Fisiopatologia Applicata dell'Insufficienza Respiratoria Acuta

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CASO 1

Donna di 60 aa, accompagnata al PS dal 118 con severa dispnea, elevata FR, respiro addominale, cute fredda e marezzata, rantoli all'auscultazione toracica, elevata PA.

Anamnesi di IMA, FE 35% in un recente ecocardio

Parametri Vitali:

PA 210/120, FC 120, SpO2 78%, FR 40

EGA

pH 7,21 pO2 49 mmHg, pCO2 52 mmHg, HCO3- 18 mEq/L, LAC 5,2

CASO 2

Uomo di 75 aa con COPD nota, in tp con bronchodilatatori. Si presenta al PS con dispnea, confusione, febbre e tosse. Il livello di coscienza risulta depresso ed il paziente tende ad addormentarsi

Parametri Vitali

PA 120/70 FC 100 FR 10 SpO2 80%

EGA

pH 7.20 pO2 54 mmHg, pCO2 98 mmHg
HCO3- 32 mEq/L

Respiratory Failure

"inability of the lung to meet the metabolic demands of the body. This can be from failure of tissue oxygenation and/or failure of CO_2 homeostasis."

Respiratory Failure

1. *Increased shunt*
2. *Diffusion impairment*
3. *Ventilation/perfusion inequality*
4. *Alveolar hypoventilation*

The Lung

The ventilatory pump

Respiratory Failure

Gas Exchange Failure

Increased D(A-a)O2

1. V/Q mismatch
2. True shunt

Pump Failure

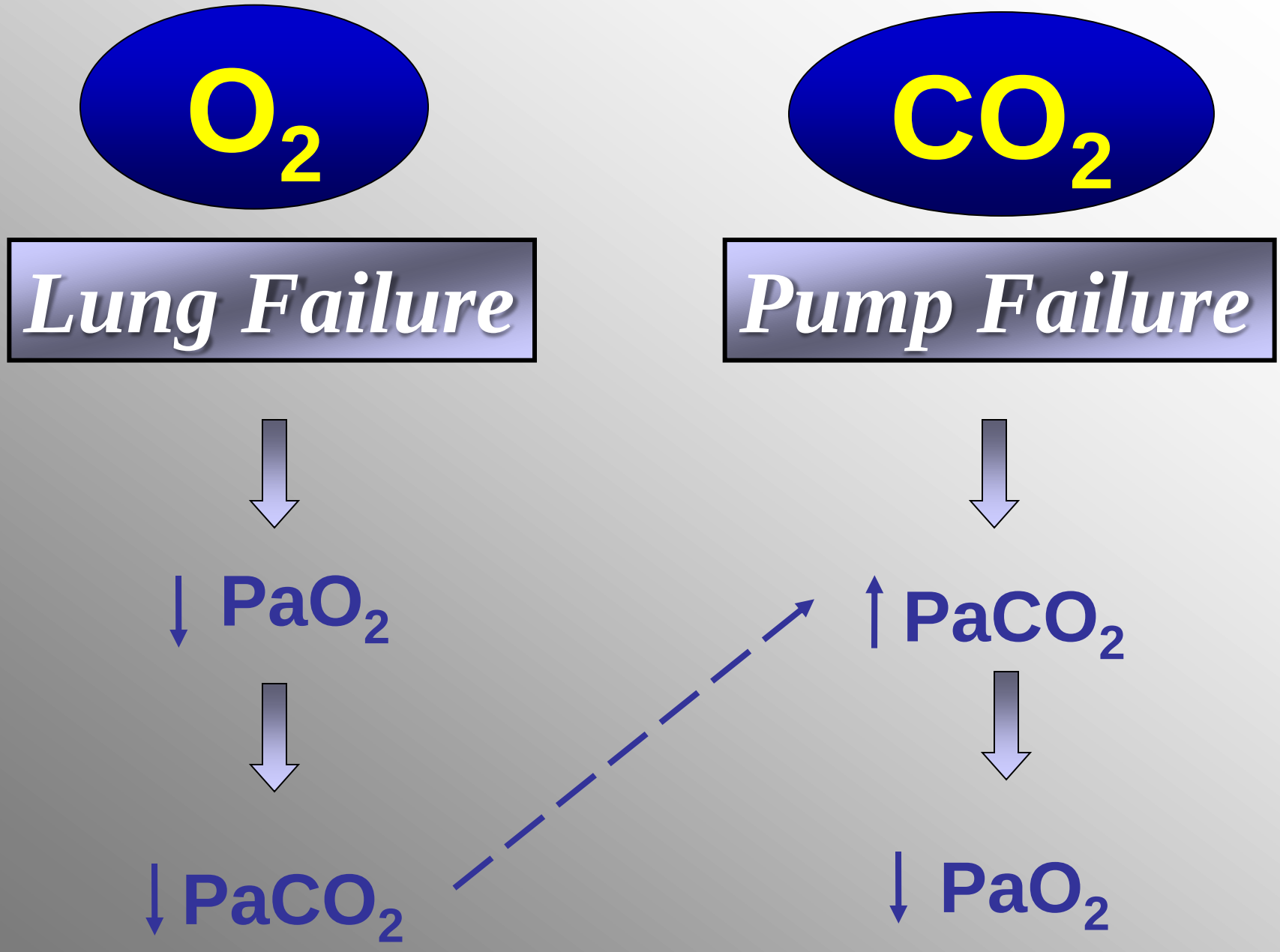
Hypercapnia

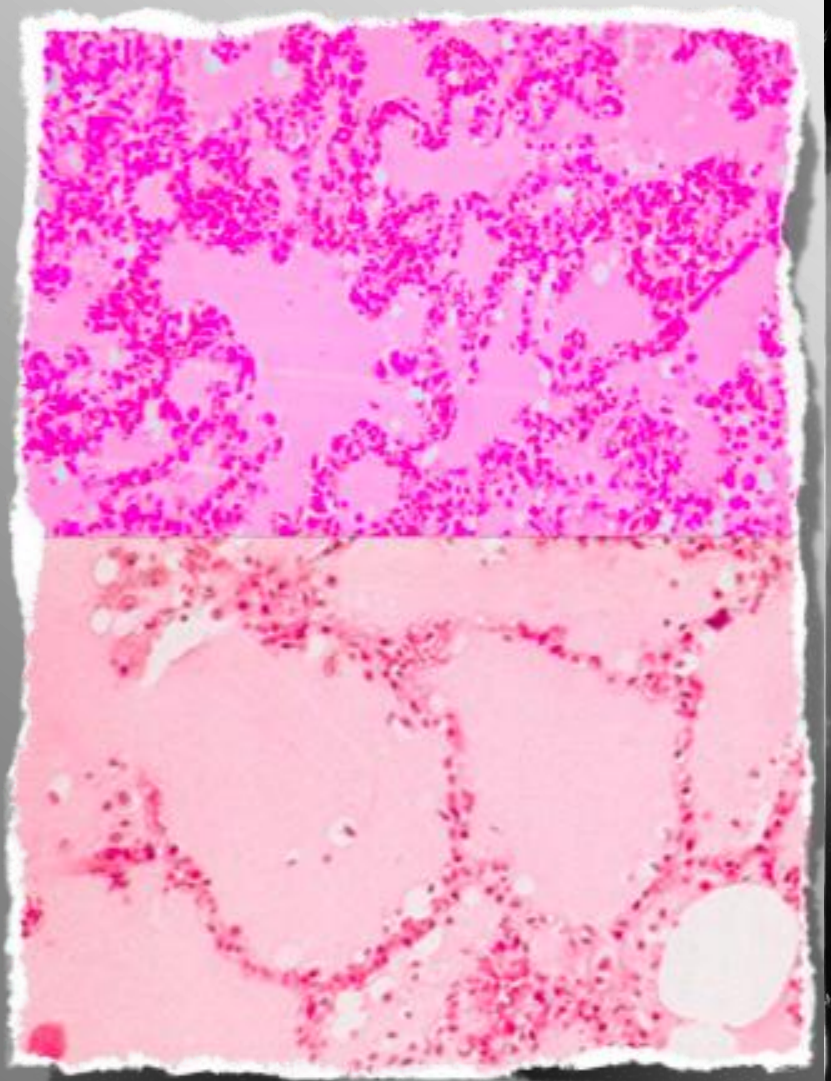
↓ pump capacity

vs

↑ Load

- CNS


O_2
CO_2
Lung Failure
Pump Failure
PaO_2
$PaCO_2$
$PaCO_2$
PaO_2




SEMISED.
D

Lung Failure

- ✓ *Diffusione CO_2 > O_2 (20 volte)*
  - ⟶ *Ipossiemia*
- ✓ *Alterazione di* ***V/Q***
- ✓ *Shunt*
- ✓ *WOB* ↑

WOB: *Equazione di moto*

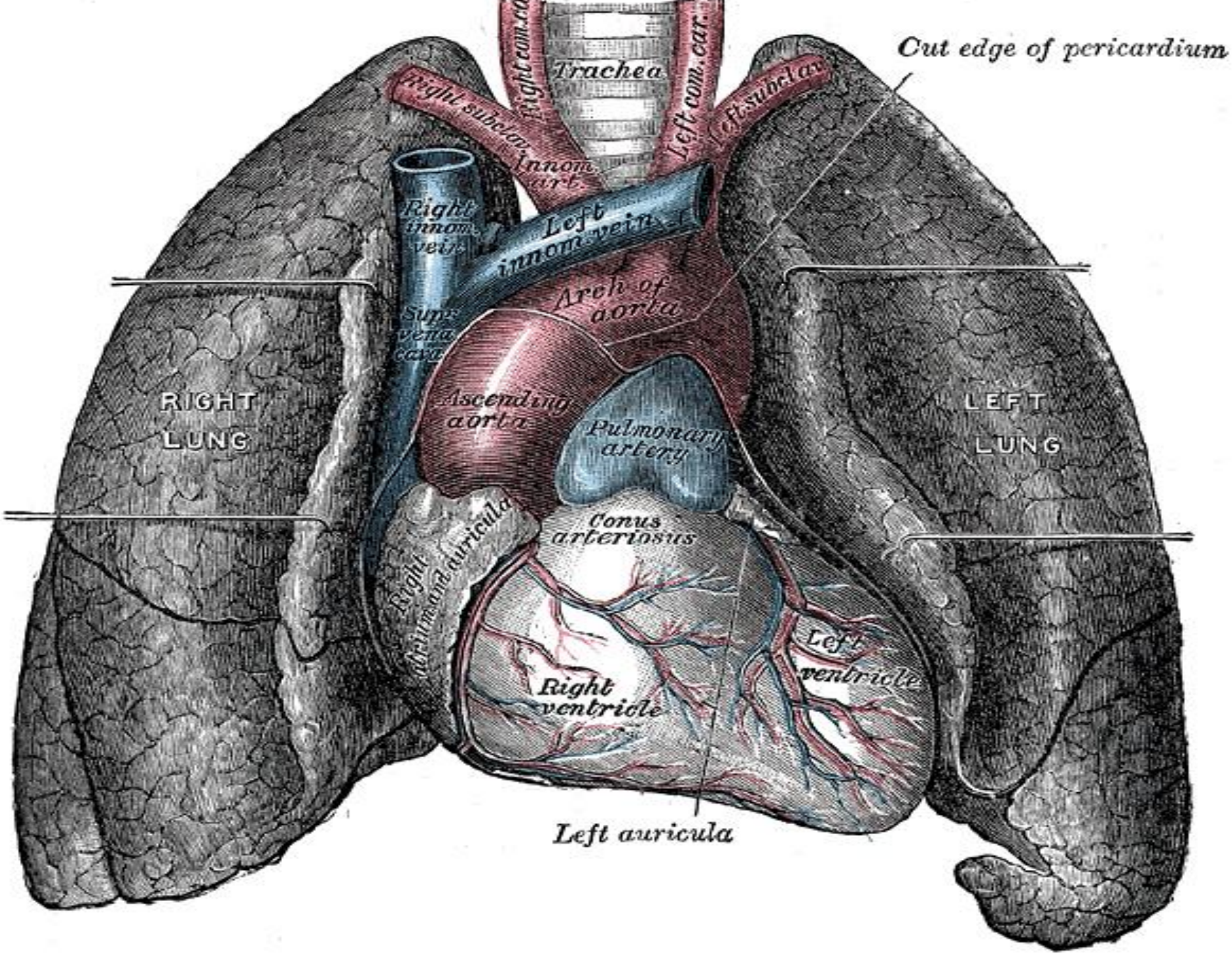
Legenda

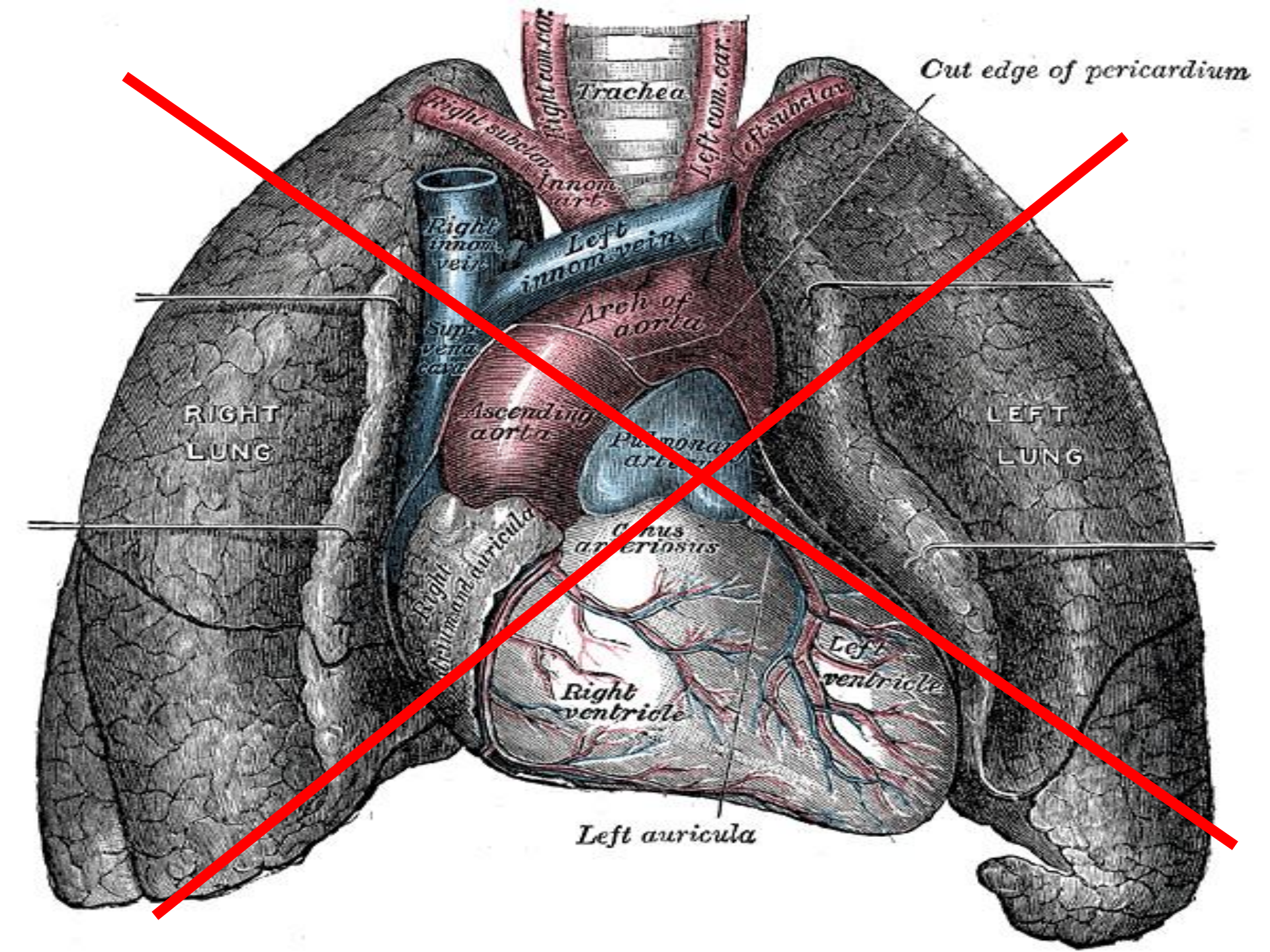
- ✓ *Pmus: pressione prodotta dai muscoli respiratori*
- ✓ *Vt: volume corrente*
- ✓ *Ers: carico elastico del sistema respiratorio*
- ✓ *V': flusso vie aeree*
- ✓ *Rtot: resistenze vie aeree*
- ✓ *PEEPi: pressione positiva di fine espirazione intrinseca*

Pmus= VT ERS + V' Rtot + PEEPi

il polmone è rigido, meno espansibile, con edema della parete bronchiale e aumento delle resistenze

QUALE E' L'ORGANO DETERMINANTE NELL'IRA TIPO 2?


Cut edge of pericardium
Trachea
Right com. car.
Left com. car.
Right subclav.
Left subclav.
Innom. art.
Right innom. vein
Left innom. vein
Arch of aorta
Sup. vena cava
Ascending aorta
Pulmonary artery
RIGHT LUNG
LEFT LUNG
Conus arteriosus
Right auricula
Left ventricle
Right ventricle
Left auricula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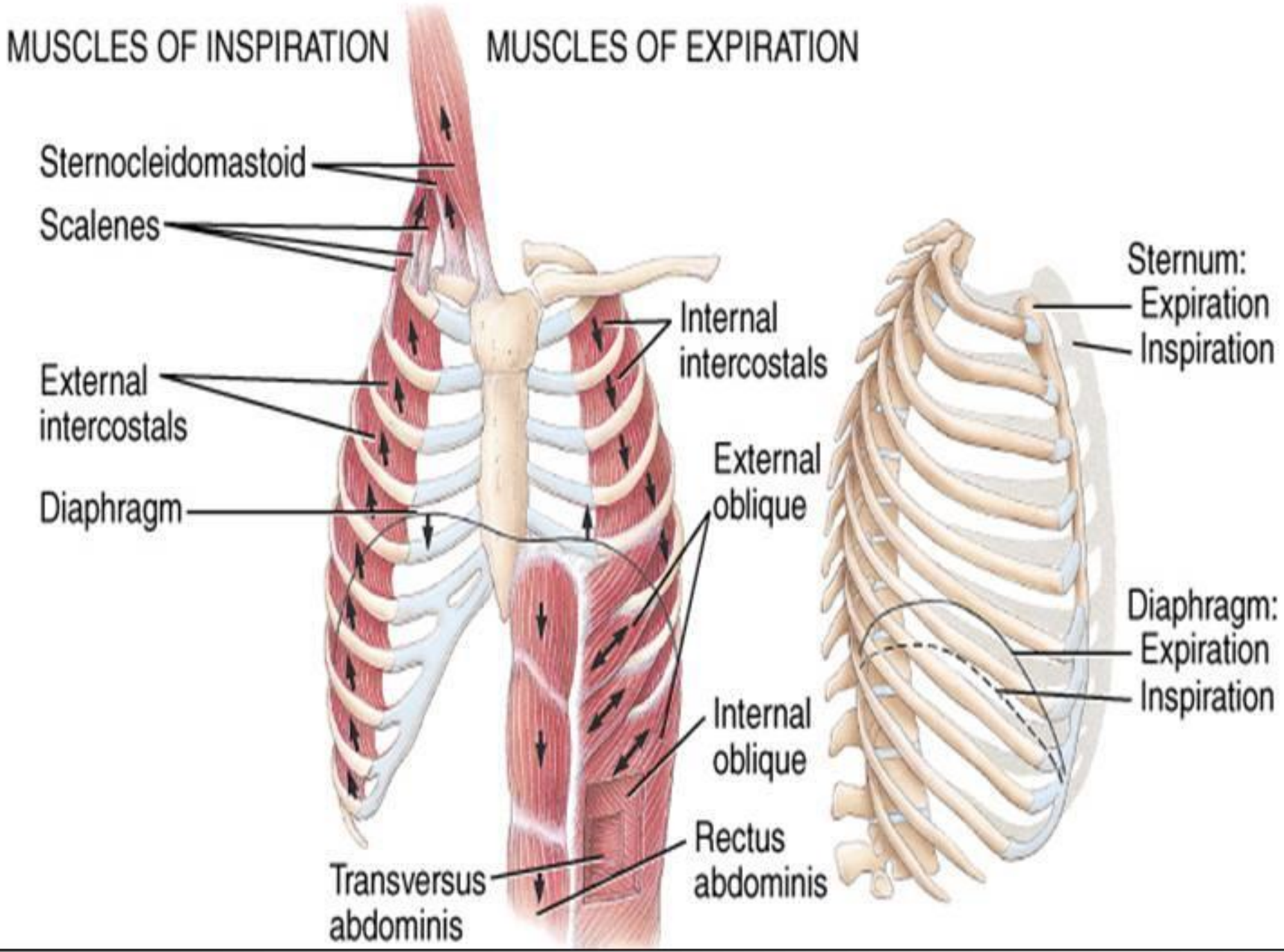
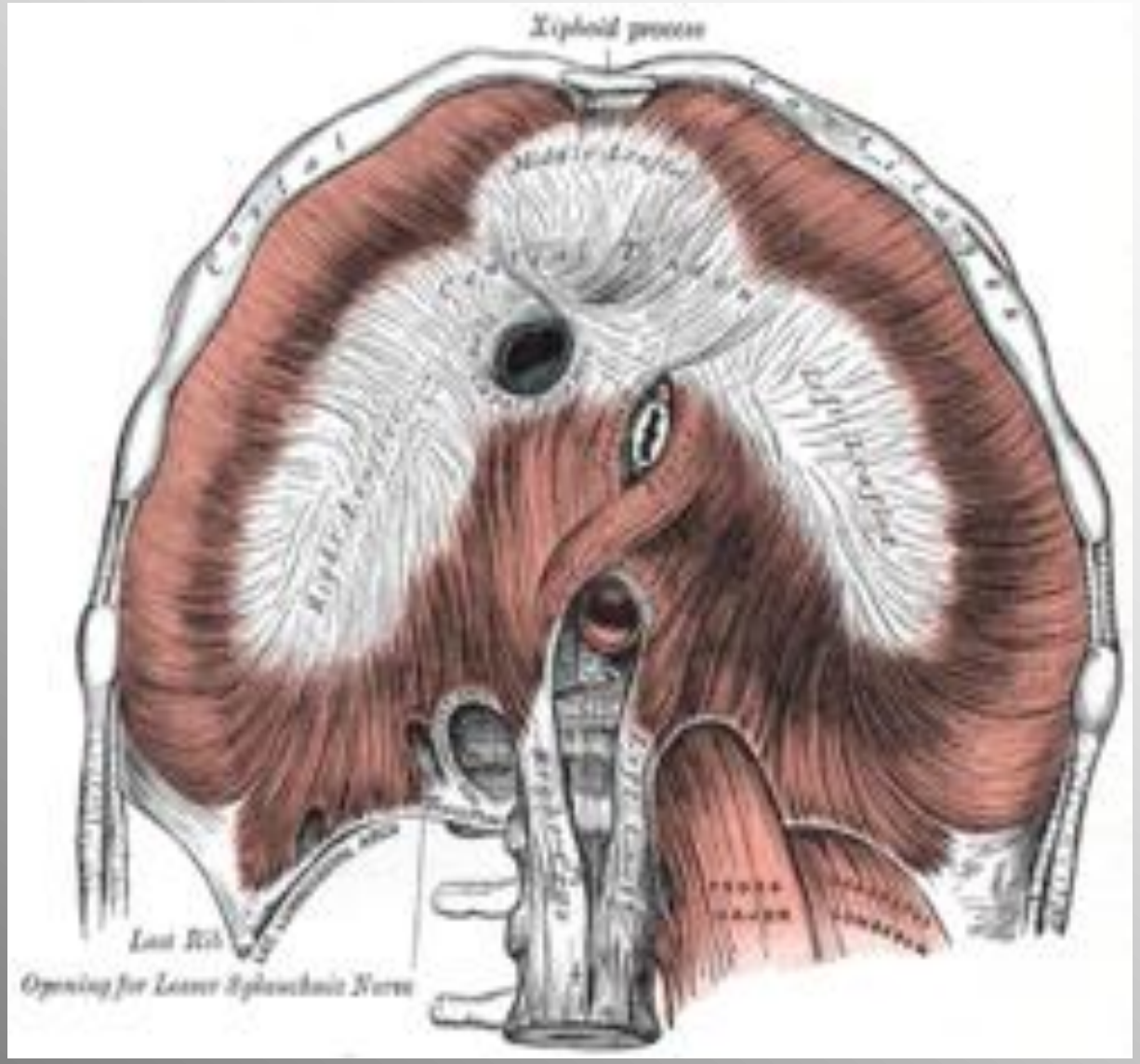
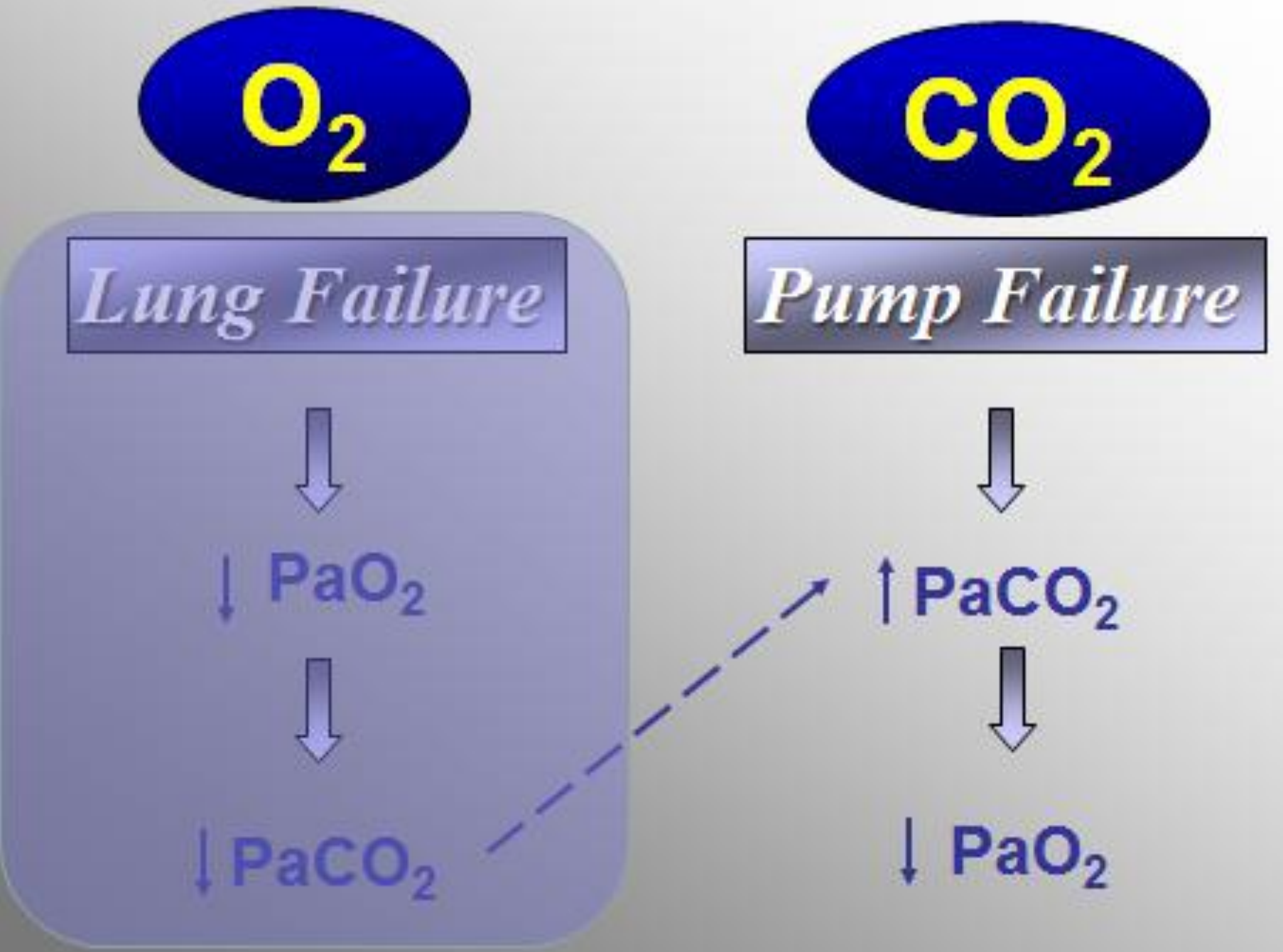
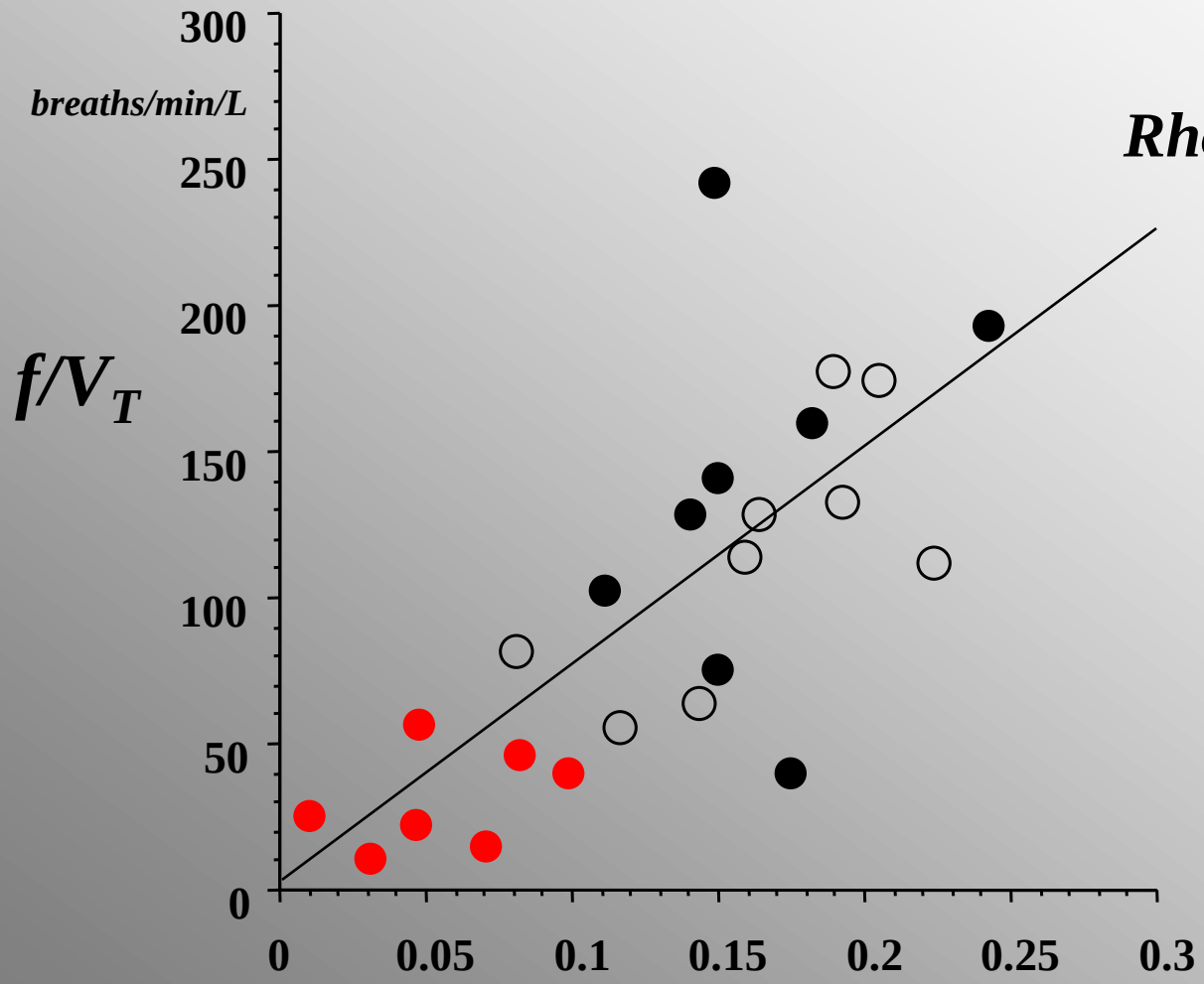
RIGHT LUNG
LEFT LUNG
Right auricula
Conus arteriosus
Left ventricle
Right ventricle
Left auricula


MUSCLES OF INSPIRATION
MUSCLES OF EXPIRATION
Sternocleidomastoid
Scalenes
External intercostals
Diaphragm
Internal intercostals
External oblique
Internal oblique
Rectus abdominis
Transversus abdominis
Sternum: Expiration
Inspiration
Diaphragm: Expiration
Inspiration


Xiphoid process
Last Rib
Opening for Lesser Splanchnic Nerve

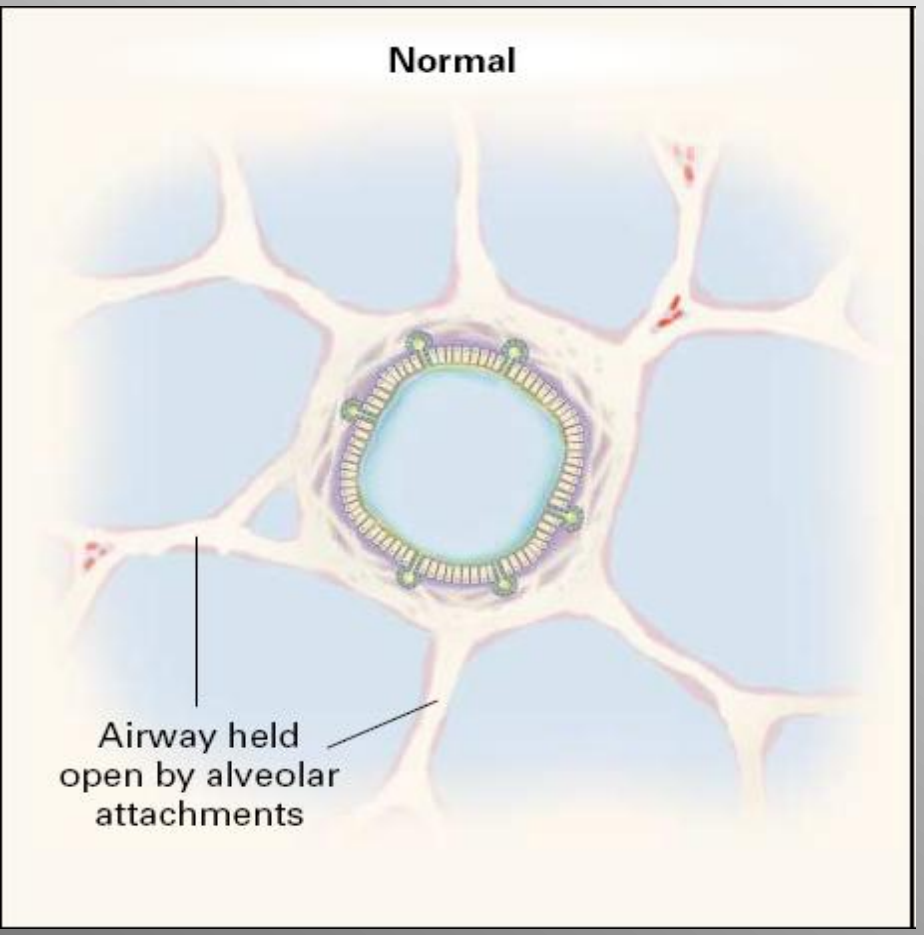

O_2
CO_2
Lung Failure
Pump Failure
↓ PaO_2
↓ $PaCO_2$
↑ $PaCO_2$
↓ PaO_2

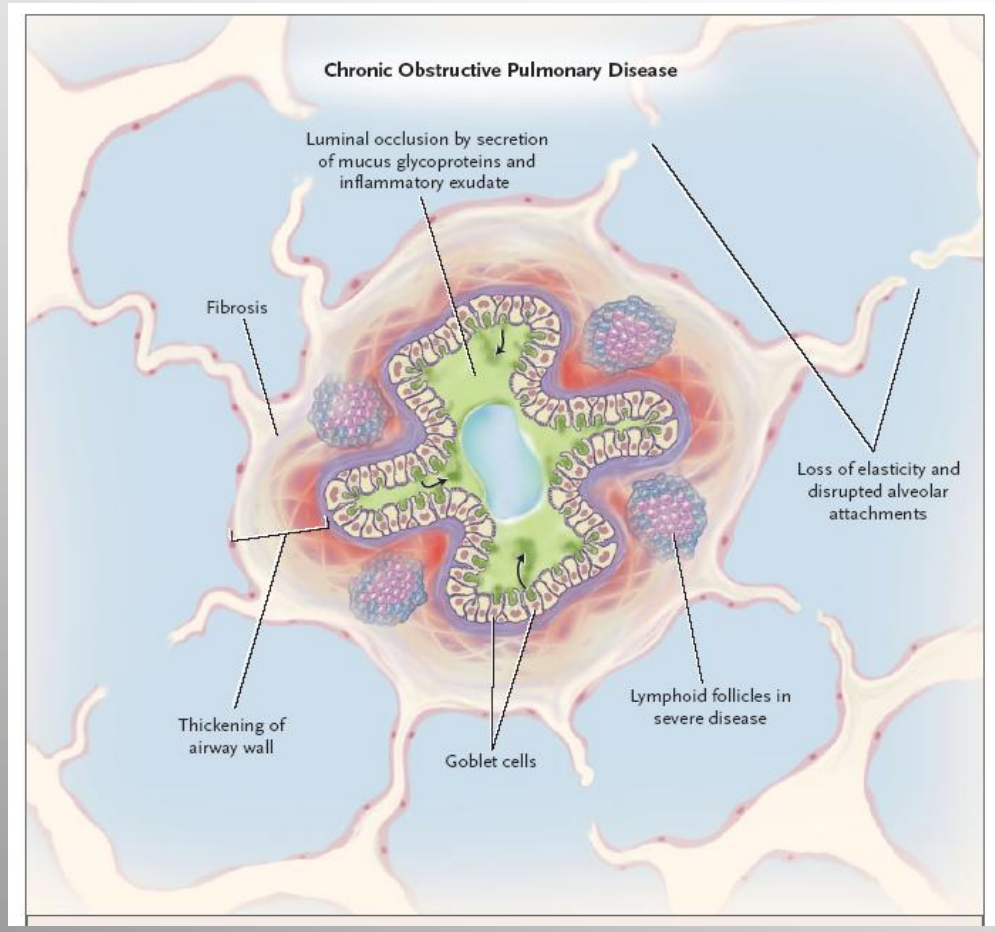
Rapporto tra "fatica" muscolare e breathing pattern



Rho= 0.756, p < 0.05

TTdi → indice di fatica del diaframma

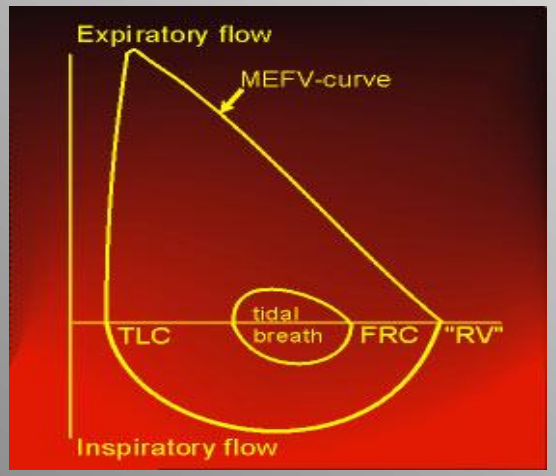


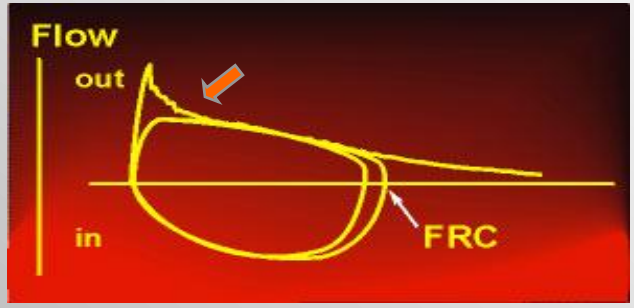


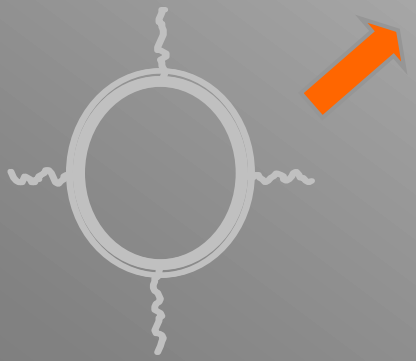
Barnes PJ. N Engl J Med 2004;350:2635-37

Expiratory Flow in healthy and COPD

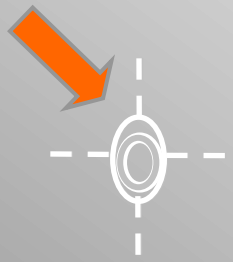
Flow-Volume curve



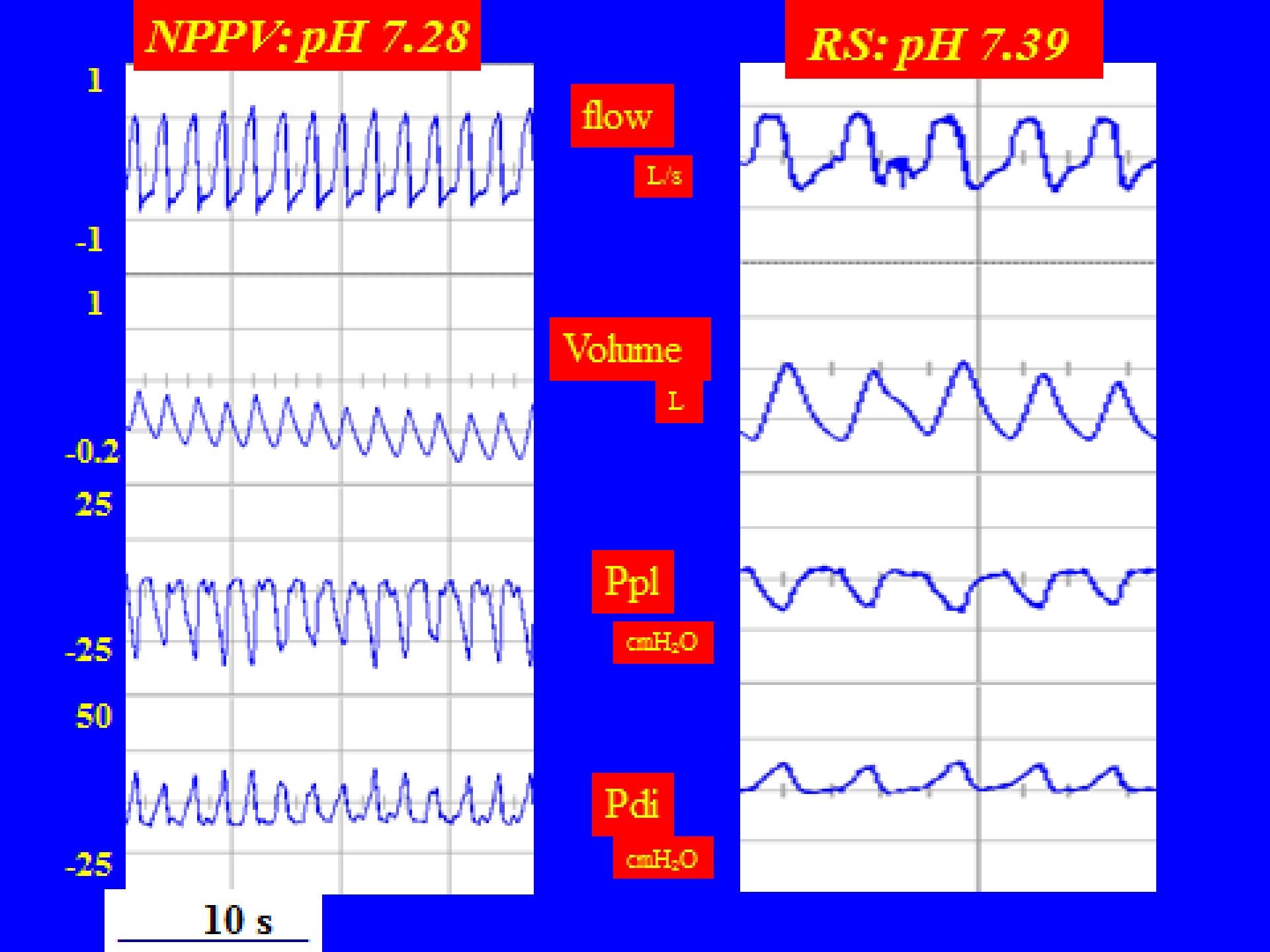




Normal Expiration



Expiration in COPD


NPPV: pH 7.28
RS: pH 7.39
1
-1
flow
L/s
1
-0.2
Volume
L
25
-25
Ppl
cmH2O
50
-25
Pdi
cmH2O
10 s

EQUAZIONE DELLA VENTILAZIONE ALVEOLARE

$$PaCO_2 = \frac{V' CO_2}{V' alv.} K$$

Rapid shallow breathing

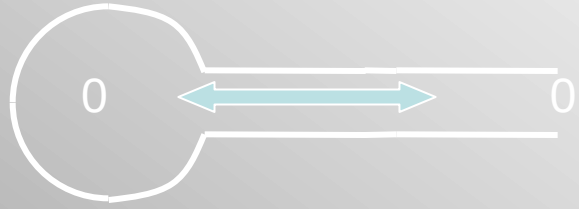
Minute Ventilation (V_E): preserved

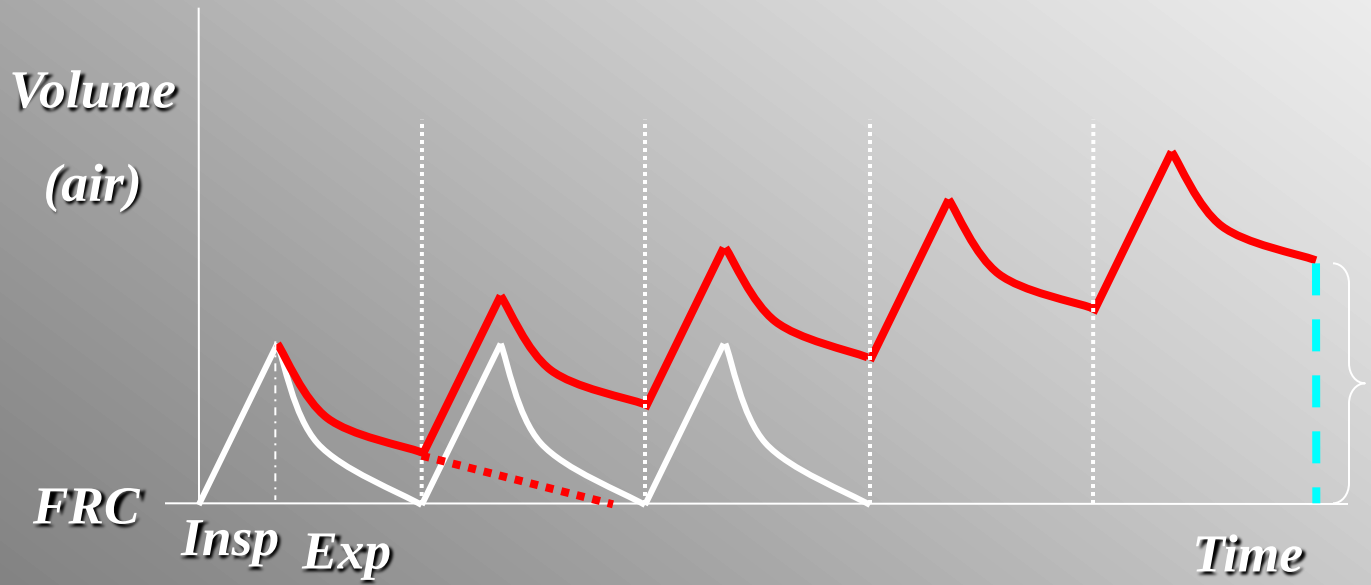
but useless

→ Respiratory Acidosis

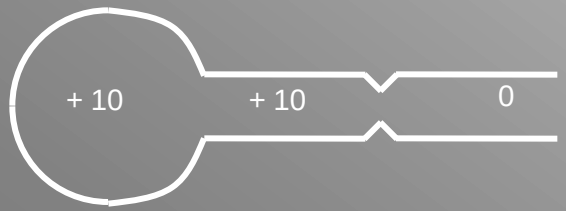

Respiratory load
Pmus = VT ERS + V' · Rtot + PEEPi

Intrinsic PEEP (PEEPi)





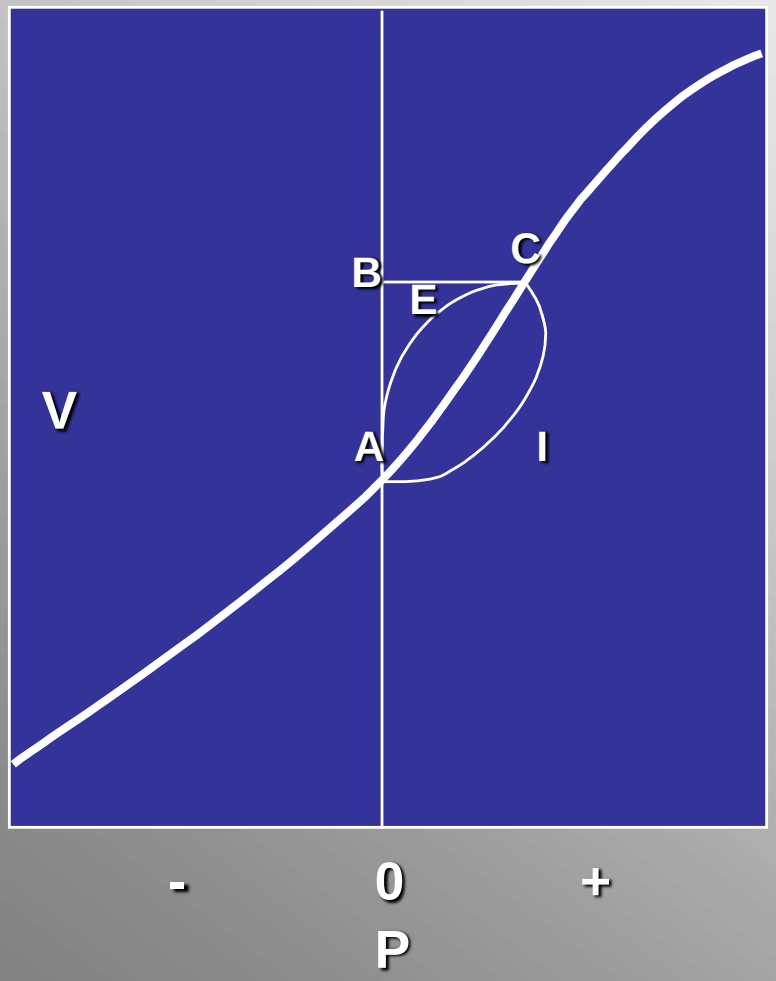
Trapped Volume (↑ FRC)

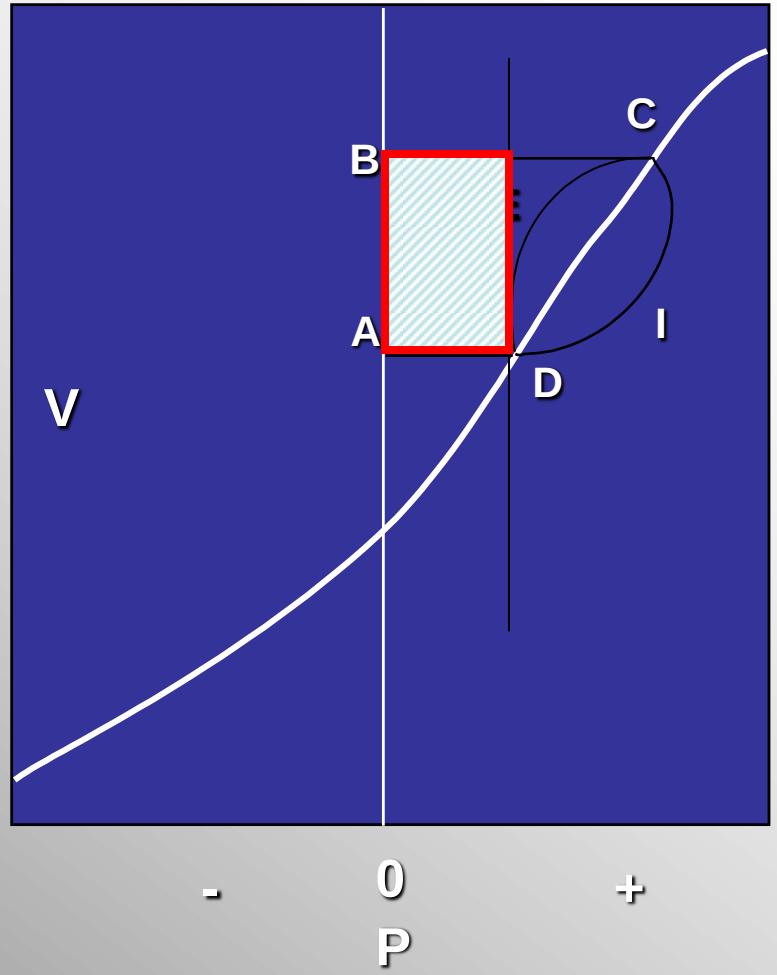


PEEP i

Courtesy of Canetta

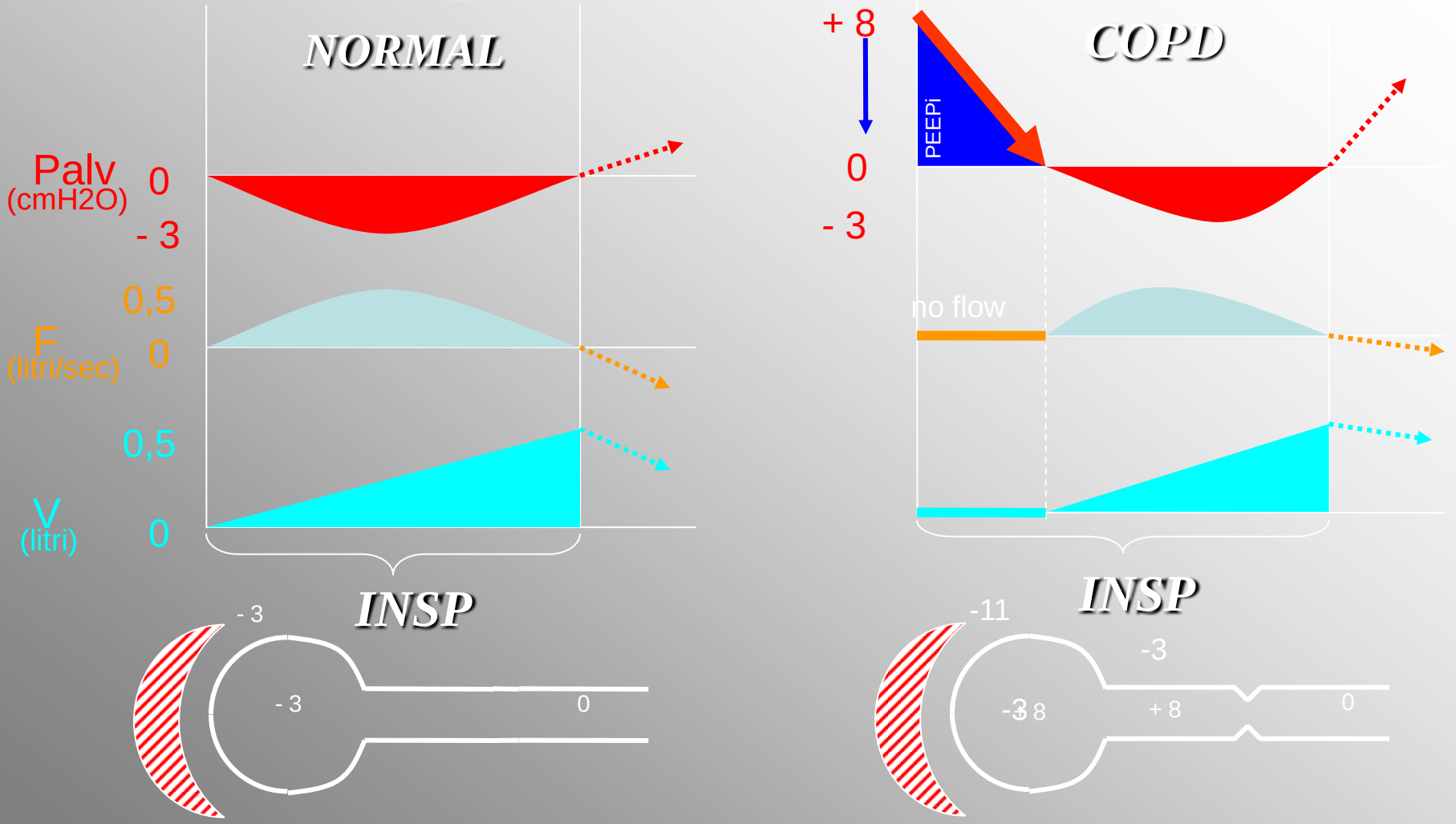
Work of Breathing: influence of PEEPi





adapted from AB Otis, Handbook of Physiology, 1964 (1986)

Inspiration and PEEPi



Intrinsic PEEP acts as a mechanical threshold load to be overcome by in spiratory muscles before inspiratory flow, on every respiratory cycle

Courtesy of Canetta


GRAZIE