



Creteil

22^{ème} Journée d'Actualités en Ventilation Artificielle

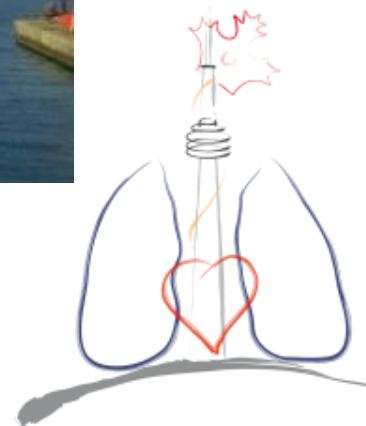


ARDS
Du Baby Lung au DeltaP
Laurent Brochard
Toronto



UNIVERSITY OF
TORONTO

Interdepartmental
Division of Critical
Care Medicine

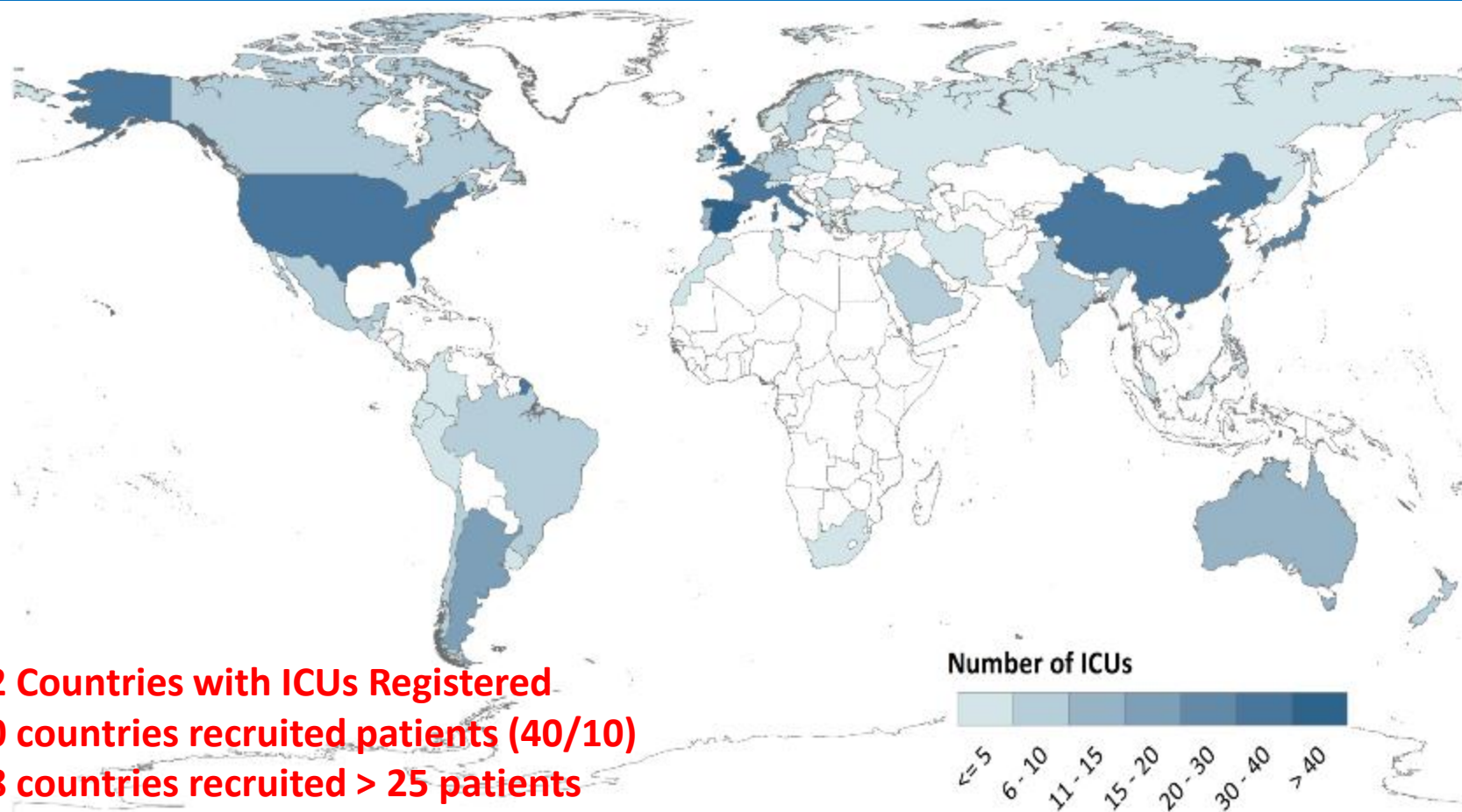


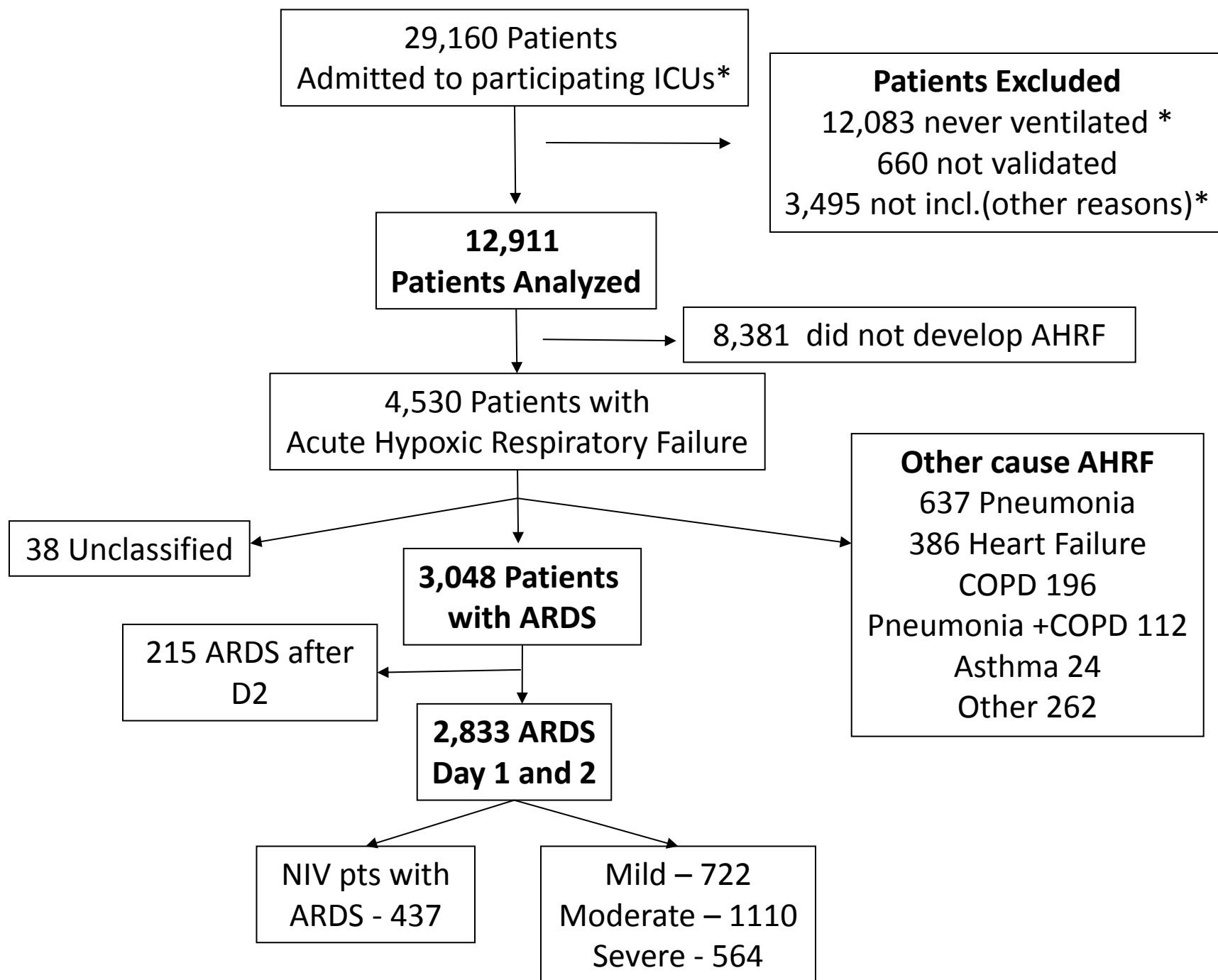
Conflicts of interest

- Our clinical research laboratory has received research grants for clinical trials from the following companies:
 - General Electric (FRC); educational tool (EELV and recruitment)
 - Respironics (NIV)
 - Fisher Paykel (Optiflow).
 - Covidien (PAV+).
 - Philips (Sleep studies)
 - Maquet (NAVA)

LUNG-SAFE: Large observational study to UNderstand the Global impact of Severe Acute respiratory Failure

Distribution of Participating ICUs







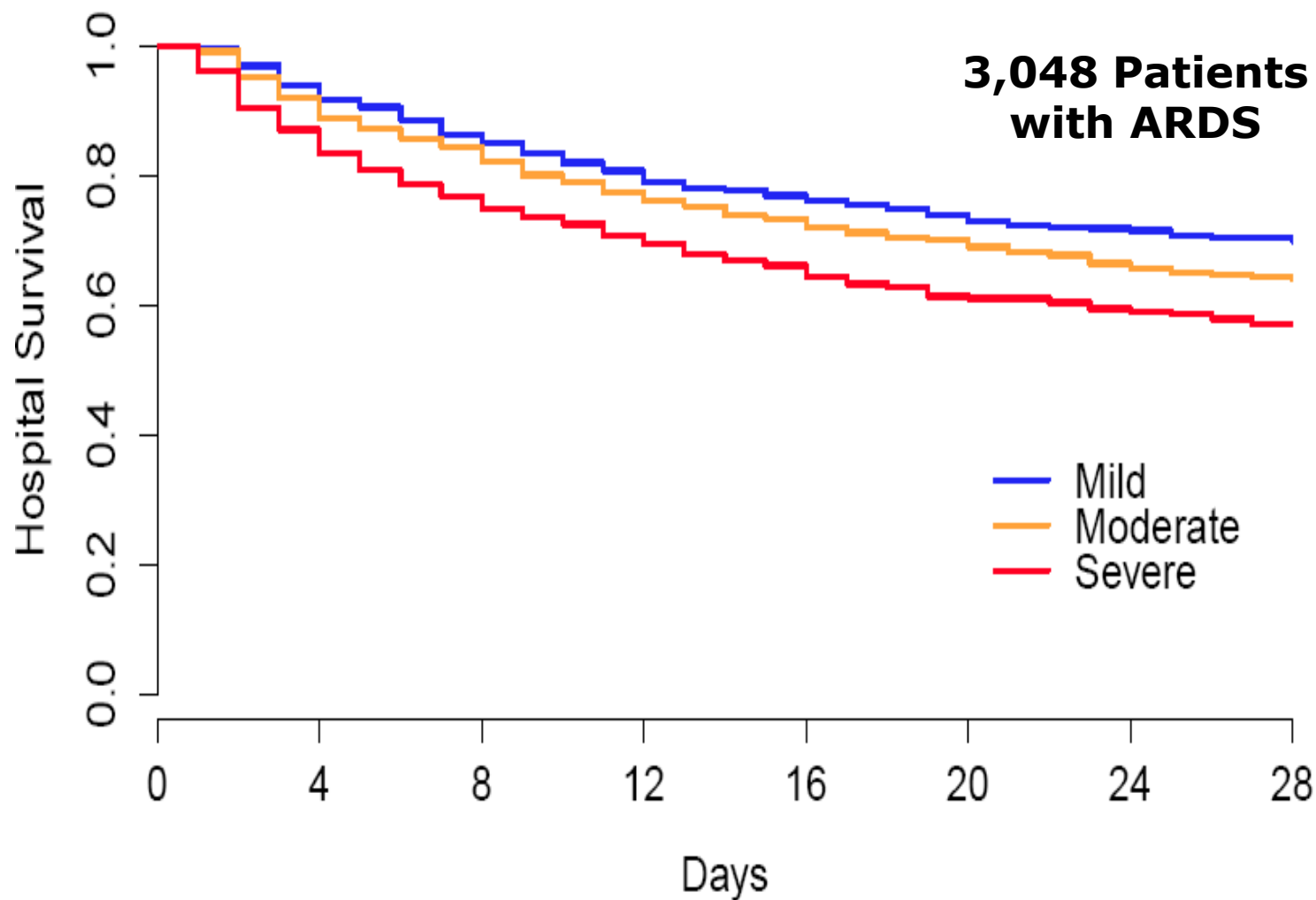
ICU incidence of ARDS

- 8.6% of all ICU Admissions
- 22% of all ventilated ICU patients
- 5.5 patients per ICU bed per year
- Limited Geographic variation [cases/ICU bed/year]
 - Europe 5.7
 - North America 5.4
 - Asia 3.8
 - Africa 4.2
 - Oceania 6.8





ARDS Survival to Day 28



Unpublished Data



ARDS Management :

Lung volume, stress and strain

- Lung volume (FRC)
- Driving pressure

Luciano Gattinoni
Antonio Pesenti

The concept of “baby lung”

Conclusions:

From a physiological perspective the “baby lung” helps to understand ventilator-induced lung injury. In this context, what appears dangerous is not the V_T /kg ratio but instead the V_T /“baby lung” ratio. The practical message is straightforward: the smaller the “baby lung,” the greater is the potential for unsafe mechanical ventilation.

Stress (pressure) and Strain (deformation)

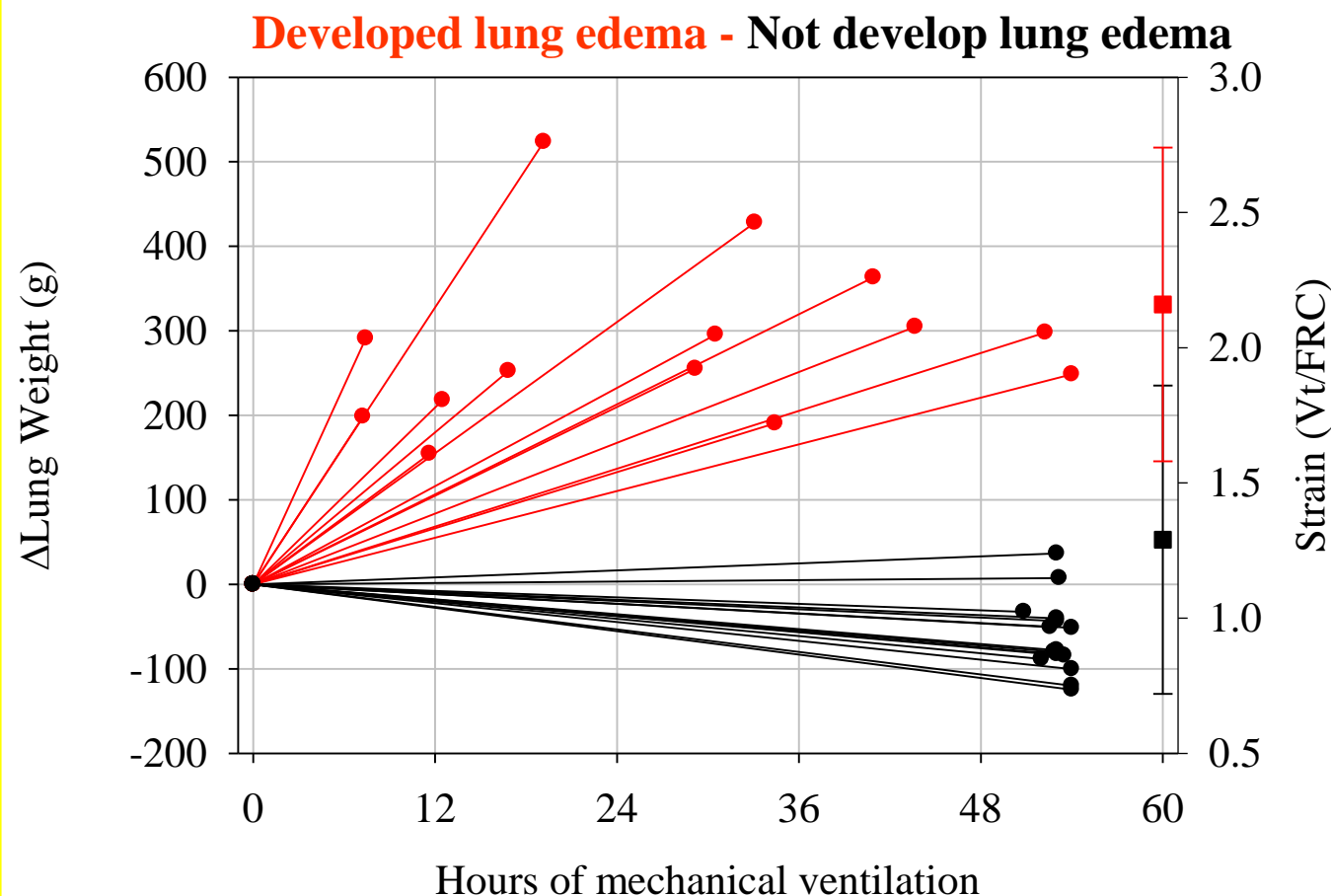
- Strain= Increase in lung volume / FRC
- Strain= Increase in lung volume / FRC + recruited volume

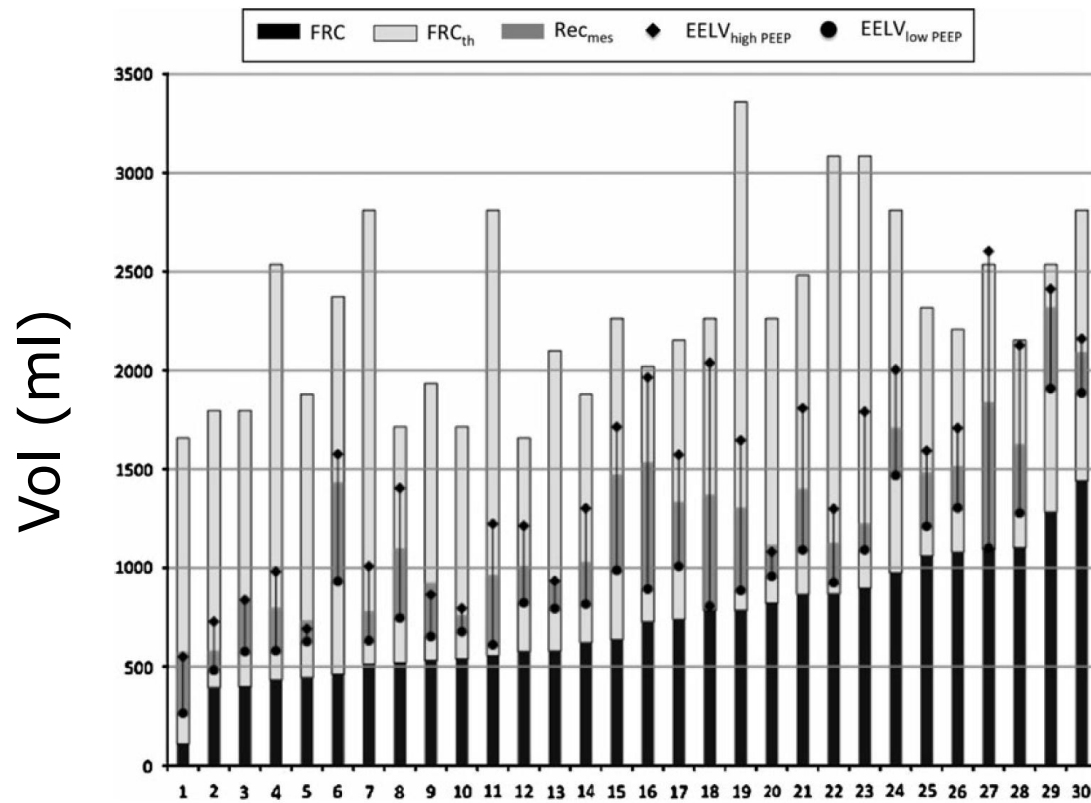
Lung Stress and Strain during Mechanical Ventilation

Any Safe Threshold?

Alessandro Protti¹, Massimo Cressoni¹, Alessandro Santini¹, Thomas Langer¹, Cristina Miletto¹, Daniela Febres¹, Monica Chierichetti¹, Silvia Coppola¹, Grazia Conte², Stefano Gatti², Orazio Leopardi¹, Serge Masson³, Luciano Lombardi⁴, Marco Lazzerini⁴, Erica Rampoldi⁵, Paolo Cadringer¹, and Luciano Gattinoni^{1,6}

Time course of ventilator induced lung injury





Compliance and Delta P

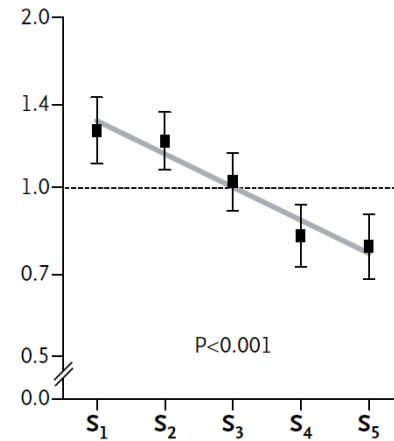
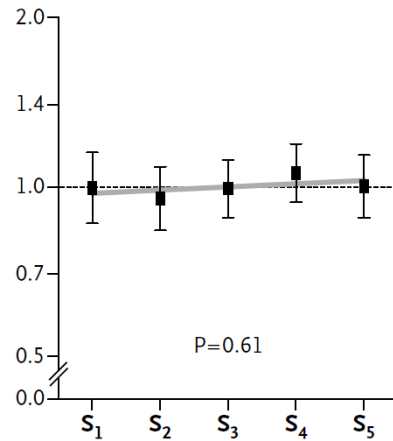
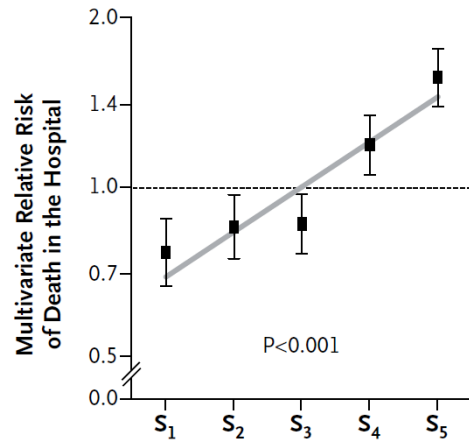
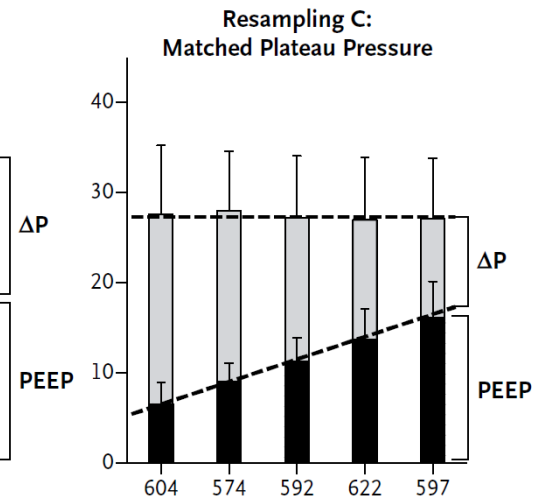
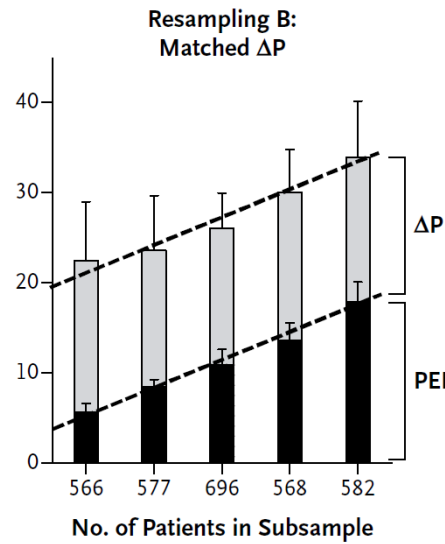
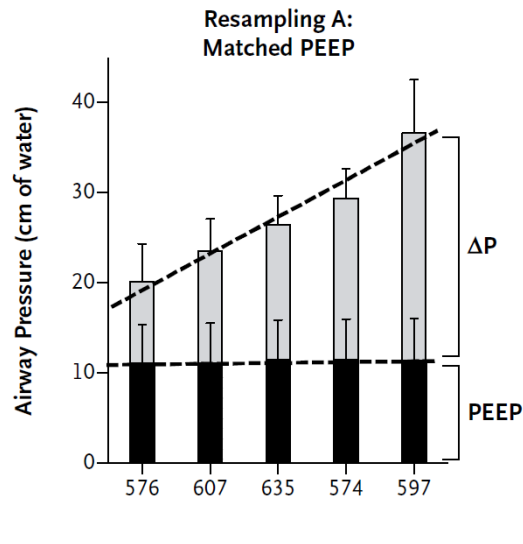
- $C = k \text{ FRC}$
- $C = \text{Vol} / \text{Elastic pressure}$
- $C = V_t / \text{Driving pressure}$
- $\text{Driving pressure} = V_t / C$
- $\text{Driving pressure} \approx V_t / k \text{ FRC}$

SPECIAL ARTICLE

Driving Pressure and Survival in the Acute Respiratory Distress Syndrome

Marcelo B.P. Amato, M.D., Maureen O. Meade, M.D., Arthur S. Slutsky, M.D.,
Laurent Brochard, M.D., Eduardo L.V. Costa, M.D., David A. Schoenfeld, Ph.D.,
Thomas E. Stewart, M.D., Matthias Briel, M.D., Daniel Talmor, M.D., M.P.H.,
Alain Mercat, M.D., Jean-Christophe M. Richard, M.D.,
Carlos R.R. Carvalho, M.D., and Roy G. Brower, M.D.

patients with ARDS, the proportion of lung available for ventilation is markedly decreased, which is reflected by lower respiratory-system compliance (C_{RS}).^{13,16-18} Therefore, we hypothesized that normalizing V_T to C_{RS} and using the ratio as an index indicating the “functional” size of the lung would provide a better predictor of outcomes in patients with ARDS than V_T alone. This ratio, termed the driving pressure ($\Delta P = V_T / C_{RS}$), can be routinely calculated for patients who are not making inspiratory efforts as the plateau pressure minus PEEP.



A

B

C

Contrast

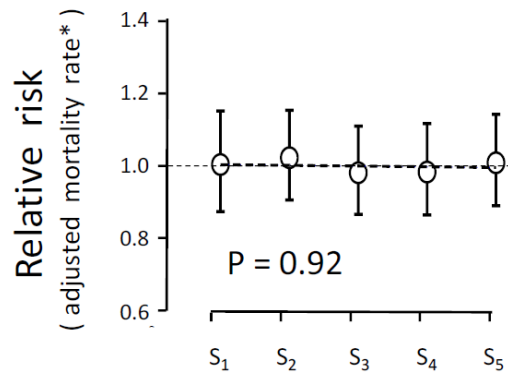
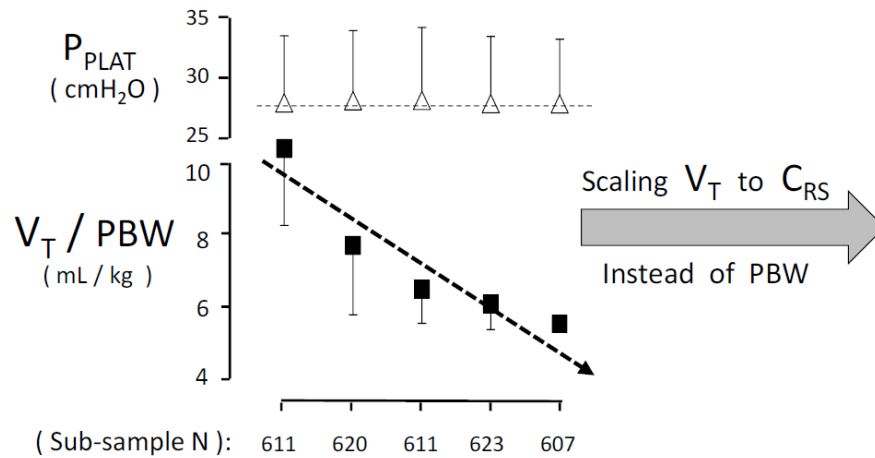
Contrast

Higher plateau pressure: Not always risky

Higher PEEP: Not always protective

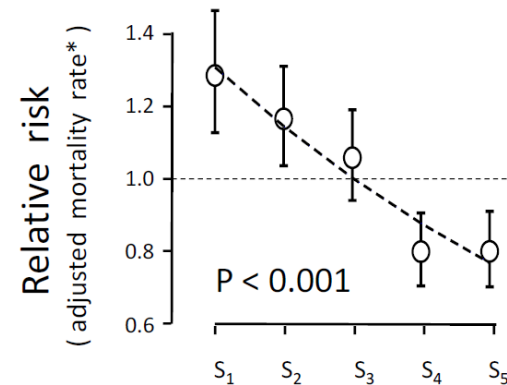
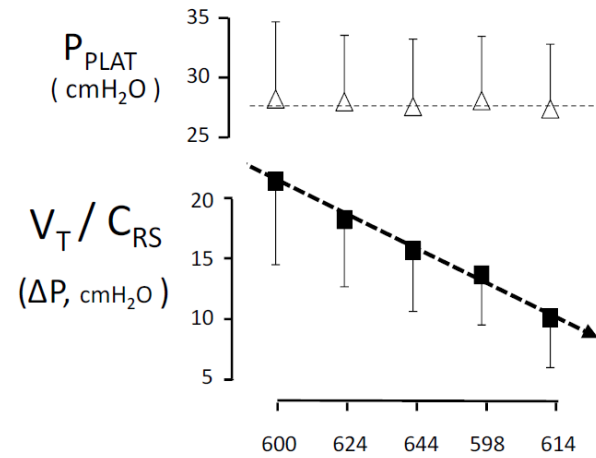
Resampling D

- matched P_{PLAT} ,
- decreasing ranks of V_T / PBW

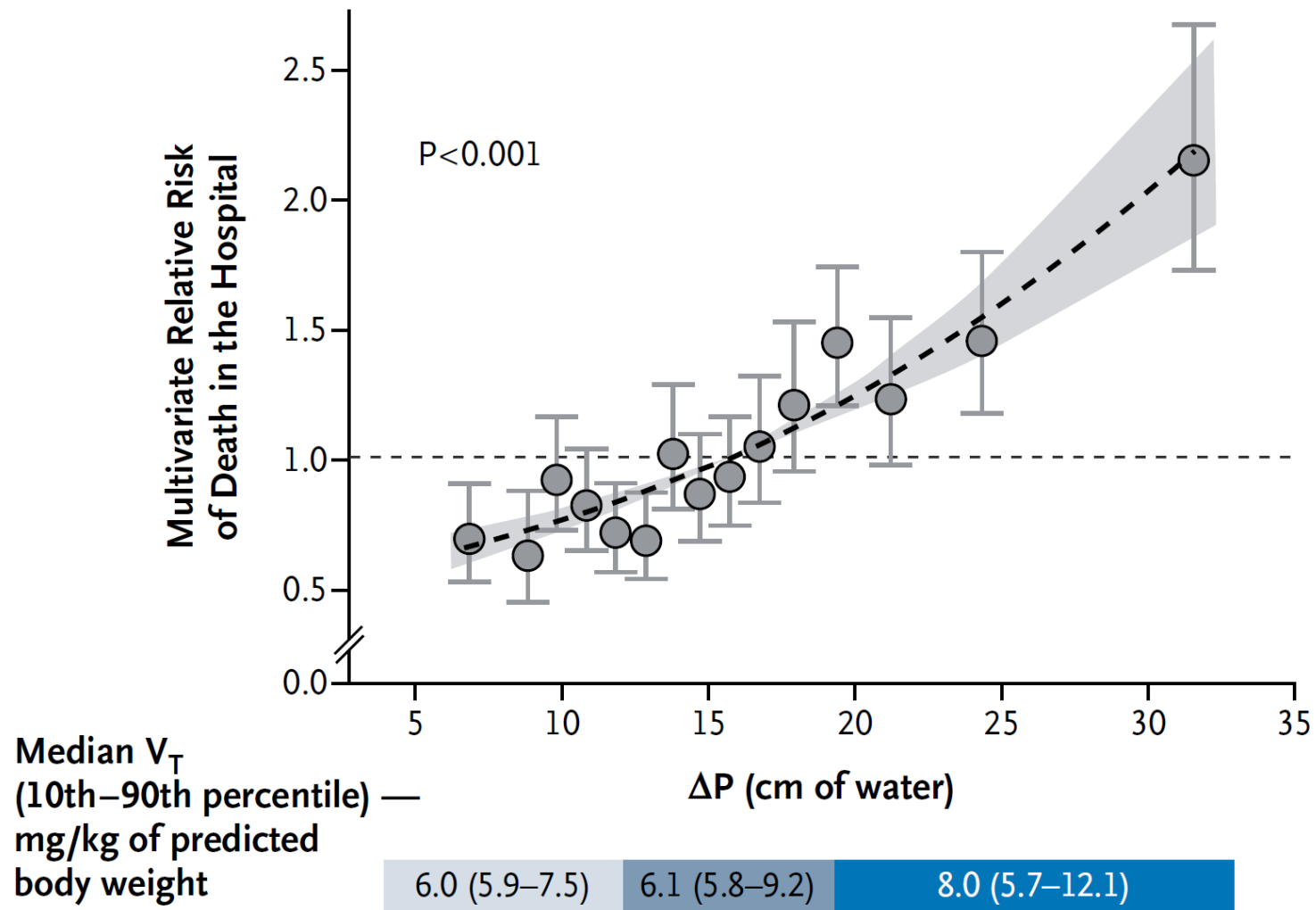


Resampling E

- matched P_{PLAT} ,
- decreasing ranks of $V_T / C_{\text{RS}} (= \Delta P)$



* : mortality rate adjusted for age, APACHE/SAPS risk, arterial-pH, P/F ratio, and Trial (Cox Proportional Hazard Regression)

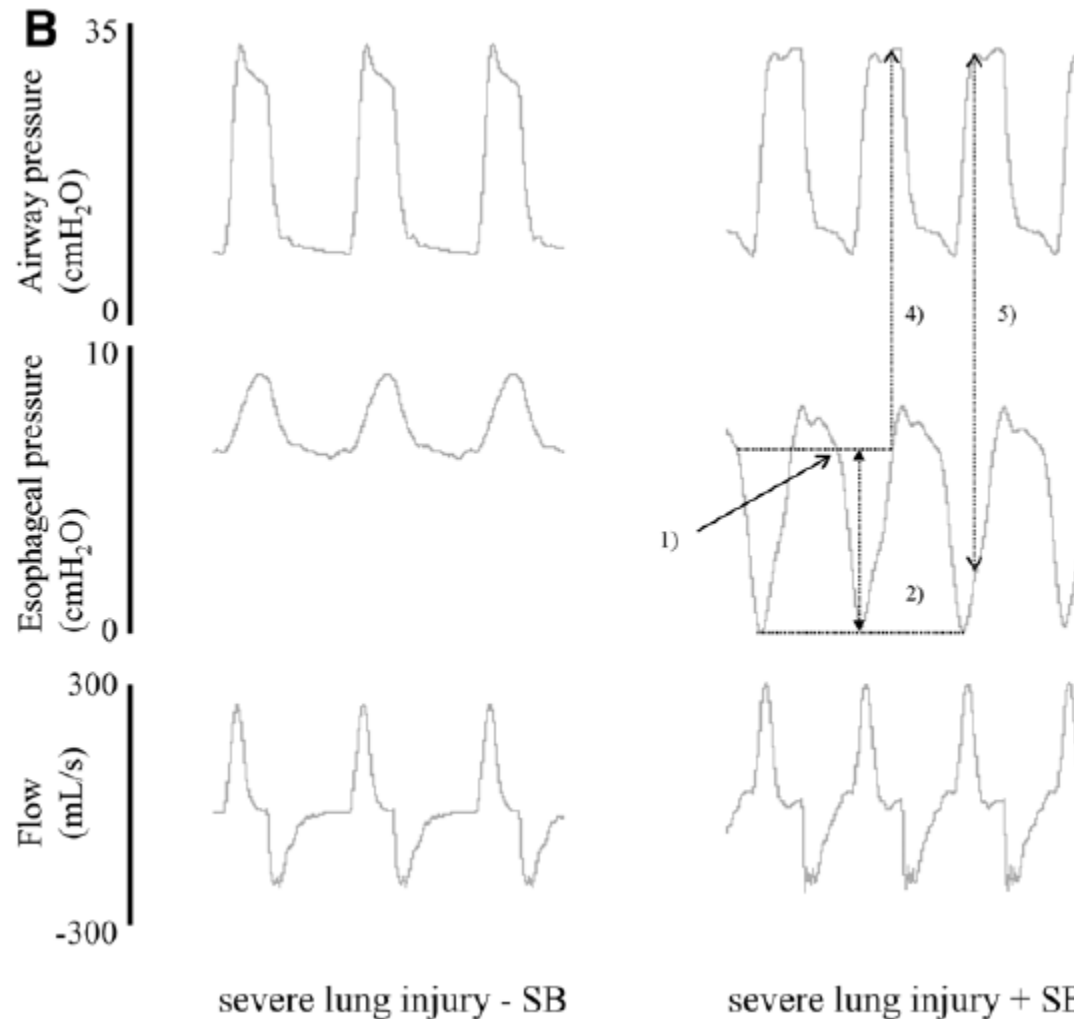


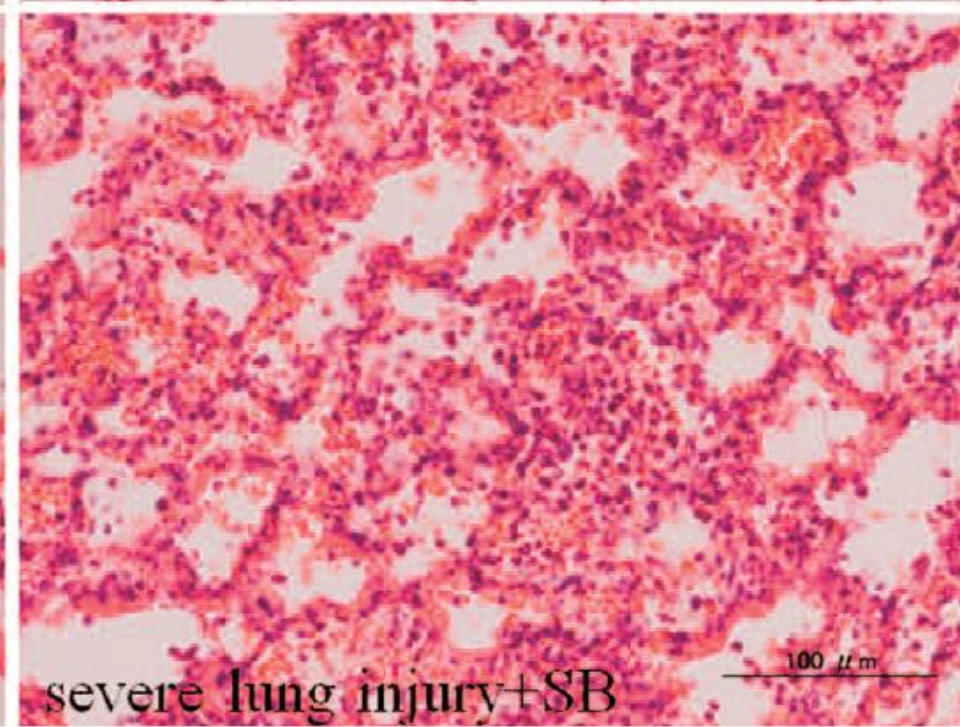
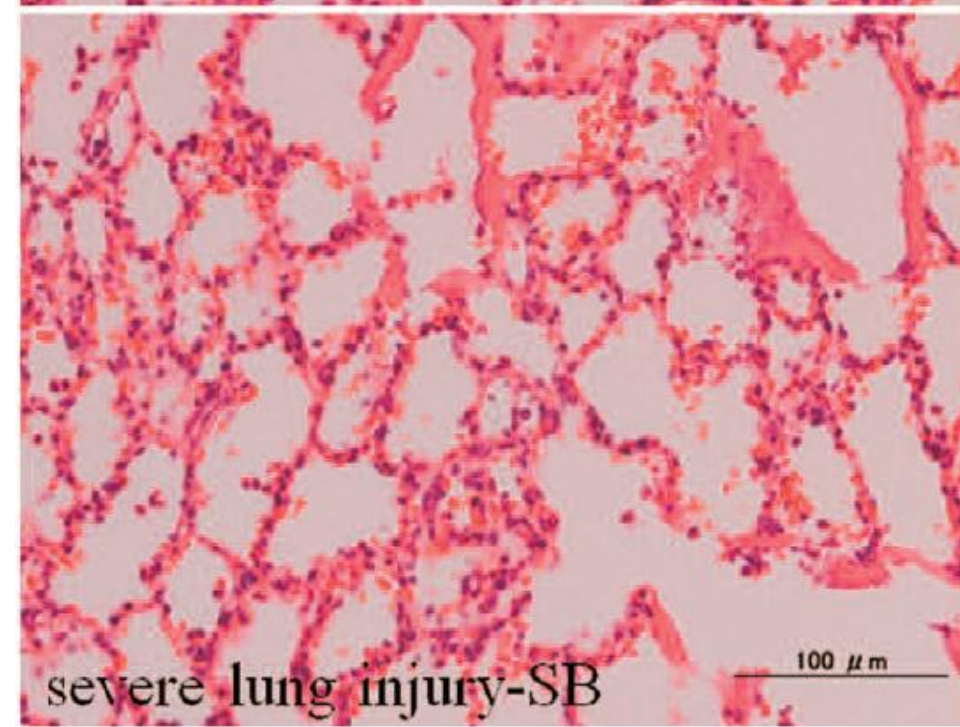
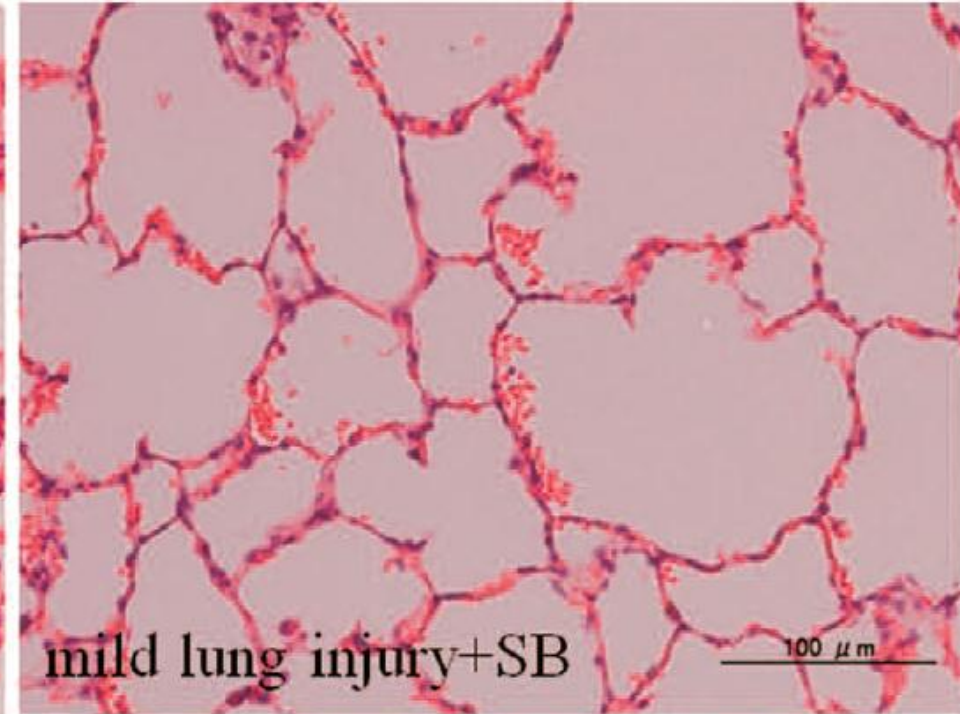
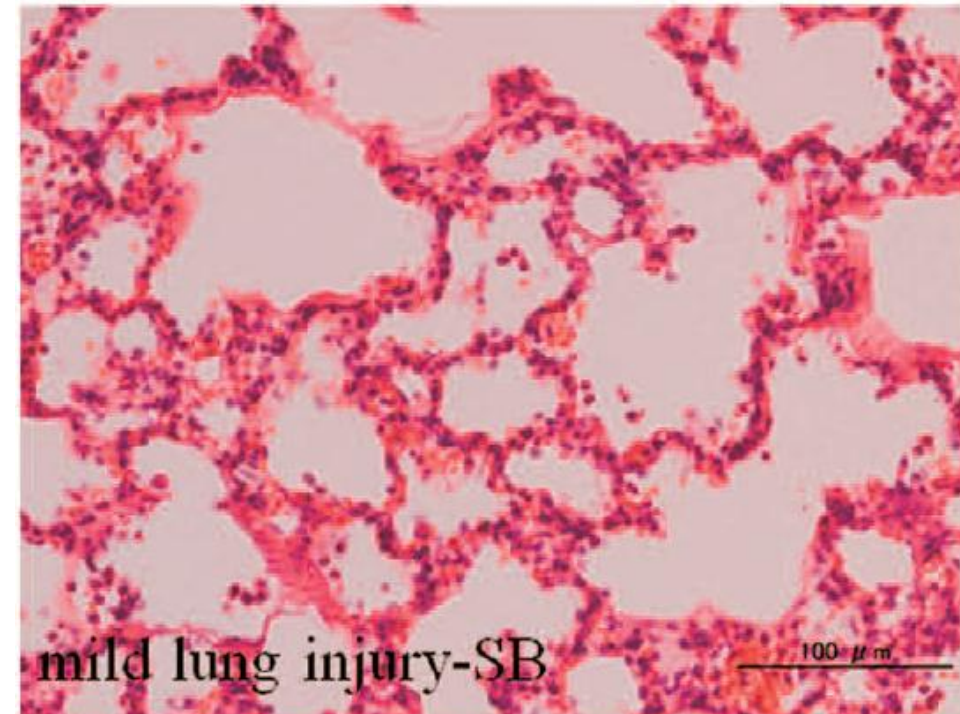
The Comparison of Spontaneous Breathing and Muscle Paralysis in Two Different Severities of Experimental Lung Injury*

Takeshi Yoshida, MD^{1,2}; Akinori Uchiyama, MD, PhD²; Nariaki Matsuura, MD, PhD³;

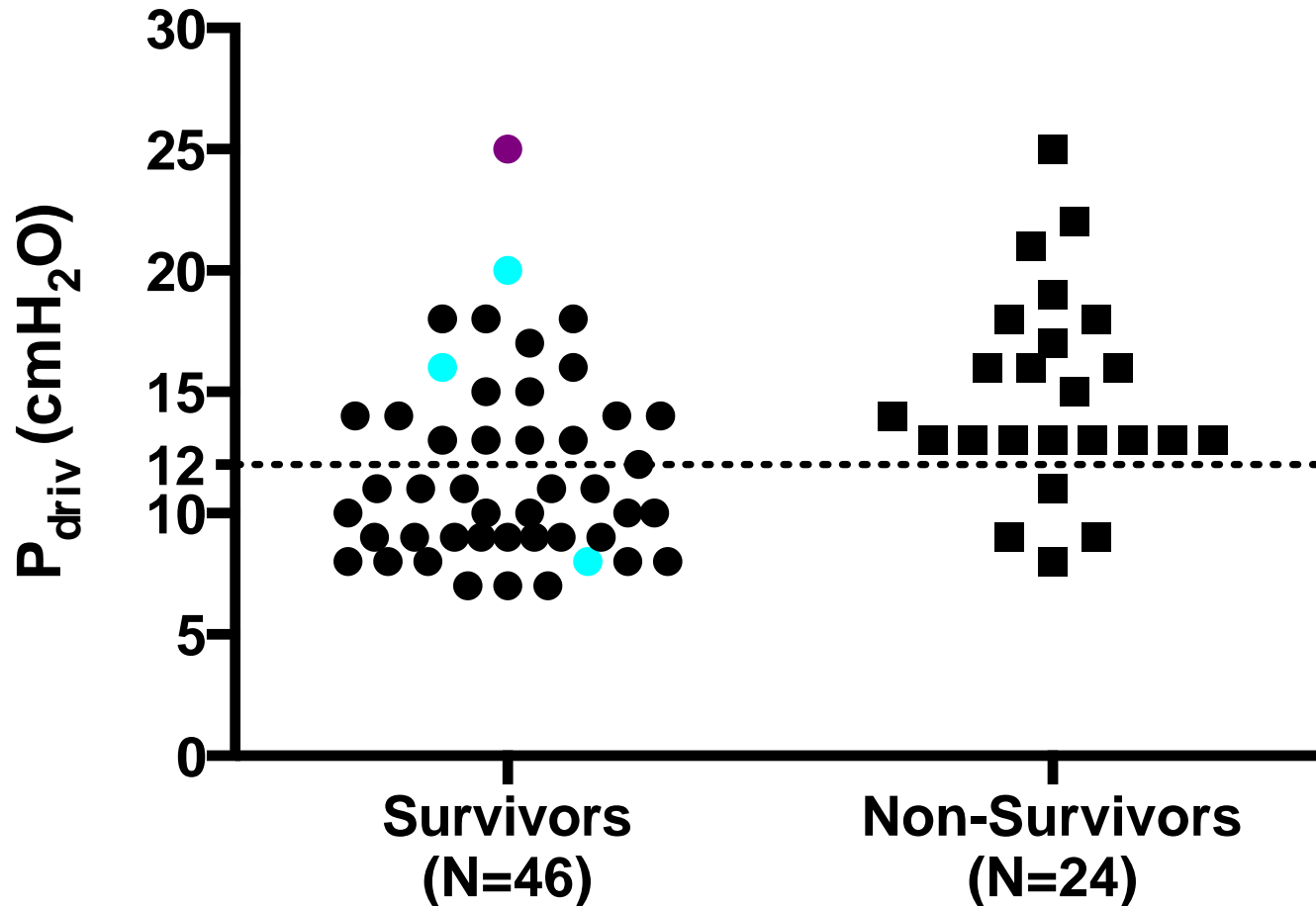
Takashi Mashimo, MD, PhD²; Yuji Fujino, MD, PhD²

[*Crit Care Med* 2013; 41:536–545]

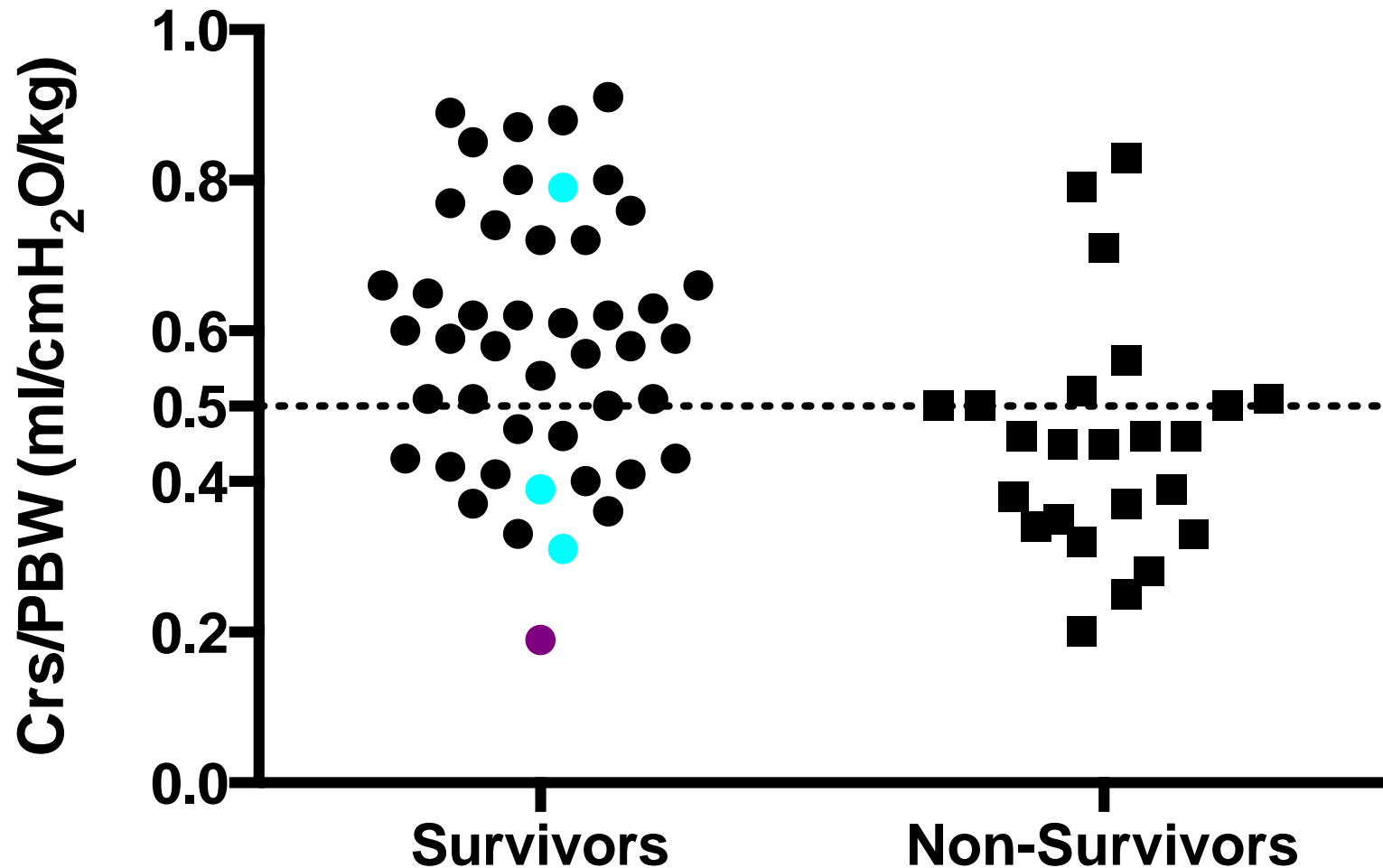




Driving pressure and 30-Day outcome (N=70)



Crs/PBW and 30-Day outcome (N=70)

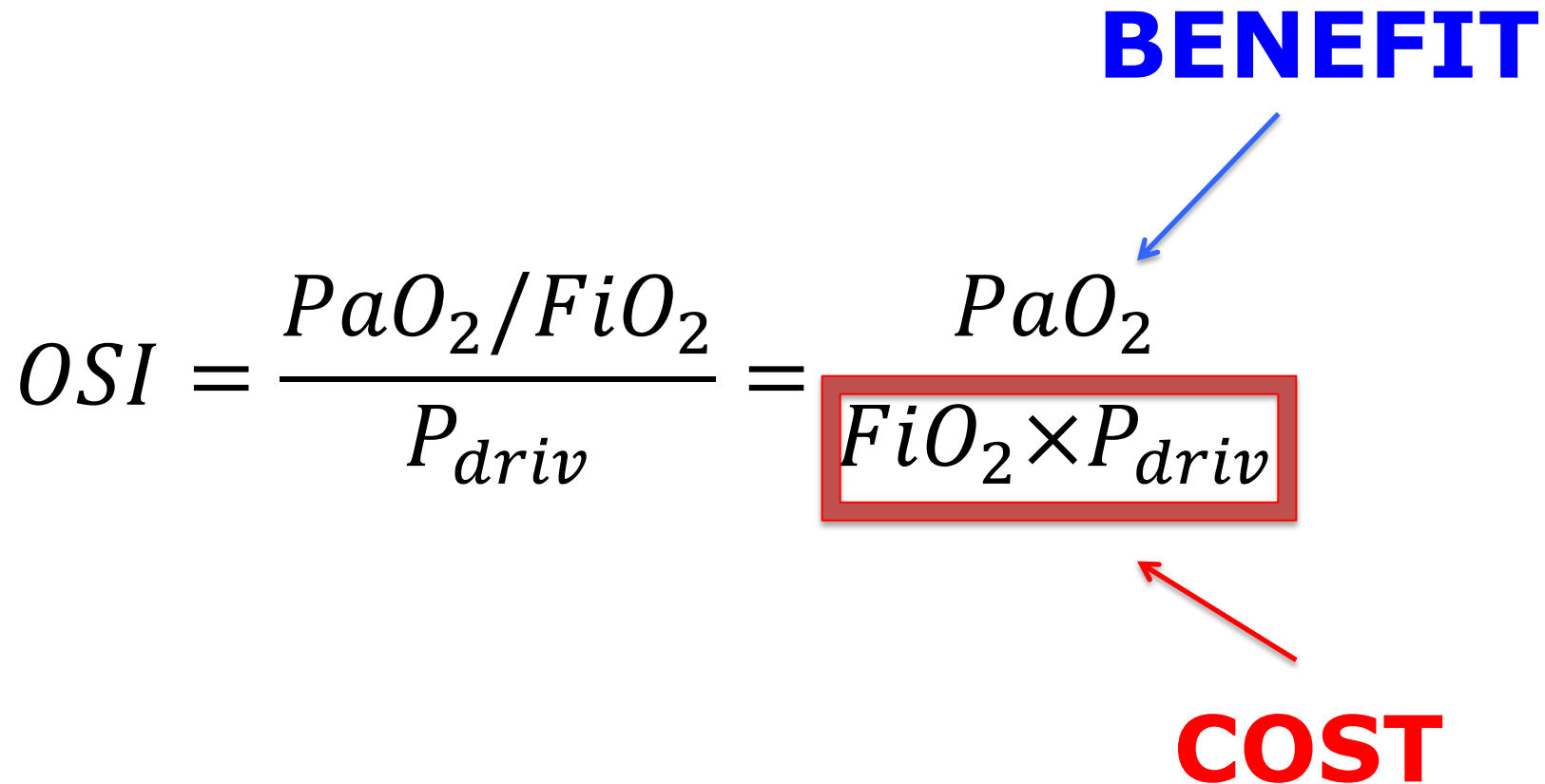


Oxygenation Stretch Index

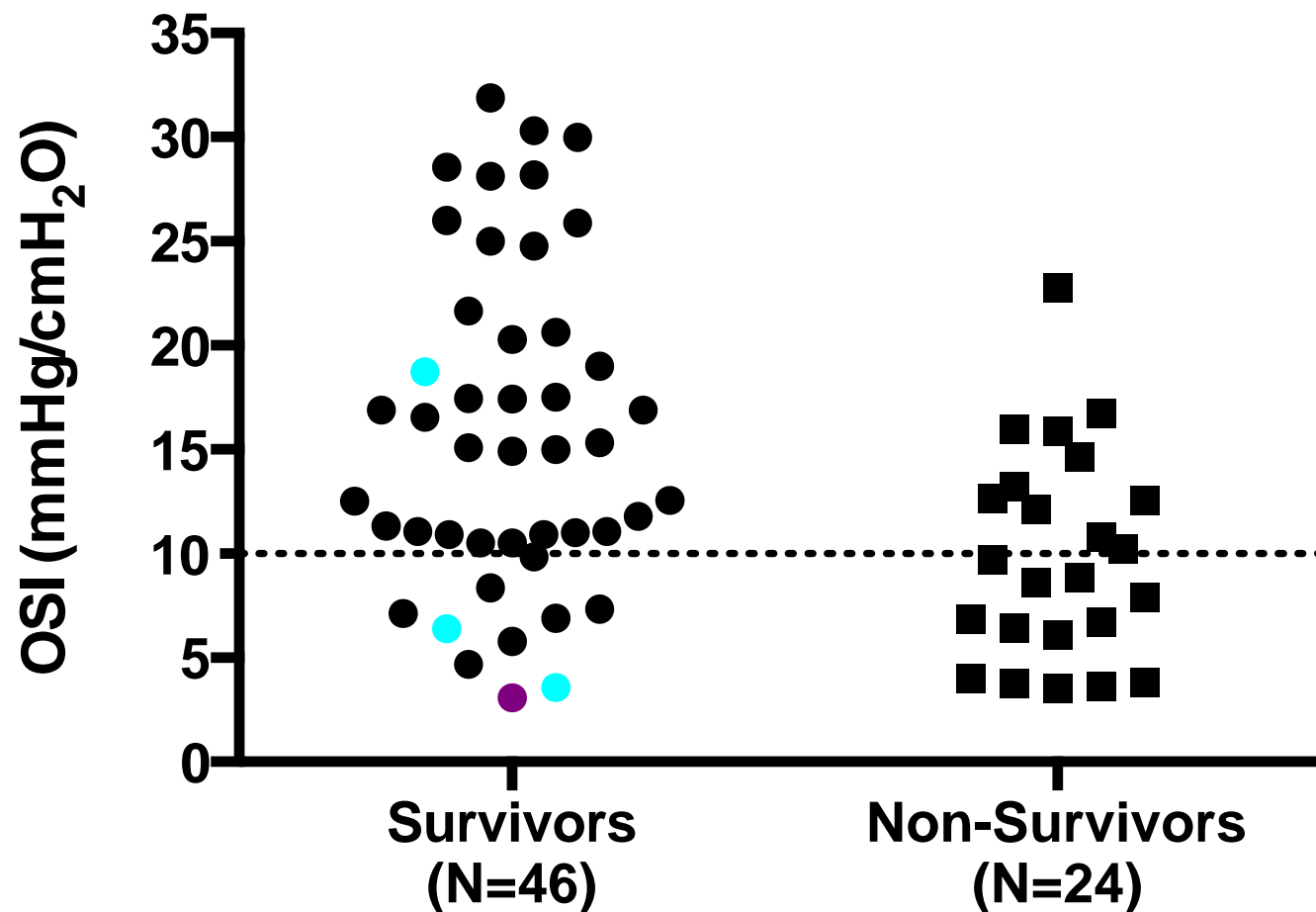
$$OSI = \frac{PaO_2/FiO_2}{P_{driv}} = \frac{PaO_2}{FiO_2 \times P_{driv}}$$

BENEFIT

COST



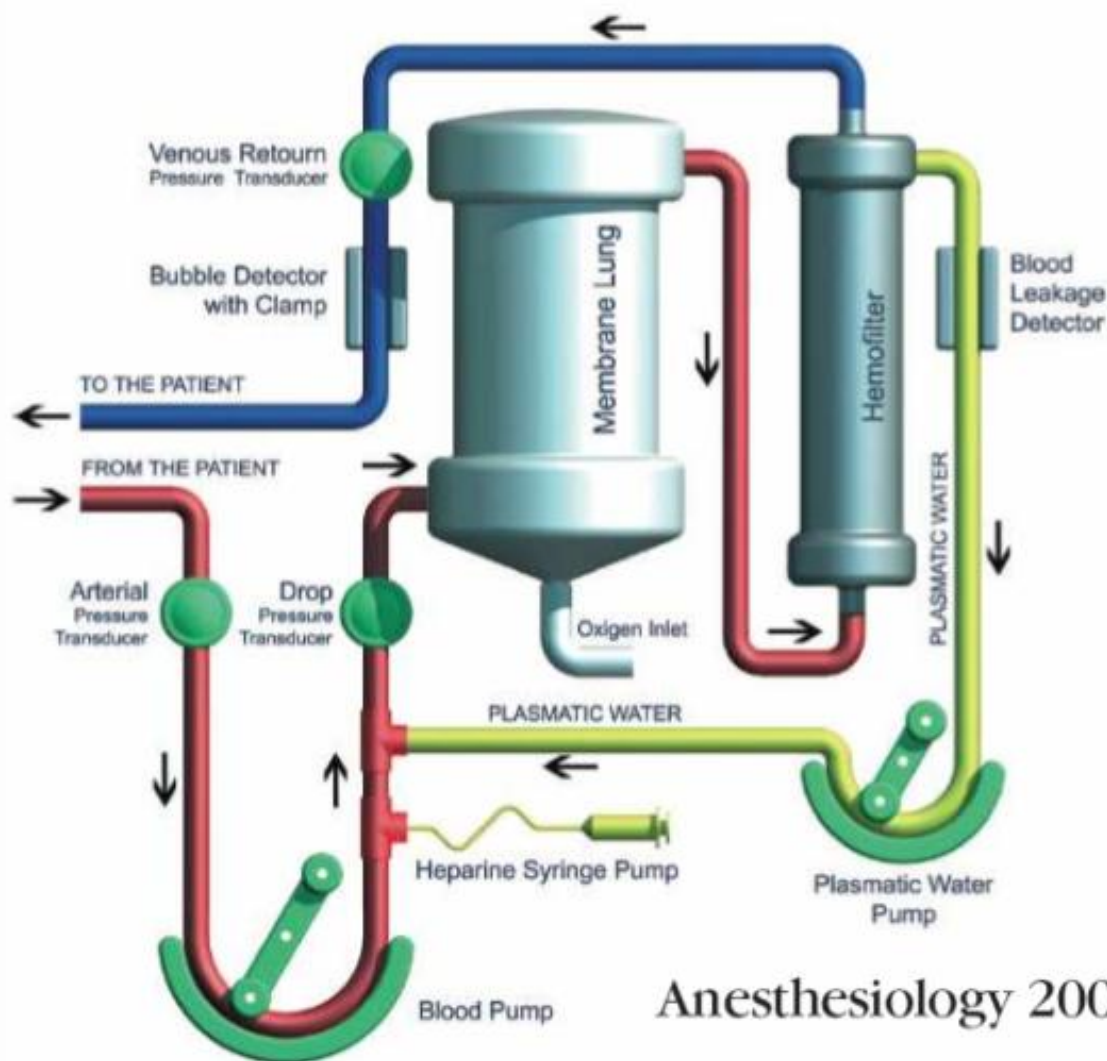
Oxygenation Stretch Index and 30-Day outcome (N=70)



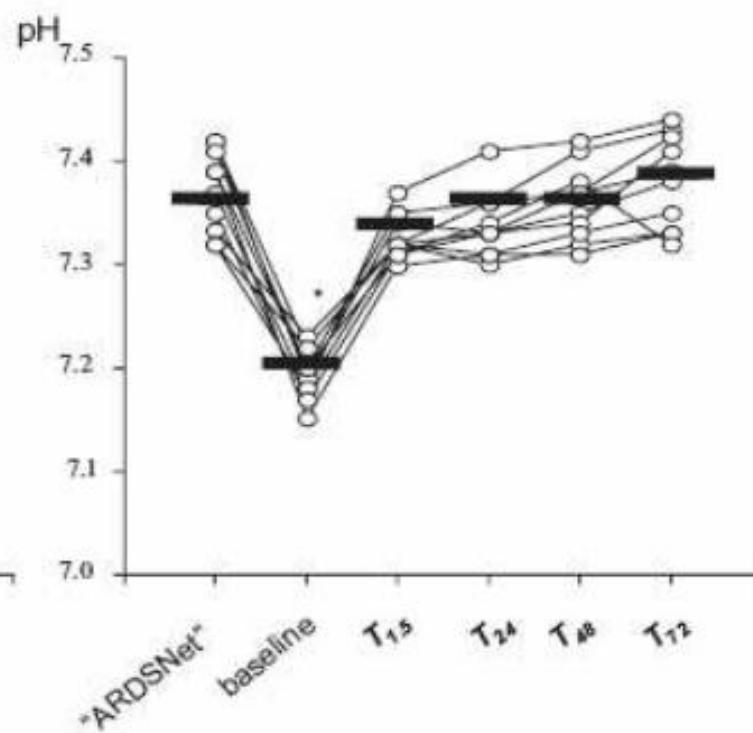
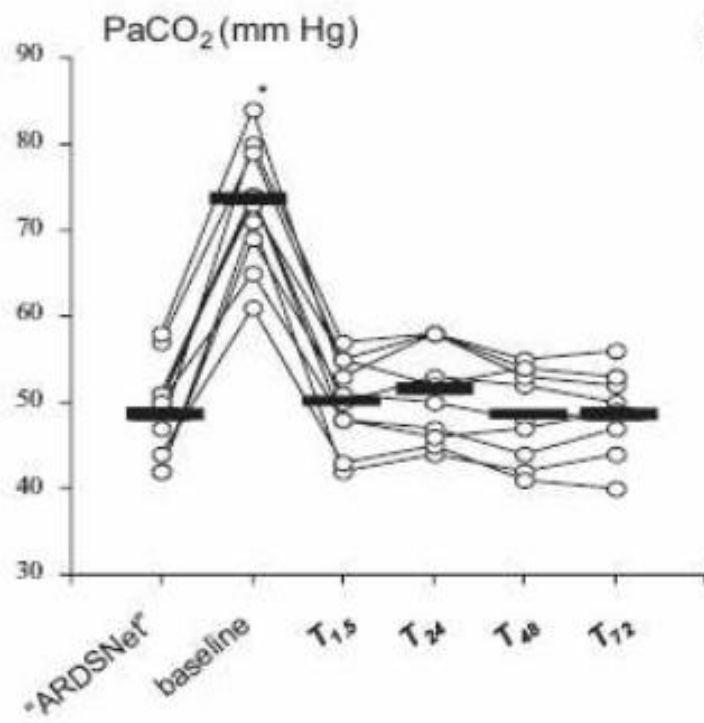
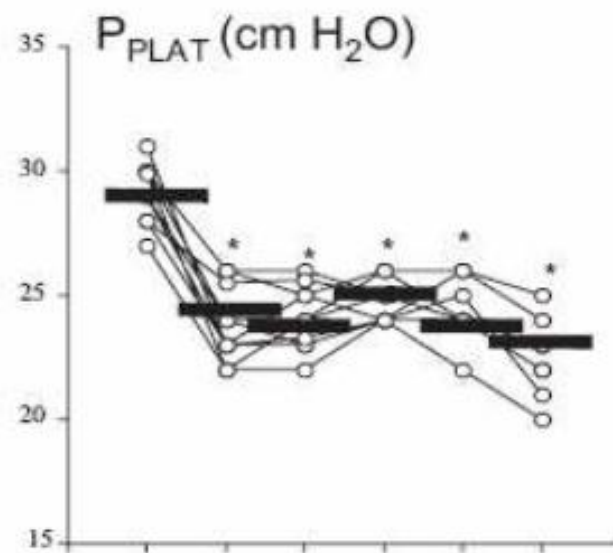
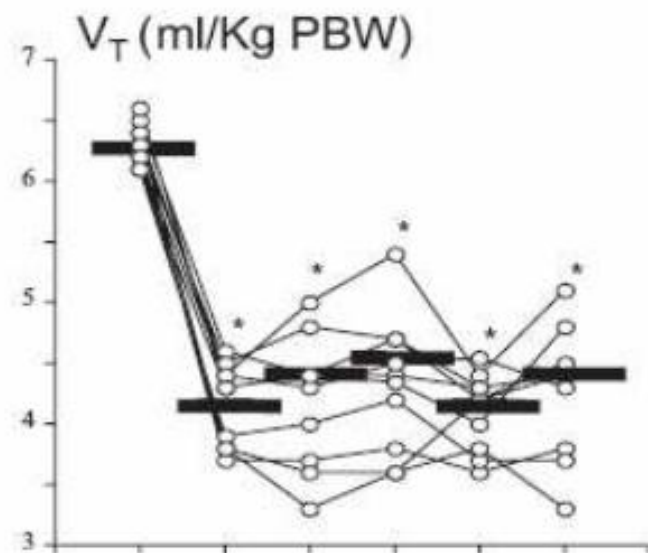
Tidal Volume Lower than 6 ml/kg Enhances Lung Protection

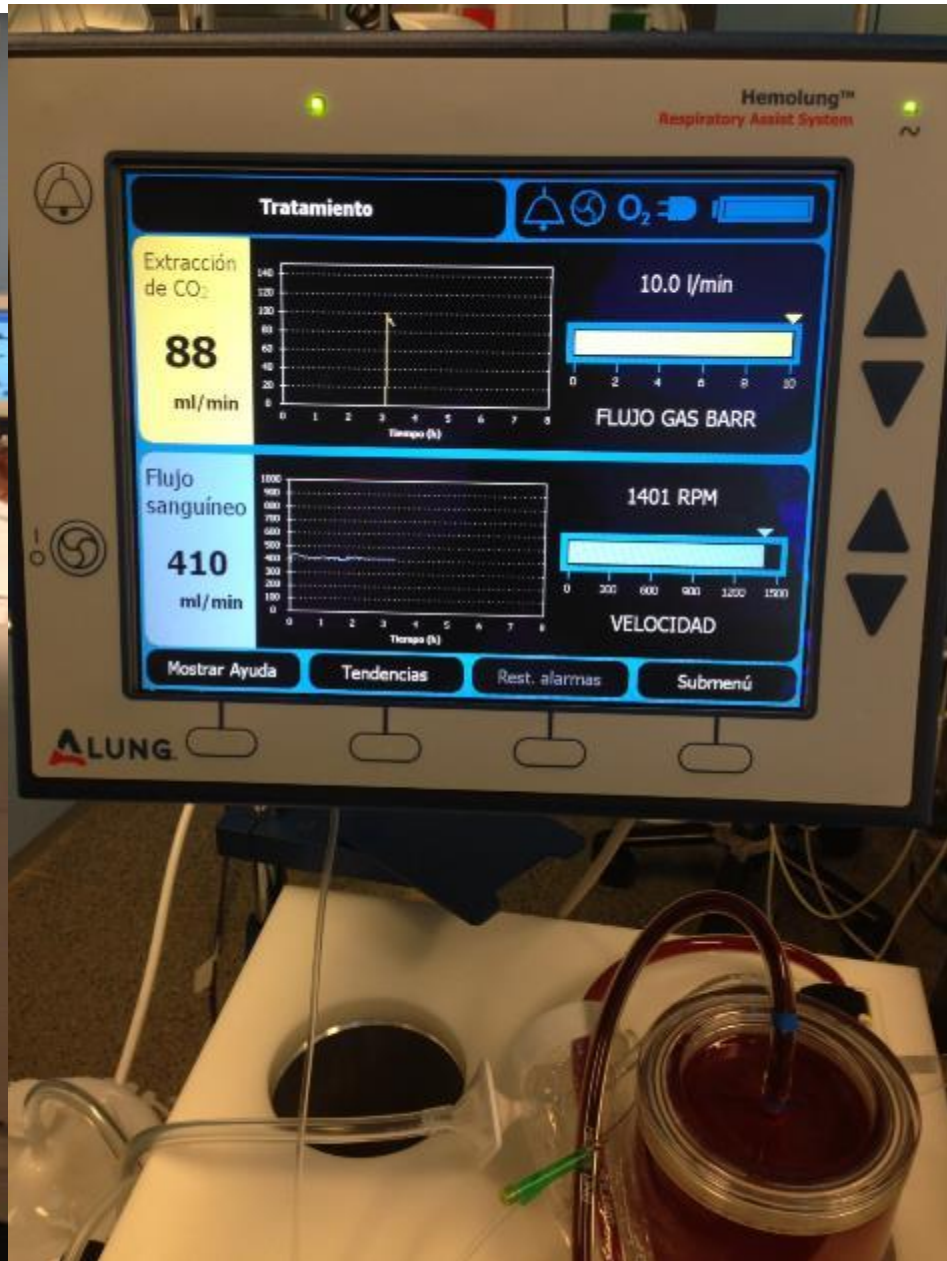
Role of Extracorporeal Carbon Dioxide Removal

Pier Paolo Terragni, M.D.,* Lorenzo Del Sorbo, M.D.,* Luciana Mascia, M.D., Ph.D.,* Rosario Urbino, M.D.,* Erica L. Martin, Ph.D.,* Alberto Birocco, M.D.,† Chiara Faggiano, M.D.,† Michael Quintel, M.D.,‡ Luciano Gattinoni, M.D.,§ V. Marco Ranieri, M.D.||



Anesthesiology 2009; 111:826-35





Conclusion

- Reducing VILI is still one of the most important possibility to improve survival in ARDS
 - To recognize ARDS
 - To estimate severity
 - To better individually titrate V_t (strain) and PEEP (strain vs. recruitment)
 - To assess the need for and magnitude of spontaneous breathing
 - To understand the physiology behind MV

Thank you

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