IL PAZIENTE CRITICO: L'ARDS

Dott. Gabriele Valli

U.O.C. Pronto Soccorso e Breve Osservazione

A.O. San Giovanni Addolorata

Roma

gvalli@hsangiovanni.roma.it

Caso Clinico

Ore 1:20
Paziente di 77 aa
Giunge da clinica convenzionata per peggioramento del quadro respiratorio e dispnea ingravescente. Ricoverata due giorni prima per polmonite a focolai multipli
APR: GIST gastrico (15 anni prima) – Ipertensione
SpO_2 86% in VMK 50% $\left({}^{SpO_2}/_{Fi_{O_2}} = 172 \right)$; Fr 38 atti/min; GCS 15

Inizia HFNC: 60 L FiO_2 70 % · SpO_2 94% · P/F 114 · Fr 35 atti/min

Ore 5:00 (+ 3 hr)
mancato miglioramento
Inizia NIV: PEEP 10 – PS 13 · FiO_2 70% · P/F 107 · Fr 35 atti/min · VT_{exp} 690 ml

Ore 18:30 (+ 16 hr)
In NIV: F_iO_2 90%, pO_2 57 mmHg; pH 7,50; pCO_2 34 mmHg; Fr 35 atti/min

IOT→ **Rianimazione**

«Multipli addensamenti polmonari bilaterali, ground-glass, crazy-paving, consolidativi estesi su 50% del parenchima»

Acute Respiratory Distress Syndrome

ACUTE RESPIRATORY DISTRESS IN ADULTS

DAVID G. ASHBAUGH
M.D. Ohio State
ASSISTANT PROFESSOR OF SURGERY

D. BOYD BIGELOW
M.D. Colorado
ASSISTANT IN MEDICINE AND AMERICAN THORACIC SOCIETY-NATIONAL TUBERCULOSIS ASSOCIATION FELLOW IN PULMONARY DISEASE

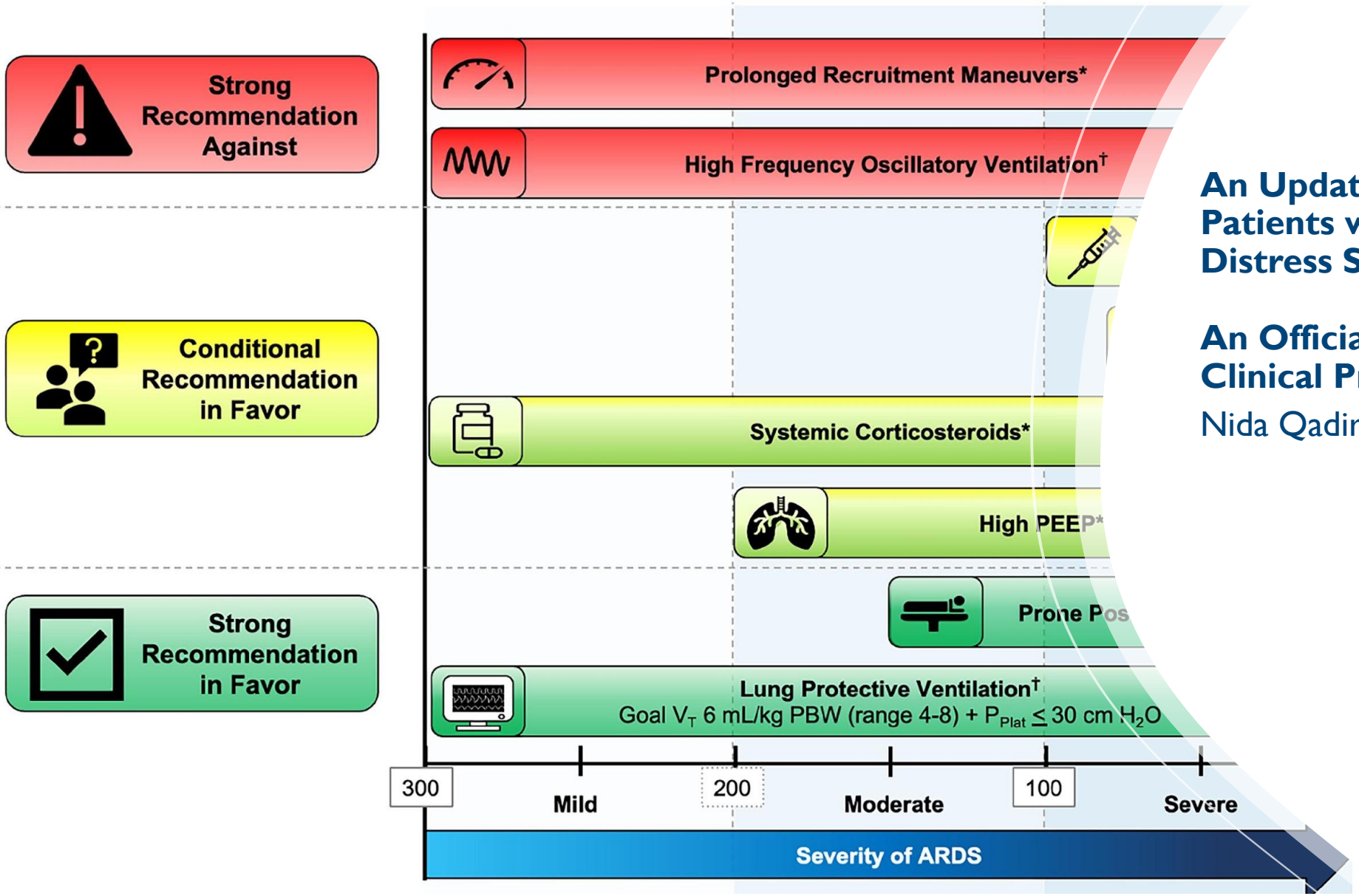
THOMAS L. PETTY
M.D. Colorado
ASSISTANT PROFESSOR OF MEDICINE

BERNARD E. LEVINE
M.D. Michigan
AMERICAN THORACIC SOCIETY-NATIONAL TUBERCULOSIS ASSOCIATION FELLOW IN PULMONARY DISEASE*

From the Departments of Surgery and Medicine, University of Colorado Medical Center, Denver, Colorado, U.S.A.

ASHBAUGH DG - 1967

The respiratory-distress syndrome in 12 patients was manifested by **acute onset of tachypnœa**, **hypoxæmia**, **and loss of compliance** after a variety of stimuli; ***the syndrome did not respond to usual and ordinary methods of respiratory therapy***. The clinical and pathological features closely resembled those seen in infants with respiratory distress and to conditions in congestive atelectasis and postperfusion lung. The theoretical relationship of this syndrome to alveolar surface active agent is postulated. ***Positive end-expiratory pressure*** was most helpful in combating atelectasis and hypoxæmia. **Corticosteroids** appeared to have value in the treatment of patients with fat-embolism and possibly viral pneumonia.

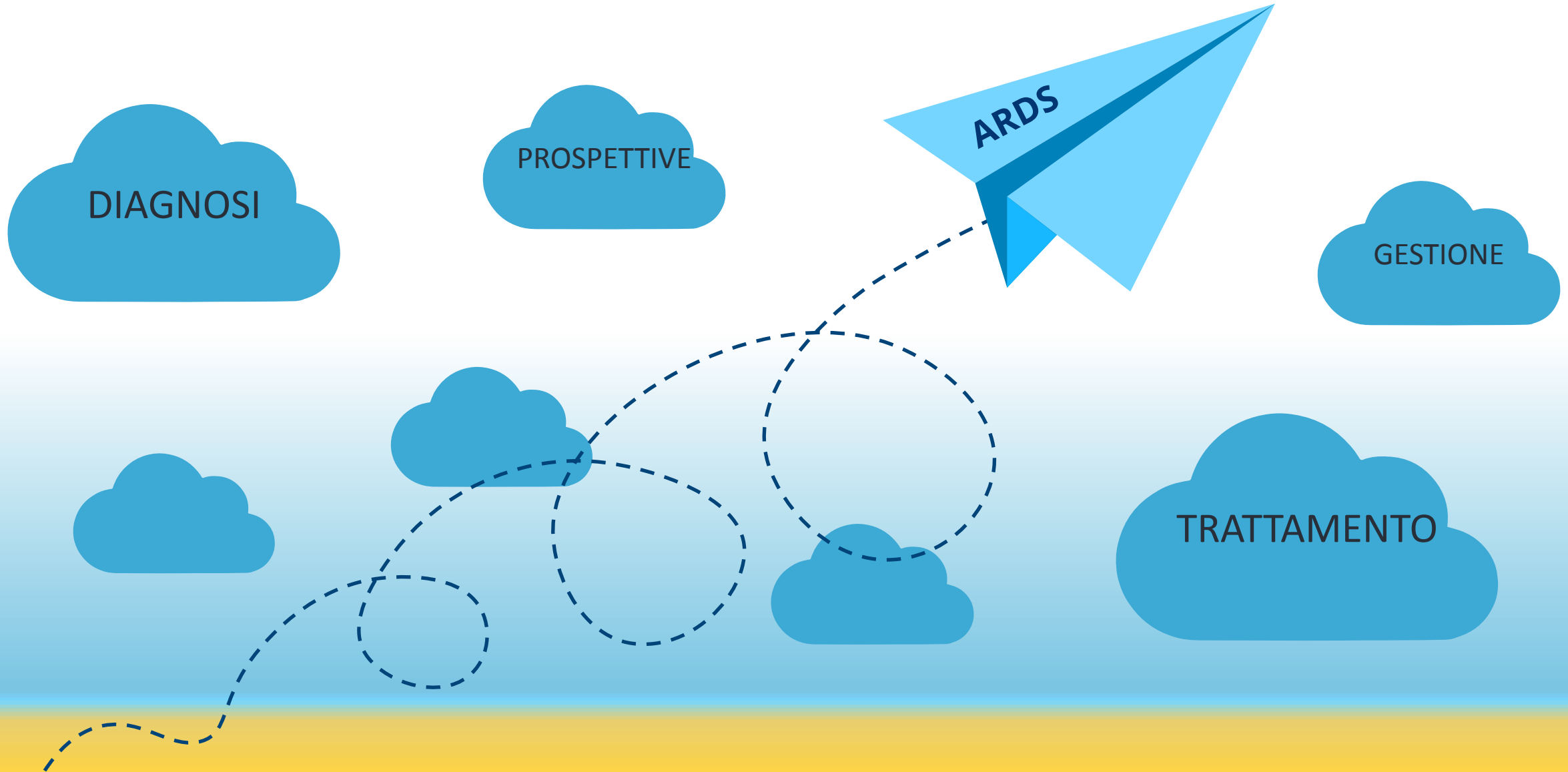


An Update on Management of Adult Patients with Acute Respiratory Distress Syndrome.

An Official American Thoracic Society Clinical Practice Guideline

Nida Qadir et al. AJCCRM, 2024

Problemi aperti sull'ARDS ?



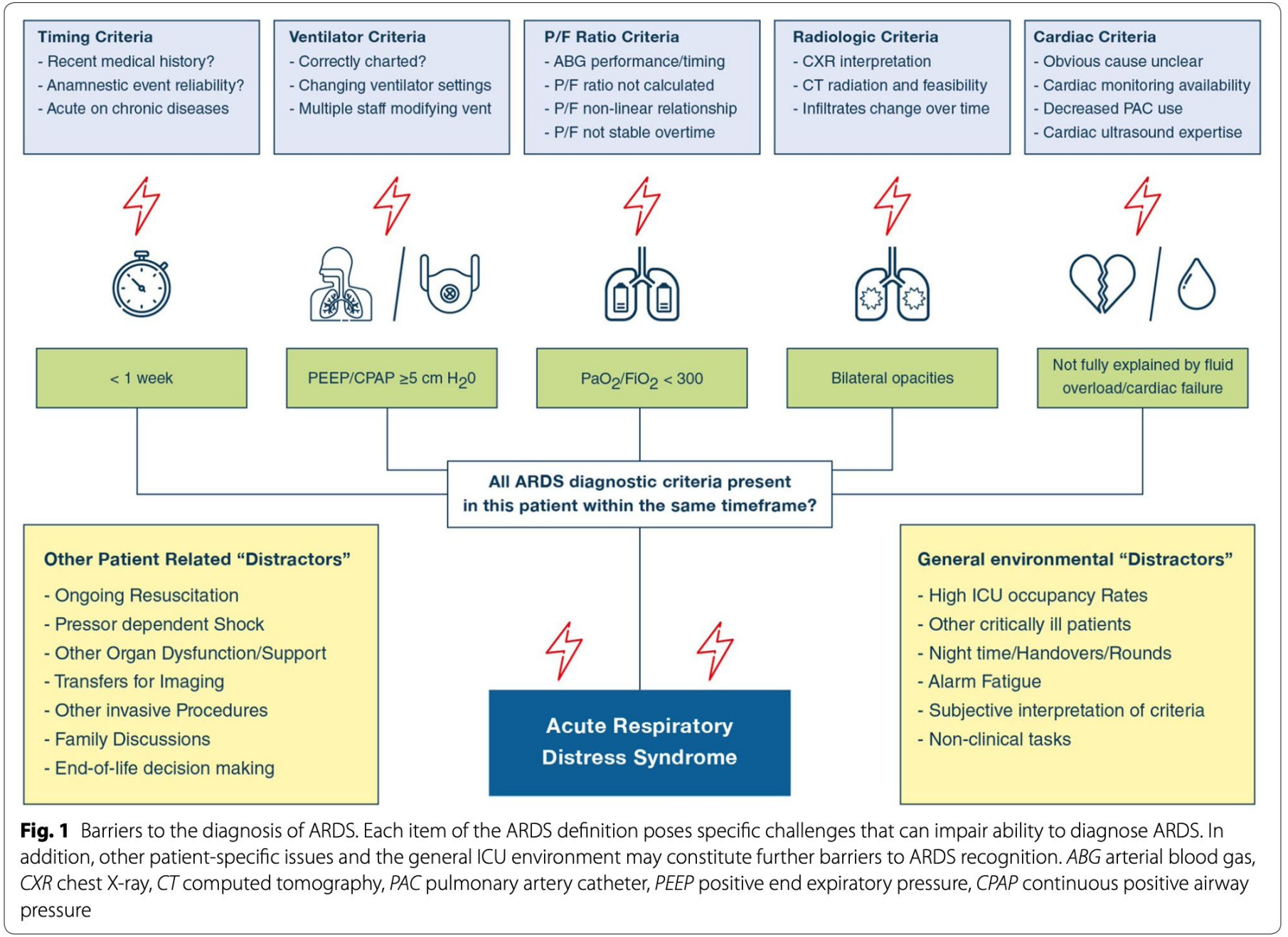


Fig. 1 Barriers to the diagnosis of ARDS. Each item of the ARDS definition poses specific challenges that can impair ability to diagnose ARDS. In addition, other patient-specific issues and the general ICU environment may constitute further barriers to ARDS recognition. *ABG* arterial blood gas, *CXR* chest X-ray, *CT* computed tomography, *PAC* pulmonary artery catheter, *PEEP* positive end expiratory pressure, *CPAP* continuous positive airway pressure

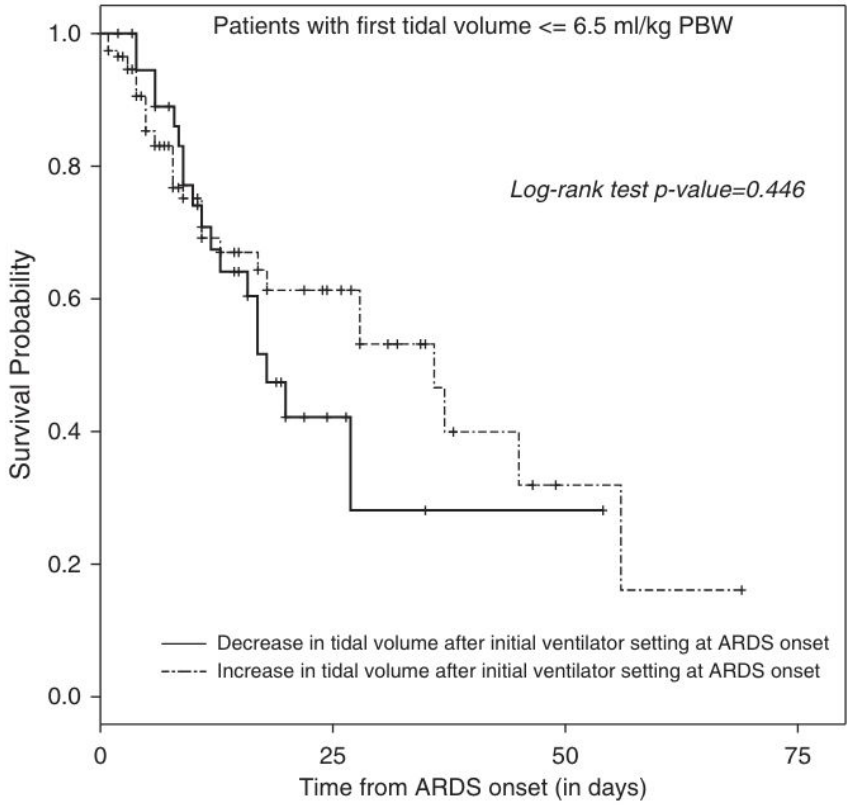
Bellani, G., Pham, T. & Laffey, J.G. Missed or delayed diagnosis of ARDS: a common and serious problem. *Intensive Care Med* **46**, 1180–1183 (202

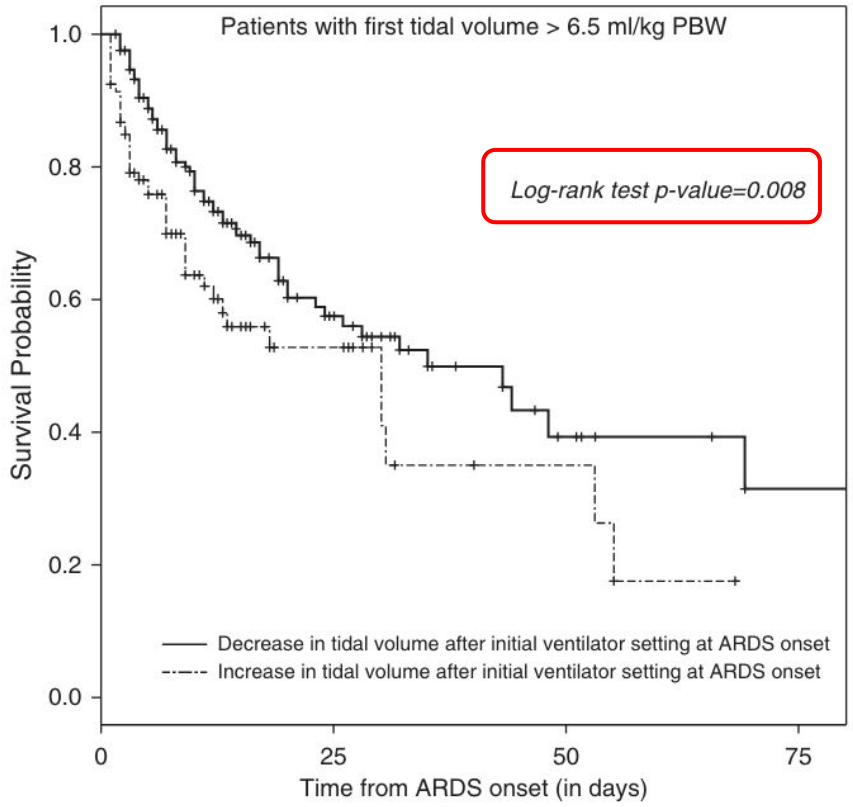
Timing of Low Tidal Volume Ventilation and Intensive Care Unit Mortality in Acute Respiratory Distress Syndrome

A Prospective Cohort Study

Dale M. Needham[1,2,3,4], Ting Yang[4], Victor D. Dinglas[1,2], Pedro A. Mendez-Tellez[1,5], Carl Shanholtz[6], Jonathan E. Sevransky[7], Roy G. Brower[2], Peter J. Pronovost[1,4,5], and Elizabeth Colantuoni[1,8]

482 pazienti





L'inizio precoce di una ventilazione protettiva riduce la mortalità

American Journal of Respiratory and Critical Care Medicine Volume 191 Number 2 | January 15 2015

What Is the Impact of Treatment Variability on Mortality in Patients With Moderate-to-Severe ARDS?

CHEST

STUDY DESIGN

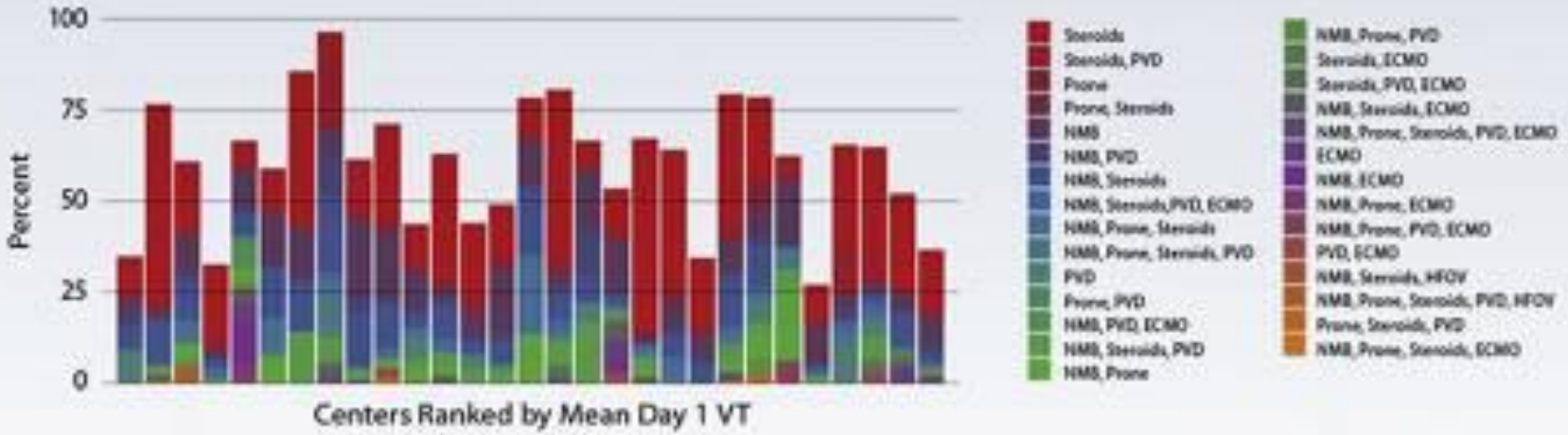
Multicenter, observational cohort study of 125 ICUs in 29 US centers between October 1, 2016, and April 30, 2017

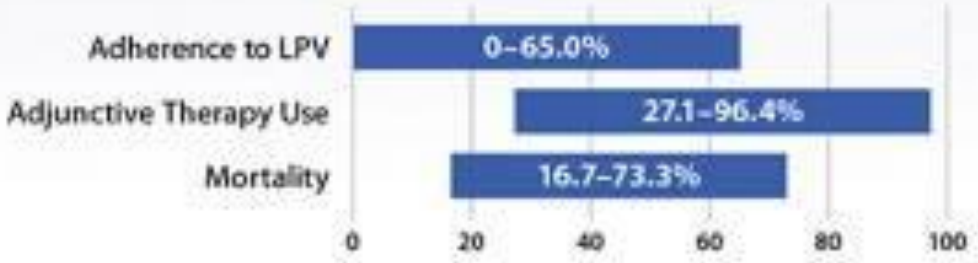
Included 2,466 mechanically ventilated adults with ARDS and Pao_2/FIO_2 < 150 on PEEP > 5 cm H_2O

Assessed adherence to lung protective strategies (LPV) and standardized mortality ratios (SMR)

RESULTS

Substantial center-to-center variability in ARDS management





Of the treatment-level factors explored, only center adherence to early (day 1) LPV correlated with SMR

Early adherence to LPV was associated with lower center mortality and may be a surrogate for overall quality of care processes.

La Nuova Definizione di ARDS

Timing **Immaging** **Origin** **Shunt**

L'ARDS è un processo infiammatorio acuto diffuso polmonare, indotto da alcuni fattori predisponenti, che produce l'aumento della premeabilità vascolare ed epiteliale, edema polmonare con perdita di tessuto polmonare aereato.
Le caratteristiche della sindrome sono: 1) l'ipossia con shunt; 2) le opacità polmonari diffuse; 3) L'aumento dello spazio morto alveolare; 4) la riduzione della compliance polmonare.

Am J Resp Crit Care Med, 2023

Criteri Diagnostici

	Criteria That Apply to Specific ARDS Categories		
	Nonintubated ARDS[†]	**Intubated ARDS**	**Modified Definition for Resource-Limited Settings**[‡]
Oxygenation[§‖]	$Pa_{O_2}:F_{I_{O_2}} \leq 300$ mm Hg or $Sp_{O_2}:F_{I_{O_2}} \leq 315$ (if $Sp_{O_2} \leq 97\%$) on HFNO with flow of ≥30 L/min or NIV/CPAP with at least 5 cm H_2O end-expiratory pressure	Mild[¶]: $200 < Pa_{O_2}:F_{I_{O_2}} \leq 300$ mm Hg or $235 < Sp_{O_2}:F_{I_{O_2}} \leq 315$ (if $Sp_{O_2} \leq 97\%$) Moderate: $100 < Pa_{O_2}:F_{I_{O_2}} \leq 200$ mm Hg or $148 < Sp_{O_2}:F_{I_{O_2}} \leq 235$ (if $Sp_{O_2} \leq 97\%$) Severe: $Pa_{O_2}:F_{I_{O_2}} \leq 100$ mm Hg or $Sp_{O_2}:F_{I_{O_2}} \leq 148$ (if $Sp_{O_2} \leq 97\%$)	$Sp_{O_2}:F_{I_{O_2}} \leq 315$ (if $Sp_{O_2} \leq 97\%$)[†]. Neither positive end-expiratory pressure nor a minimum flow rate of oxygen is required for diagnosis in resource-limited settings.

La nuova definizione permette di identificare, anche in condizioni di ridotte capacità diagnostiche, di individuare i pazienti potenzialmente a rischio di un deterioramento grave.

Scompare dai criteri necessari alla diagnosi la ridotta compliance. (la PEEP non è più necessaria alla diagnosi).

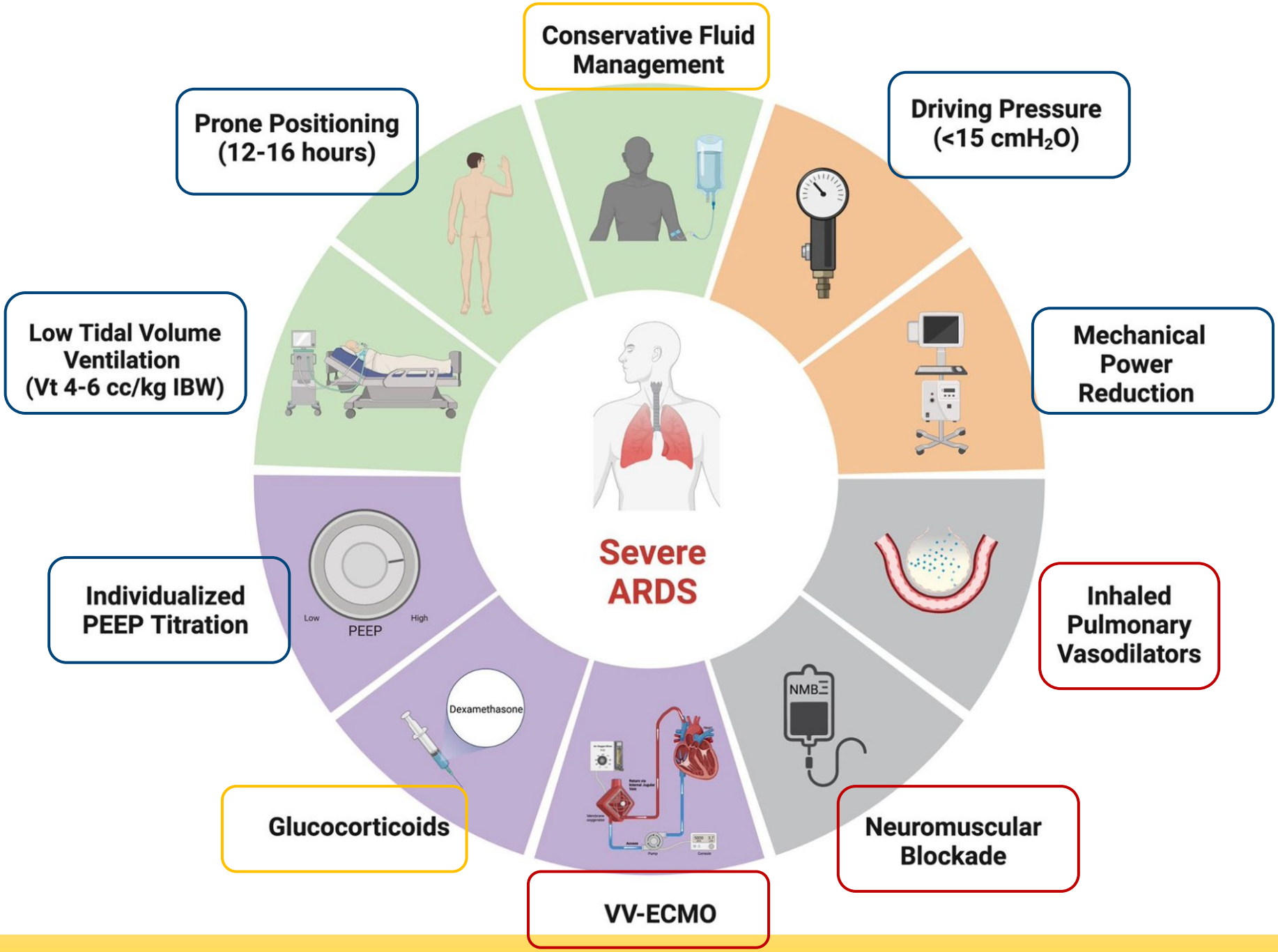
La diagnosi diventa una responsabilità specifica del medico d'urgenza

LA DIAGNOSI PRECOCE DIVENTA UN PUNTO ESSENZIALE NEL TRATTAMENTO DELL'ARDS

Quale trattamento?

Quale specialista?

Quale setting e quale percoso assistenziale?


Conservative Fluid Management
Driving Pressure (<15 cmH2O)
Mechanical Power Reduction
Inhaled Pulmonary Vasodilators
Neuromuscular Blockade
VV-ECMO
Glucocorticoids
Individualized PEEP Titration
Low Tidal Volume Ventilation (Vt 4-6 cc/kg IBW)
Prone Positioning (12-16 hours)
Severe ARDS
Low
PEEP
High
Dexamethasone
NMB

The NEW ENGLAND JOURNAL of MEDICINE

ESTABLISHED IN 1812 MAY 25, 2023 VOL. 388 NO. 21

Hydrocortisone in Severe Community-Acquired Pneumonia

P.-F. Dequin, F. Meziani, J.-P. Quenot, T. Kamel, J.-D. Ricard, J. Badie, J. Reignier, N. Heming, G. Plantefève, B. Souweine, G. Voiriot, G. Colin, J.-P. Frat, J.-P. Mira, N. Barbarot, B. François, G. Louis, S. Gibot, C. Guitton, C. Giacardi, S. Hraiech, S. Vimeux, E. L'Her, H. Faure, J.-E. Herbrecht, C. Bouisse, A. Joret, N. Terzi, A. Gacouin, C. Quentin, M. Jourdain, M. Leclerc, C. Coffre, H. Bourgoin, C. Lengellé, C. Caille-Fénérol, B. Giraudeau, and A. Le Gouge, for the CRICS-TriGGERSep Network*

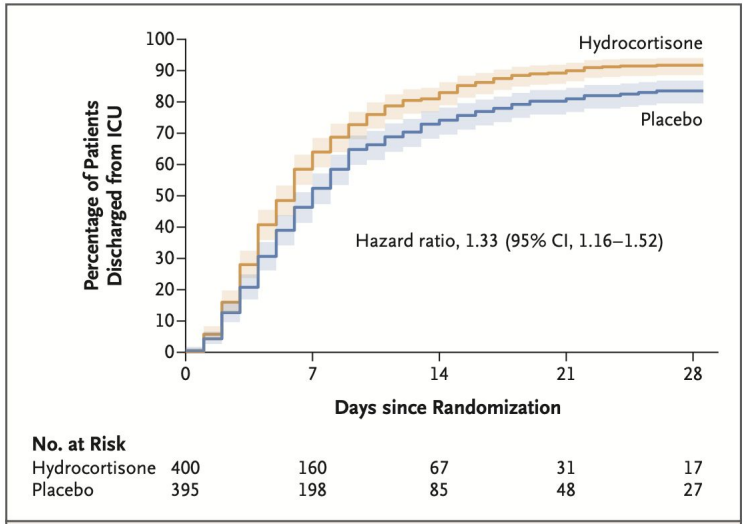
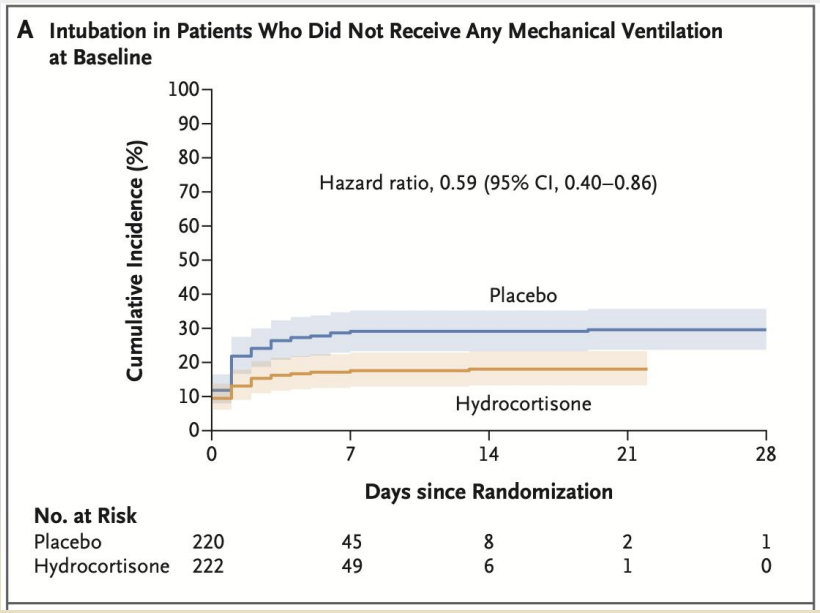
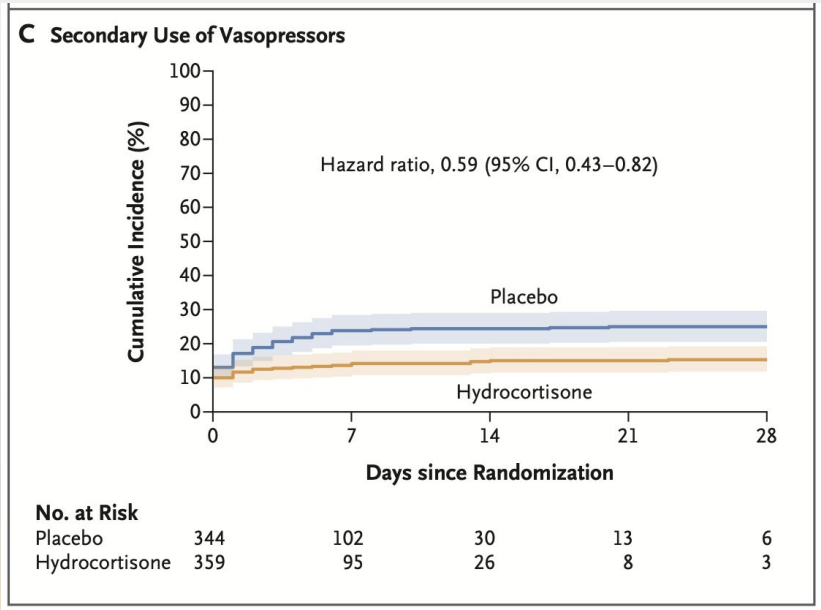


Figure 2. Discharge from ICU by Day 28.

Shown is the cumulative percentage of patients who were discharged from the ICU by day 28 (a secondary outcome in the trial). The length of ICU stay was compared in the framework of a competing-risk model, with death considered as a competing event. For secondary outcomes, the widths of the confidence intervals have not been adjusted for multiplicity and may not be used in place of hypothesis testing.



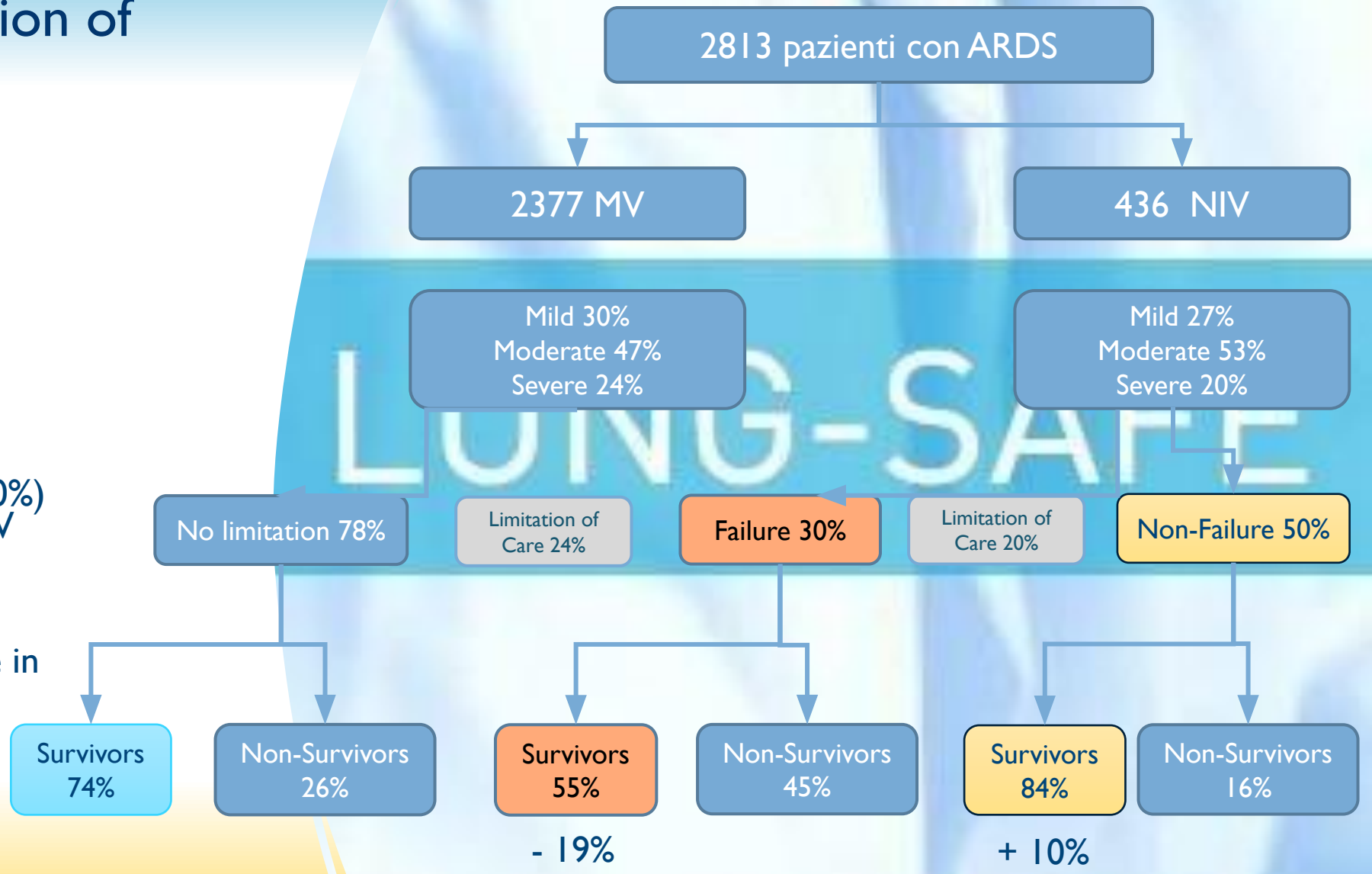


Noninvasive ventilation of patients with acute respiratory distress syndrome

1. I pazienti che falliscono la NIV (30%) hanno una prognosi peggiore dei MV

2. I pazienti che non falliscono (50%) hanno prognosi migliore dei MV

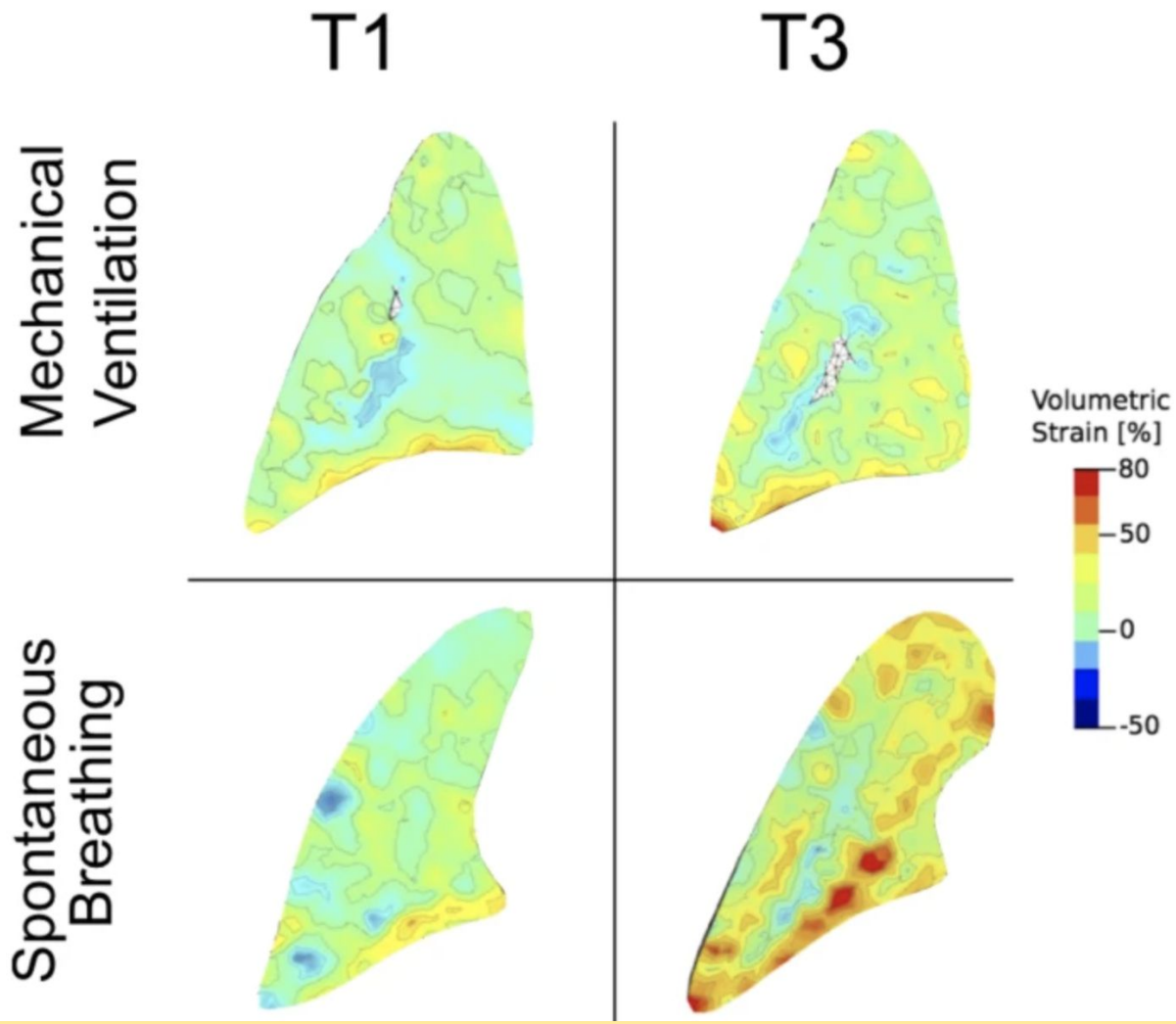
3. I pazienti con P/F < 150 hanno una probabilità più alta di fallire in trattamento in NIV



Bellani G et al. AJRCC, 2016

A physiological approach to understand the role of respiratory effort in the progression of lung injury in SARS-CoV-2 infection

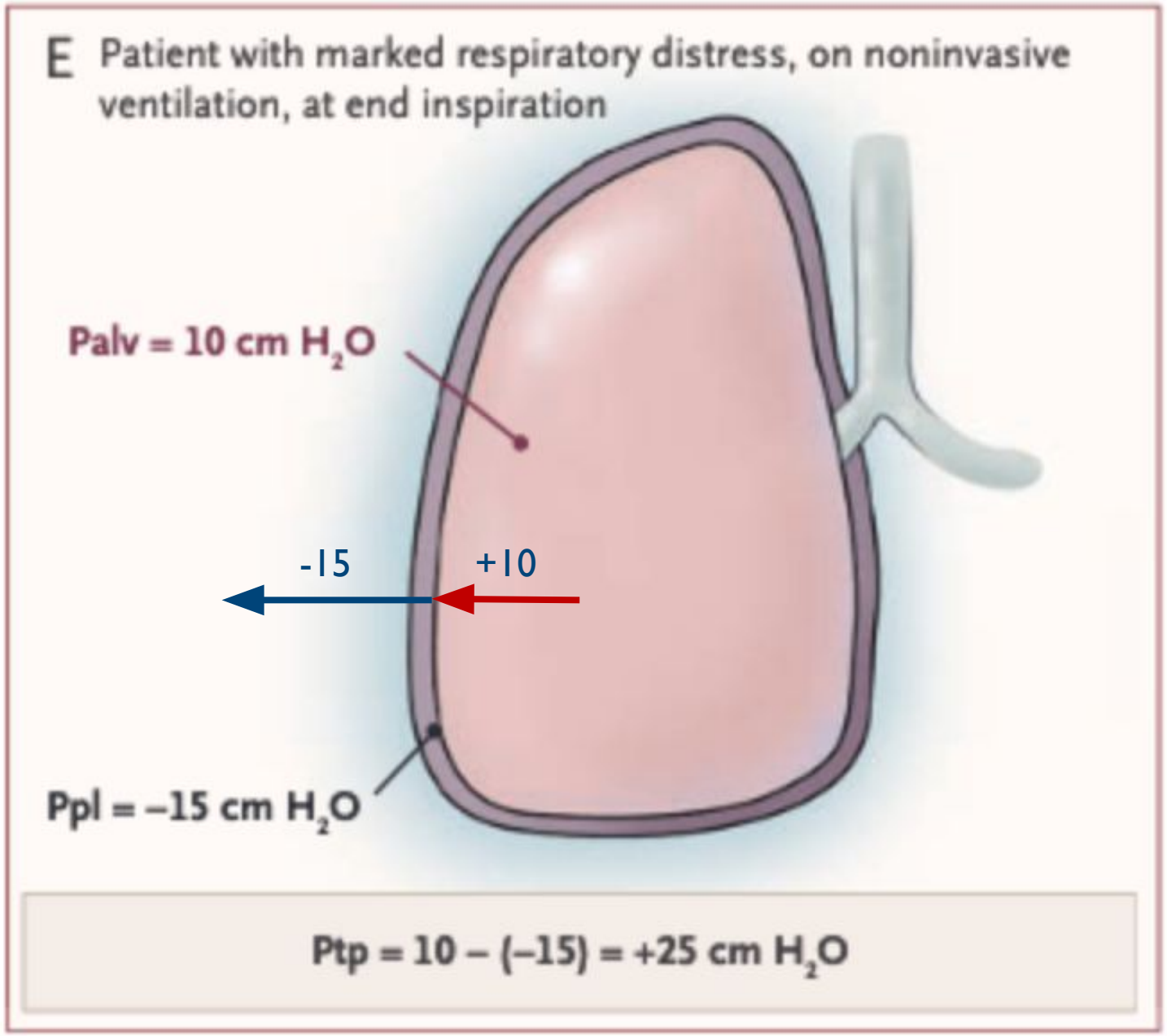
Fig. 2



Il respiro spontaneo in condizioni di ventilazione elevata induce uno stress alveolare sulla parete alveolare che può essere causa di peggioramento del danno polmonare (PSILI)

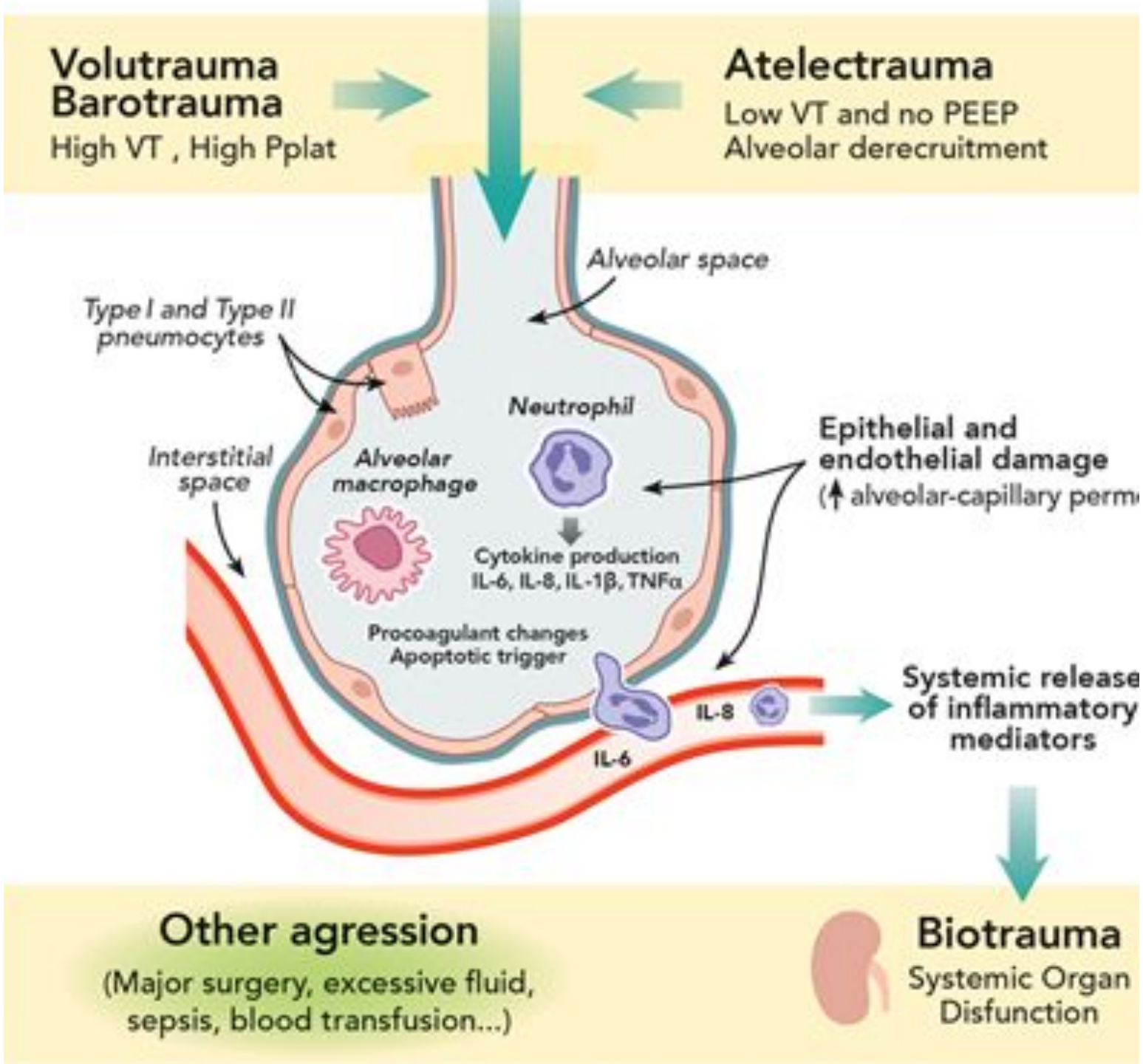
Pablo Cruces, *Critical Care* **volume 24**, : 494 (2020)

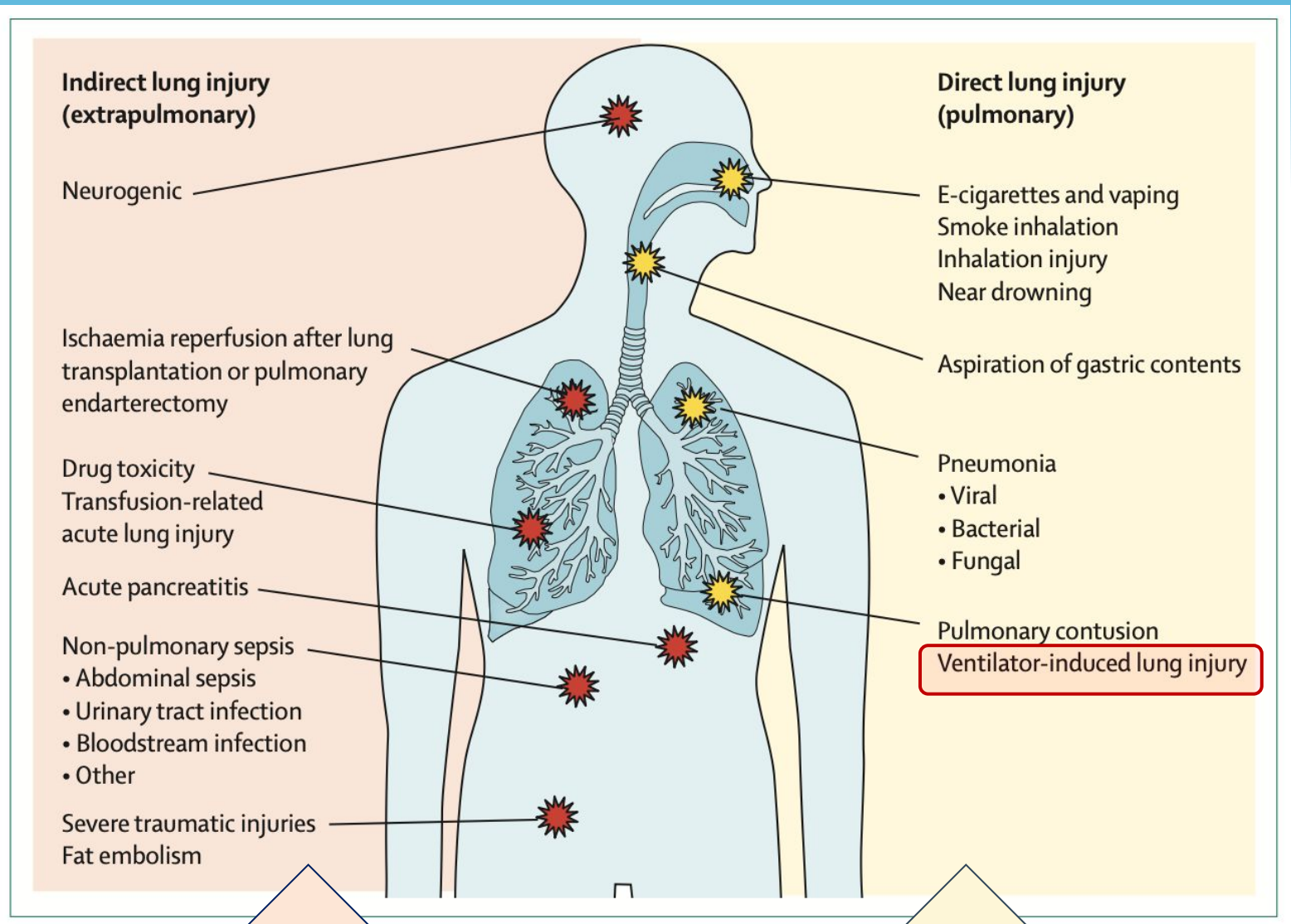
VILI



In **ventilaizone non invasiva**, la pressione di Picco anche modesta (i.e. 10 cmH_2O) **si somma con la pressione negativa che genera il paziente** e si può tradurre in una pressione trans.polmonare anche molto alta

Nel paziente intubato questo fenomeno non c'è perché il paziente è curarizzato !


Volutrauma
Barotrauma
High VT , High Pplat
Atelectrauma
Low VT and no PEEP
Alveolar derecruitment
Alveolar space
Type I and Type II pneumocytes
Neutrophil
Interstitial space
Alveolar macrophage
Epithelial and endothelial damage
(↑ alveolar-capillary perm
Cytokine production
IL-6, IL-8, IL-1β, TNFα
Procoagulant changes
Apoptotic trigger
IL-8
IL-6
Systemic release of inflammatory mediators
Other agression
(Major surgery, excessive fluid, sepsis, blood transfusion...)
Biotrauma
Systemic Organ Disfunction



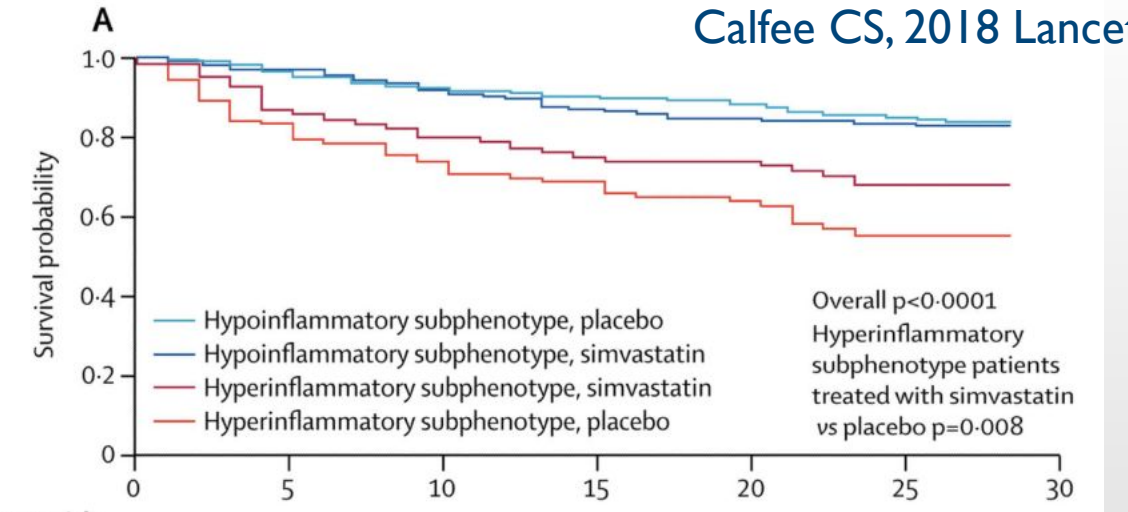
La reazione infiammatoria abnorme distrugge le giunzioni endoteliali (VE-Cadherine) e altera la permeabilità del capillare

Il danno alveolare si sviluppa a livello dell'epitelio alveolare con distruzione degli pneumociti (ATI)

Nelle fasi iniziali dello sviluppo della sindrome, il meccanismo con cui si instaura il danno polmonare avrà implicazioni rilevanti sul trattamento del malato

Implicazioni del fenotipo sul trattamento

Calfee CS, 2018 Lancet Repir Med



Sottoanalisi dello studio HARP-2 (540 pazienti) che confrontava Sinvastatina 80 mg vs Placebo nei pazienti con ARDS.

Il farmaco aveva un effetto significativo sulla mortalità nel sottotipo Iper-infiammatorio.

Calfee CS, 2014 Lancet Repir Med

Differences in response to PEEP strategy by probable latent class assignment, in ALVEOLI Cohort

	Phenotype 1 (n=404)		Phenotype 2 (n=145)		
	Low PEEP (n=202)	High PEEP (n=202)	Low PEEP (n=71)	High PEEP (n=74)	p-value*
Dead at 90 days, n (%)	33 (16%)	48 (24%)	36 (51%)	31 (42%)	0.049
Ventilator Free Days, median (IQR)	20 (10, 25)	21 (3, 24)	2 (0, 21)	4.5 (0, 20)	0.018
Organ Failure Free Days, median (IQR)	22 (11, 26)	22 (9, 26)	4 (0, 18)	6.5 (0, 21)	0.003
p-value for interaction between PEEP assignn					

Ipo-infiammatorio Iper-infiammatorio

Sottoanalisi dei dati provenienti da due studi (ARMA e ALVEOLI) che confrontava bassi valori di PEEP verso alti valori di PEEP nei pazienti con ARDS.

Il valore di PEEP ideale dipendeva dal fenotipo dell'ARDS

Association between ARDS Etiology and Risk of Noninvasive Ventilation Failure

Weiwei Shu[1,2*], Shuliang Guo[1*], Fuxun Yang[3*], Bicui Liu[4*], Zhongxing Zhang[5*], Xiaoyi Liu[6*], Baixu Chen[7], Tao Huang[8], Liucun Li[9], Ke Wang[10], Dehua He[11], Qimin Chen[11], Bilin Wei[12], Lijuan Chen[13], Manyun Tang[14], Guodan Yuan[15], Min Mao[16], ZhiJun Tang[17], Fei Ding[4], Wenpin Ge[5], Xiaoli Han[1], Rui Zhang[1], Lei Jiang[1], Linfu Bai[1], and Jun Duan[1]

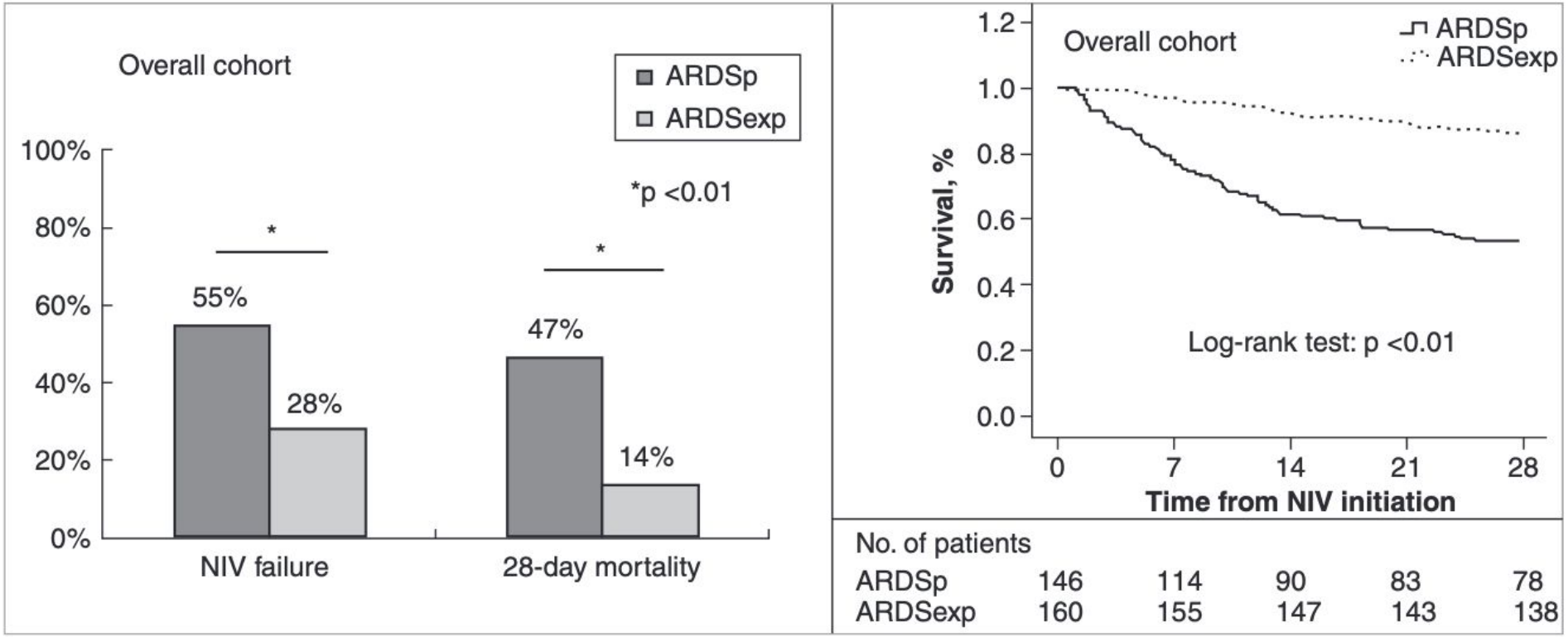


Figure 3. Noninvasive ventilation (NIV) failure and 28-day mortality in patients with pulmonary acute respiratory distress syndrome (ARDSp) and extrapulmonary acute respiratory distress syndrome (ARDSexp). *$P < 0.01$.

Ann Am Thorac Soc 2022; 19:255-253.

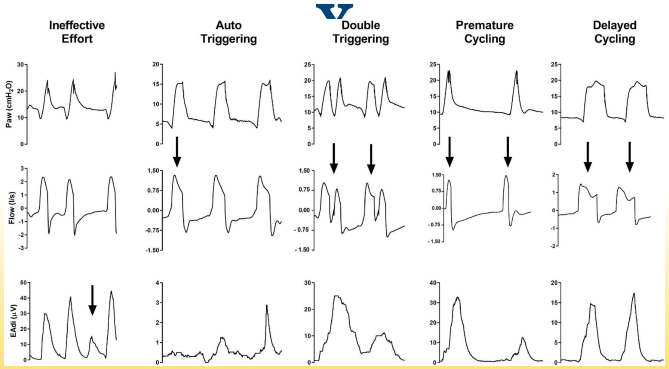
CLINICAL SCORES

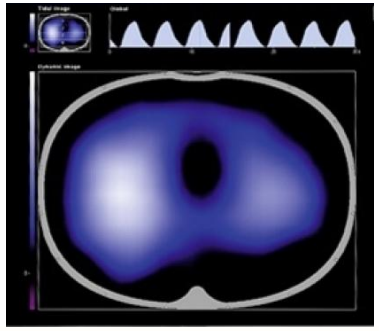
ROX – HANCOR – P_{CO_2} - Fr

VILI / PSILI

DIAPHRAGM ULTRASOUND

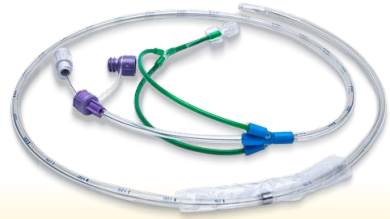
DISSINCRON





ELECTRIC IMPADENCE TOMOGRAPY

ESOPHAGEAL PRESSURE MEASURMENTS



ECMO

- P/F < 80
- Ipercapnia ed acidosi non compensabili (*i.e pH < 7.15*)
- Pressione di plateau troppo alte (*>35-40 cmH_2O*)
- Strategie ventilatorie estreme (*i.e. decapnizzazione per permettere volumi molto bassi*)

Brodie D, Bacchetta M. Extracorporeal membrane oxygenation for ARDS in adults. *N Engl J Med* 2011;365:1905-14

Take home messages

- Necessità di una diagnosi precoce
- Strategie di ventilazione estremamente prudenti e complesse
- Fenotipi differenti, che si possono giovare di terapie differenti
- Pazienti con progressione rapida e catastrofica della funzione polmonare (a volte iatrogena).

Prospettive di ricerca in Emergenza

- Abbiamo bisogno di implementare i percorsi clinici di questi malati.
- Abbiamo bisogno di strumenti che ci permettano di scegliere la ventilazione che non arrechi danno ai pazienti.
- Abbiamo bisogno di strumenti che consentano di identificare precocemente il fallimento della metodica.

Grazie dell’attenzione