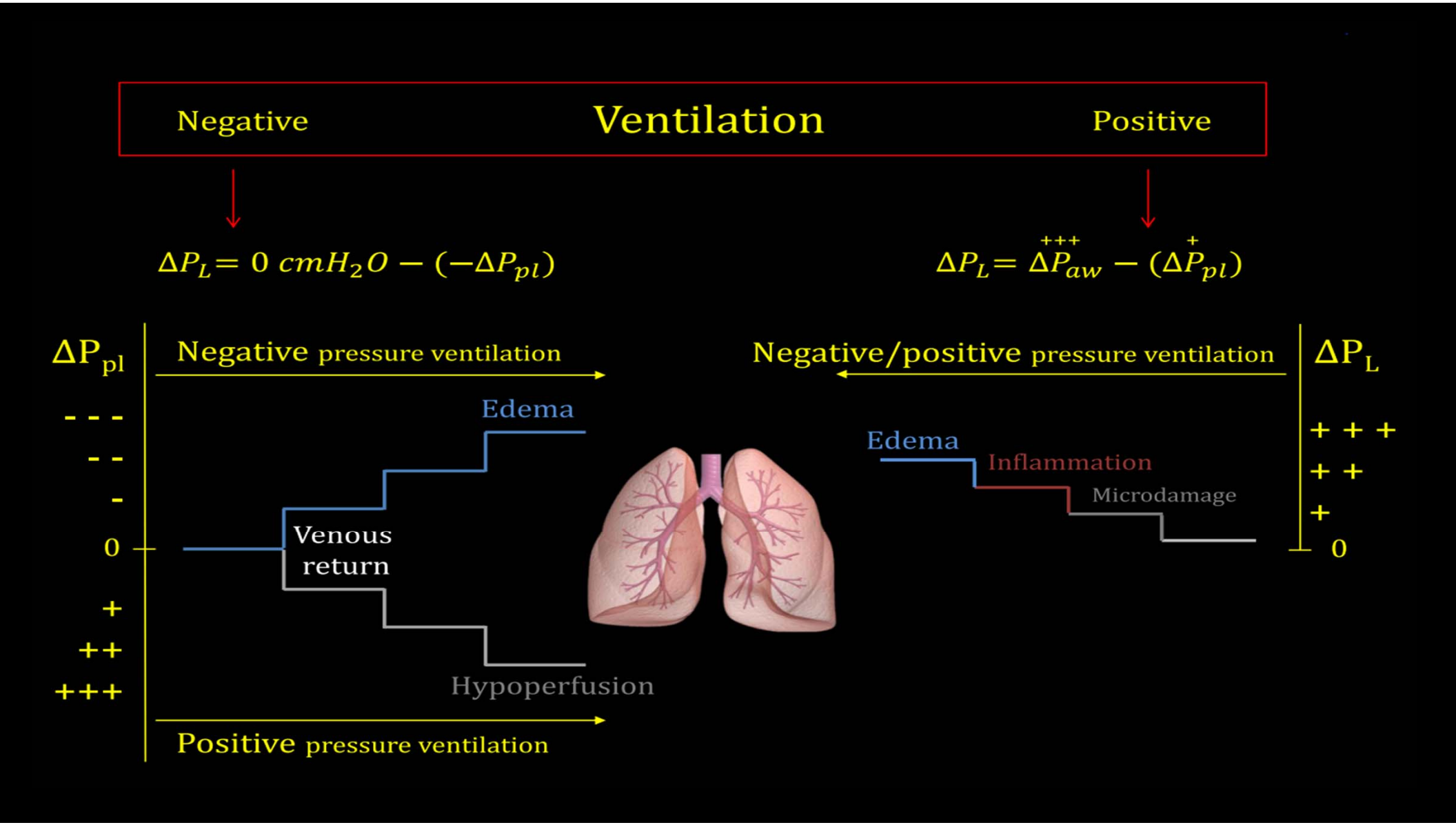

Lung vasoplegia
(undetermined mechanism)
Nitric oxide
cGMP
Phosphorylated
myosin
Angiotensin I
ACE2
Angiotensin II
Vasodilation ?

Gravity dependent VA/Q mismatch



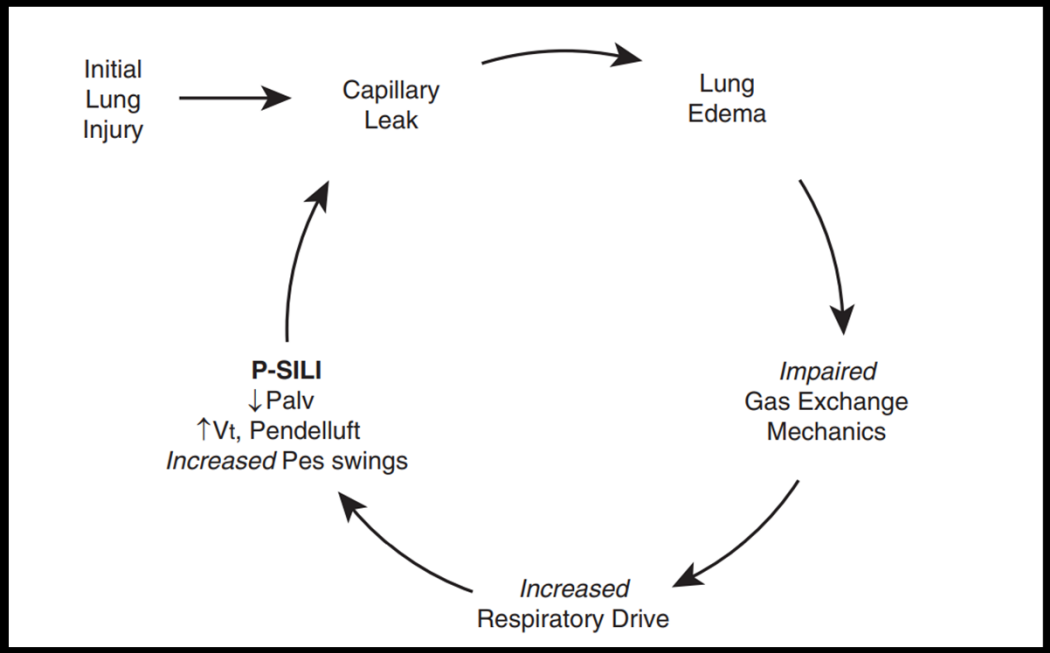
VA/Q mismatch


Hypoxemia
Undetermined factors
Increased respiratory drive
VE – TV increase


Negative
Ventilation
Positive
$\Delta P_L = 0\ cmH_2O - (-\Delta P_{pl})$
$\Delta P_L = \overset{+++}{\Delta P_{aw}} - (\overset{+}{\Delta P_{pl}})$
ΔP_{pl}
Negative pressure ventilation
Negative/positive pressure ventilation
ΔP_L
Edema
Edema
Inflammation
Microdamage
Venous return
Hypoperfusion
- - -
- -
-
0
+
++
+++
+ + +
+ +
+
0
Positive pressure ventilation

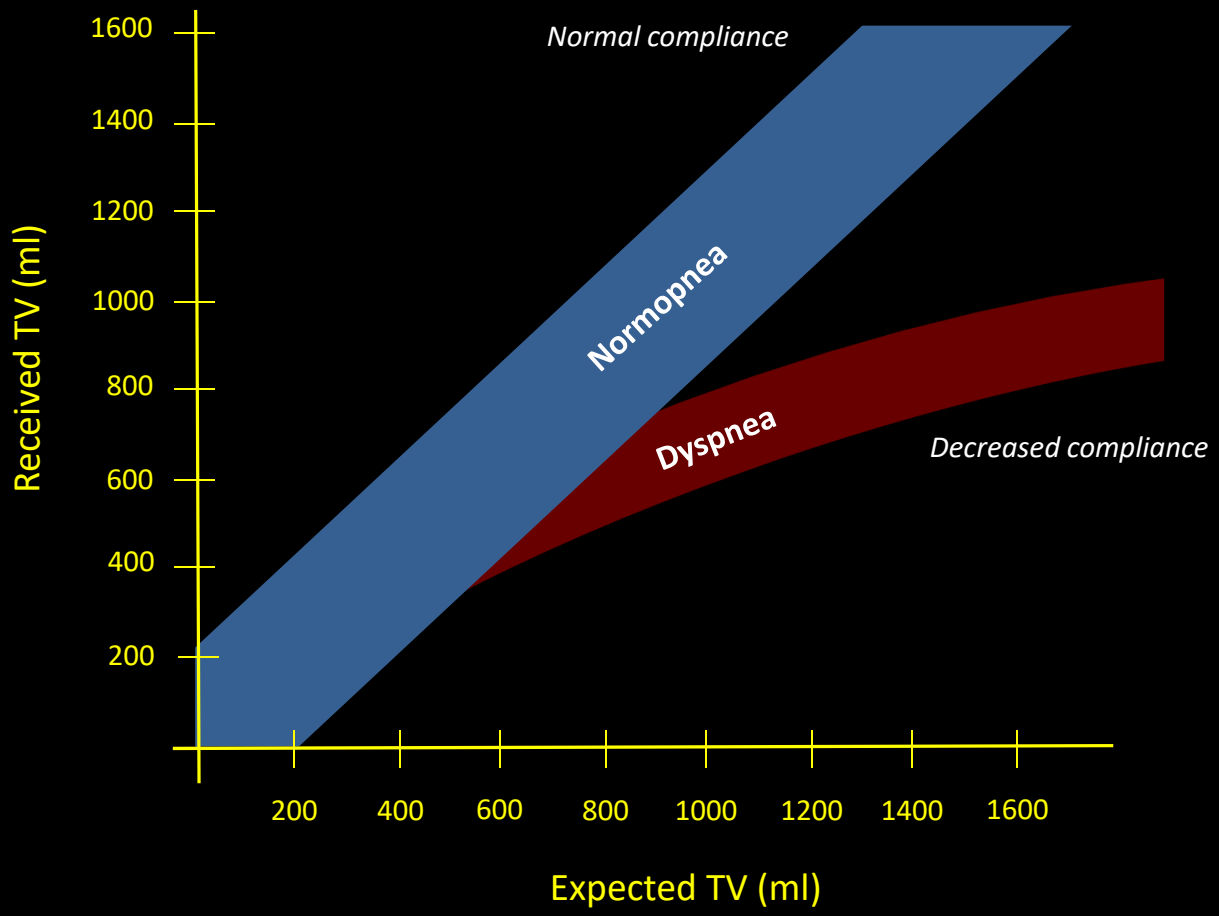
Positive pressure respiration and its application to the treatment of acute pulmonary edema
L. Barach,
Annals of Internal Medicine, 1938

Acute Respiratory Failure Following Pharmacologically Induced Hyperventilation: An Experimental Animal Study
D. Mascheroni et al,
ICM, 1988



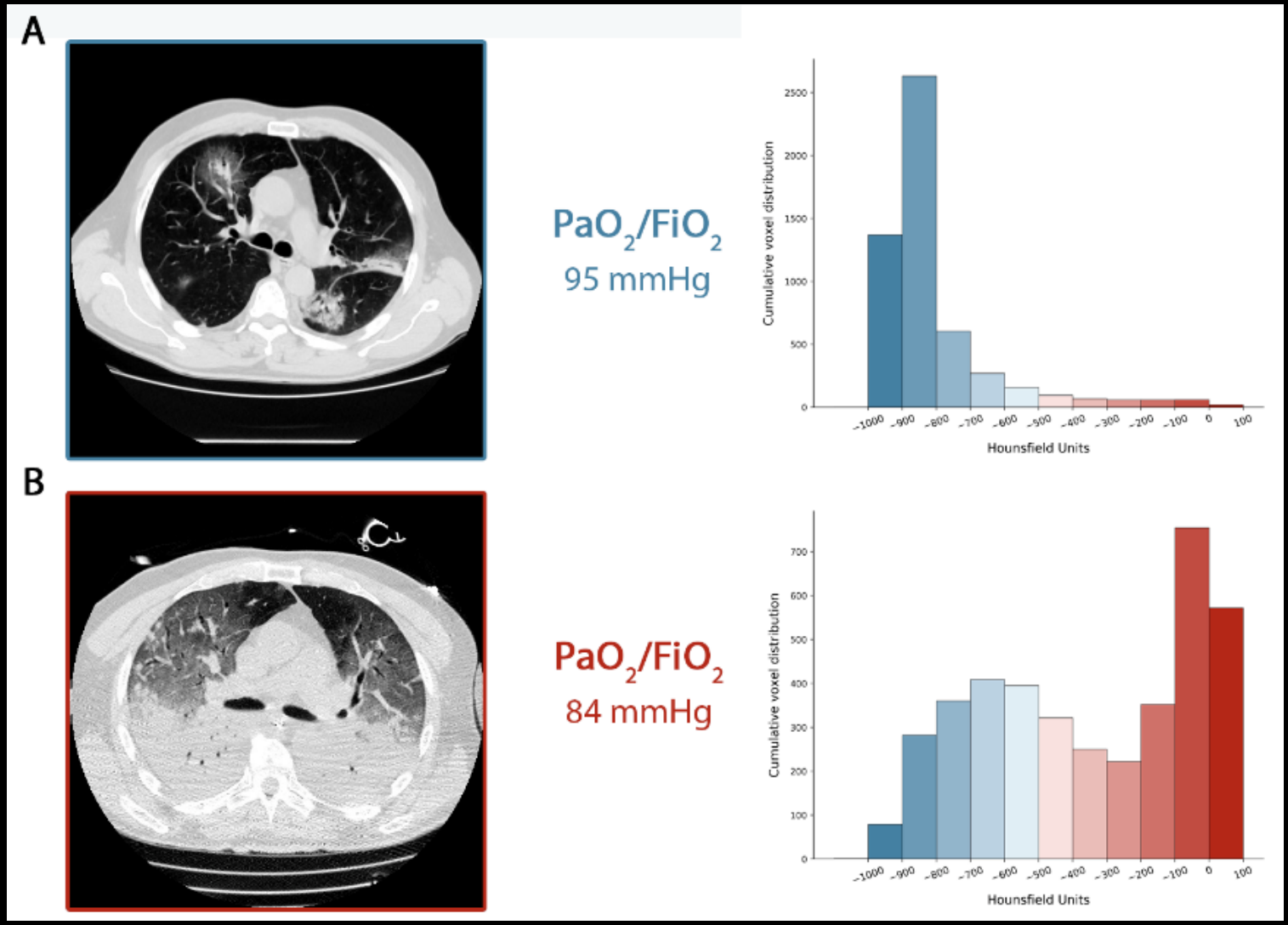
Mechanical Ventilation to Minimize Progression of Lung Injury in Acute Respiratory Failure
L. Brochard, A. Slutsky, A. Pesenti
AJRCCM 2017

When does the patient become dyspneic?

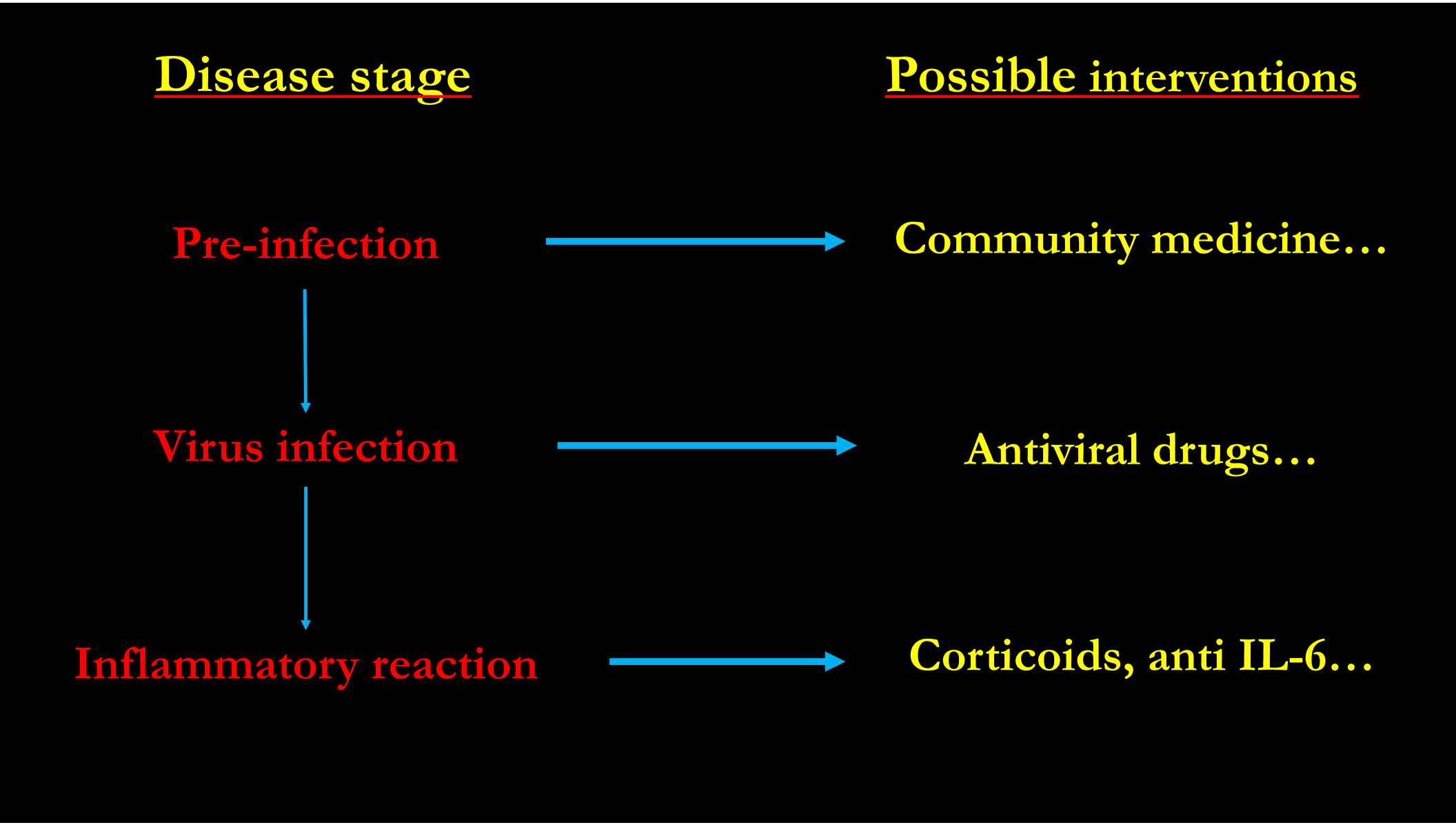


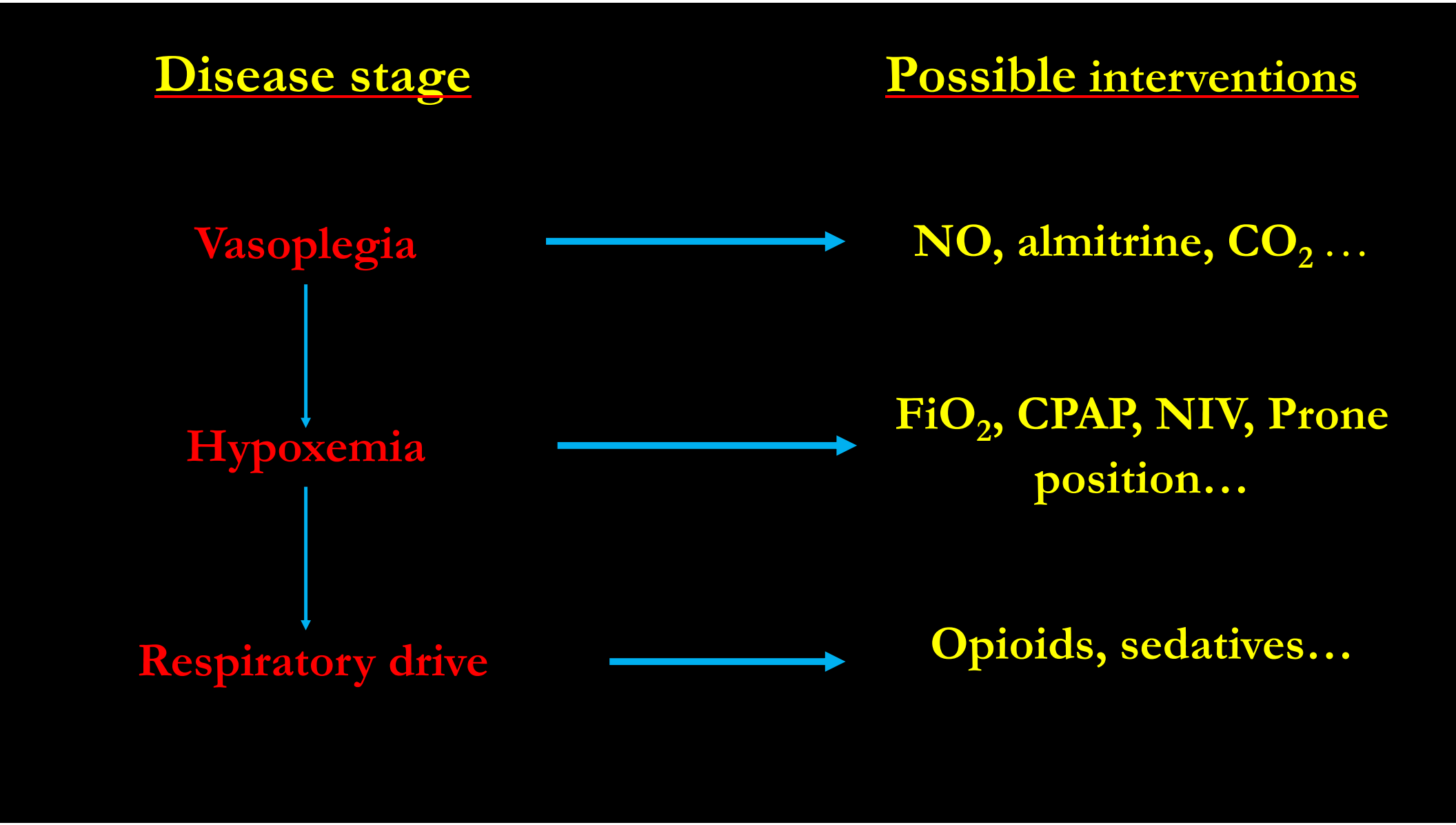
7 days spontaneously breathing

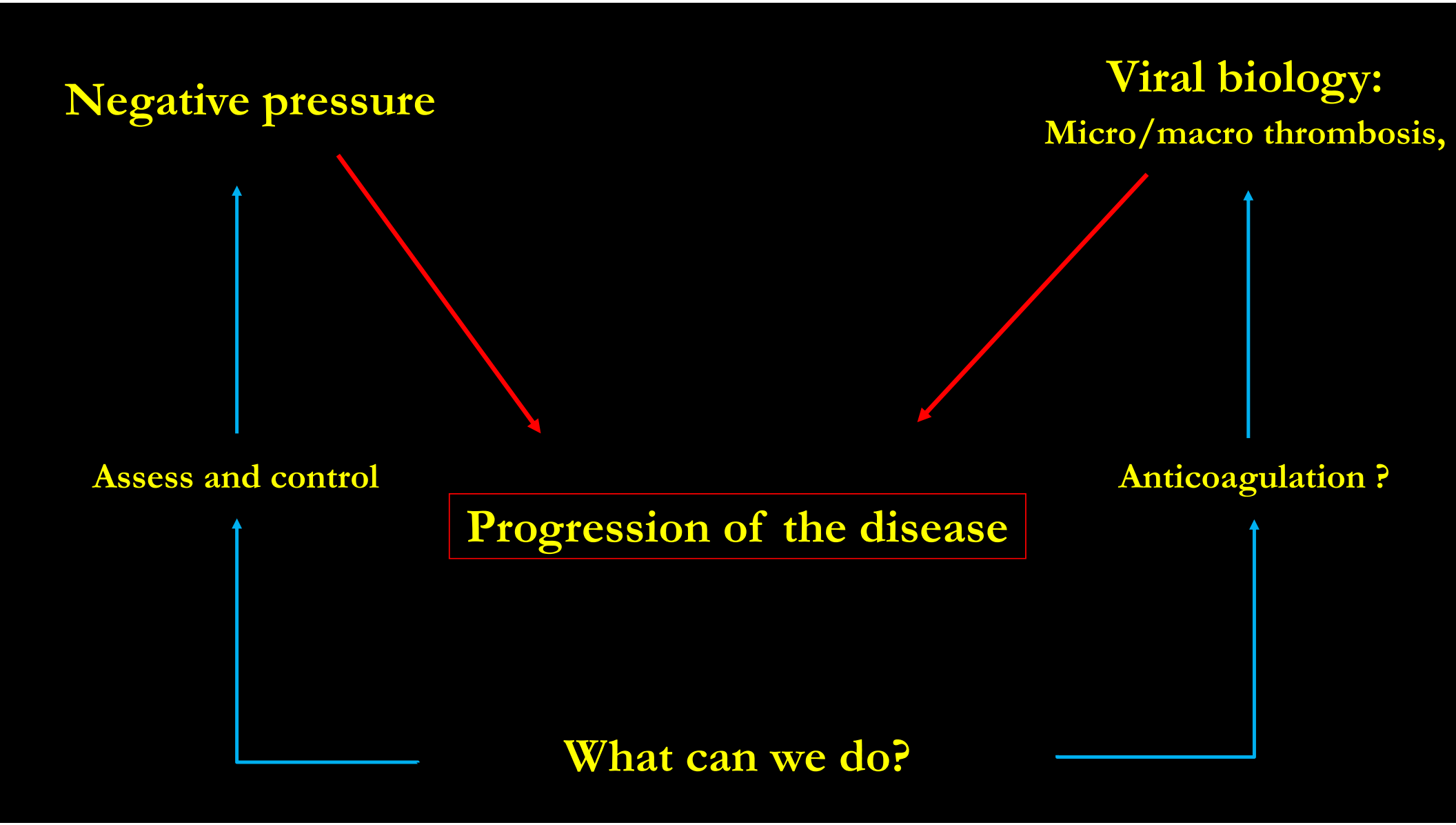
O_2 mask, CPAP, NIV



COVID-19 pneumonia: different respiratory treatment for different phenotypes?
L. Gattinoni et al, ICM 2020 *(in press)*


Disease stage
Possible interventions
Pre-infection
Community medicine…
Virus infection
Antiviral drugs…
Inflammatory reaction
Corticoids, anti IL-6…


Disease stage
Possible interventions
Vasoplegia
NO, almitrine, CO_2 …
Hypoxemia
FiO_2, CPAP, NIV, Prone position…
Respiratory drive
Opioids, sedatives…


Negative pressure
Viral biology:
Micro/macro thrombosis,
Assess and control
Progression of the disease
Anticoagulation ?
What can we do?

Negative intrathoracic pressure

- **How to assess**
  - Esophageal pressure
  - Surface electromyography
  - Clinical signs
- **How to control**
  - CPAP?
  - NIV?
  - Mechanical ventilation

Non invasive support

Pro

- Increase oxygenation
- May decrease the Ppl swings

Con

- Increase $PaCO_2$
- May not decrease effort
- Right ventricular failure
- Acute Kidney Injury

How I set the ventilator

- Mode
- FiO2
- Tidal Volume
- Respiratory rate
- PEEP

Remember that it is

a long lasting disease

1. Which patient am I treating?

Type L

Type H

1. Which patient am I treating?

Type L

- Low elastance
- Low VA/Q
- Low lung weight
- Low recruitability

Type H

- High elastance
- High shunt
- High lung weight
- High recruitability

Mechanical ventilation

Type L

Sedation and muscle relax

- **Mode:** Volume Controlled Ventilation — Why?
- **FiO_2:** high as needed — Why?
- **Tidal Volume:** even > than 6 ml/kg — Why?
- **Respiratory rate:** try < 20 bpm — Why?
- **PEEP:** 8-10 cmH_2O — Why?
- **Prone position**: only as a rescue — Why?

Mechanical ventilation

Sedation and muscle relax

Type L

In these high compliance patients (> 50 ml/cmH_2O) the plateau, driving pressure and mechanical power levels are well below the “classical” severe ARDS

Mechanical ventilation

Type H

Sedation and muscle relax

- **Mode:** Volume Controlled Ventilation — Why?
- **FiO_2:** high as needed — Why?
- **Tidal Volume:** possibly 6 ml/kg — Why?
- **Respiratory rate:** to stay < 60 mmHg $PaCO_2$ — Why?
- **PEEP:** possibly < 15 cmH_2O — Why?
- **Prone position**: daily — Why?

Mechanical ventilation

Sedation and muscle relax

Type H

In these low compliance patients (< 50 ml/cmH_2O) the plateau, driving pressure and mechanical power levels are the same of the “classical” severe ARDS

Weaning

COVID-19 pneumonia lasts long,

early weaning is problematic

Remember

1. More than 50% do not have a "classical" ARDS
2. It's a long course disease
3. 10 cmH_2O of PEEP, sedation and especially patience is likely the best we can offer