Insufficienza respiratoria acuta: CPAP/HFNC/NIV

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S.C. di Pneumologia e UTIR

ASL1 Imperiese

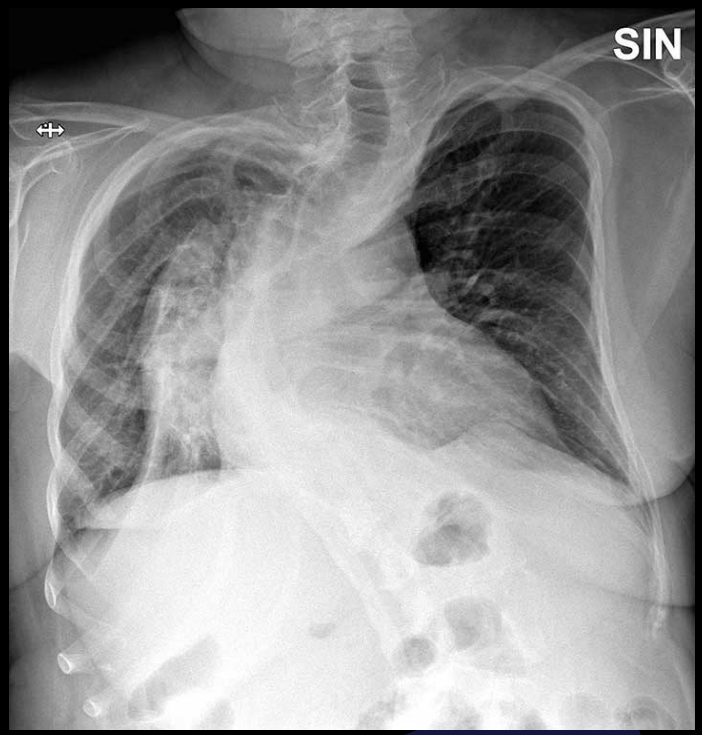
CPAP, HFNC, NIMV = LOVE

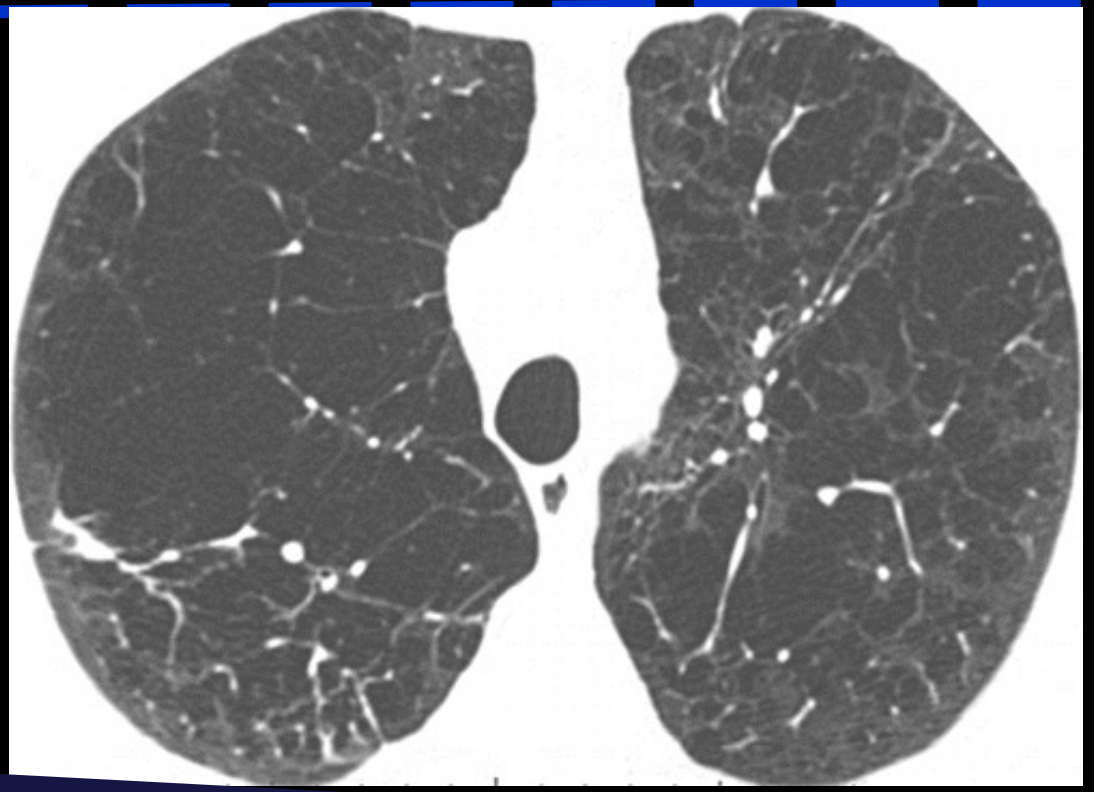
You say love is just a four letter word.

— Bob Dylan —

Acidosi respiratoria

Cause di Ipercapnia





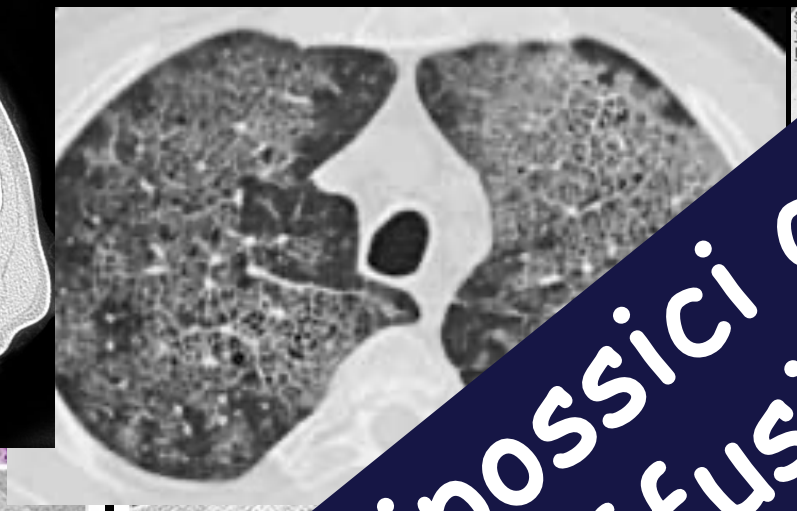
KSC: Bassa compliance asimmetrica

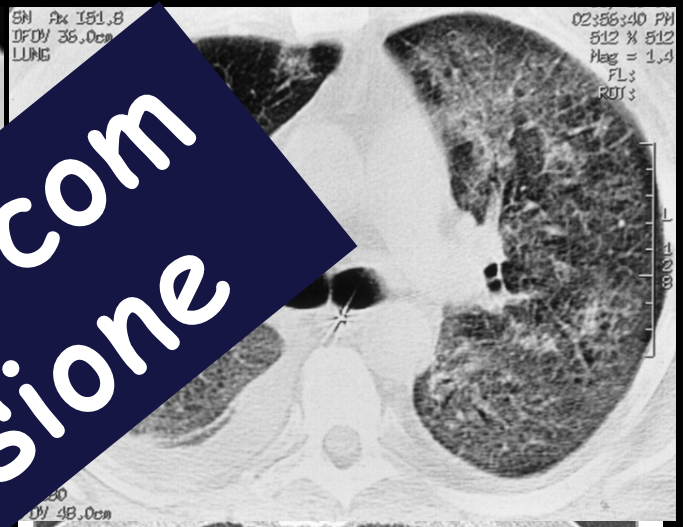
COPD: alta compliance, alta resistemnze

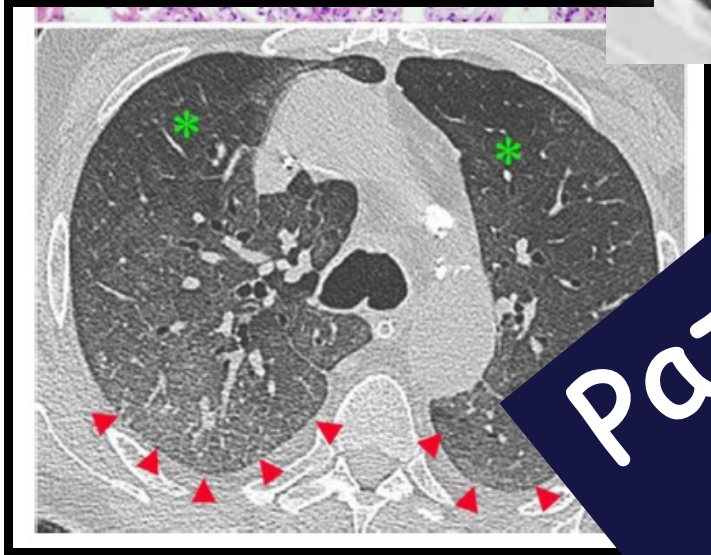
Acidosi respiratoria

SLA: altaa compliance +secrezioni

I problemi della ventilazione 2

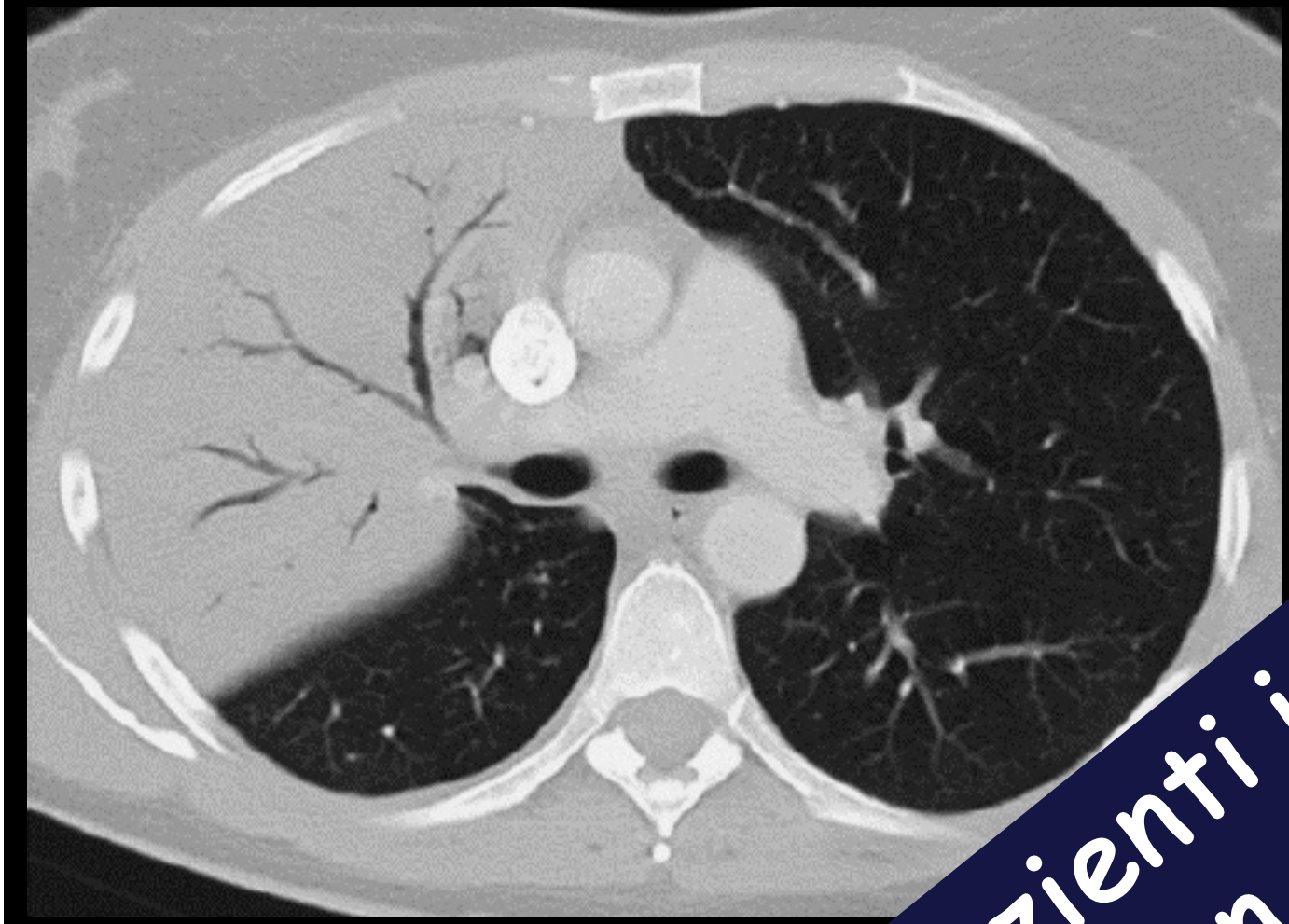






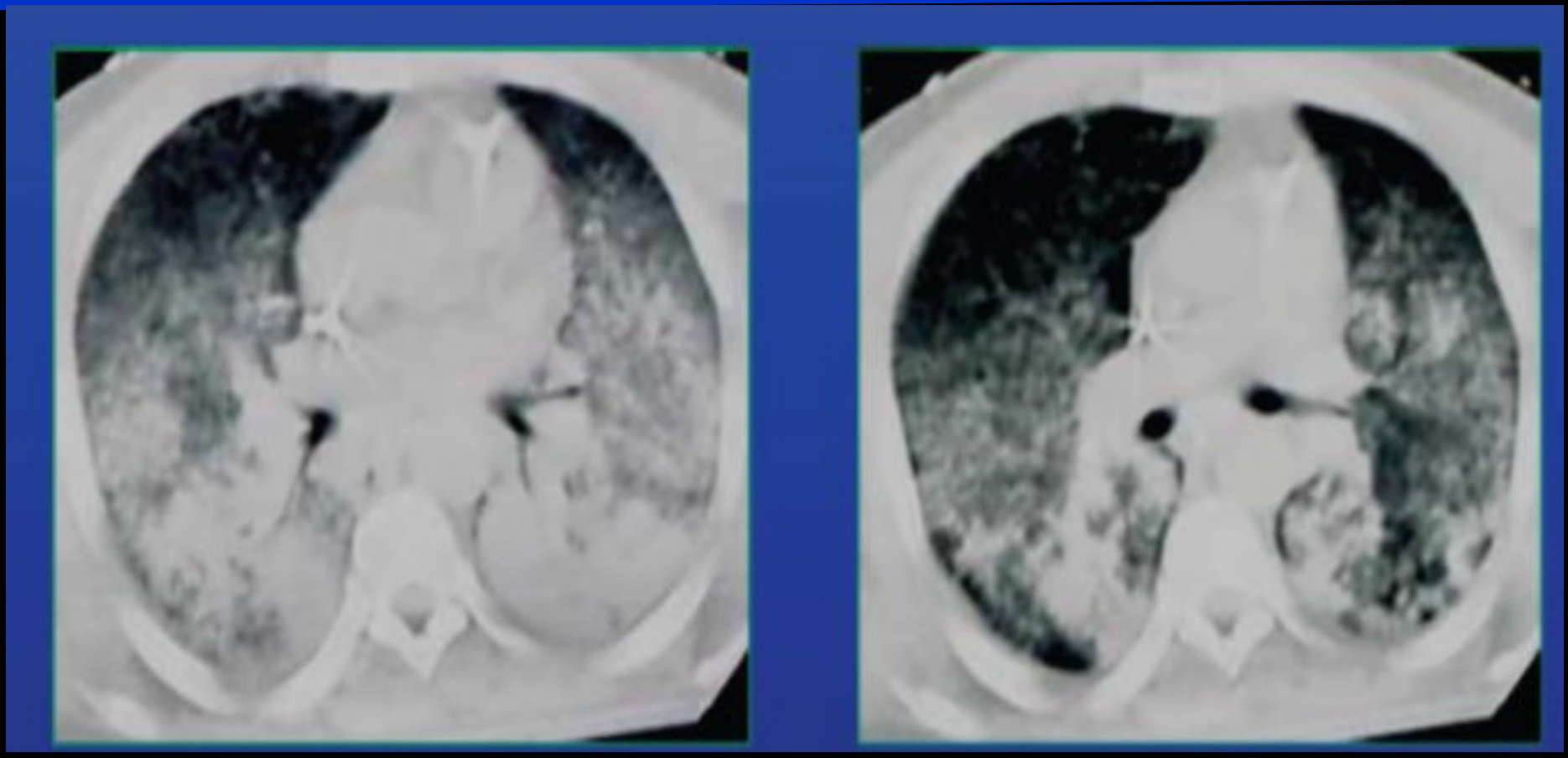
Pazienti ipossici con ridotta diffusione

I problemi della ventilazione 2



Pazienti ipossici con shunt

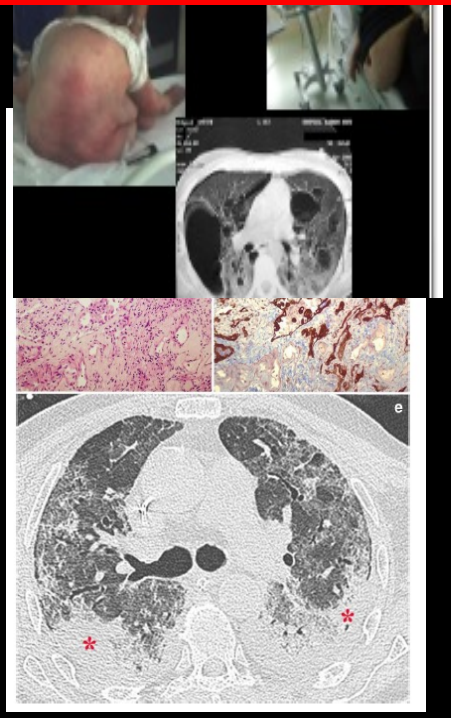
I problemi della ventilazione 2

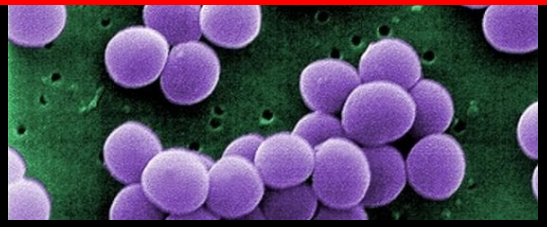


Pazienti ipossici con basso V/Q

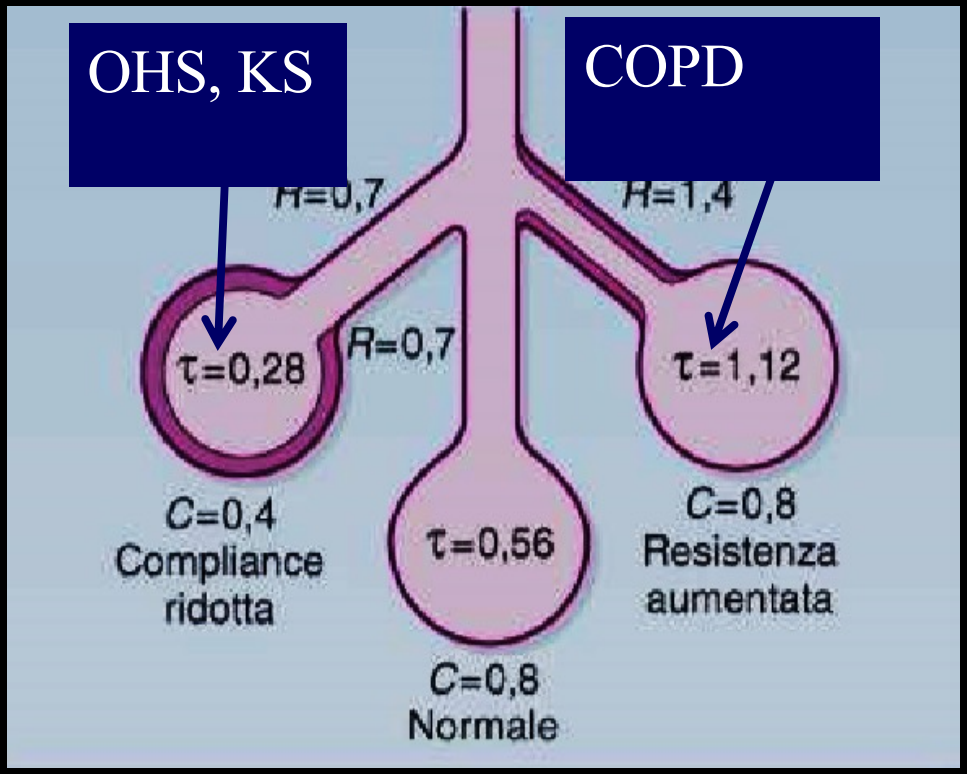
Usiamo lo stesso antibiotico?

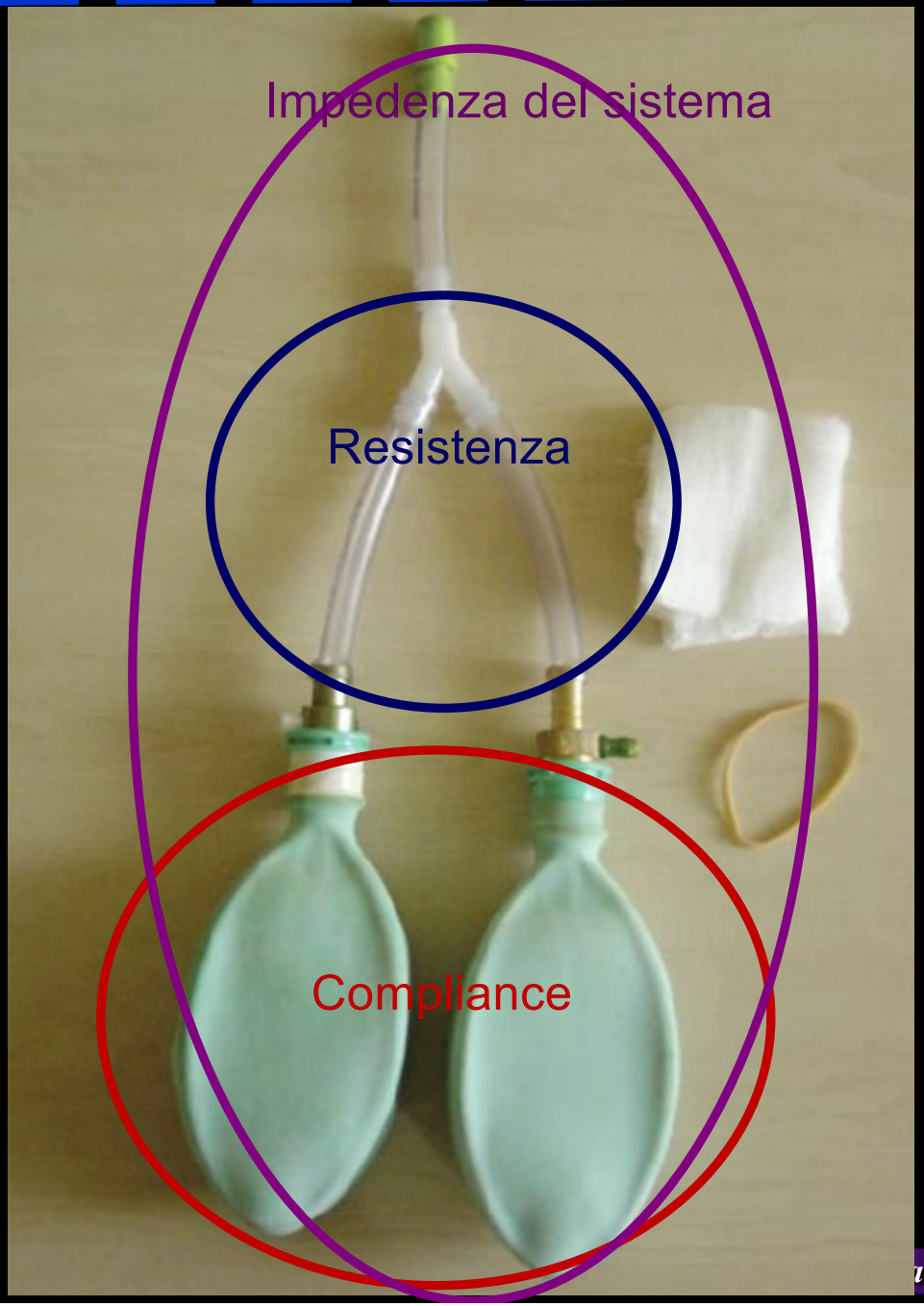
Si ventilano allo stesso modo?





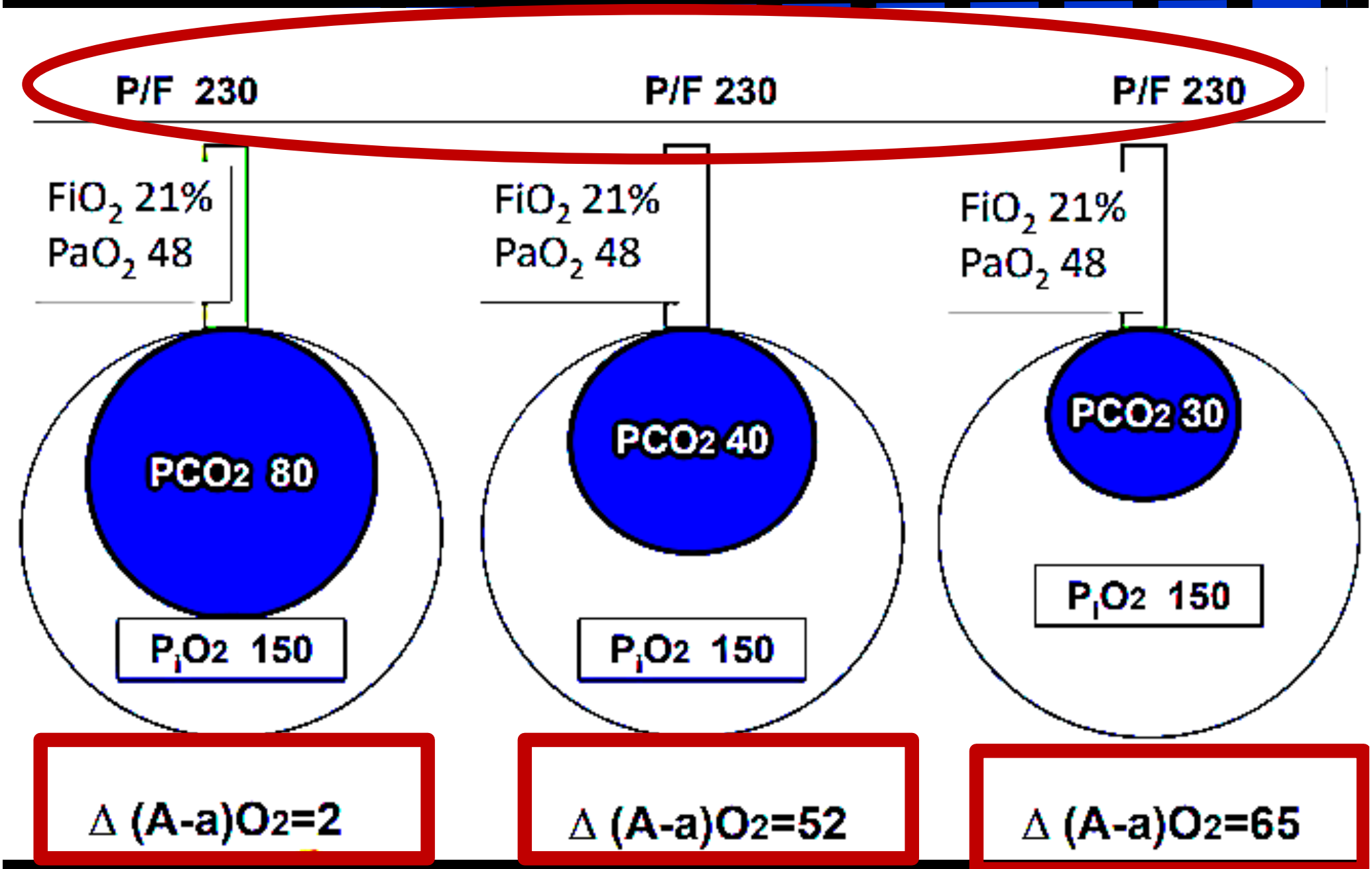
Relazioni tra Compliance, Raw e ciclaggio





Il vero P/F….!

Occhio al P/F: da solo ti frega!



PaO_2 standard

PaO_2 standard:

PaO_2 corretta per il grado di iperventilazione:

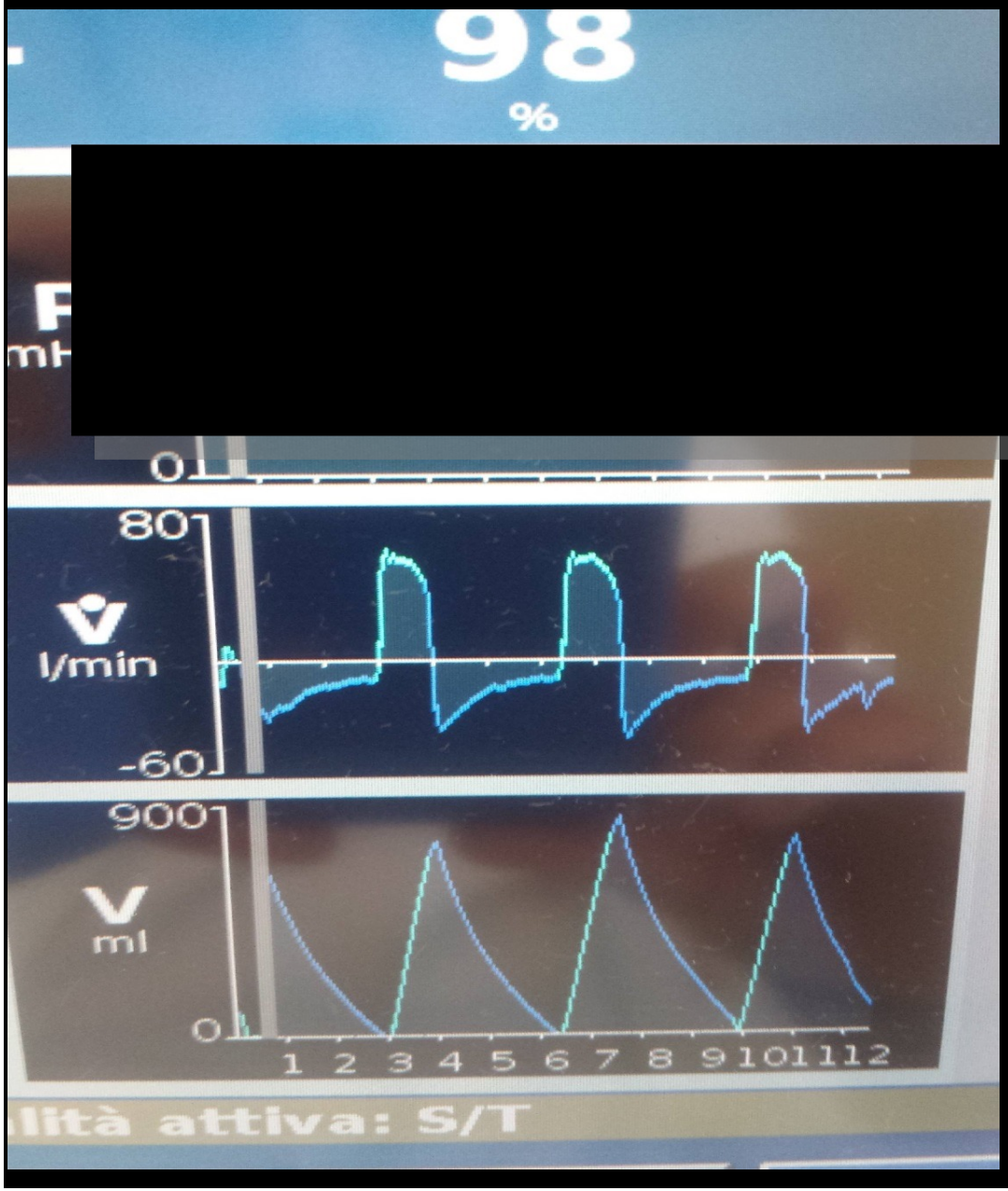
EGA:

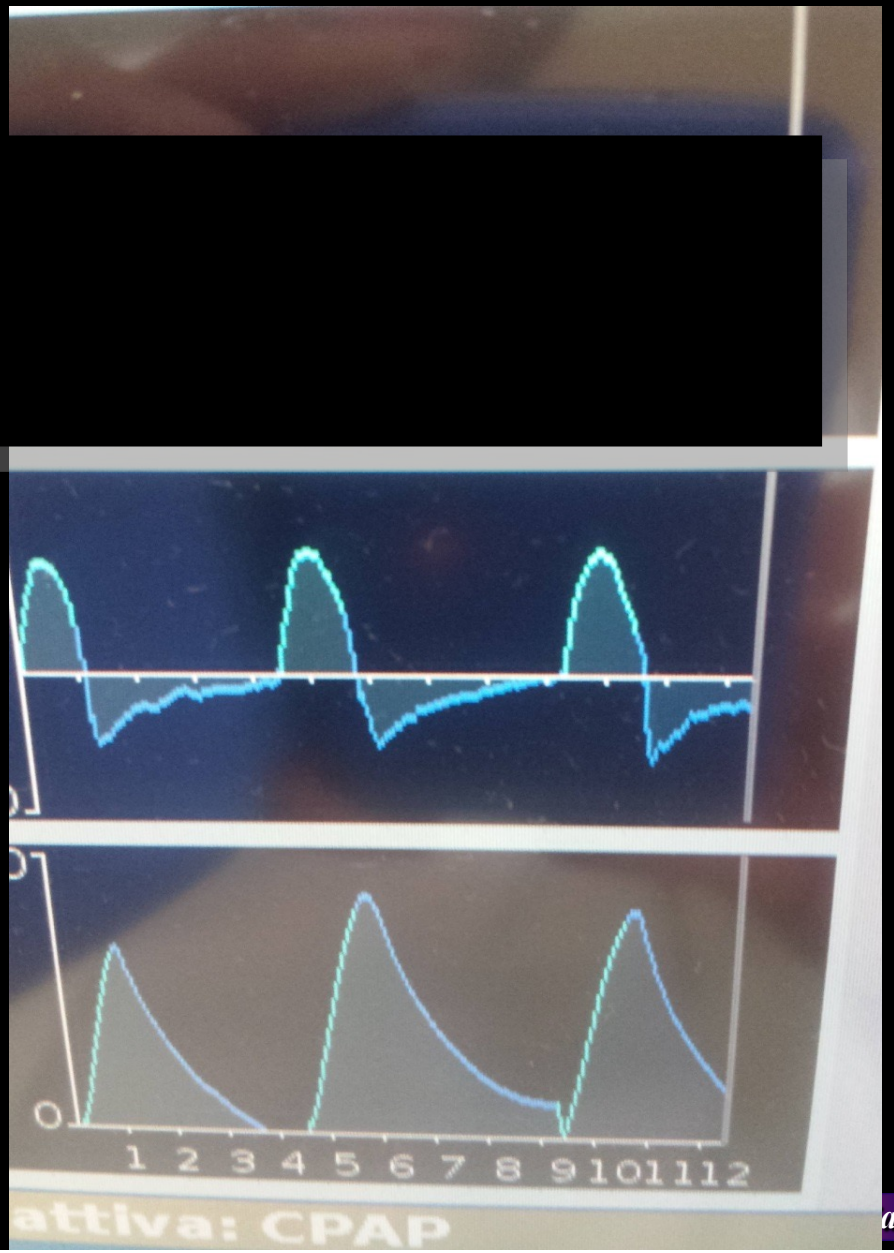
PaO2 64, PaCO2 29, Sat% 93, pH 7,49

PaO2 standard=

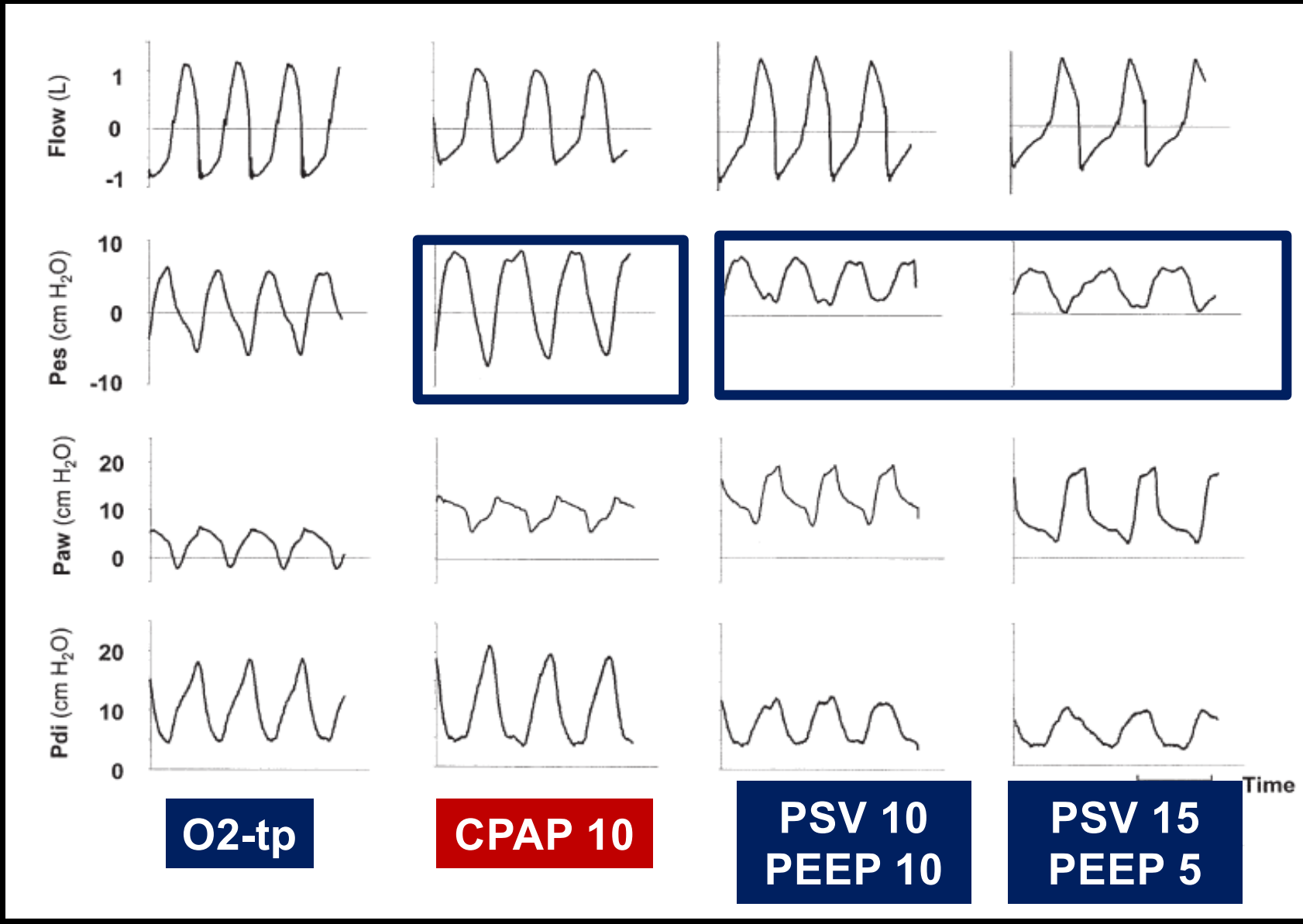
(1,66 x 29) +64 - 66,4= 45,7

Chi fa cosa?


98
%
80
l/min
-60
900
V
ml
0
1 2 3 4 5 6 7 8 9 10 11 12
lità attiva: S/T


0
1 2 3 4 5 6 7 8 9 10 11 12
attiva: CPAP

PSV vs CPAP


Flow (L)
1
0
-1
Pes (cm H_2O)
10
0
-10
Paw (cm H_2O)
20
10
0
Pdi (cm H_2O)
20
10
0
Time
O2-tp
CPAP 10
PSV 10
PEEP 10
PSV 15
PEEP 5

Cosa hanno in comune?

OHS

SLA

BPCO

Cifoscoliosi

SMA 2

Miopatia mitocondriale

Respiro rapido e superficiale

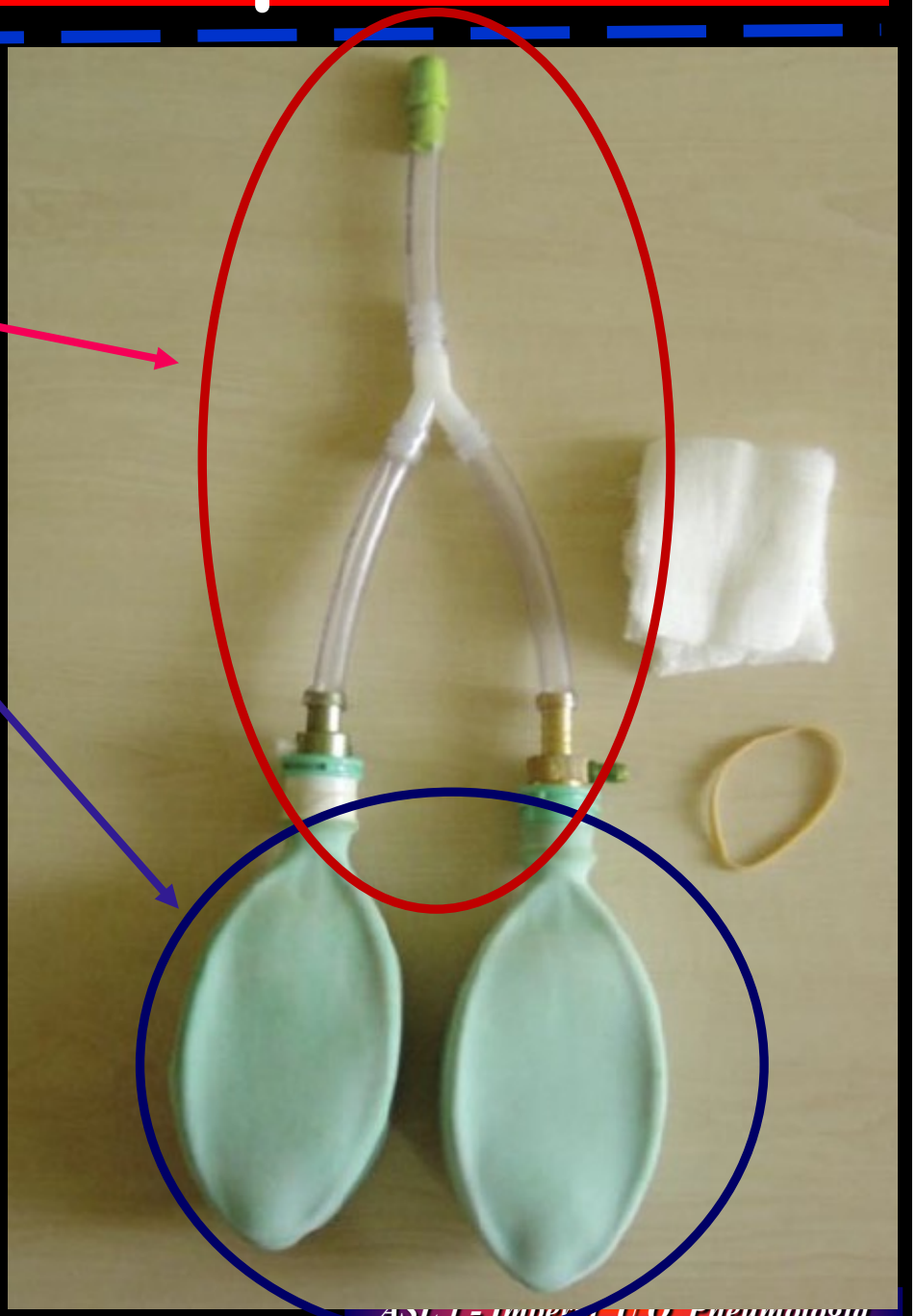
Volume corrente:

Volume spazio morto +

Volume alveolare

Spazio morto: 150 ml

in adulto standard



Respiro rapido e superficiale

Vt 300, FR 30, Ve = 9 l/min

Nel paziente ipercapnico si deve incrementare il Vt e ridurre la FR

Vt 600, FR 15, Ve = 9 l/min

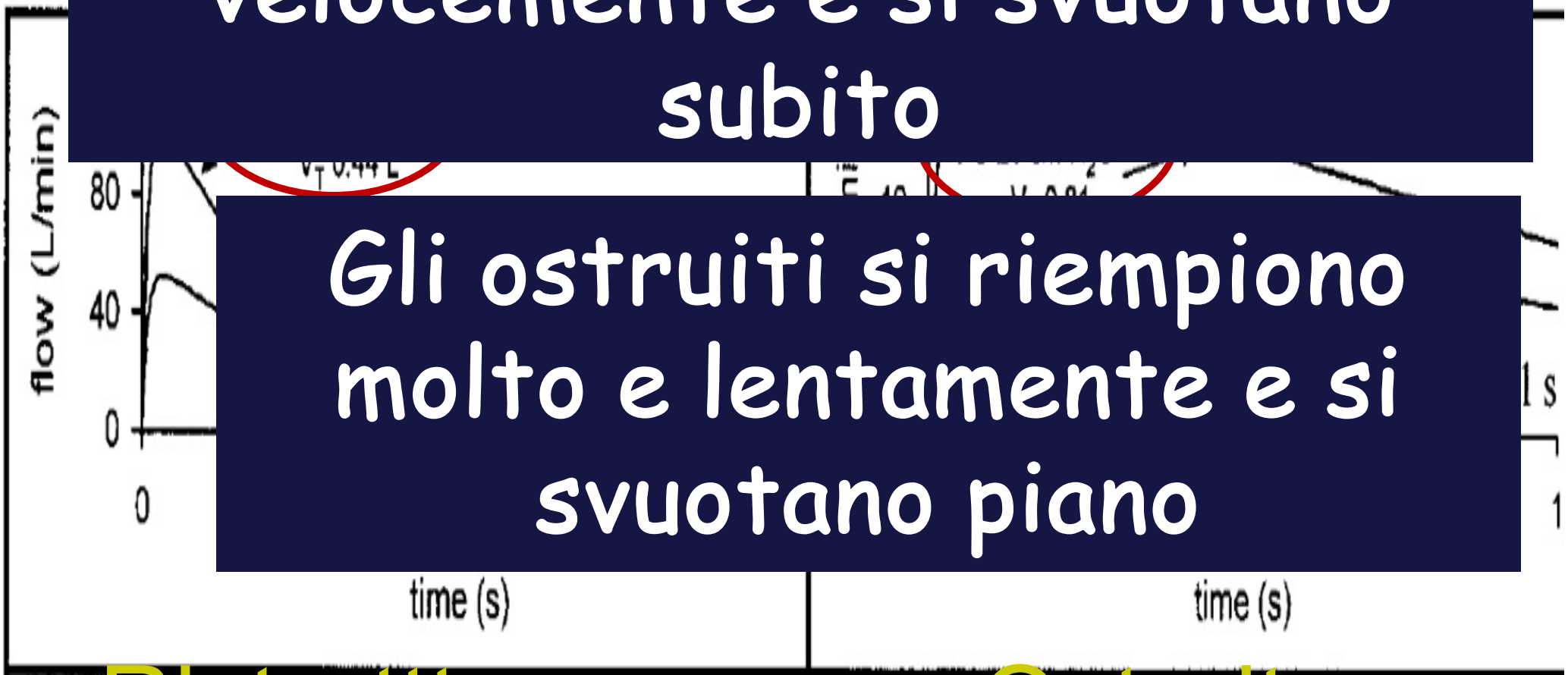
- VA = 9 – (Vd x FR) =

= 9 x (0,150 x 15) = 6,75

Come variano i volumi?

I ristretti si riempiono poco e velocemente e si svuotano subito

Gli ostruiti si riempiono molto e lentamente e si svuotano piano



Ristrettto

Ostruito

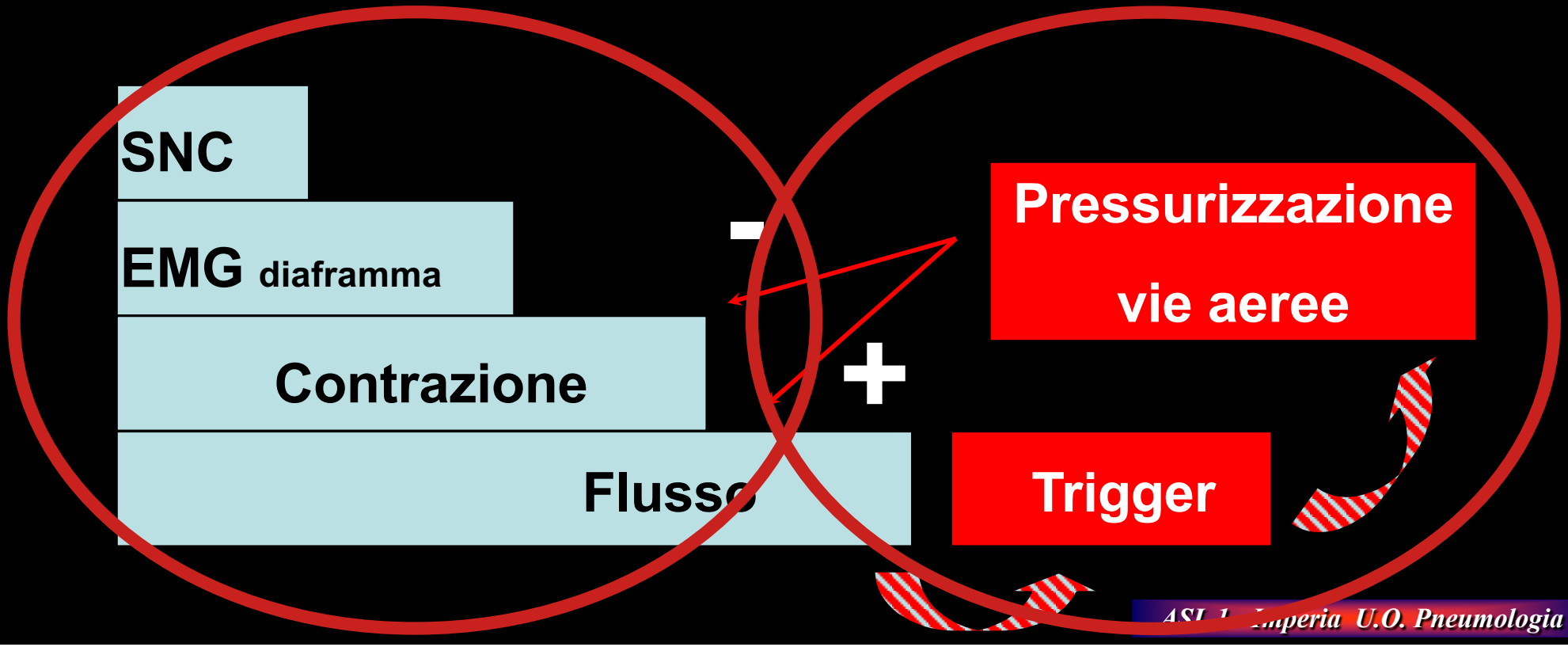
Tempo neurale

Assessment of Neural Inspiratory Time in

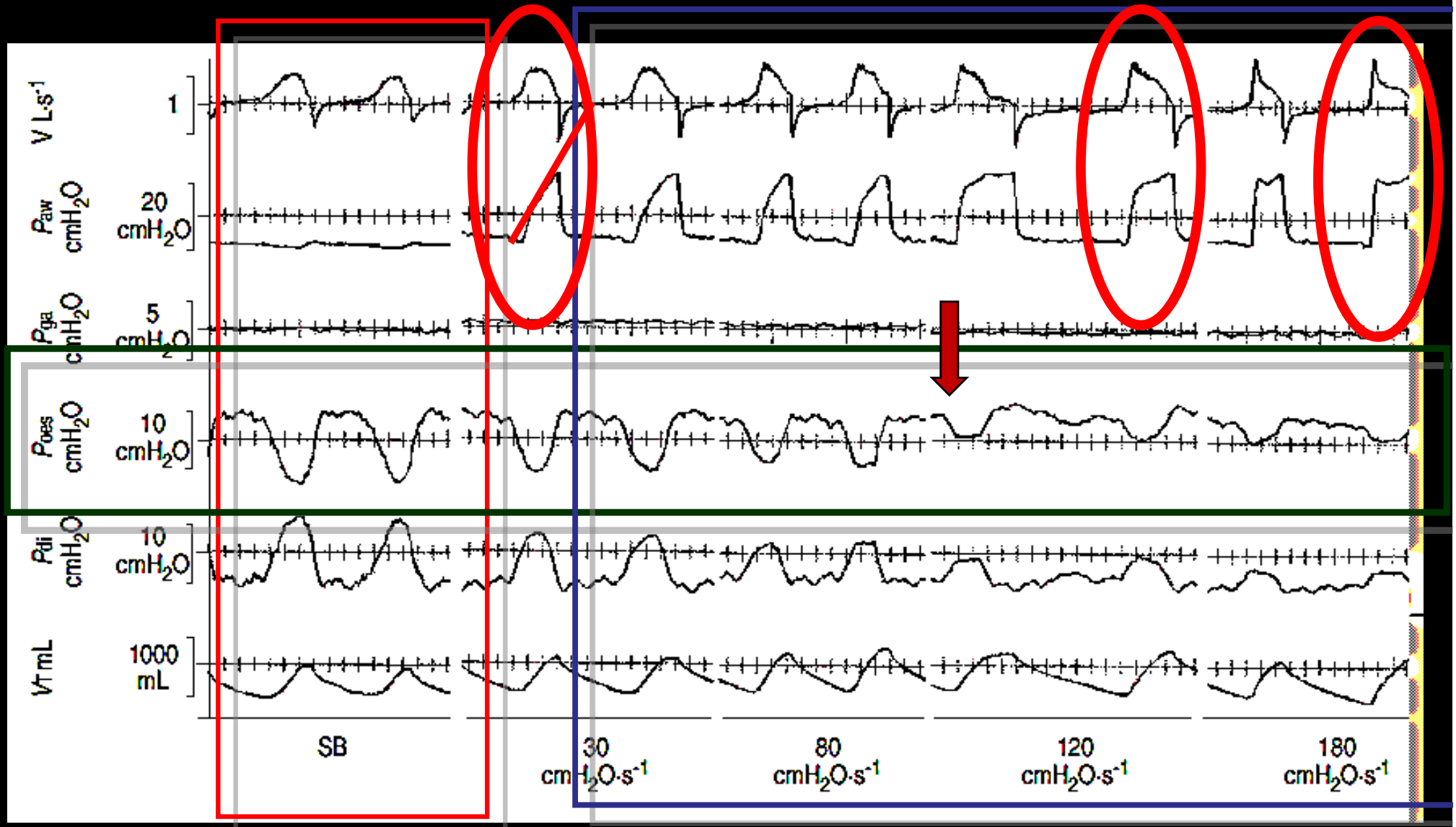
In corso di CPAP non esistono problemi di interazione tra paziente e ventilatore

Chicago Stritch School of Medicine, Hines, Illinois

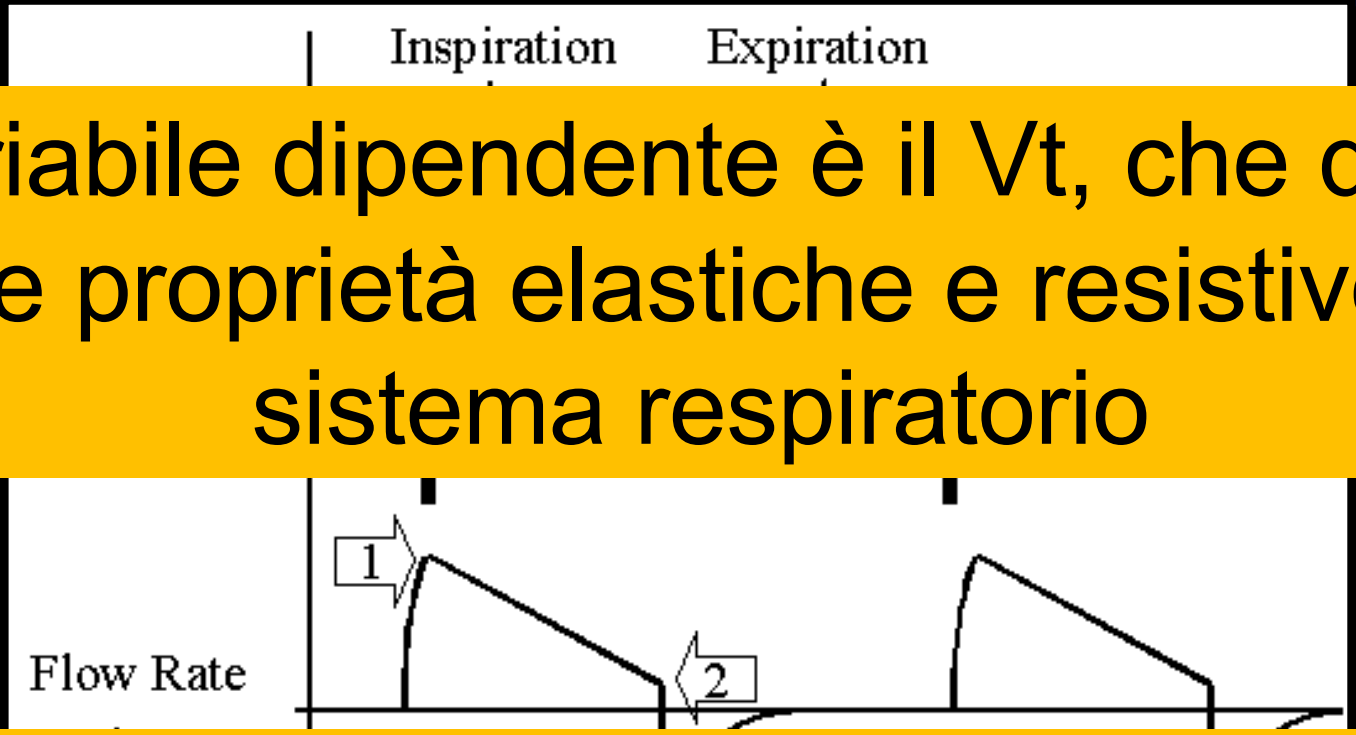
AMERICAN JOURNAL OF RESPIRATORY AND CRITICAL CARE MEDICINE VOL 162 2000



Non basta dare pressione…



Ventilazione Pressometriche



La variabile dipendente è il Vt, che dipende dalle proprietà elastiche e resistive del sistema respiratorio

In modalità pressometrica si può incrementare il Vt aumentando il livello di **pressione inspiratoria** o **la durata** della fase di pressurizzazione

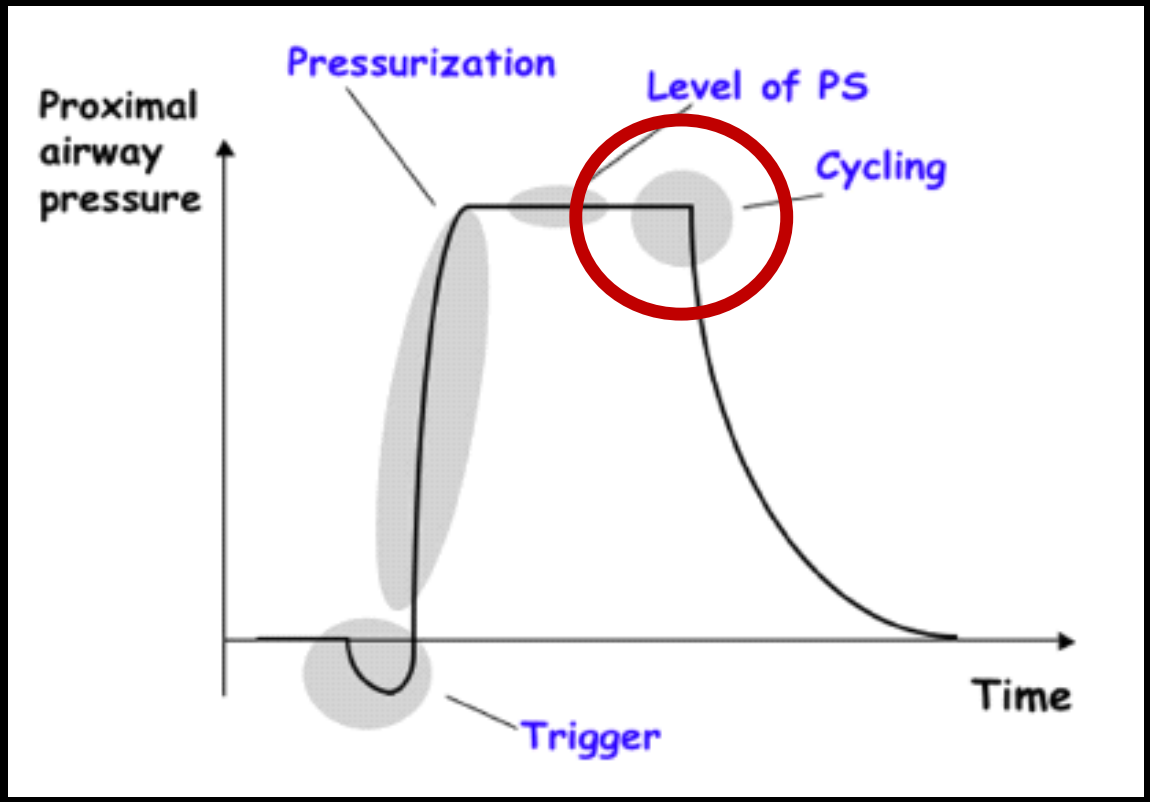
I trigger espiratori

Il ciclaggio Insp. – Esp. può avvenire

- A tempo

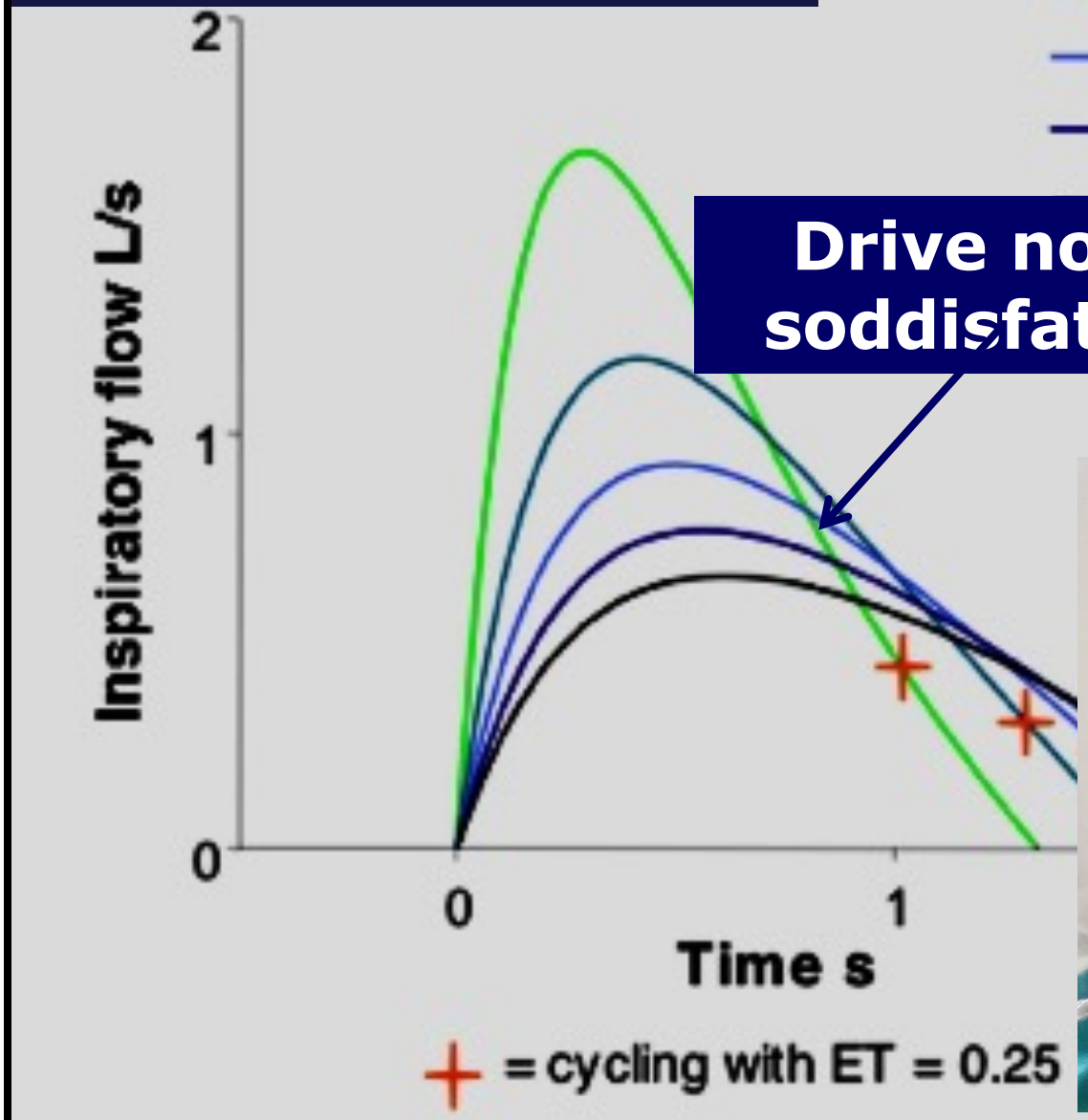
–A flusso

- A volume
- A pressione

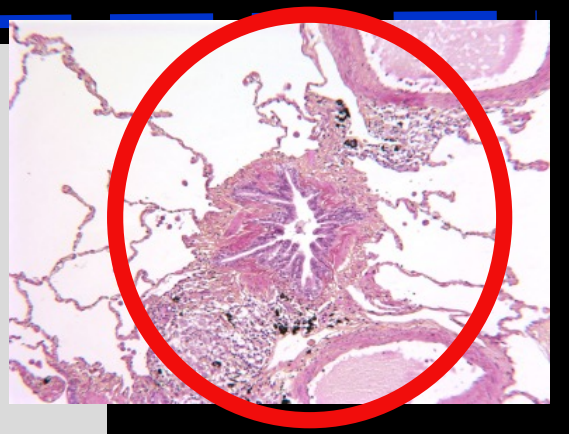


Vt e Raw in BPCO: PSV mode

Vt: Flusso x Ti

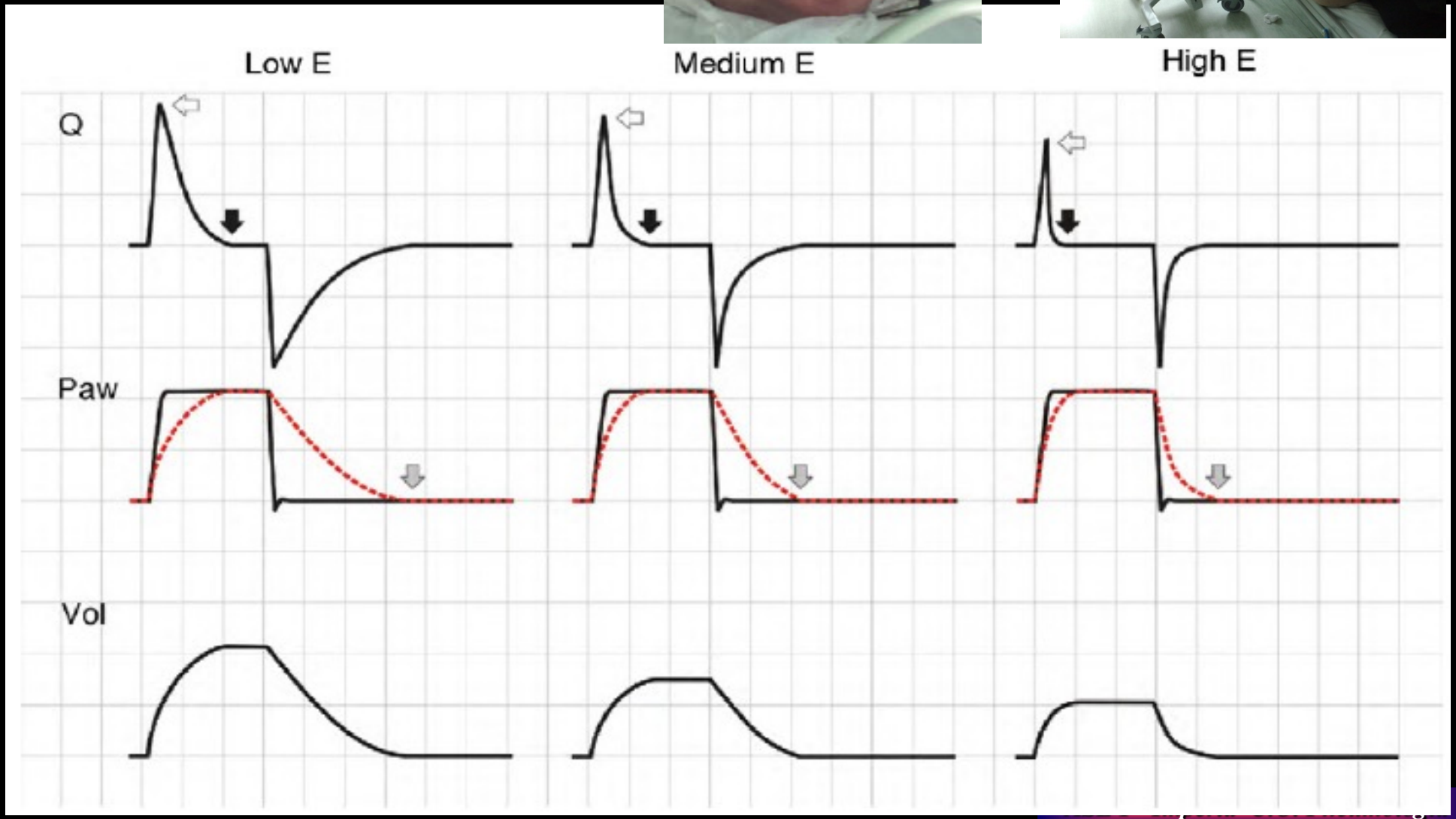


Drive non soddisfatto



Vt in restrittivi parietali: ventil. pressometrica

In PSV si aggiunge anche ciclaggio I/E precoce



Le scelte ragionate

Quale impostazione del ventilatore per quale problema:

<u>Ristretti di parete</u>:

Il Vt target si ottiene con alta pressione e lungo Ti . L'espirazione è rapida

Modalità PCV

Ti 1,2-1,5

PS 15-30

PEEP 4-12

Quanta pressione?
Come allungae Ti?

Le scelte ragionate

Quale impostazione del ventilatore per quale problema:

Ostruttivi:

Il Vt. Target si ottienee con poca pressione e breve Ti. L'espirazione è lenta

Modalità PSV

Ti 0,7-1,1

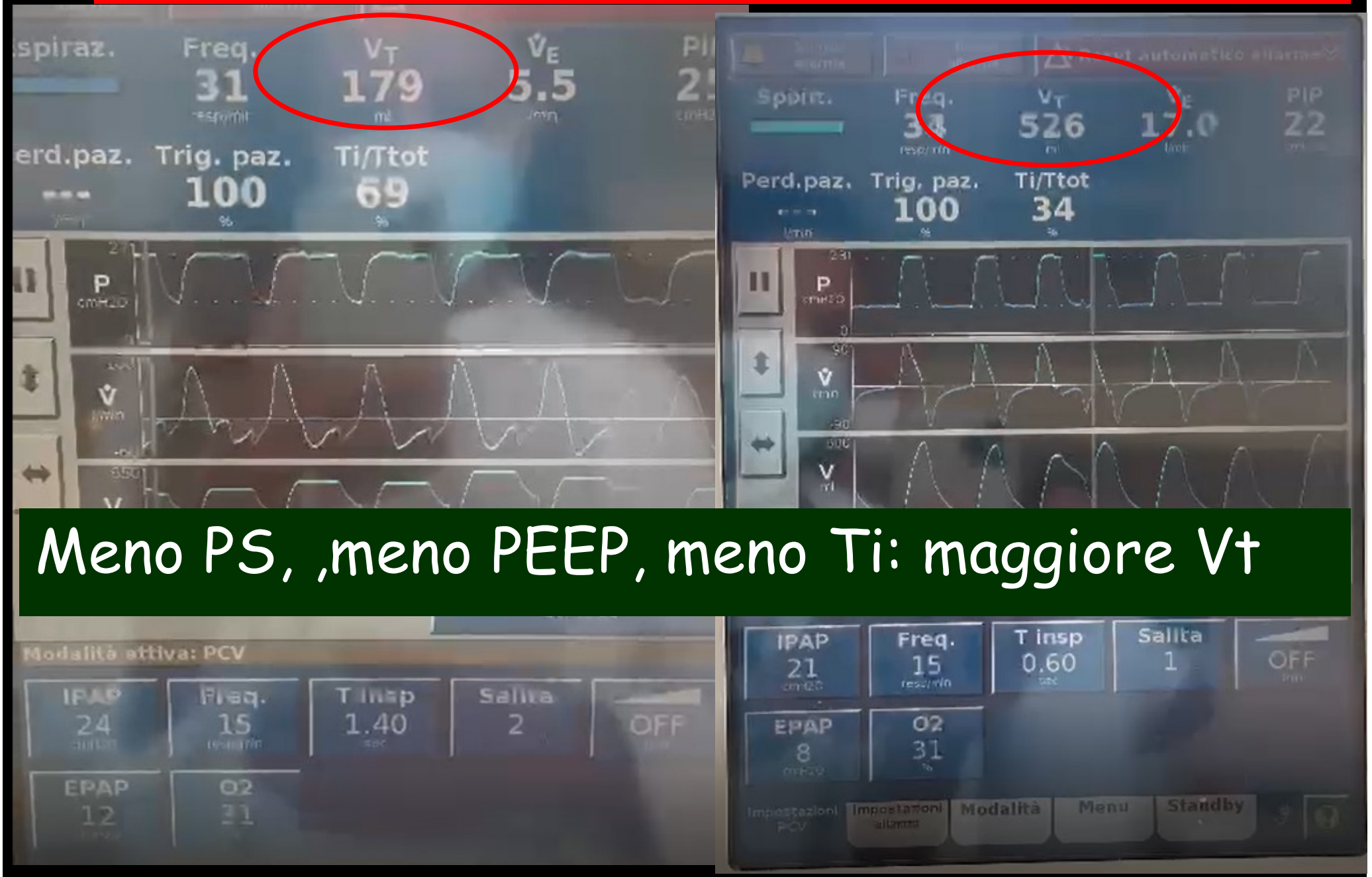
PS 8 - 20

PEEP 5-8

Come accorciare Ti?

Come allungare Te?

Sovrassistenza e sua risoluzione



Meno PS, ,meno PEEP, meno Ti: maggiore Vt

A cosa serve la PEEP/CPAP?

PEEP per consentire Ventilazione:

bassa / da valutarsi

Paziente Ipercapnico

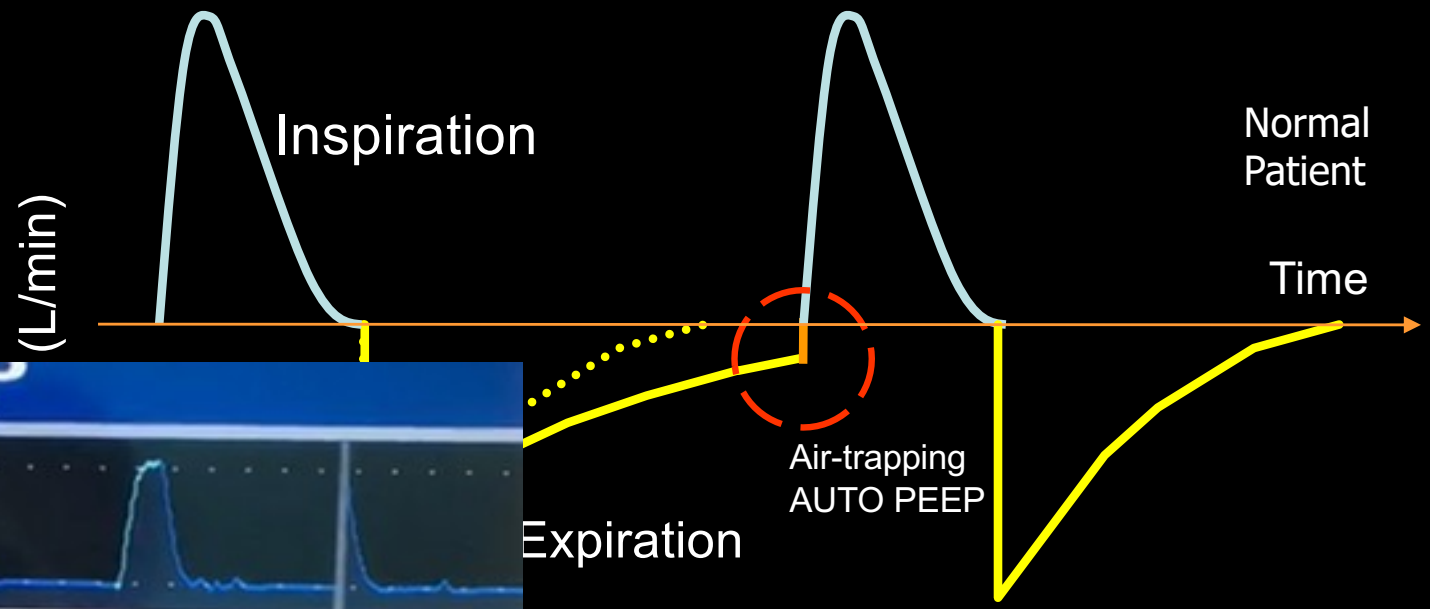
Ridurre PEEP intrinseca

Incrementare CFR

Stabilizzare VAS

Air Trapping…… AUTO PEEP

Probabile iPEEP

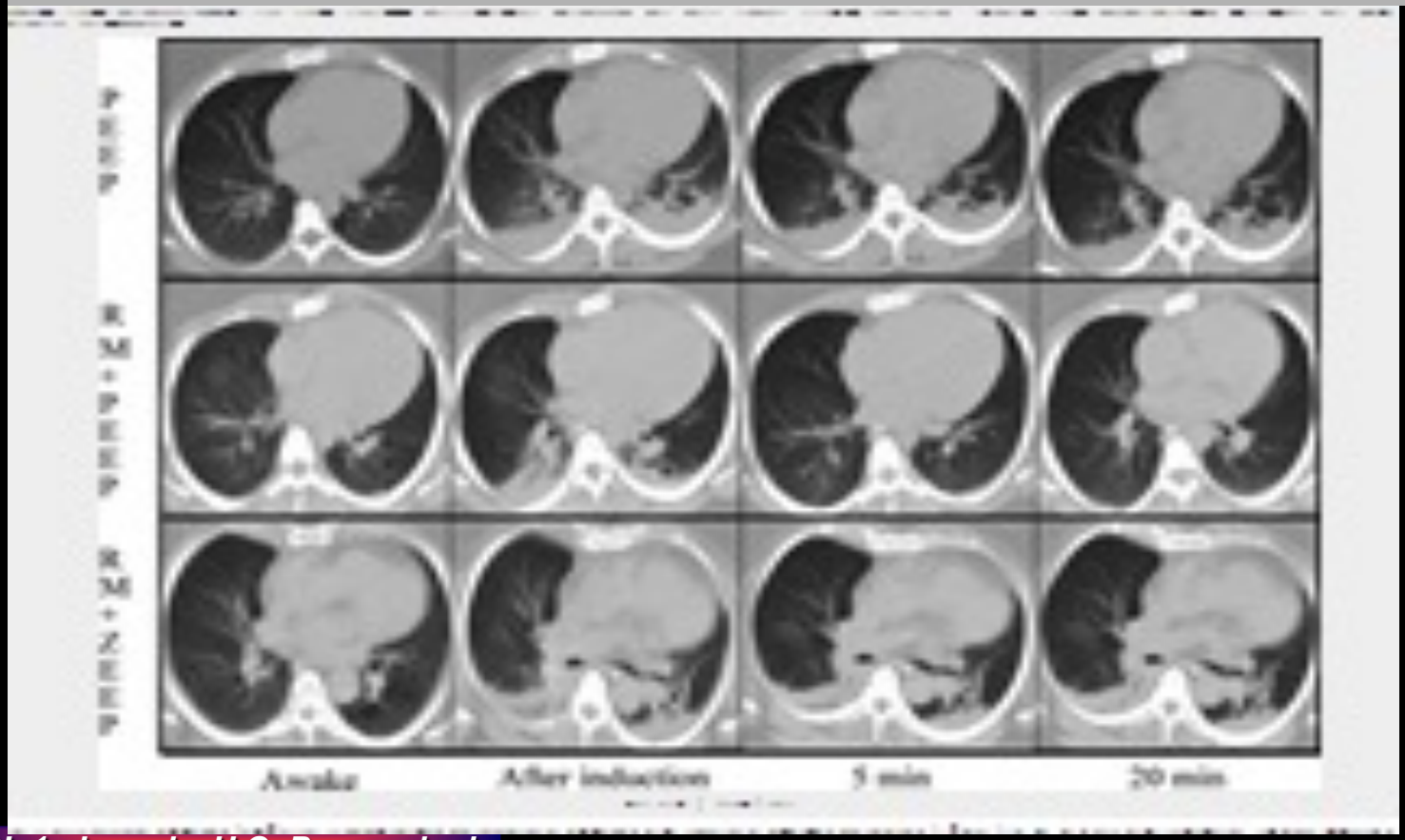


PEEP in obesità

Perioperative Medicine | November 2009

Prevention of Atelectasis in Morbidly Obese Patients during General Anesthesia and Paralysis: A Computerized Tomography Study

Henrik Reinius, M.D.; Lennart Jonsson, M.D.; Sven Gustafsson, M.D., Ph.D.; Magnus Sundbom, M.D., Ph.D.; Olov Duvernoy, M.D., Ph.D.; Paolo Pelosi, M.D., Ph.D.; Göran Hedenstierna, M.D., Ph.D.; Filip Fredén, M.D., Ph.D.

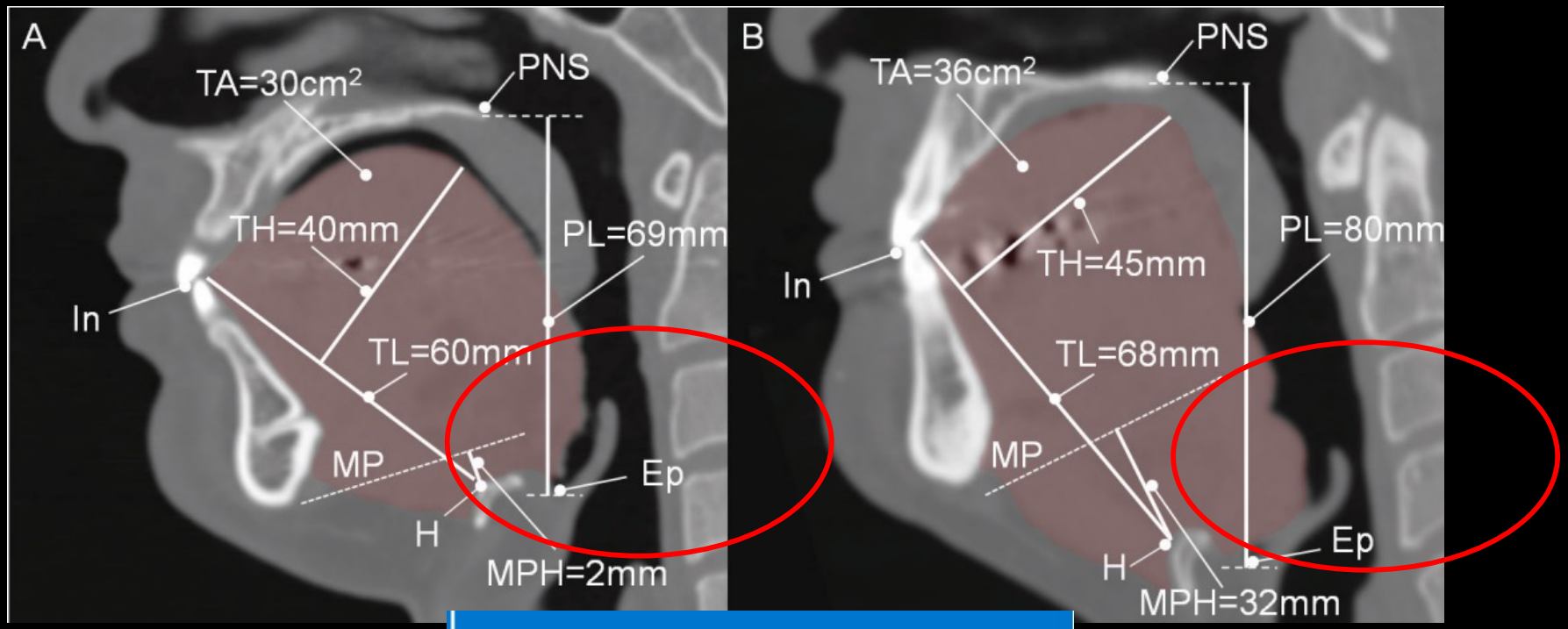


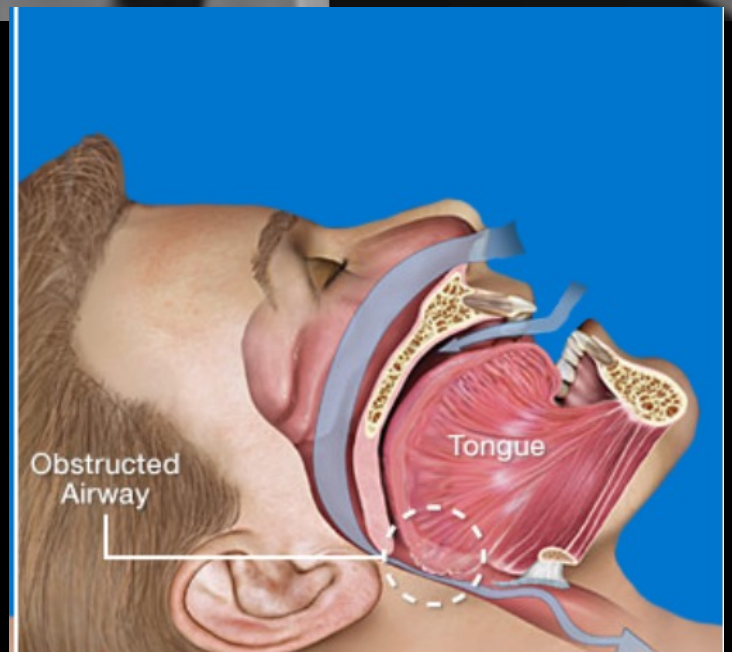
PEEP

PEEP + reclutamento

ZPEEP

Perché la PEEP 3: ostruzione VAS





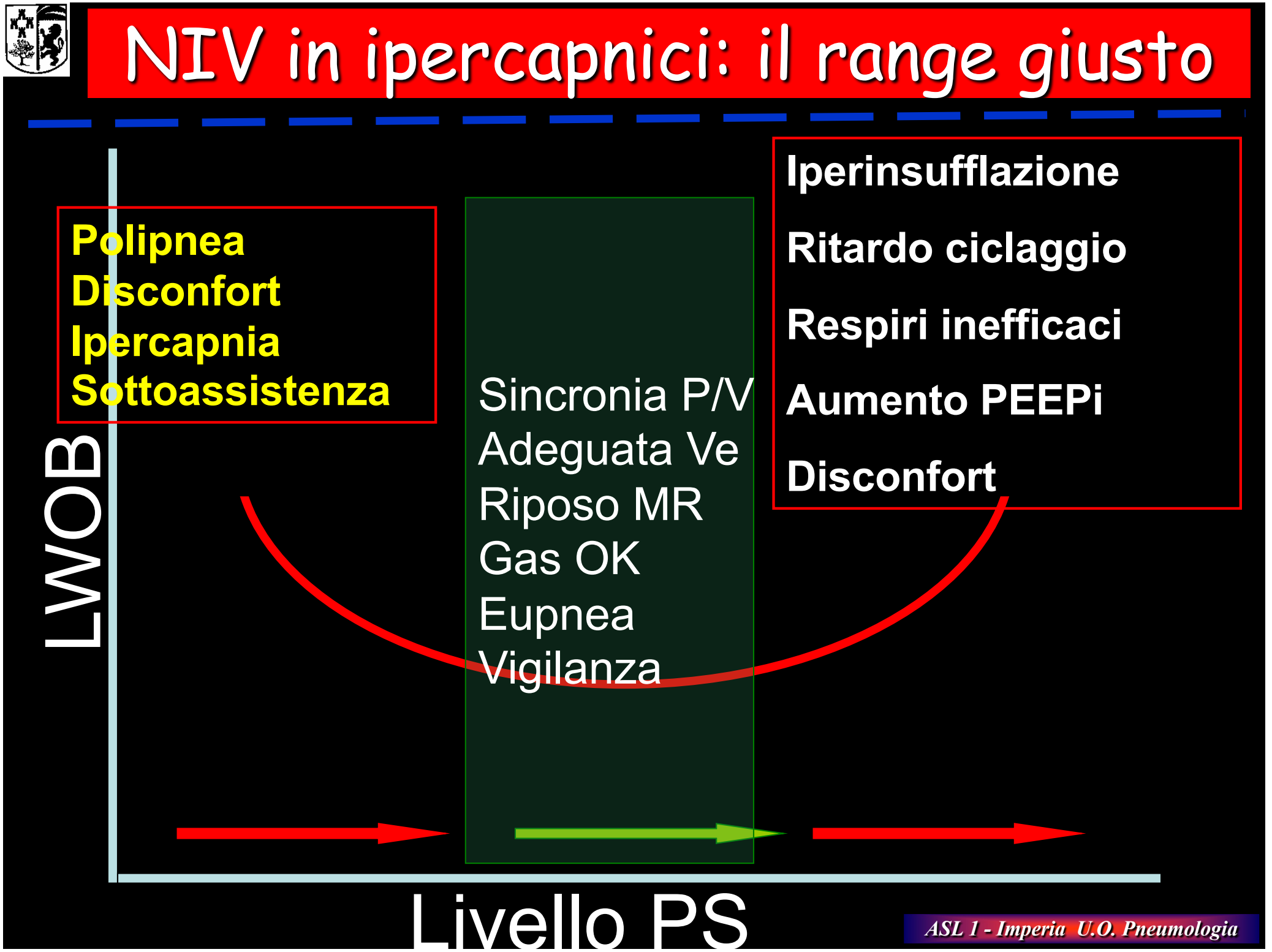
Ostruzione VAS

Interfaccia paziente / ventilatore

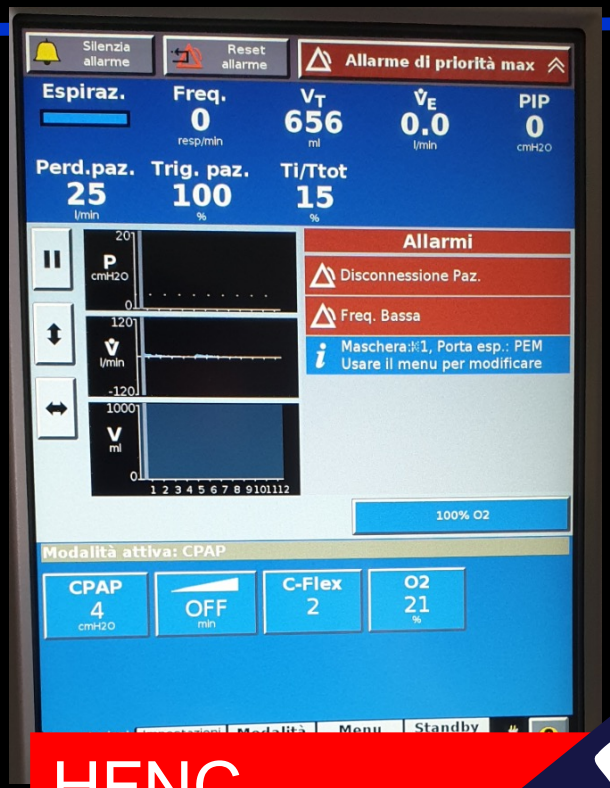
Indicato per CPAP

Indicata per NIV e CPAP

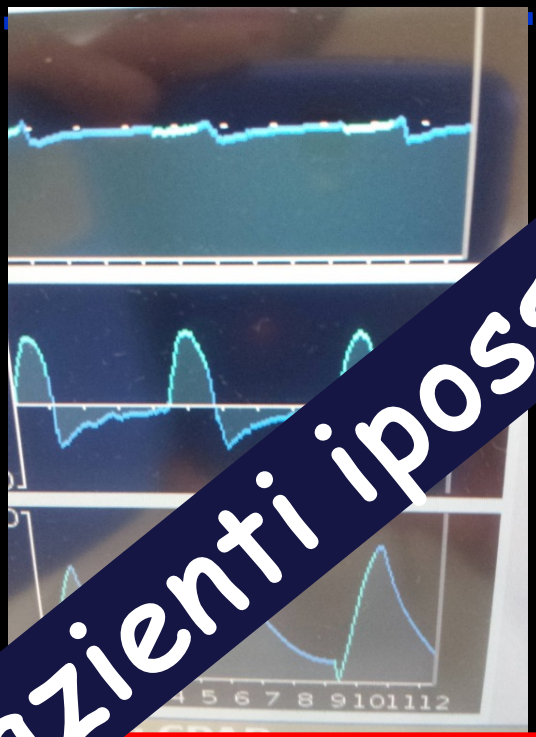
NIV in ipercapnici: il range giusto



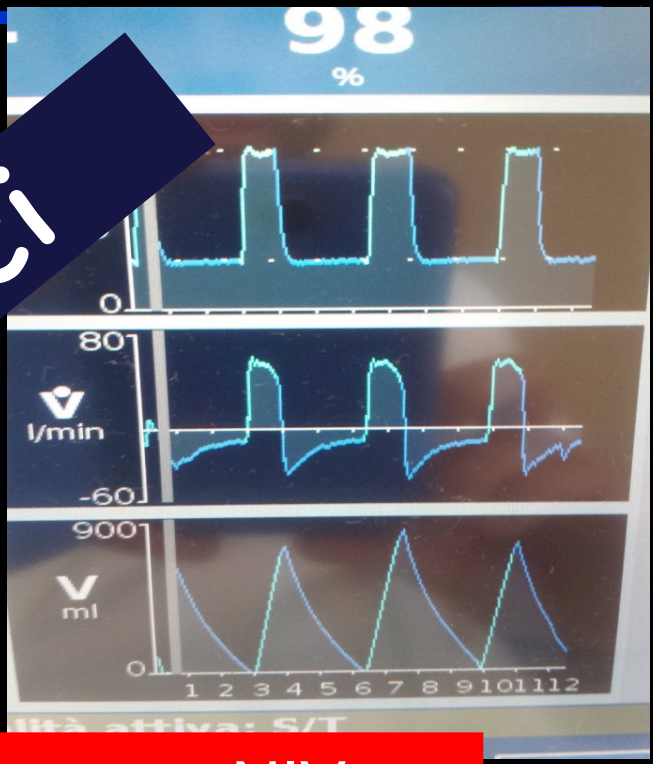
Quale supporto respiratorio?



HFNC



CPAP



NIV

Pazienti ipossici

IMV

1° step

NIV failure:
Come individuare il rischio?

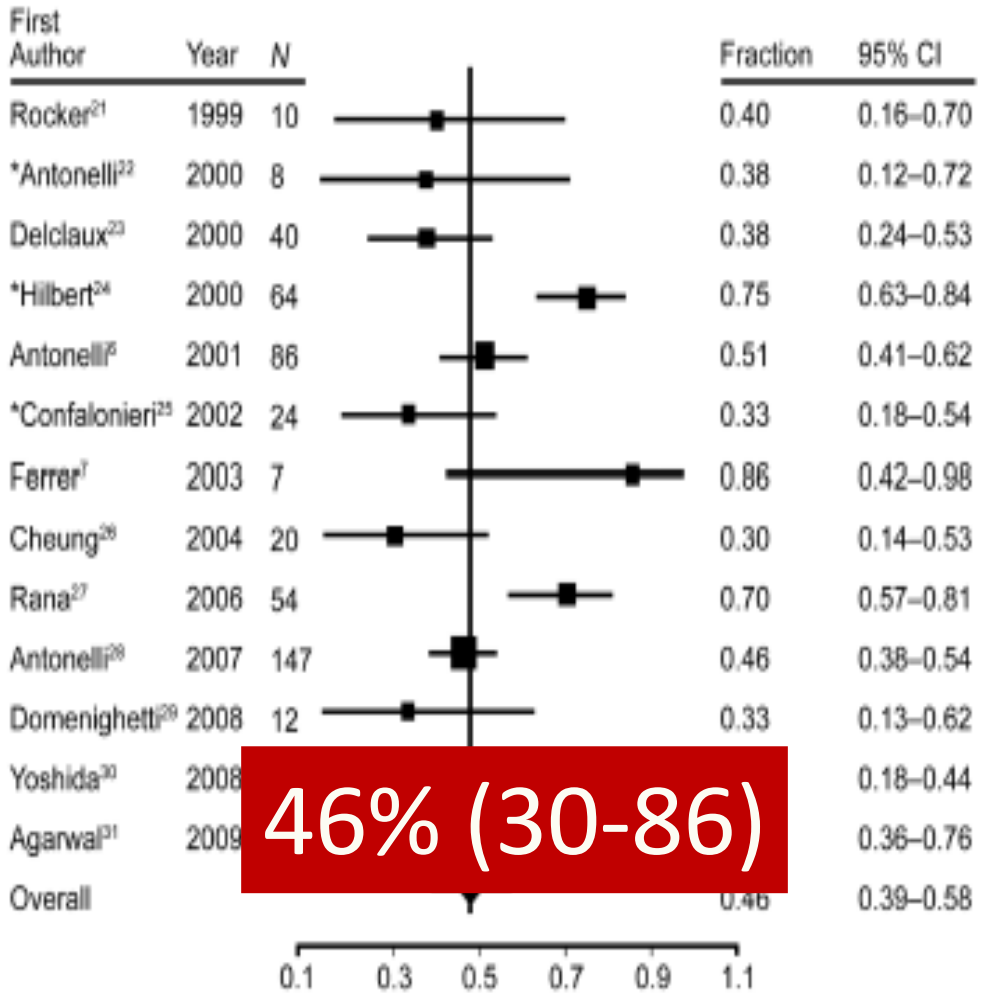
NIV failure in AHRF

Ritesh Agarwal MD DM, Ashutosh N Aggarwal MD DM, and Dheeraj Gupta MD DM

Role of Noninvasive Ventilation in Acute Lung Injury/Acute Respiratory Distress Syndrome: A Proportion Meta-analysis

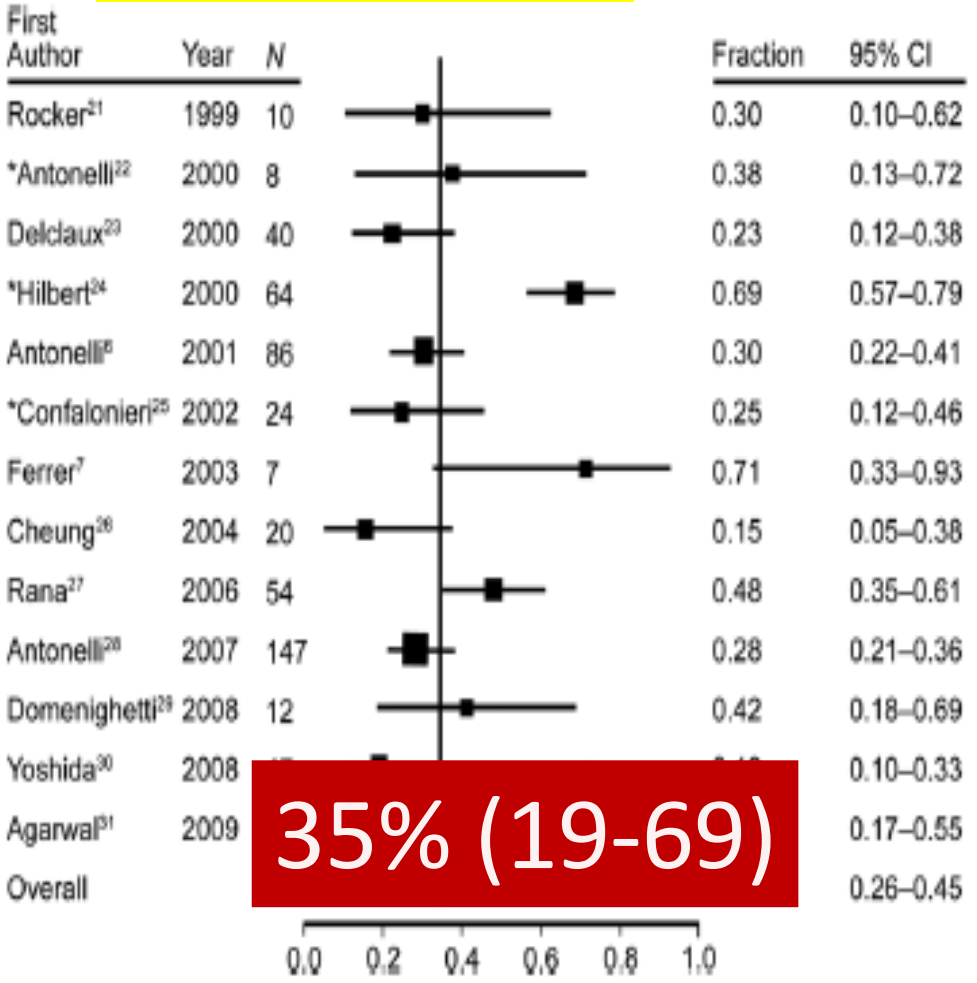
Respir Care 2010;55(12):1653–1660.

INTUBATION RATE



46% (30-86)

MORTALITY RATE



35% (19-69)

NIV failure in ARF: risk score 2017

Assessment of heart rate, acidosis, consciousness, oxygenation, and respiratory rate to predict noninvasive ventilation failure in hypoxemic patients

Jun Duan*, Xiaoli Han, Linfu Bai, Lintong Zhou and Shicong Huang

Intensive Care Med (2017) 43:192–199
DOI 10.1007/s00134-016-4601-3

NIV failure: 215 pts
Pneumonia 48%

NIV sucess: 234 pts
Pneumonia 60%

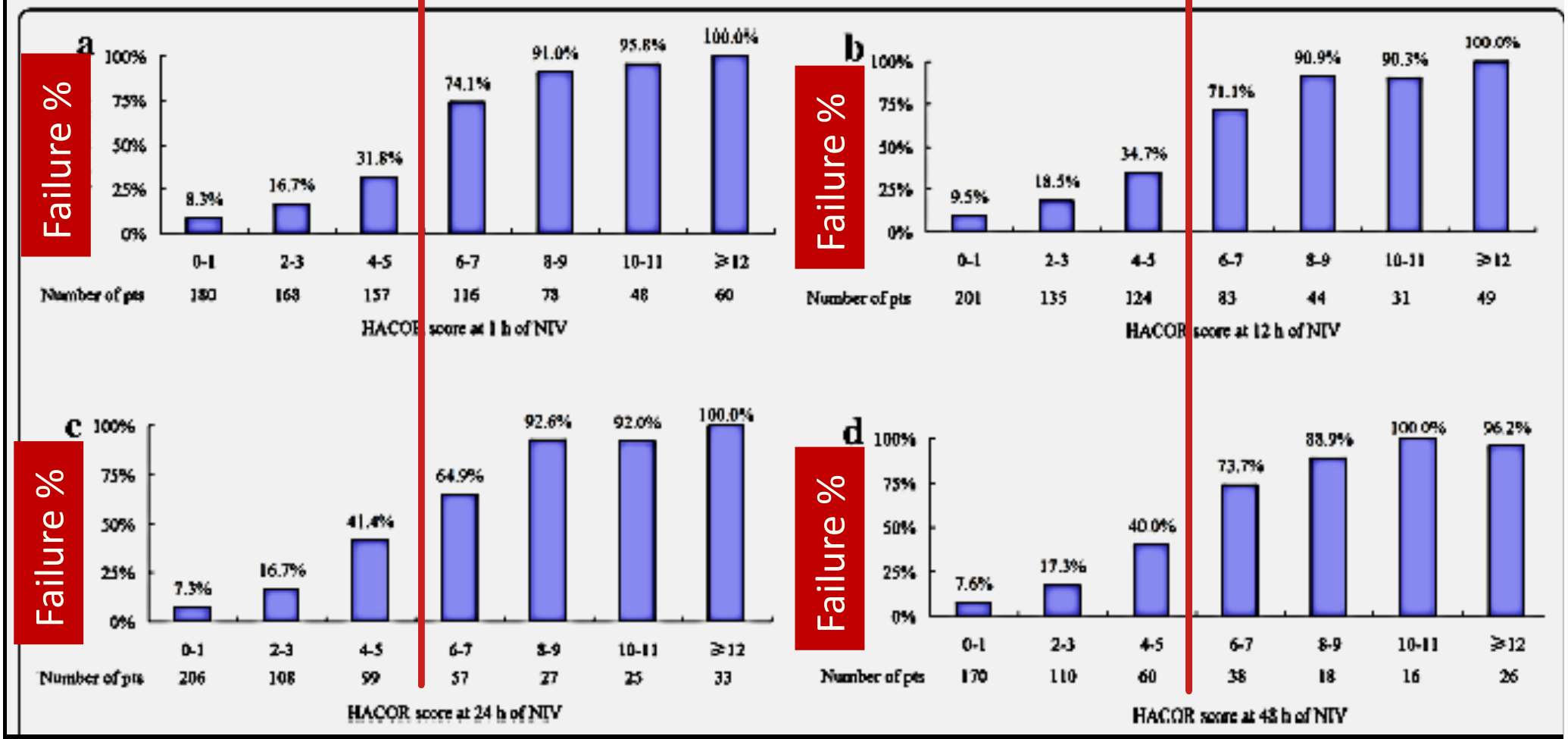
HACOR score

		Category	Points
Freq. Card.	H	≤120	0
		>120	1
pH	A	≥7.35	0
		7.30-7.34	2
		7.25-7.29	3
		<7.25	4
Glasgow	C	15	0
		13-14	2
		11-12	5
		≤10	10
P/F	O	>200	0
		176-200	2
		151-175	3
		126-150	4
		101-125	5
		≤100	6
Feq. Respir.	R	≤30	0
		31-35	1
		36-40	2
		41-45	3
		>45	4

NIV failure in ARF: risk score 2017

Basale

Dopo 12 ore



Dopo 24 ore

Dopo 48 ore

HACOR SCORE >5 : necessità intubazione

NIV failure: Vt elevato 2016

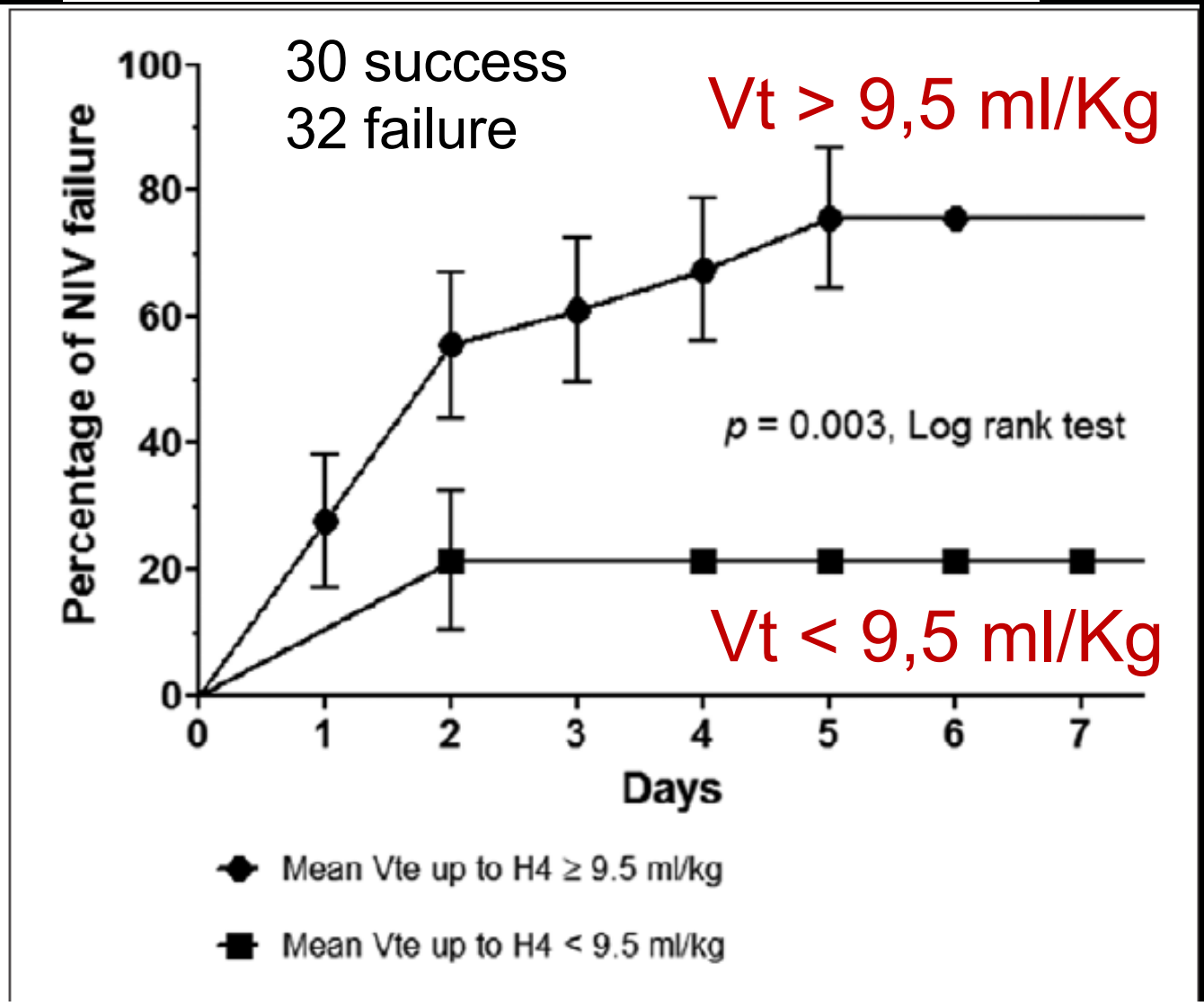
Failure of Noninvasive Ventilation for De Novo Acute Hypoxemic Respiratory Failure: Role of Tidal Volume*

Guillaume Carteaux, MD[1,2,3]; Teresa Millán-Guilarte, MD[4]; Nicolas De Prost, MD, PhD[1,2,3]; Keyvan Razazi, MD[1,2,3]; Shariq Abid, MD, PhD[3]; Arnaud W. Thille, MD, PhD[5]; Frédérique Schortgen, MD, PhD[1,3]; Laurent Brochard, MD[3,6,7]; Christian Brun-Buisson, MD[1,2,8]; Armand Mekontso Dessap, MD, PhD[1,2,3]

Crit Care Med. 2016 Feb;44(2):282-90

P/F 177 / 122

SAPS score: 30 / 41

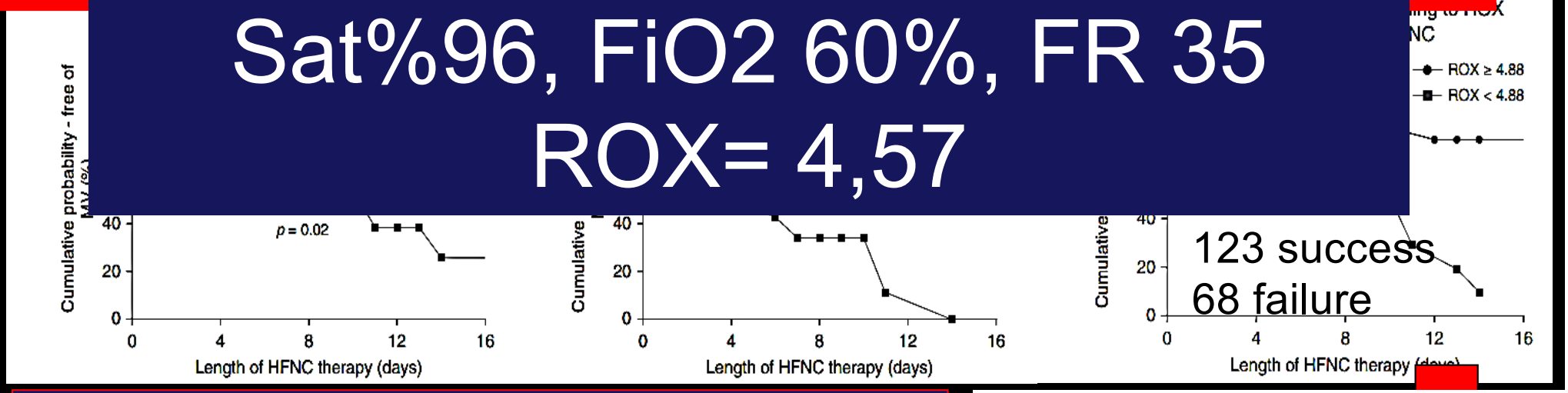


HFNC failure ROX: 2019

Sat%/FiO2/FR >4,88 a 12 ore = 80% sopravvivenza

A 2 ore a 6 ore a 12 ore

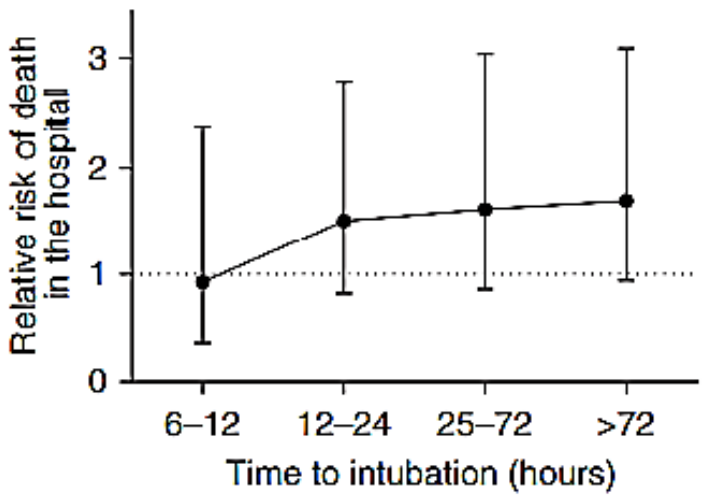
Sat%96, FiO2 60%, FR 35
ROX= 4,57



Pazienti con polmonite

	123 succ.	/	68 insucc.
S/F	187	/	106
APACHE		/	

Ritardo di intubazione: aumento mortalità

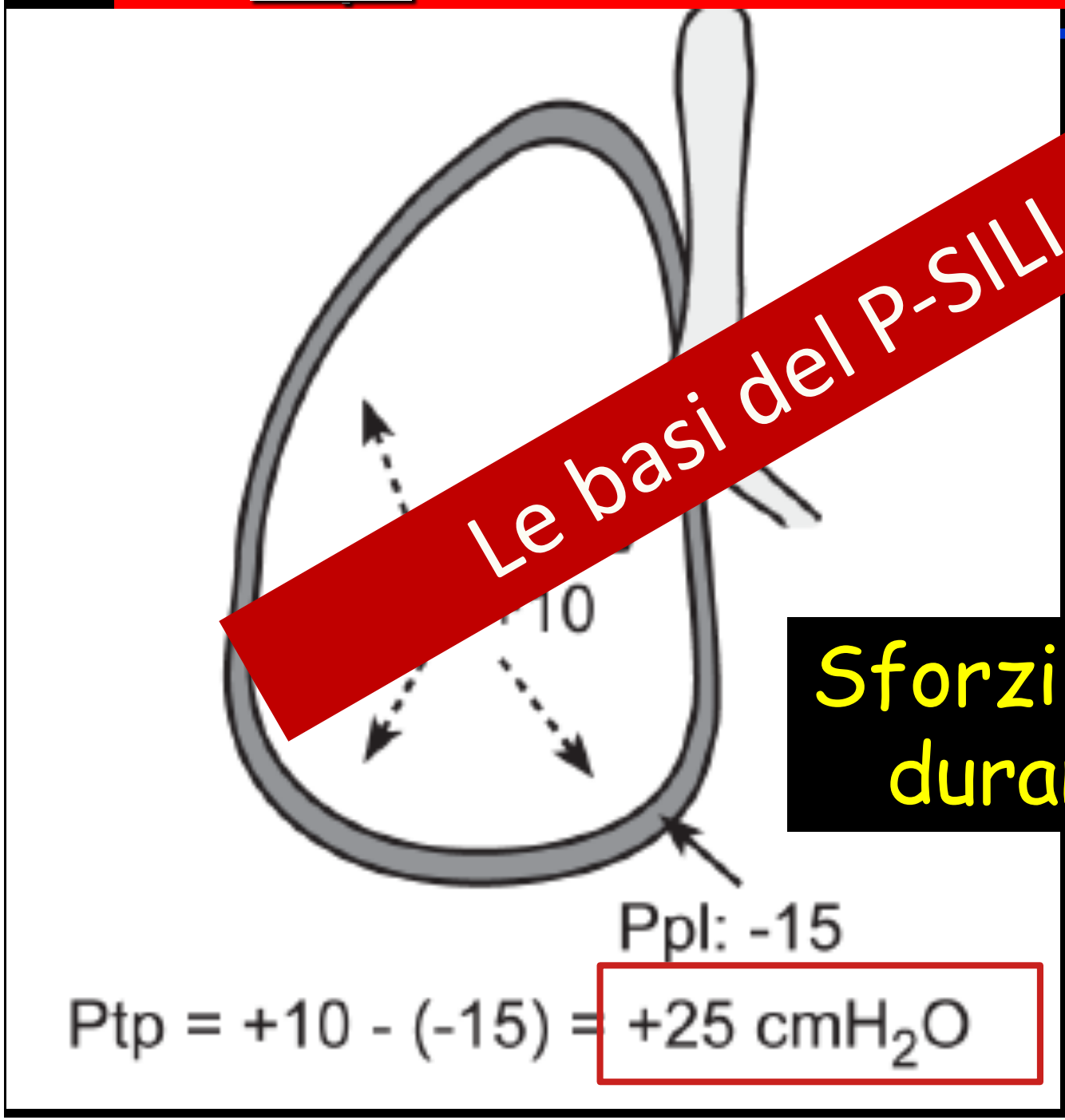


2º step

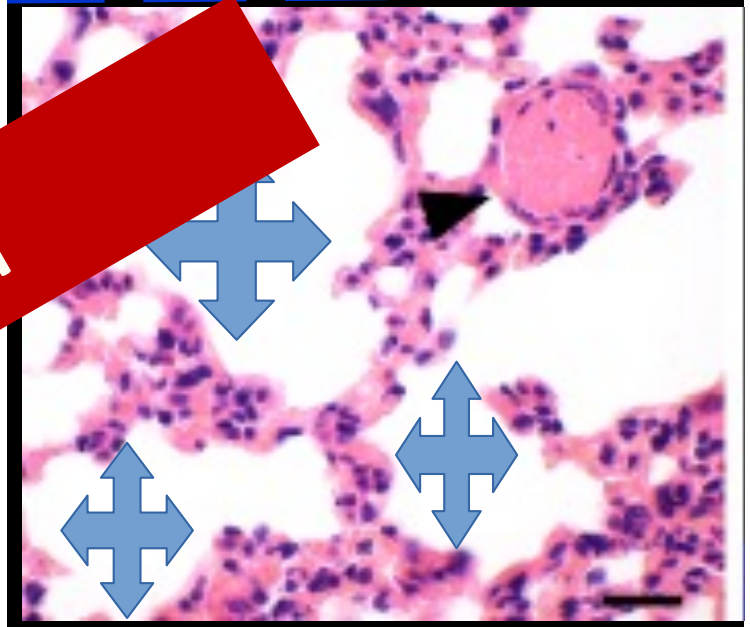
NIV failure:

Ruolo del paziente

Ptp: ruolo del drive respiratorio



Le basi del P-SILI



Sforzi respiratori durante VM

Ruolo del drive respiratorio

COVID-19 pneumonia: different respiratory treatments for different phenotypes?

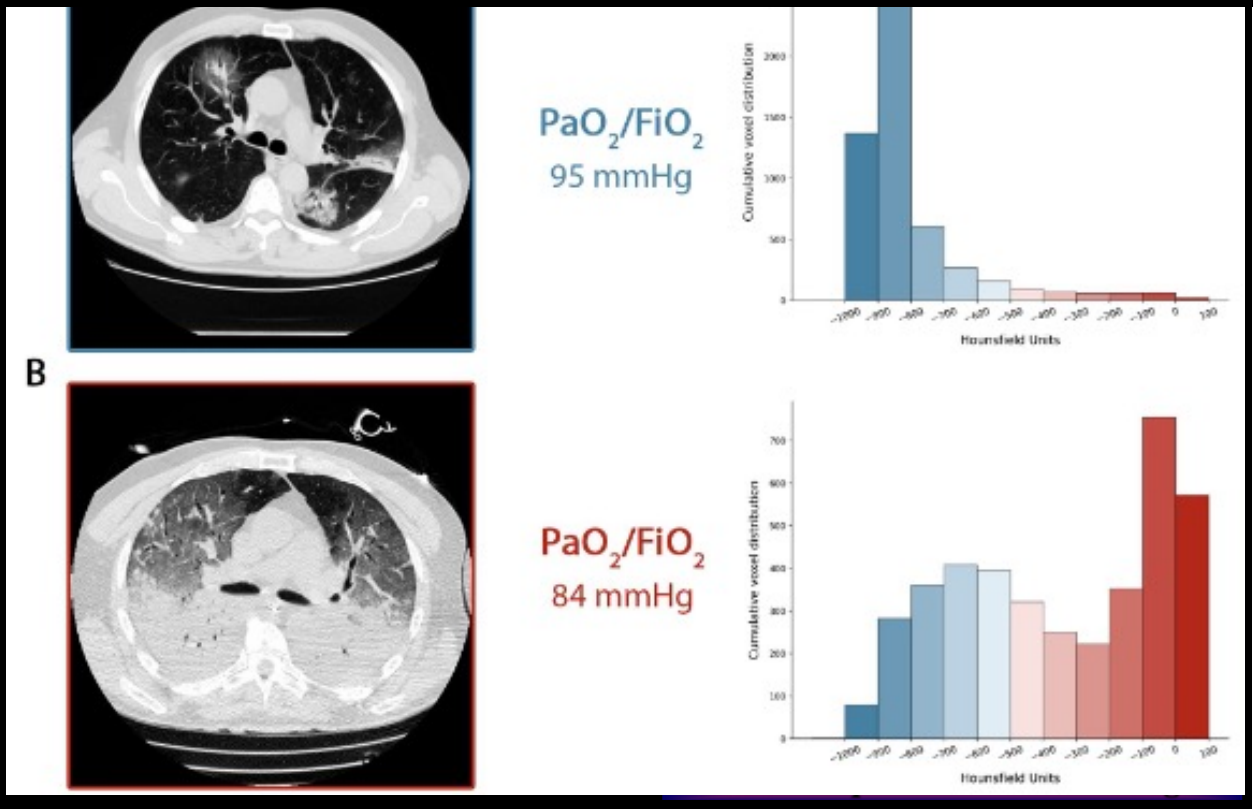
Luciano Gattinoni[1*], Davide Chiumello[2], Pietro Caironi[3,4], Mattia Busana[1], Federica Romitti[1], Luca Brazzi[5] and Luigi Camporota[6]

Intensive Care Med (2020) 46:1099–1102
https://doi.org/10.1007/s00134-020-06033-2

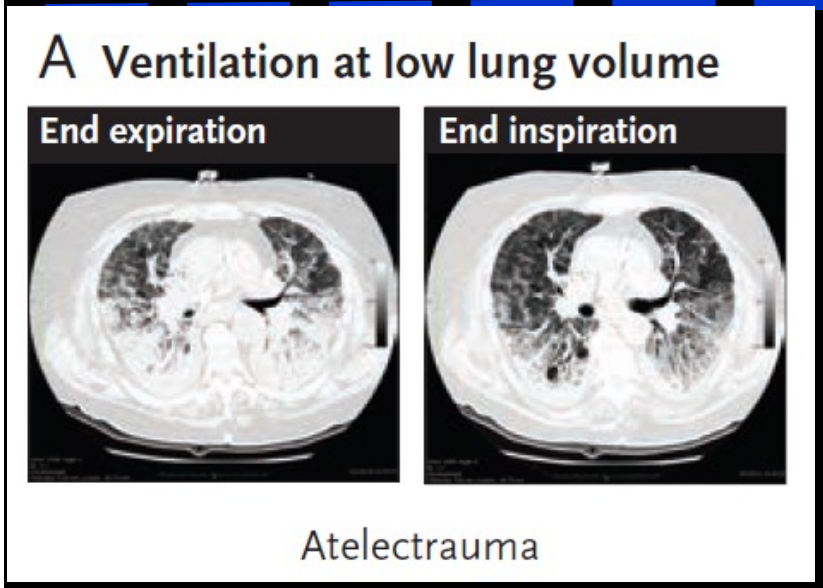
L: low elastance, low V/Q, low lung weight, low recruitability

H: high elasatnce, high Right to left shunt, high lung weight, high recruitability

Il passaggio dal fenotipo L a quello H è favorito dagli sforzi respiratori eccessivi <u>non sempre corretti da HFNC/NIV</u>



Ventilator Induced Lung Injury

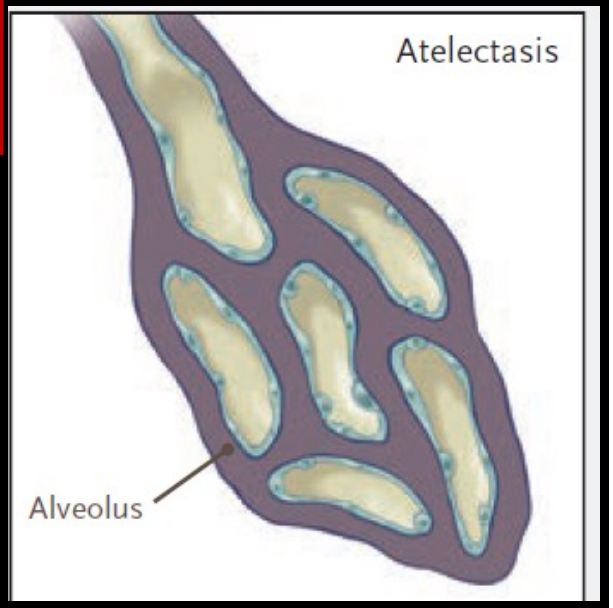


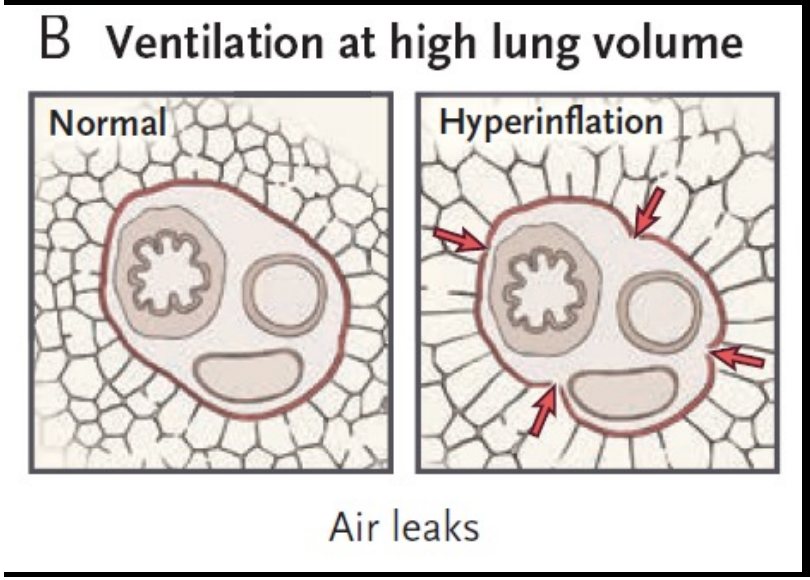
Che fare?

PEEP,

pronosupinazione

1

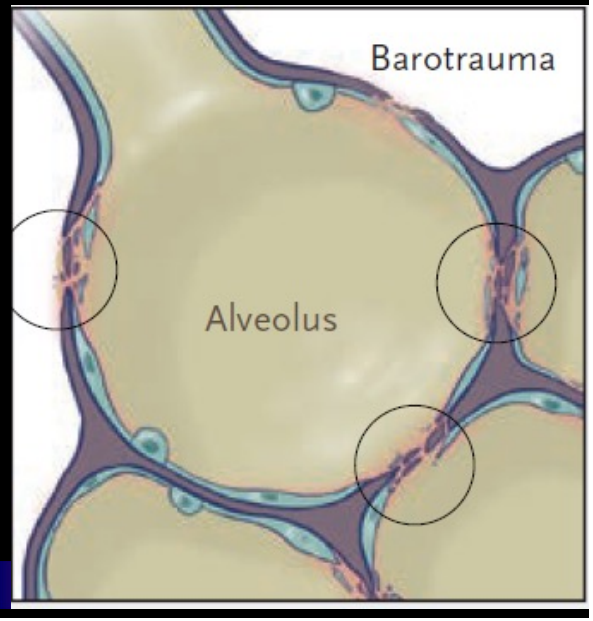




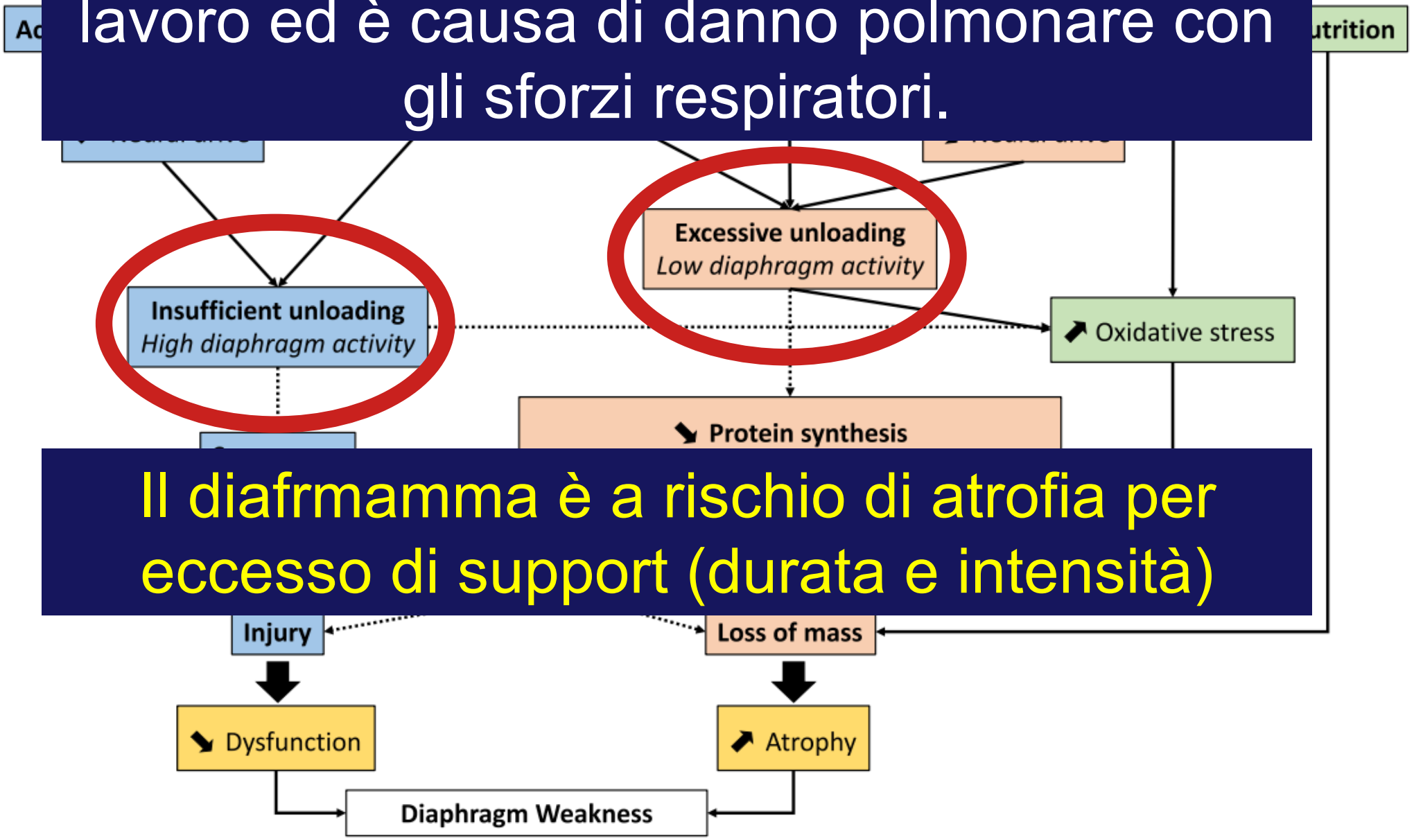
Che fare?

Controllo Vt con adeguate strategie ventilatorie

2



Il diaframma è colpito dal sovraccarico di lavoro ed è causa di danno polmonare con gli sforzi respiratori.

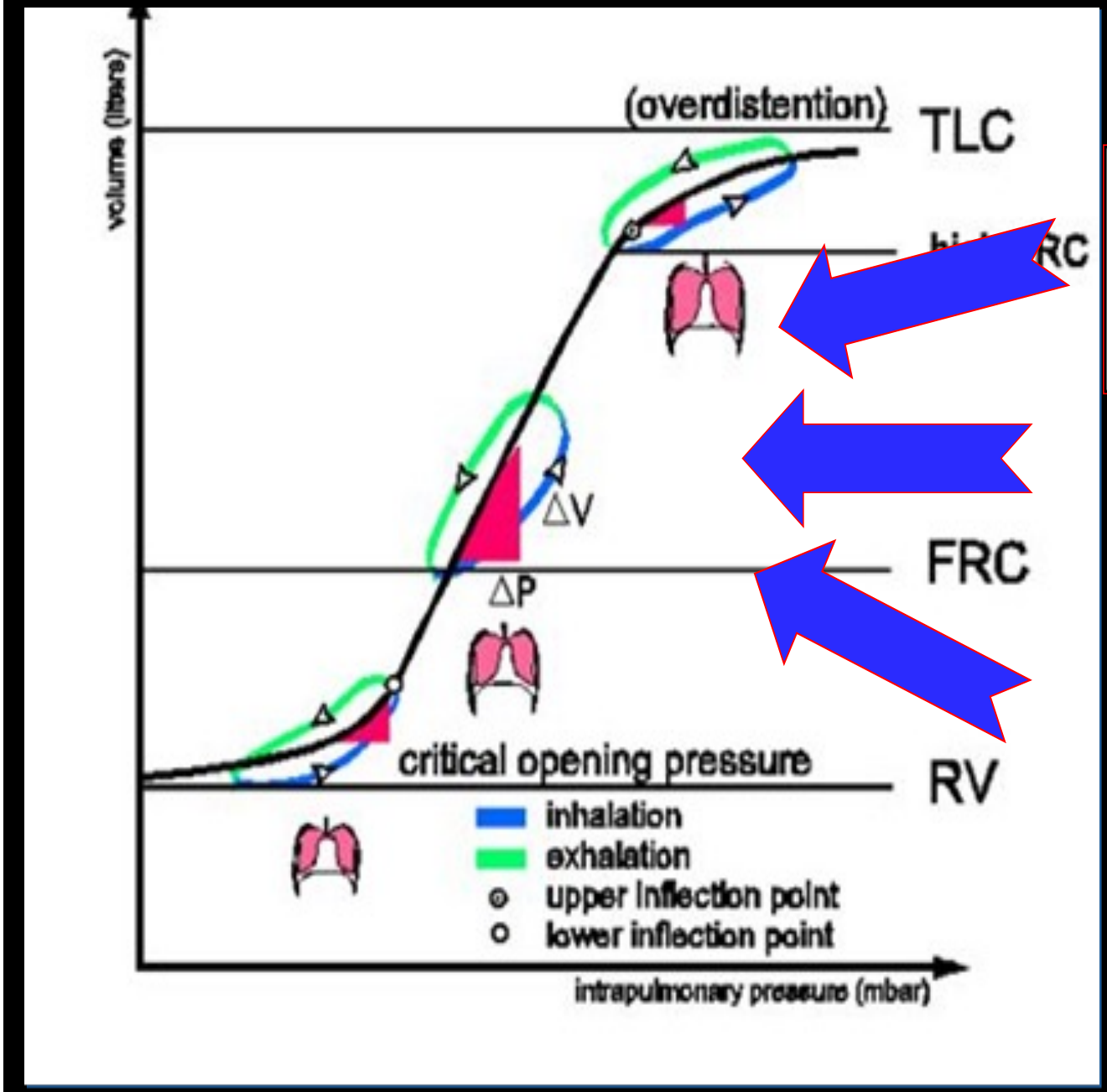


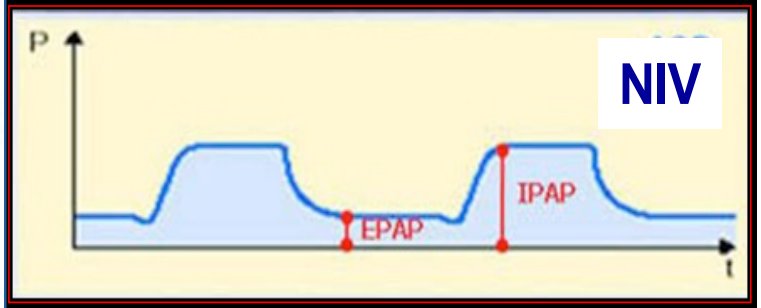
Il diafrmamma è a rischio di atrofia per eccesso di support (durata e intensità)

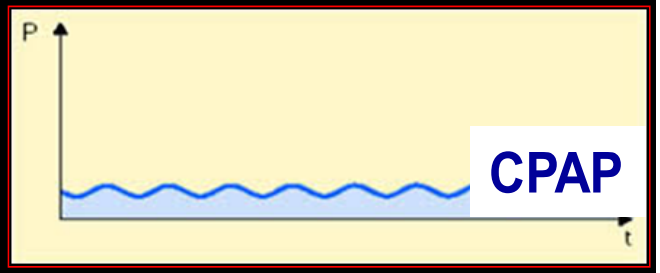
3° step

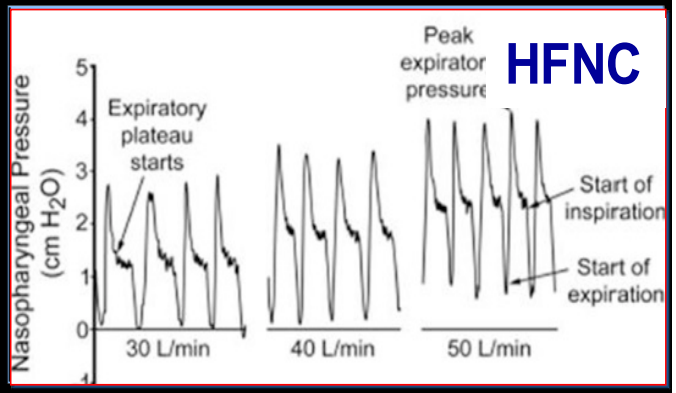
A cosa serve il supporto respiratorio non invasivo?

Reclutamento alveolare: le differenze









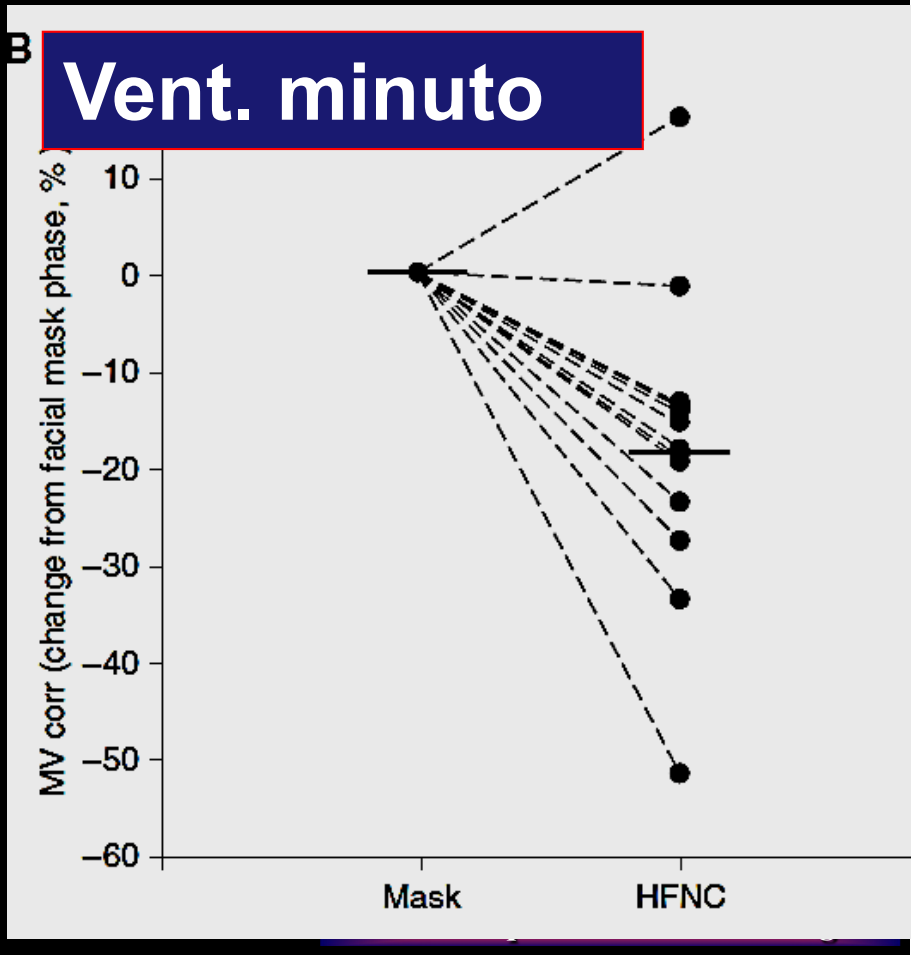
HFNC vs maschera Venturi

Physiologic Effects of High-Flow Nasal Cannula in Acute Hypoxemic Respiratory Failure

Tommaso Mauri[1,2], Cecilia Turrini[1,3], Nilde Eronia[4], Giacomo Grasselli[1], Carlo Alberto Volta[3], Giacomo Bellani[4,5], and Antonio Pesenti[1,2]

HFNC > Maschera Venturi

nel ridurre sforzi inspiratori e Ve nei pazienti ipossici



HFNC e drive respiratorio

Intensive Care Med

Optimum support by high-flow nasal

ilure:

Taccone[2],

Aumentando livello del flusso in HFNC

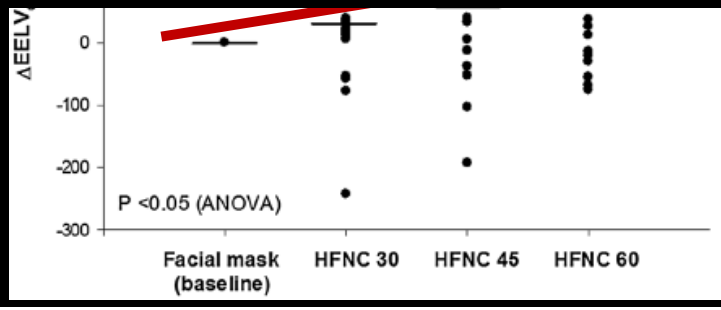
Sforzi inspiratori ↓

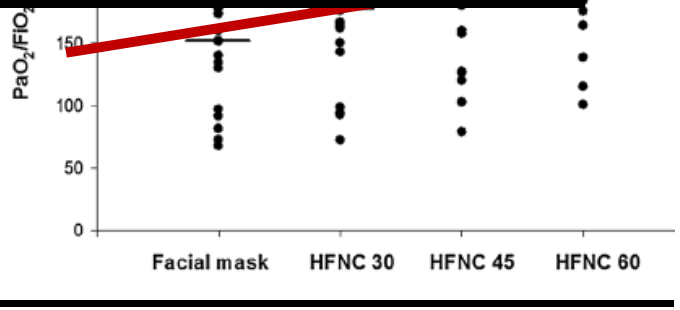
Compliance ↑

Recruitment ↑

Ossigenzaione ↑

Partire da <u>60 l/min</u> e ridurre per mantenere il flusso massimo tollerato dal paziente





NIV e sforzo respiratorio

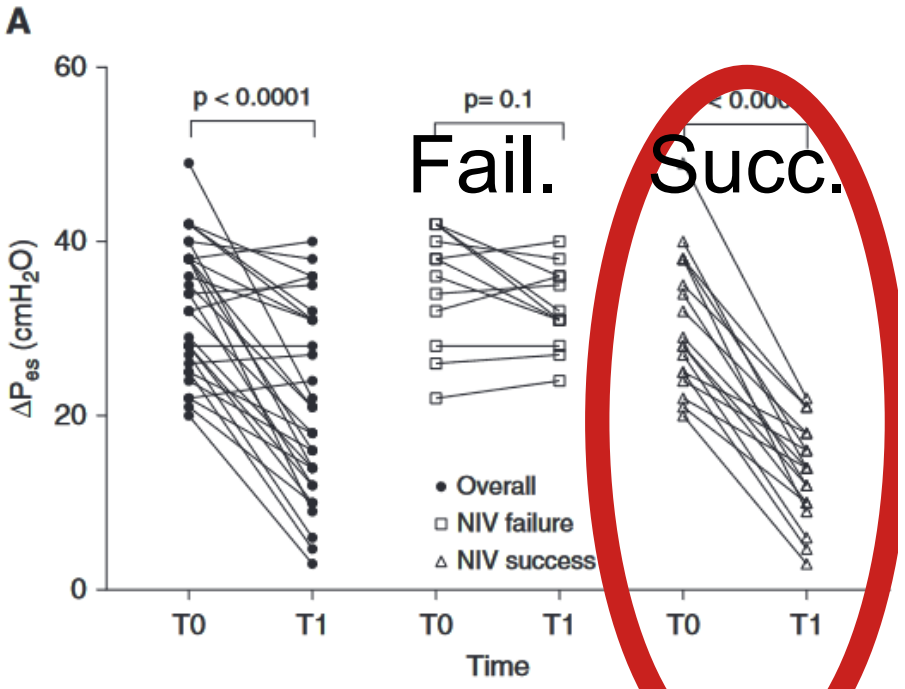
Early Inspiratory Effort Assessment by Esophageal Manometry Predicts Noninvasive Ventilation Outcome in *De Novo* Respiratory Failure

A Pilot Study

American Journal of Respiratory and Critical Care Medicine Volume 202 Number 4 | August 15 2020

Roberto Tonelli[1,2], Riccardo Fantini[1], Luca Tabbì[1], Ivana Castaniere
Giovanni Della Casa[4], Roberto D'Amico[5], Massimo Girardis[6], Stefa
Alessandro Marchioni[1]

The magnitude of inspiratory effort within the first 2 hours of NIV was an early and accurate predictor of NIV outcome at 24 hours



Feature	OR	95% CI	*P* Value
ΔPes < 10 cm H_2O post 2 h NIV	15	2.8–110	0.001
V_{TE} > 9.5 ml/kg of PBW	7.9	1.5–72	0.02
HACOR score >5 post 2 h NIV	6.3	0.9–49	0.046
RR > 30 bpm	5.5	0.8–112	0.14
Pa_{O_2}/FI_{O_2} ratio < 150 mm Hg	2	0.5–9.8	0.4
$V_{TE}/\Delta P_L$ ratio < 0.33 ml/kg/cm H_2O	2	0.4–9.8	0.36

NIV vs HFNC in AHRF

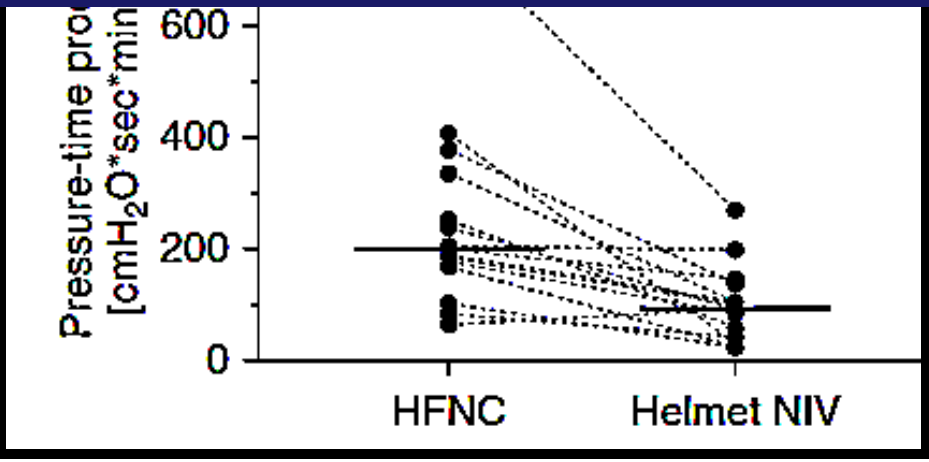
Physiological Comparison of High-Flow Nasal Cannula and Helmet Noninvasive Ventilation in Acute Hypoxemic Respiratory Failure

Domenico Luca Grieco[1,2], Luca S. Menga[1,2], Valeria Raggi[1,2], Filippo Bongiovanni[1,2], Gian Marco Anzellotti[1,2], Eloisa S. Tanzarella[1,2], Maria Grazia Bocci[1,2], Giovanna Mercurio[1,2], Antonio M. Dell'Anna[1,2], Davide Eleuteri[1,2], Giuseppe Bello[1,2], Riccardo Maviglia[1,2], Giorgio Conti[1,2], Salvatore Maurizio Maggiore[3], and Massimo Antonelli[1,2]

A[illegible] 2020

Conclusions:

As compared with HFNC in AHRF, helmet NIV improves oxygenation, reduces dyspnea, inspiratory effort, and simplified pressure–time product,



NIV helmet vs mask

Effect of Noninvasive Ventilation Delivered by Helmet vs Face Mask on the Rate of Endotracheal Intubation in Patients With Acute Respiratory Distress Syndrome:

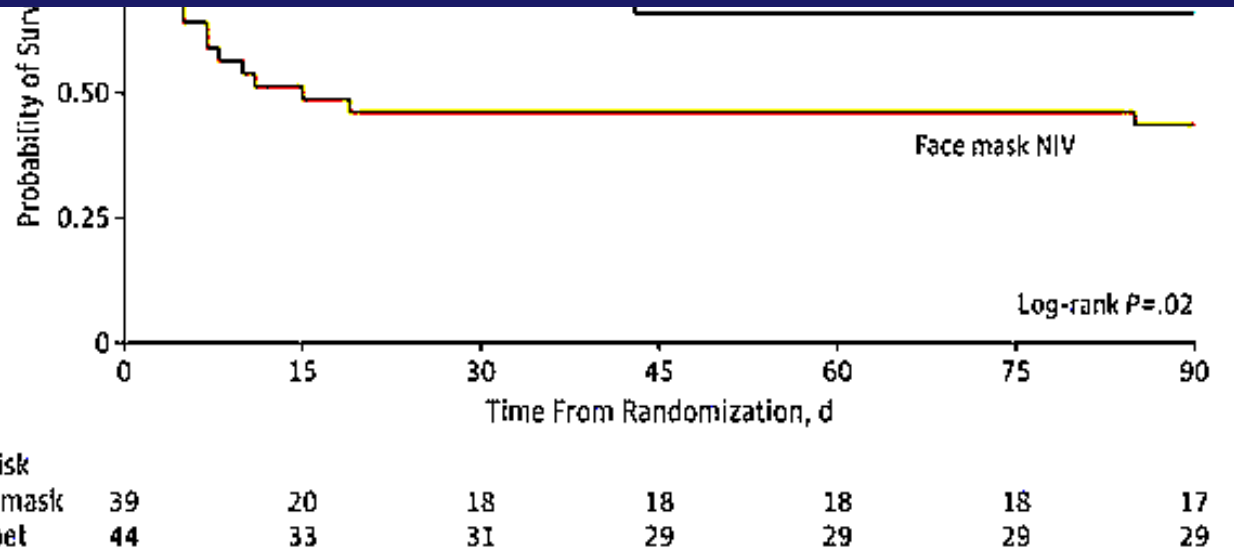
A Randomized Clinical Trial

Published in final edited form as:
JAMA. 2016 June 14; 315(22): 2435–2441. doi:10.1001/jama.2016.6338.

Bhakti K. Patel, MD, **Krysta S. Wolfe, MD**, **Anne S. Pohlman, MSN**, **Jesse B. Hall, MD**, and **John P. Kress, MD**

Mask: 39, pneumonia 14 /Helmet: 44, pneumonia 23

La scelta della interfaccia deve consentire di mantenere PEEP alta per lungo tempo



A cosa serve la PEEP/CPAP?

Paziente ipossico

Ridurre atelettasia

Stabilizzare alveoli

Migliorare V/Q

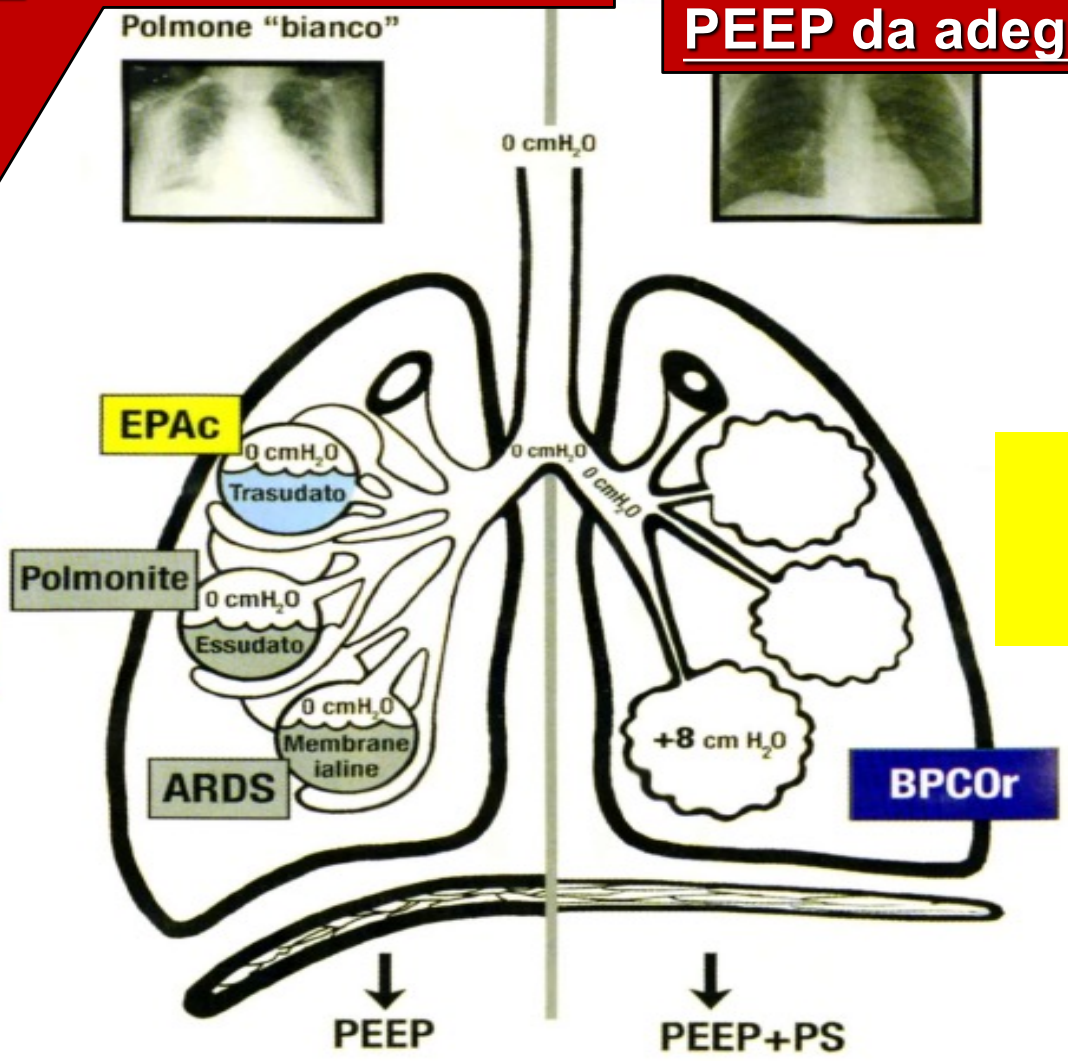
PEEP per Ossigenare:

alta

NIV « basic »

RidurreVolume corrente e frequenza respiratoria PEEP alta

Aumentare Volume corrente e ridurre frequenza respiratoria PEEP da adeguare



HFNC CPAP

NIV

Prima gli strumenti…?

Insufficienza respiratoria acuta: CPAP/HFNC/NIV

...o prima la conoscenza…?

"Amico mio...li pisci, per pigliarli, li devi sapere quando, donde e cosa ci piace di mangiare...altrimenti ti attacchi…"

Peppino o' Trigliarolo