Le cercle infernal de l'insuffisance respiratoire aigüe

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UNIVERSITY OF TORONTO

Interdepartmental Division of Critical Care Medicine

the PLG

ReVA Réseau Européen

Conflicts of interest

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

Critical care 1

Clinical challenges in mechanical ventilation

Ewan C Goligher, Niall D Ferguson, Laurent J Brochard

Enhance perfusion of ventilated regions
Increase cardiac output*
Avoid lung overdistension (consider reducing PEEP)
Inhaled pulmonary vasodilators
Prone positioning

Enhance mixed venous oxygenation
Increase cardiac output
Veno-venous extracorporeal membrane oxygenation

Enhance ventilation of perfused regions
Lung recruitment manoeuvres
Higher PEEP
Prone positioning

THE LANCET

Lancet 2016

Baby Lung

Intensive Care Med (2016) 42:663–673
DOI 10.1007/s00134-015-4200-8

REVIEW

Luciano Gattinoni
John J. Marini
Antonio Pesenti
Michael Quintel
Jordi Mancebo
Laurent Brochard

The "baby lung" became an adult

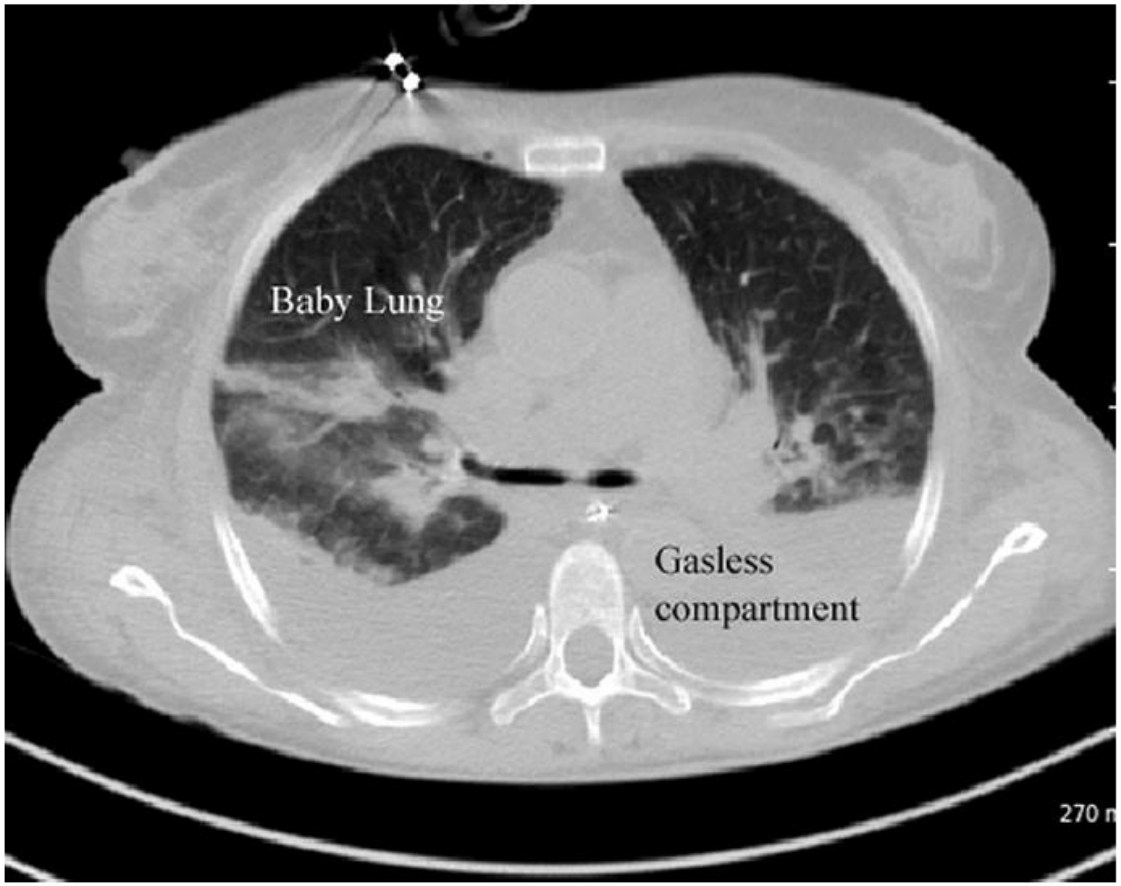
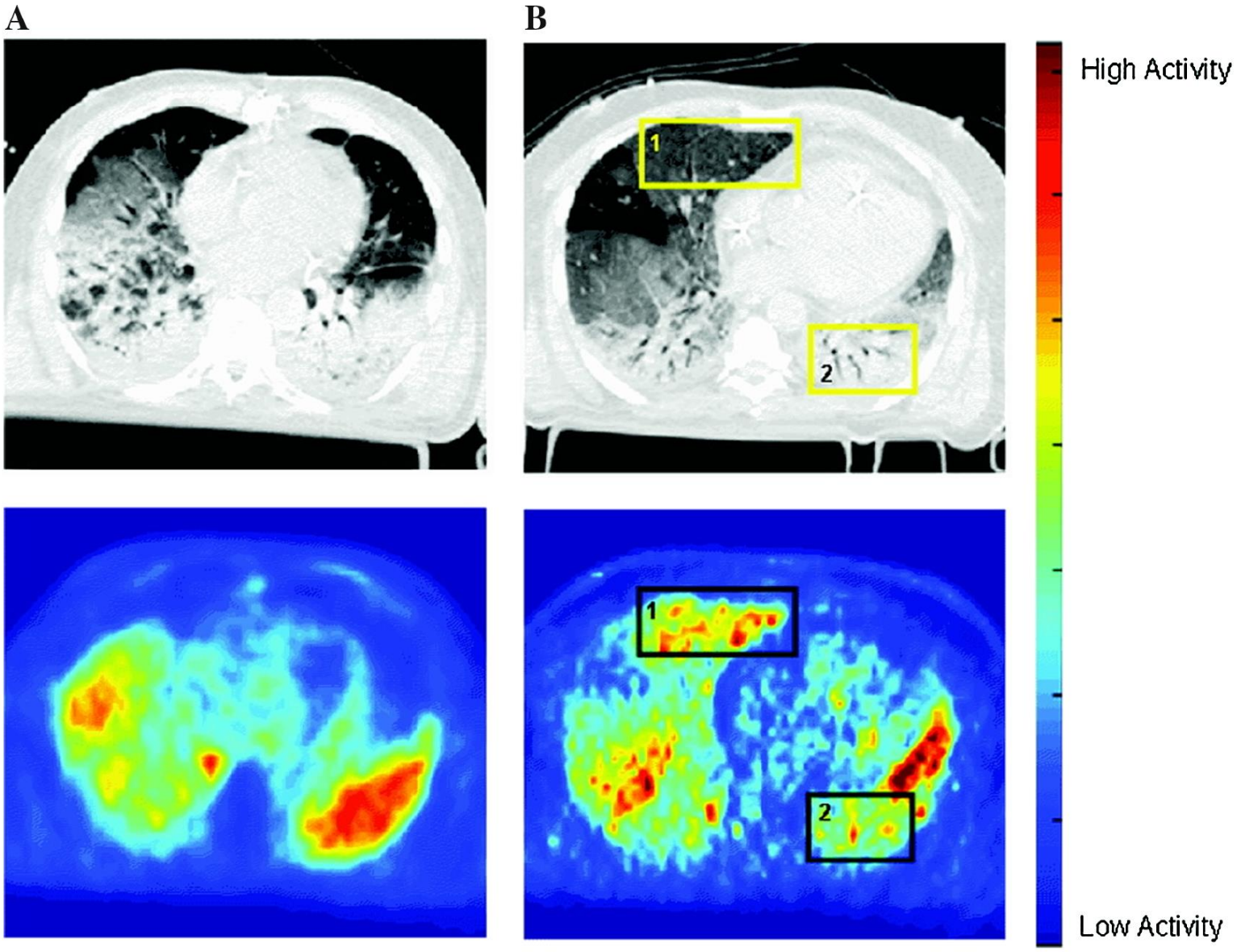


Fig. 1 A representative CT scan image of an ARDS patient showing that the ARDS lung can be modeled in one nearly normal region (having dimensions similar to those of a healthy baby) and a gasless region


A
B
1
2
1
2
High Activity
Low Activity

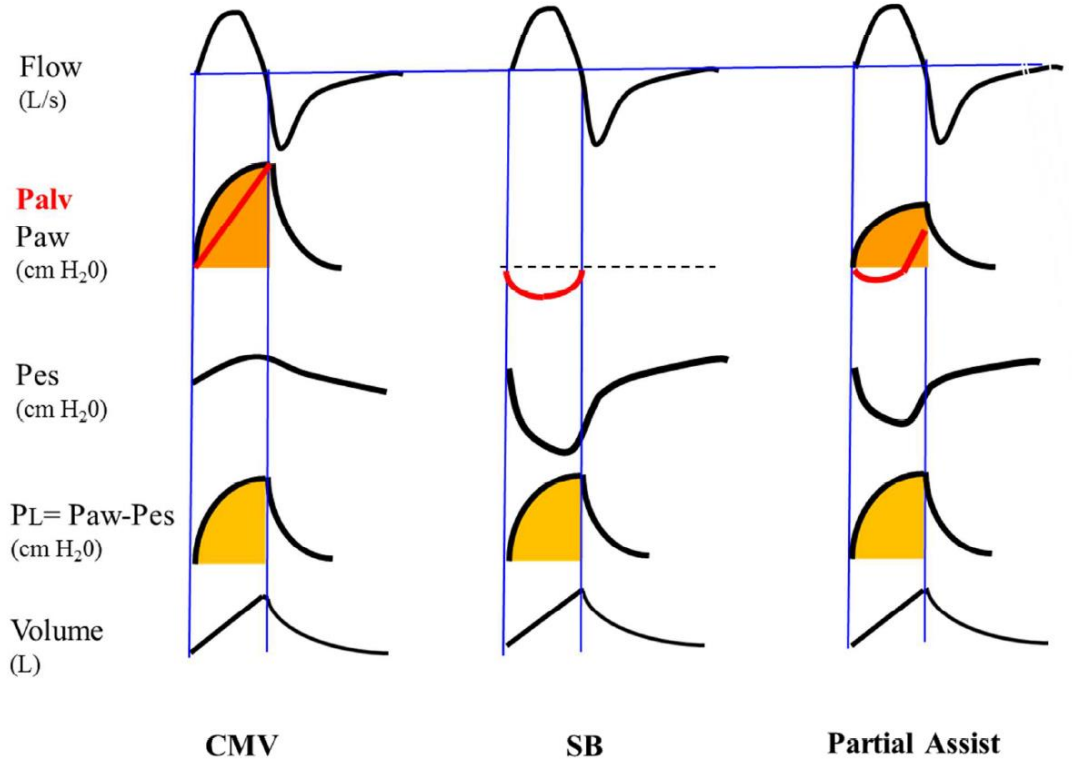
The Baby Lung

- Anatomical Characteristics
- Inflammation
- Increasing the Size, Proning
- Mechanical Ventilation
- **Spontaneous Breathing**

MECHANICAL VENTILATION TO MINIMIZE PROGRESSION OF LUNG INJURY IN ACUTE RESPIRATORY FAILURE

Laurent Brochard[1,2], Arthur Slutsky[1,2], Antonio Pesenti[3,4]

American Journal of Respiratory and Critical Care Medicine/AJRCCM



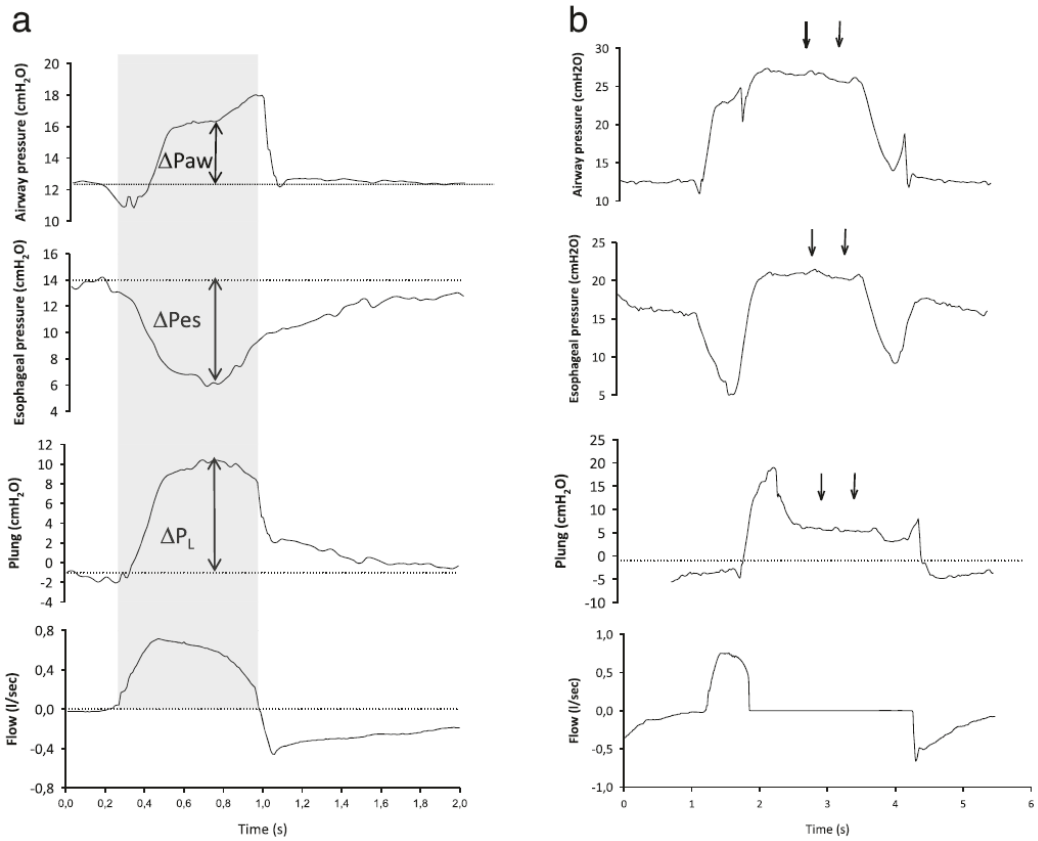
Bellani et al. Critical Care (2016) 20:142
DOI 10.1186/s13054-016-1290-9

Critical Care

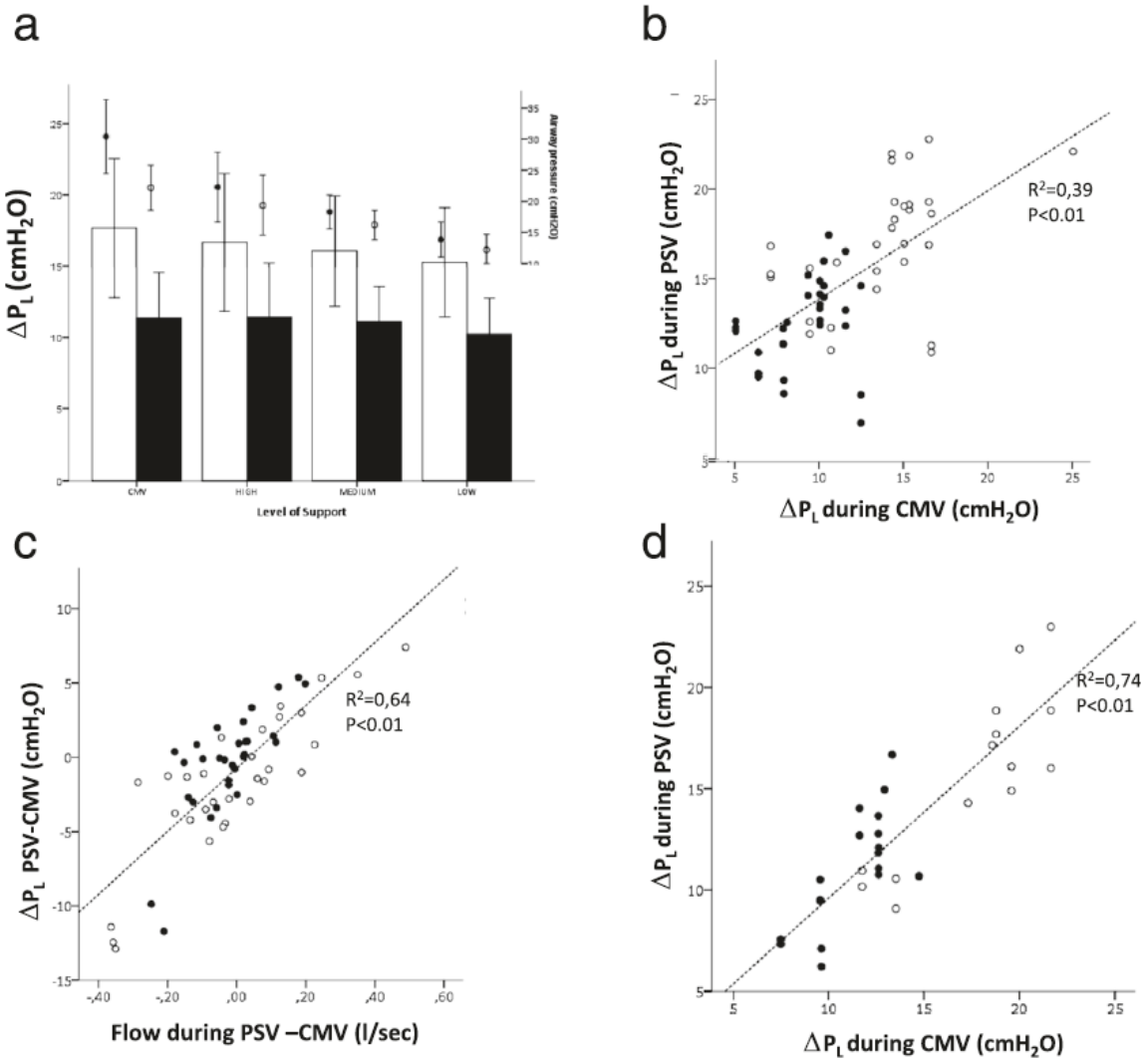
RESEARCH Open Access

Do spontaneous and mechanical breathing have similar effects on average transpulmonary and alveolar pressure? A clinical crossover study

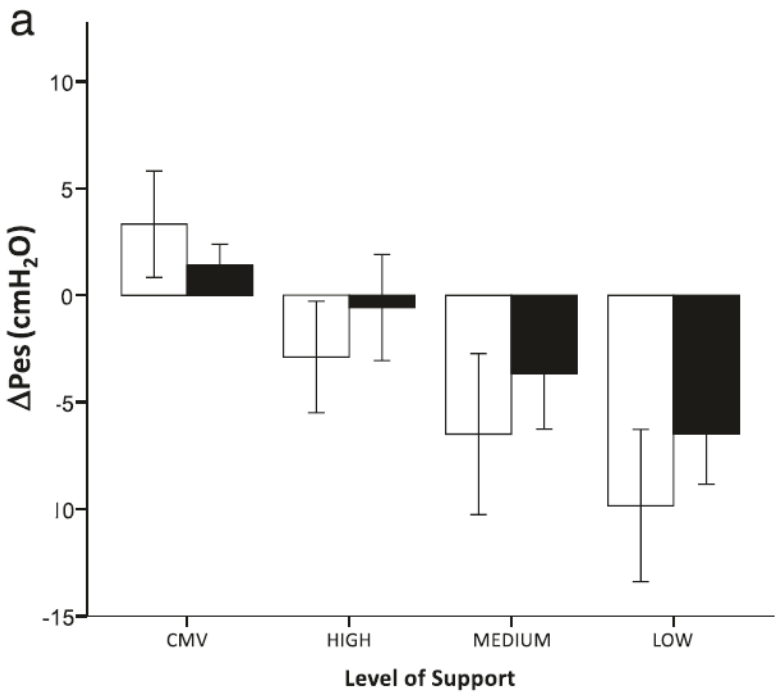
Giacomo Bellani[1,2*], Giacomo Grasselli[2,3], Maddalena Teggia-Droghi[1,2], Tommaso Mauri[3], Andrea Coppadoro[4], Laurent Brochard[5,6] and Antonio Pesenti[1,2,3]

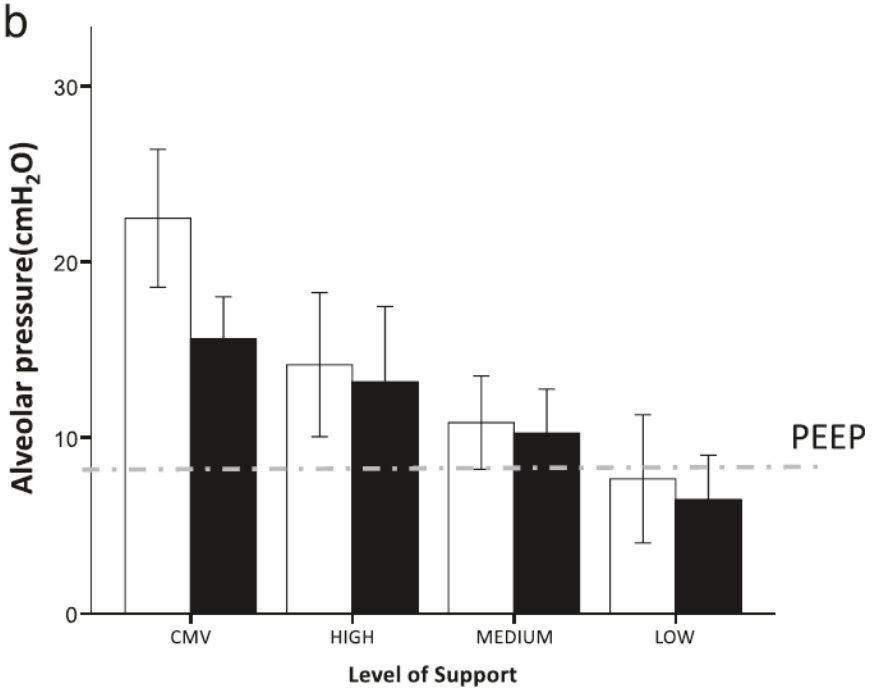


ΔP_L (cmH_2O)



Bellani G et al Crit Care 2016





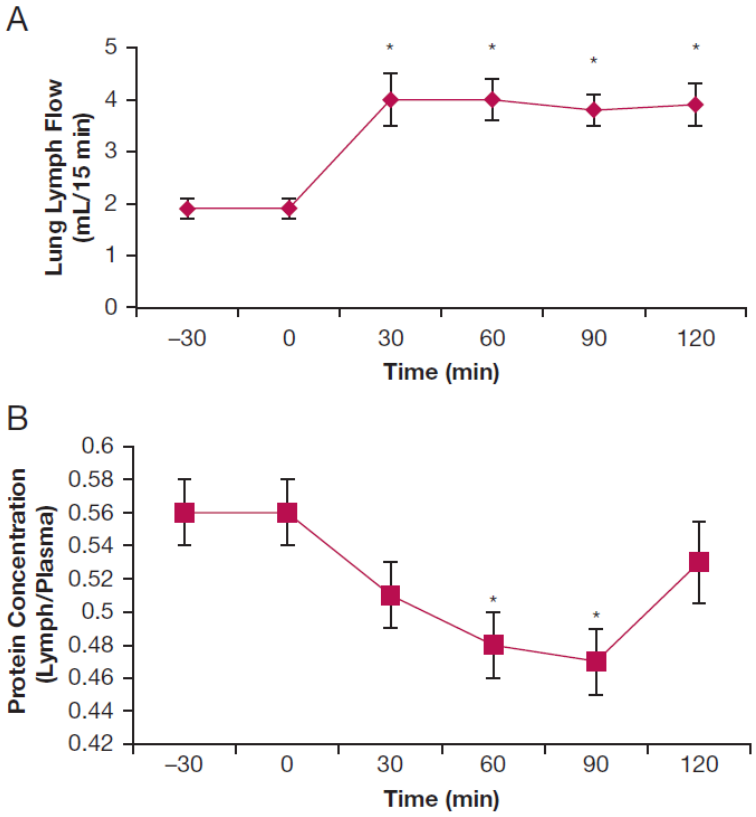
Bellani G et al Crit Care 2016

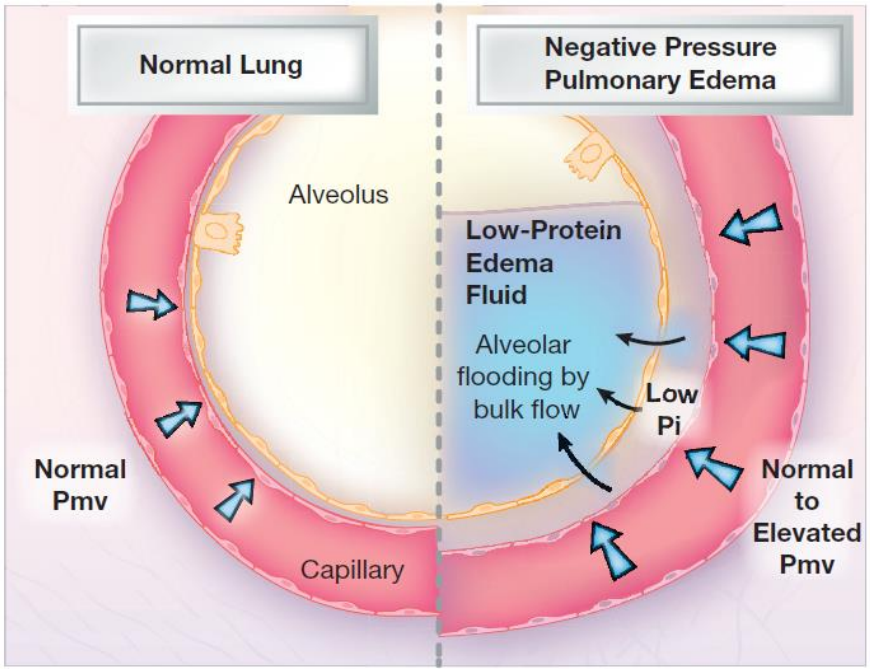
CHEST

2016

Negative-Pressure Pulmonary Edema

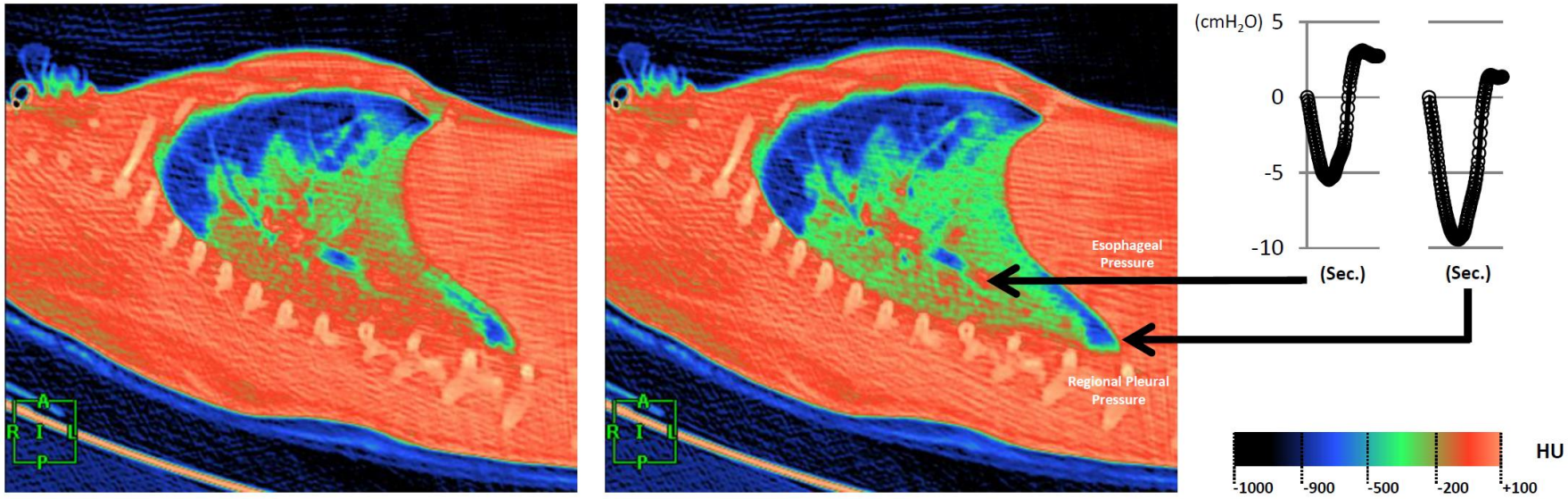
Mallar Bhattacharya, MD; Richard H. Kallet, MS, RRT; Lorraine B. Ware, MD; and Michael A. Matthay, MD





Spontaneous Breath *End-Expiration*

Spontaneous Breath *End-Inspiration*

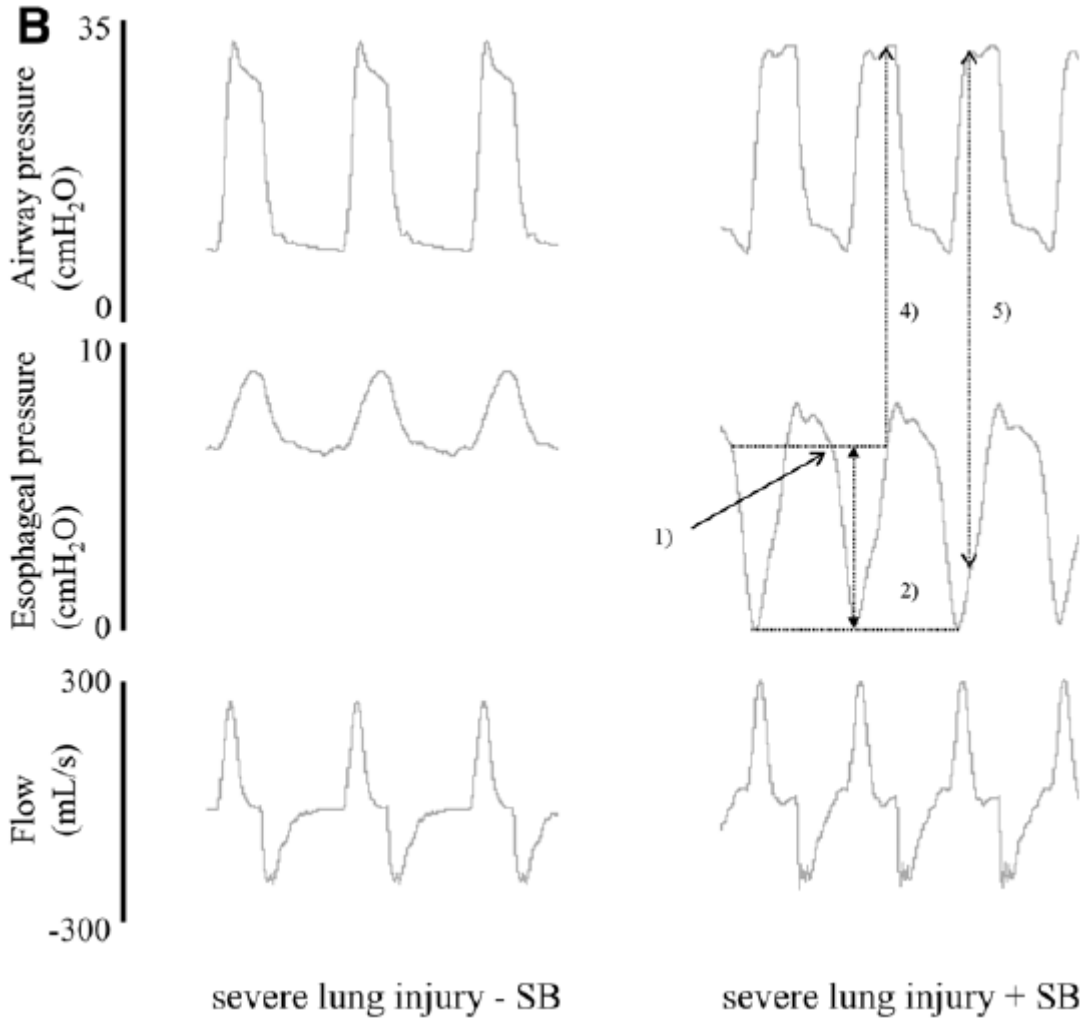


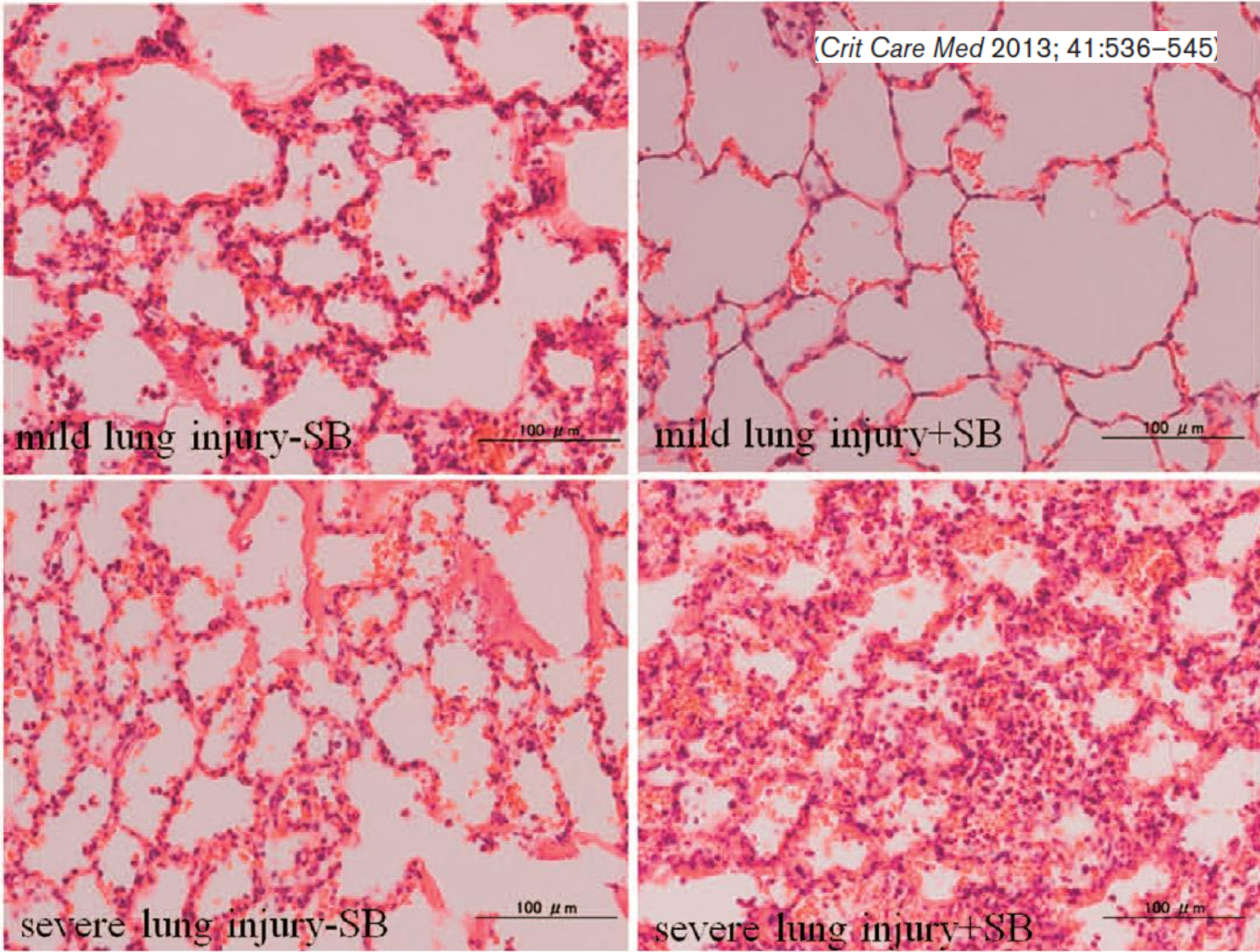
Yoshida T et AJRCCM 2016

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

Takeshi Yoshida, MD[1,2]; Akinori Uchiyama, MD, PhD[2]; Nariaki Matsuura, MD, PhD[3]; Takashi Mashimo, MD, PhD[2]; Yuji Fujino, MD, PhD[2]

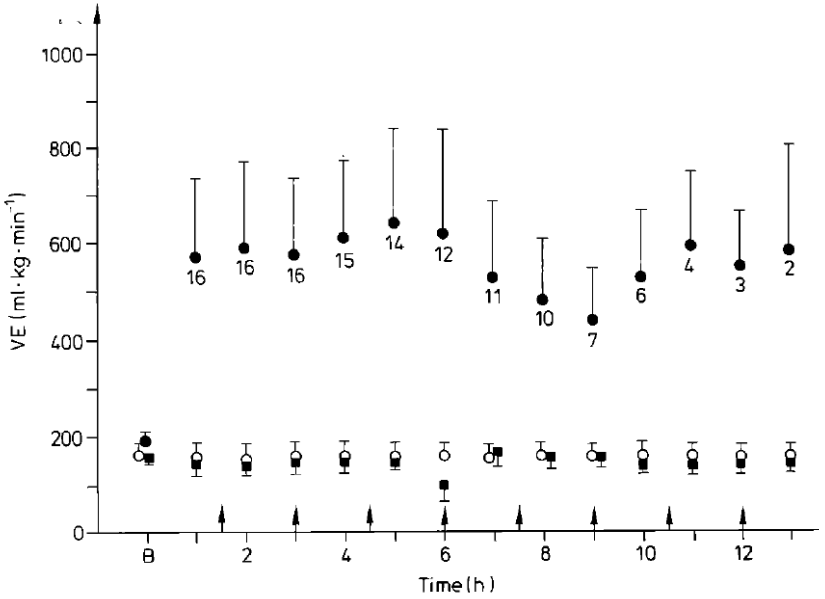
(*Crit Care Med* 2013; 41:536–545)

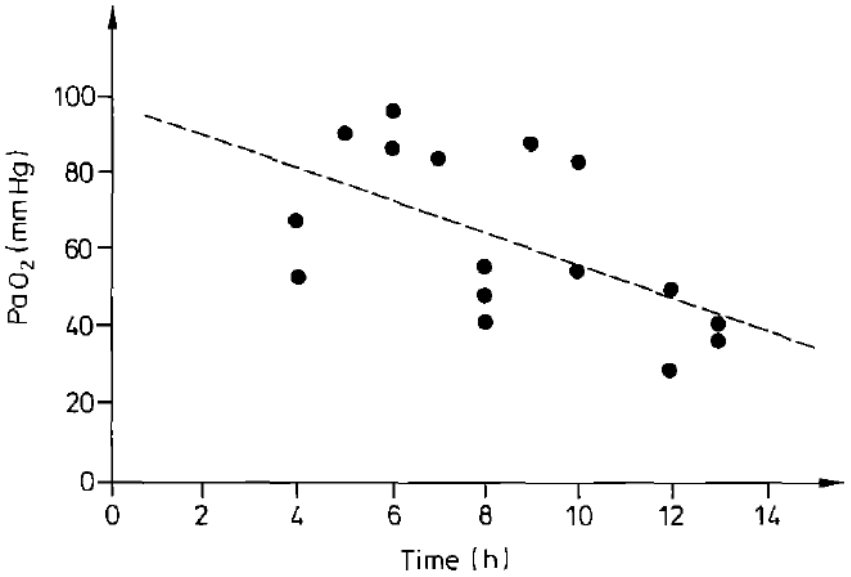



(Crit Care Med 2013; 41:536–545)
mild lung injury-SB
100 μm
mild lung injury+SB
100 μm
severe lung injury-SB
100 μm
severe lung injury+SB
100 μm

Acute respiratory failure following pharmacologically induced hyperventilation: an experimental animal study

D. Mascheroni*, T. Kolobow, R. Fumagalli*, M. P. Moretti**, V. Chen and D. Buckhold

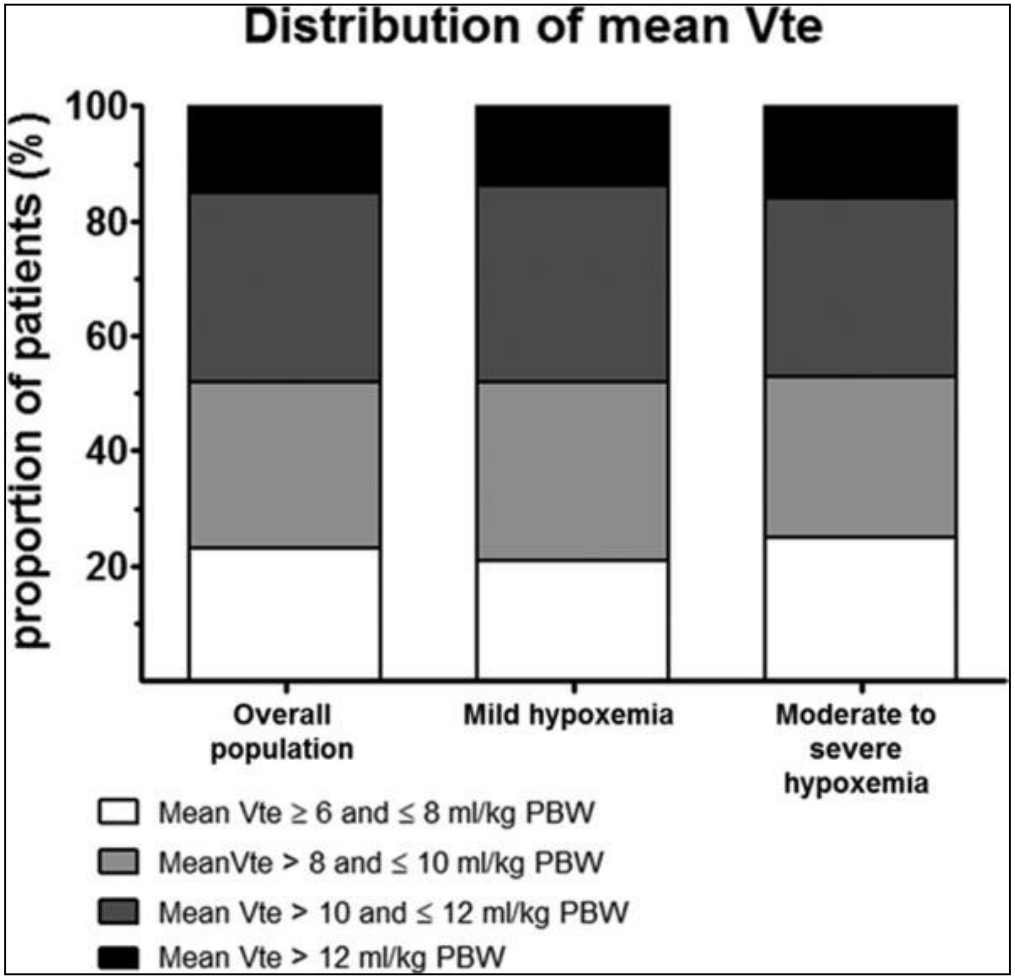




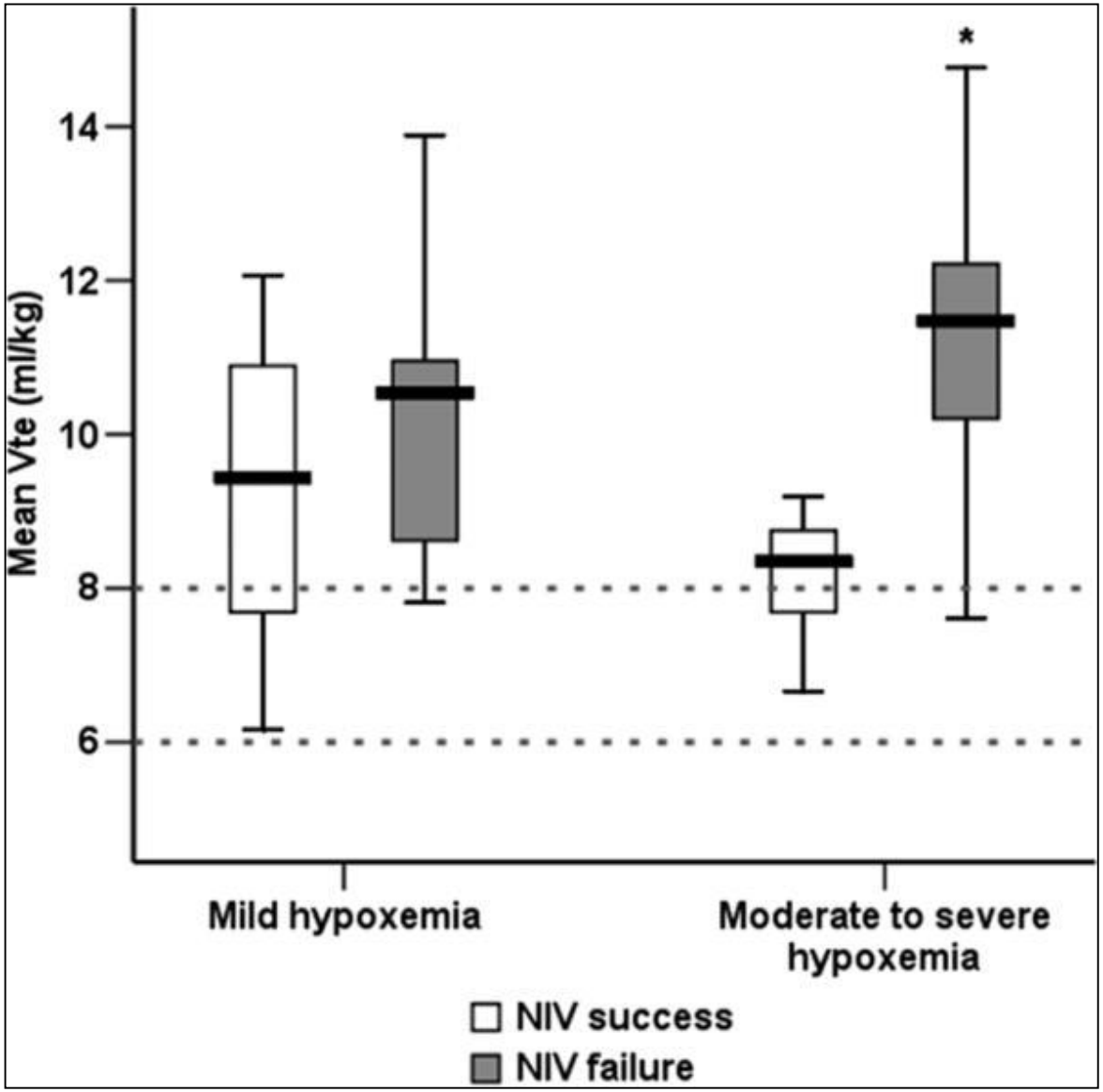
ICM 1988

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]



CCM 2016

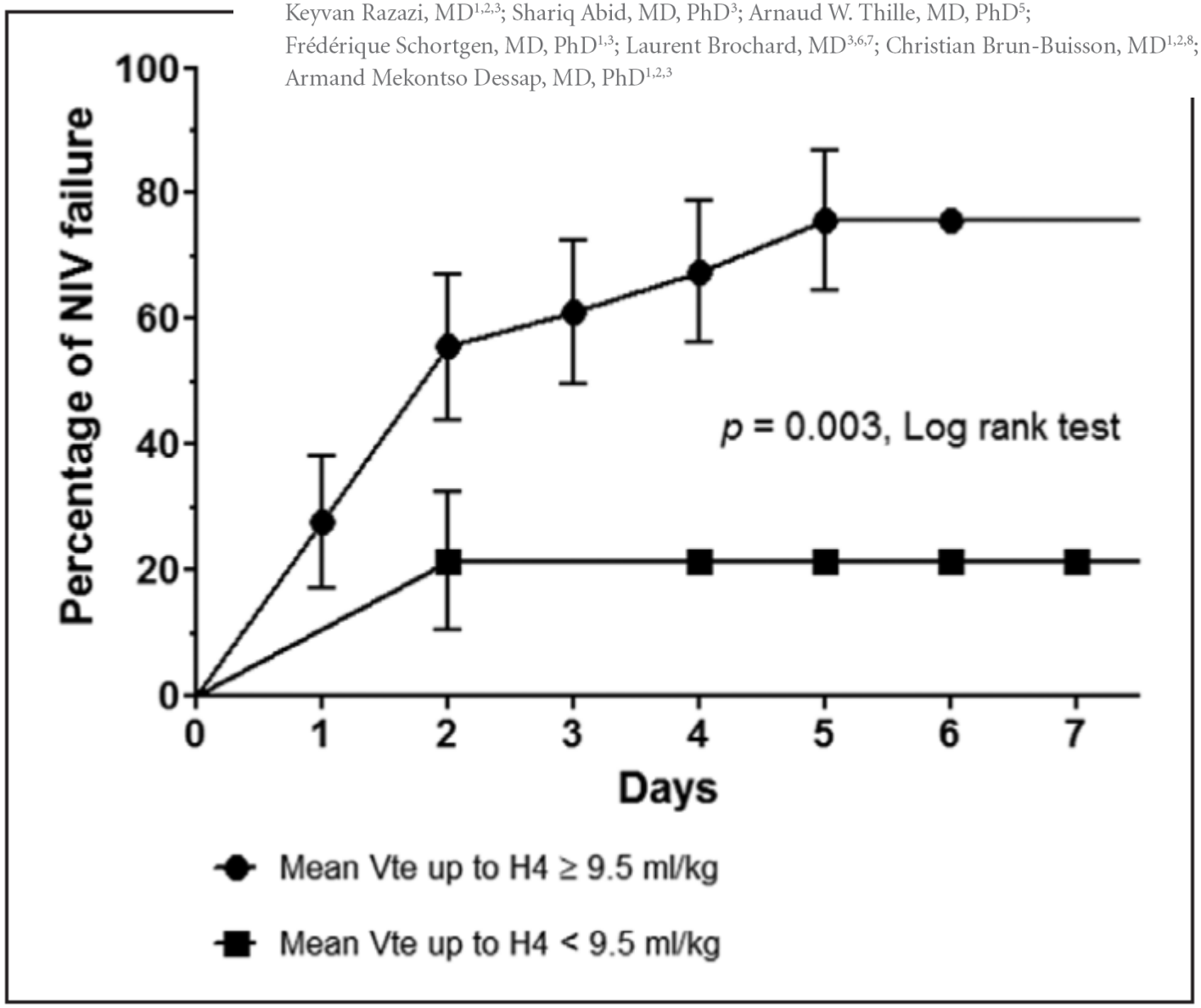


Failure of Noninvasive Ventilation for De Novo Acute Hypoxemic Respiratory Failure: Role of Tidal Volume*.
Carteaux, Guillaume; Millan-Guilarte, Teresa; De Prost, Nicolas; MD, PhD; Razazi, Keyvan; Abid, Shariq; MD, PhD; Thille, Arnaud; MD, PhD; Schortgen, Frederique; MD, PhD; Brochard, Laurent; Brun-Buisson, Christian; Mekontso Dessap, Armand; MD, PhD

Critical Care Medicine. 44(2):282-290, February 2016.
DOI: 10.1097/CCM.0000000000001379

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]

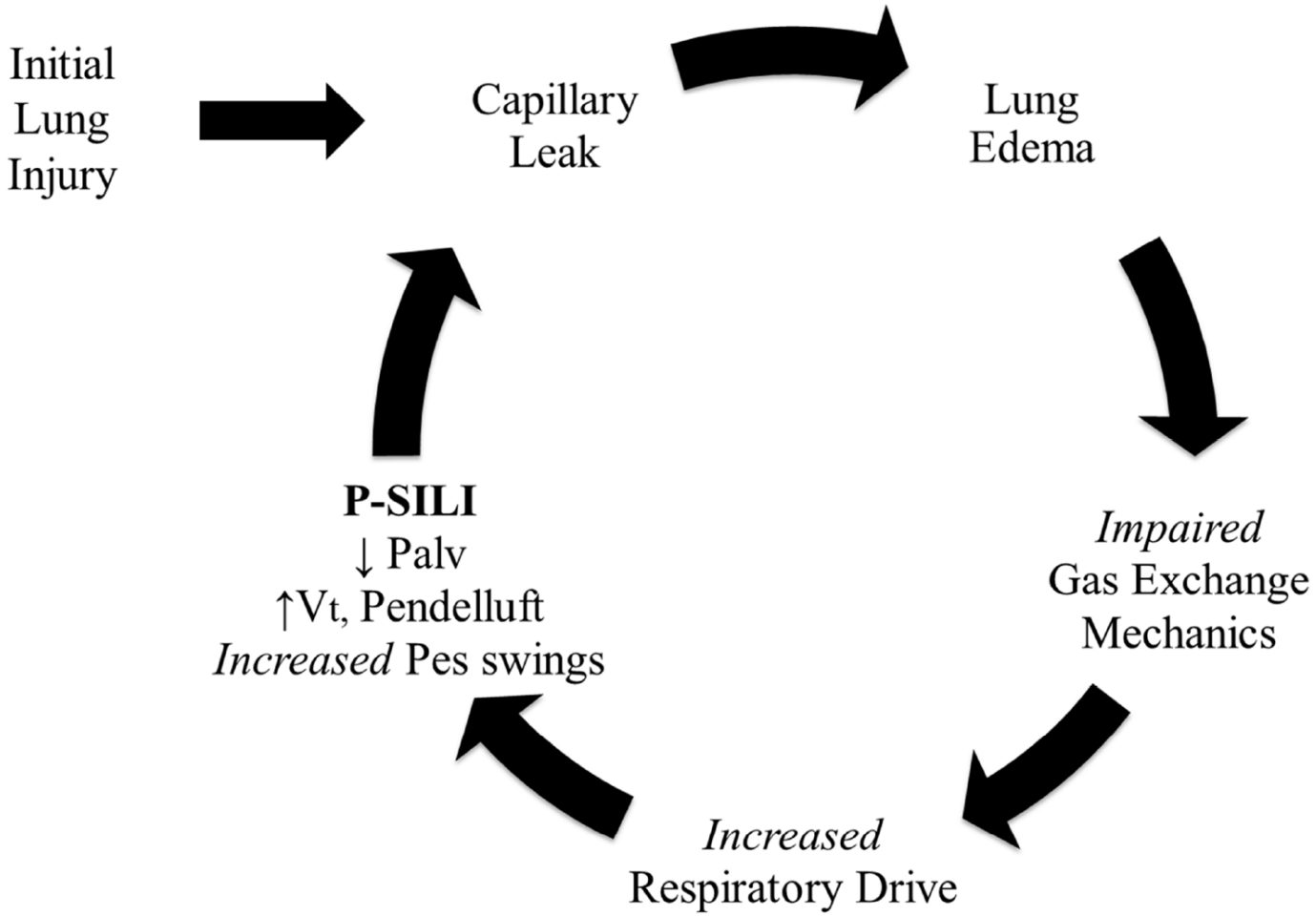


CCM 2016

MECHANICAL VENTILATION TO MINIMIZE PROGRESSION OF LUNG INJURY IN ACUTE RESPIRATORY FAILURE

Laurent Brochard[1,2], Arthur Slutsky[1,2], Antonio Pesenti[3,4]

American Journal of Respiratory and Critical Care Medicine/AJRCCM



The NEW ENGLAND JOURNAL of MEDICINE

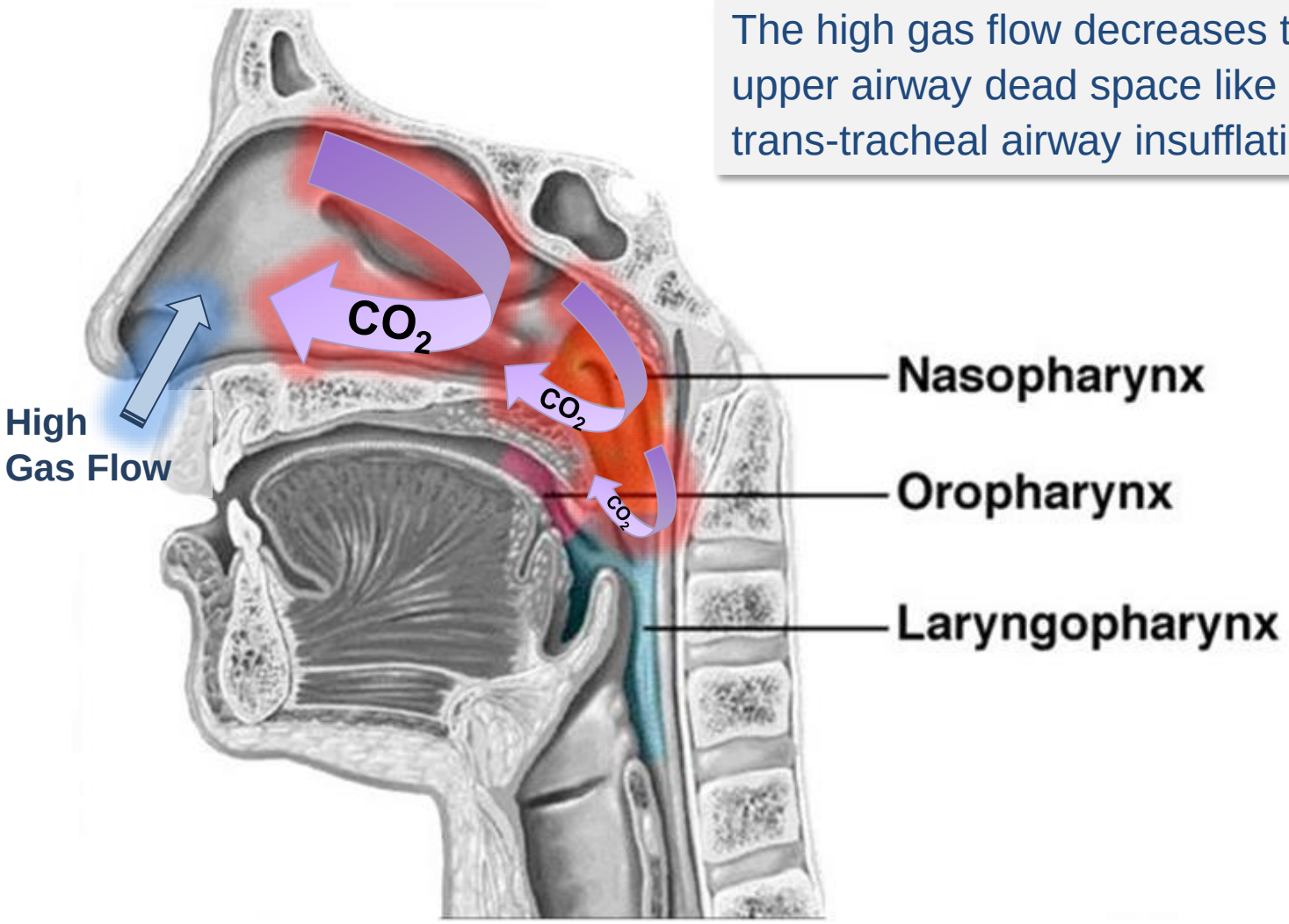
ESTABLISHED IN 1812 JUNE 4, 2015 VOL. 372 NO. 23

High-Flow Oxygen through Nasal Cannula in Acute Hypoxemic Respiratory Failure

Jean-Pierre Frat, M.D., Arnaud W. Thille, M.D., Ph.D., Alain Mercat, M.D., Ph.D., Christophe Girault, M.D., Ph.D., Stéphanie Ragot, Pharm.D., Ph.D., Sébastien Perbet, M.D., Gwénael Prat, M.D., Thierry Boulain, M.D., Elise Morawiec, M.D., Alice Cottereau, M.D., Jérôme Devaquet, M.D., Saad Nseir, M.D., Ph.D., Keyvan Razazi, M.D., Jean-Paul Mira, M.D., Ph.D., Laurent Argaud, M.D., Ph.D., Jean-Charles Chakarian, M.D., Jean-Damien Ricard, M.D., Ph.D., Xavier Wittebole, M.D., Stéphanie Chevalier, M.D., Alexandre Herbland, M.D., Muriel Fartoukh, M.D., Ph.D., Jean-Michel Constantin, M.D., Ph.D., Jean-Marie Tonnelier, M.D., Marc Pierrot, M.D., Armelle Mathonnet, M.D., Gaëtan Béduneau, M.D., Céline Delétage-Métreau, Ph.D., Jean-Christophe M. Richard, M.D., Ph.D., Laurent Brochard, M.D., and René Robert, M.D., Ph.D., for the FLORALI Study Group and the REVA Network*

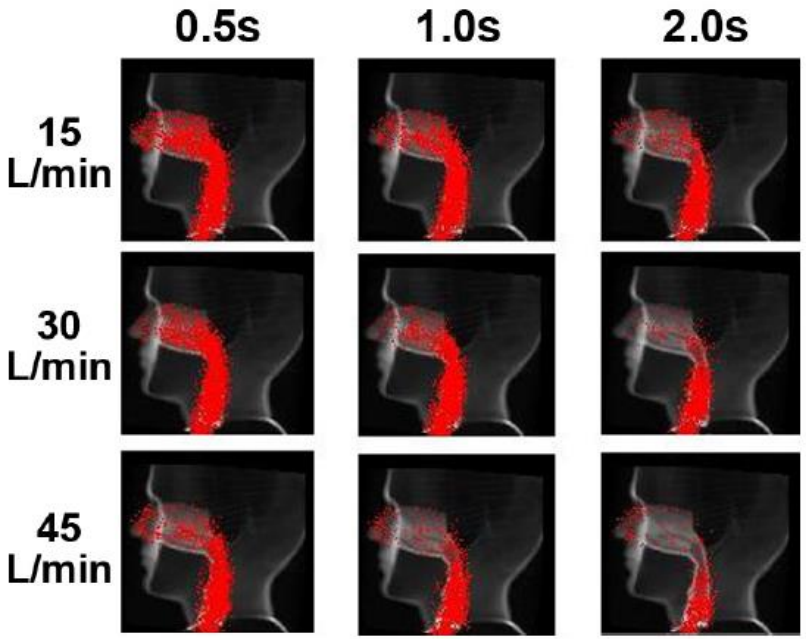
Washout of nasopharyngeal dead space

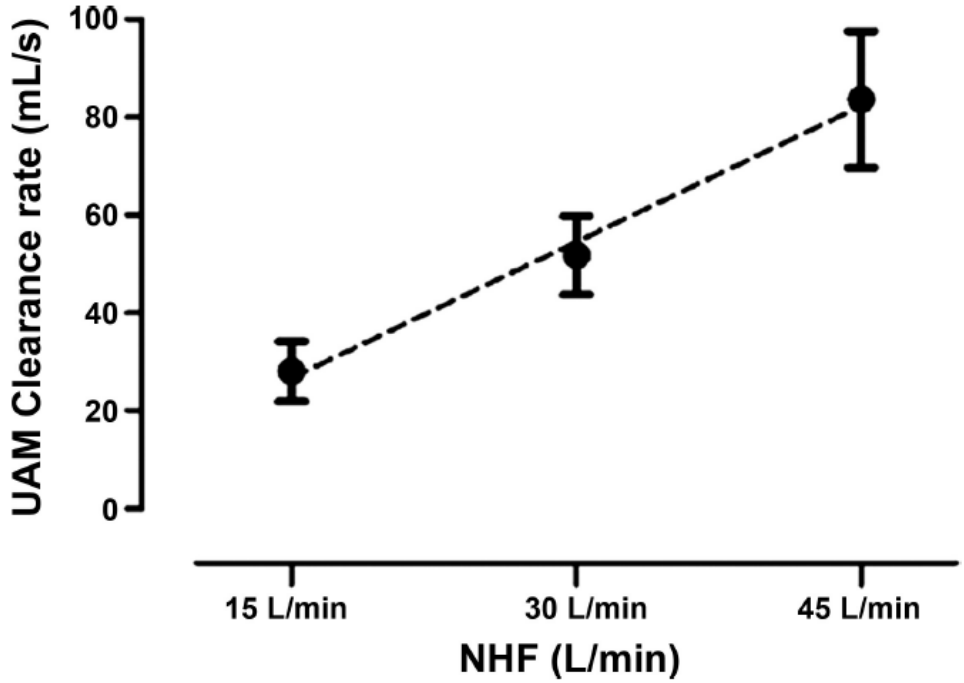
The high gas flow decreases the upper airway dead space like trans-tracheal airway insufflation



Nasal high flow clears anatomical dead space in upper airway models

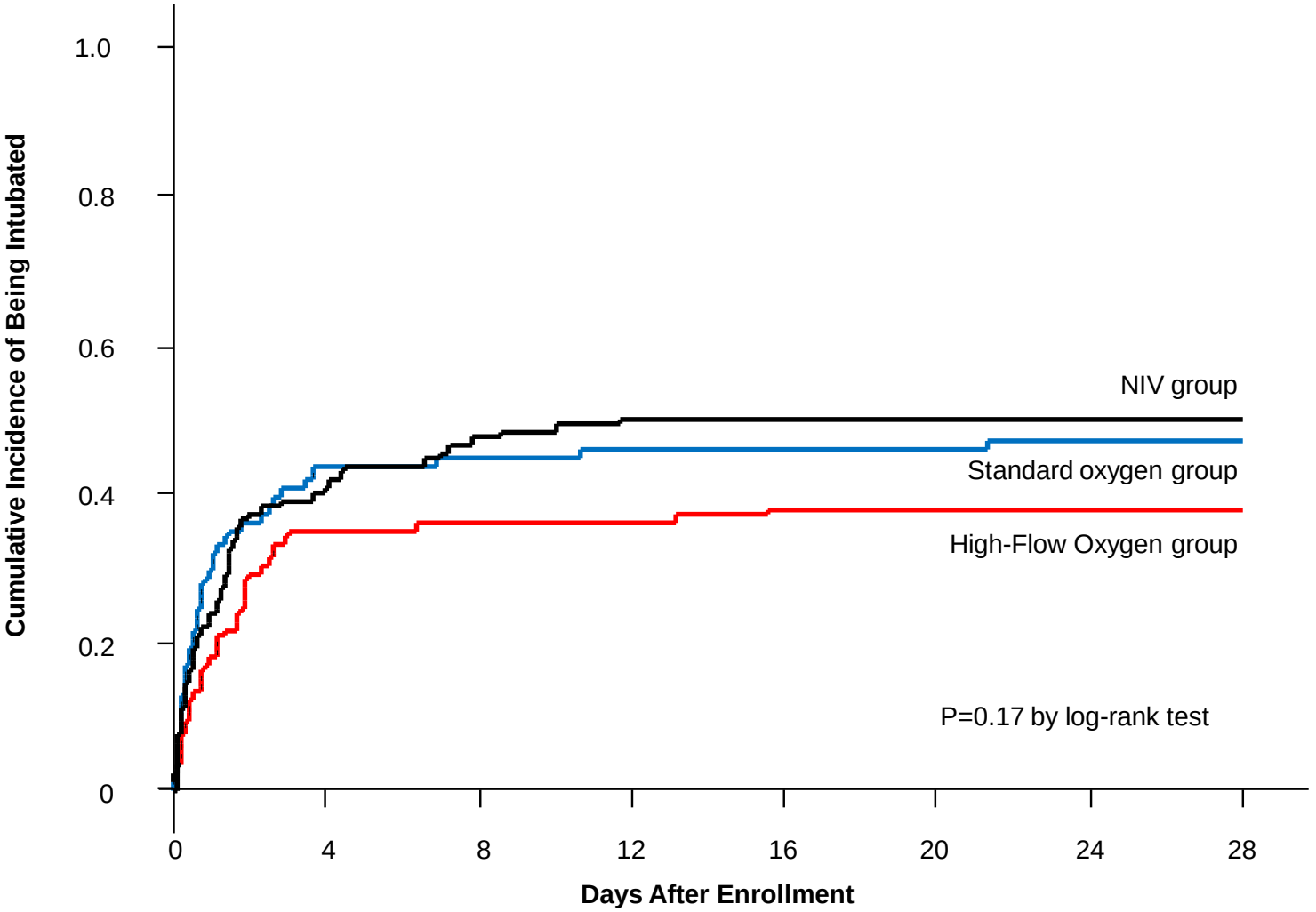
Winfried Möller,[1,2] Gülnaz Celik,[1,2] Sheng Feng,[3] Peter Bartenstein,[4] Gabriele Meyer,[5] Oliver Eickelberg,[1,2,6] Otmar Schmid,[1,2] and Stanislav Tatkov[3]





J Appl Physiol 118: 1525–1532, 2015.

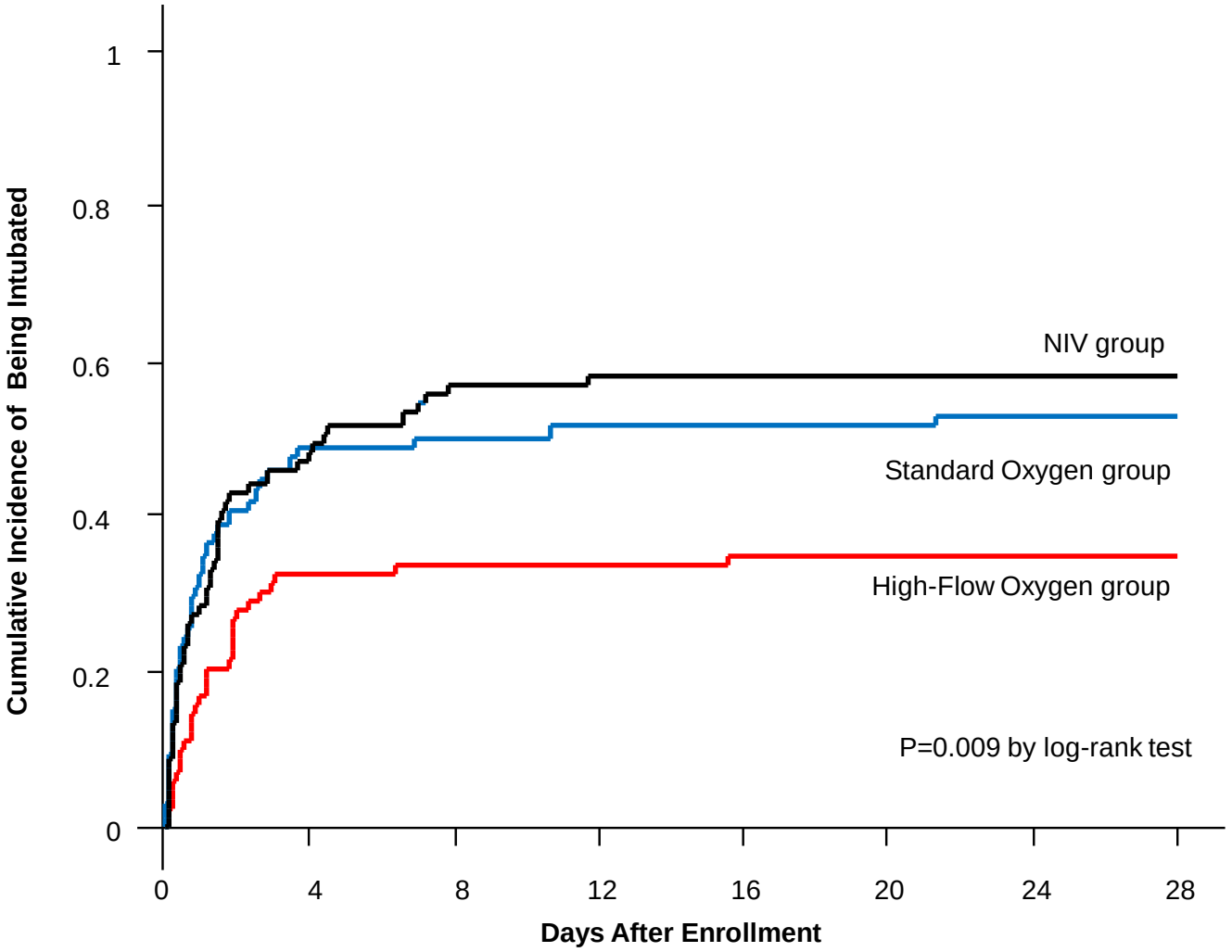
Cumulative incidence of Being Intubated in the Overall Population



Number at risk

High-Flow Oxygen group	106	68	67	67	65	65	65	65
Standard Oxygen group	94	**52**	50	49	49	49	48	48
NIV group	110	64	57	53	53	53	53	52

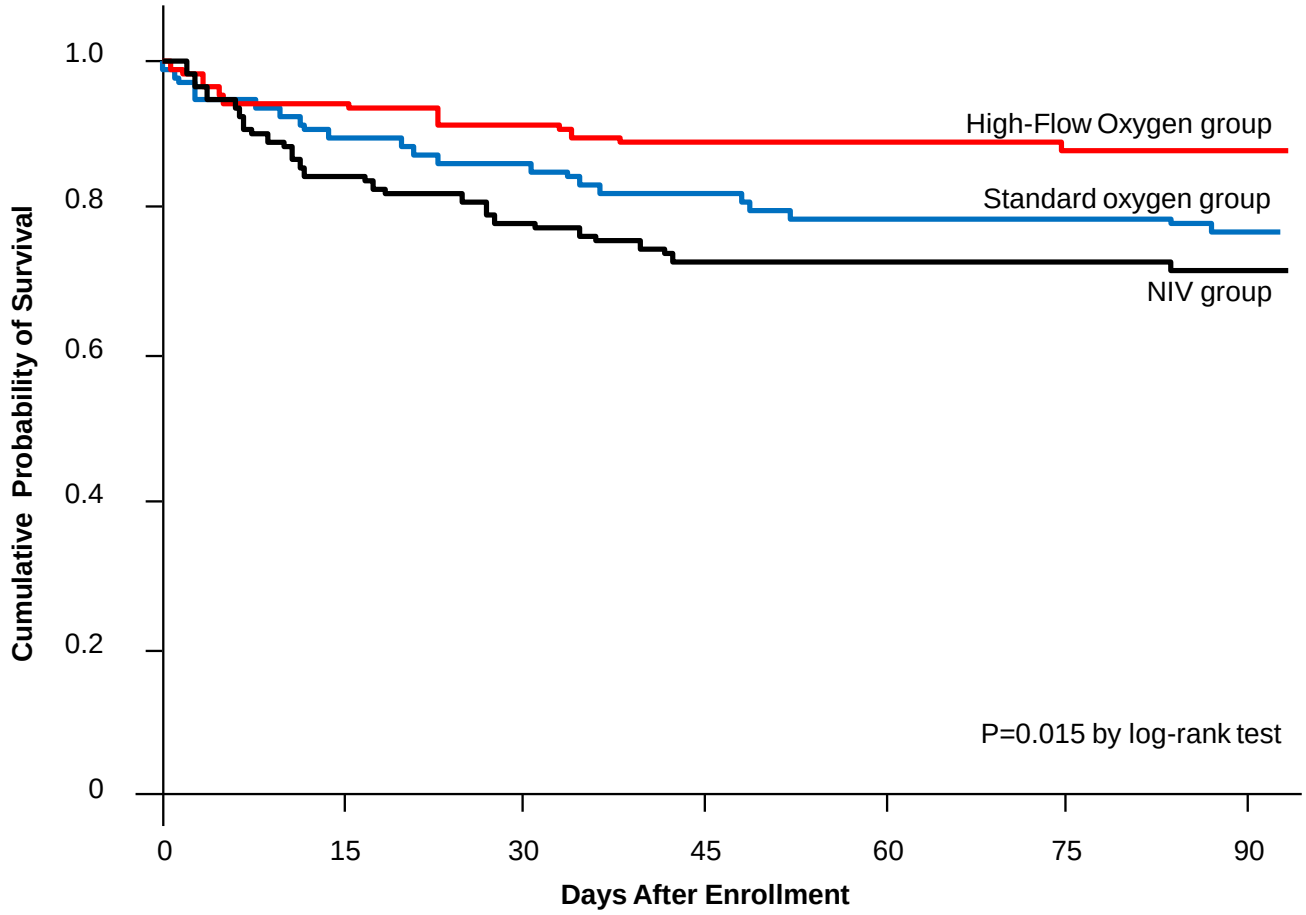
Cumulative Incidence of Being Intubated in the Patients With a PaO_2:FiO_2 ≤ 200 mm Hg



Number at risk

High-Flow Oxygen group	83	55	54	54	53	53	53	53
Standard Oxygen group	74	37	35	34	34	34	33	33
NIV group	81	41	34	32	32	32	32	32

Kaplan-Meier Plot of the Probability of Survival from Randomization to Day 90



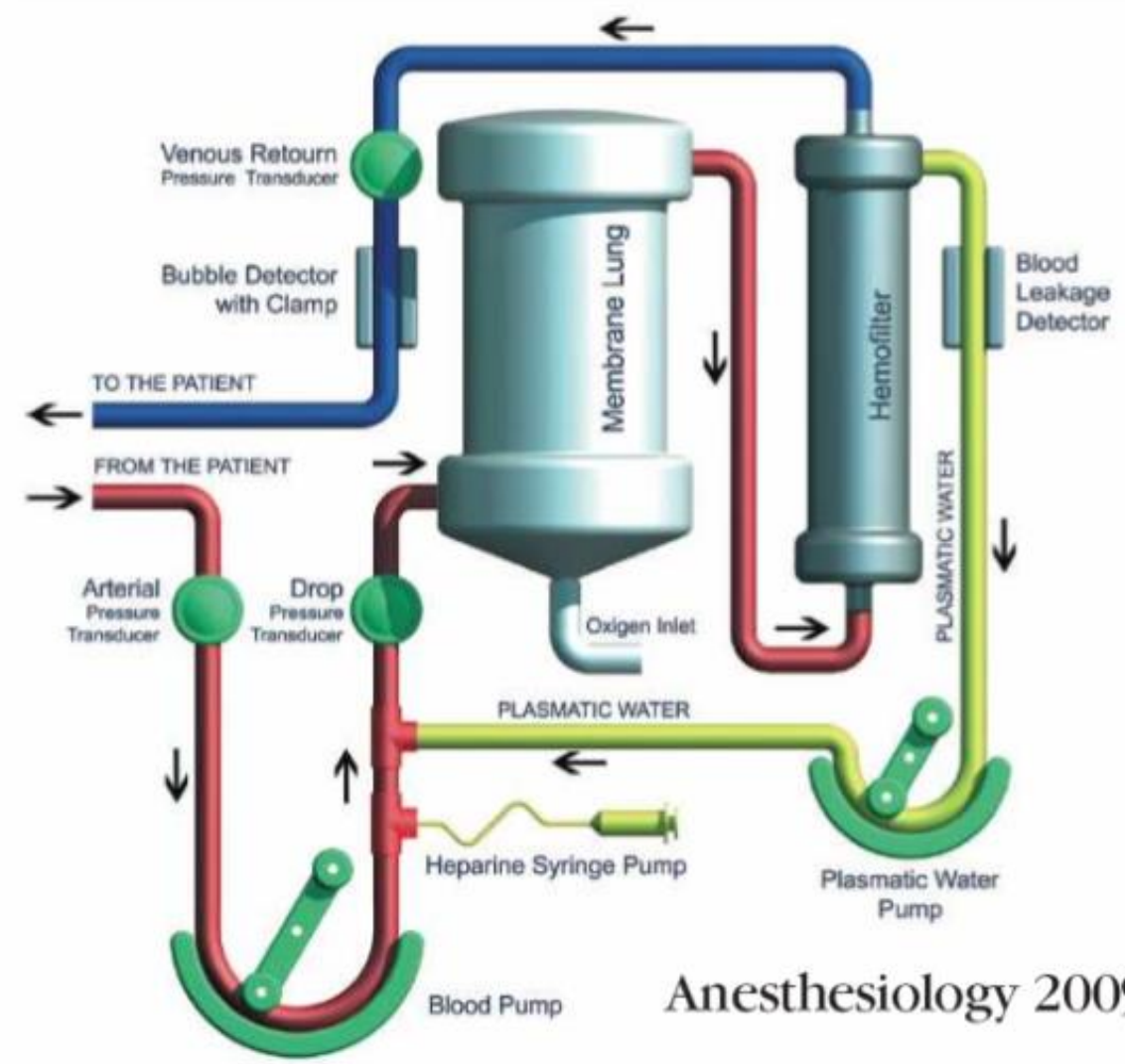
Number at risk

High-Flow Oxygen group	106	100	97	94	94	93	93
Standard Oxygen group	94	84	81	77	74	73	72
NIV group	110	93	86	80	79	78	77

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

Fanelli *et al. Critical Care* (2016) 20:36
DOI 10.1186/s13054-016-1211-y

Critical Care

RESEARCH Open Access

Feasibility and safety of low-flow extracorporeal carbon dioxide removal to facilitate ultra-protective ventilation in patients with moderate acute respiratory distress sindrome

Vito Fanelli[1*], Marco V. Ranieri[2], Jordi Mancebo[3], Onnen Moerer[4], Michael Quintel[4], Scott Morley[5], Indalecio Moran[3], Francisco Parrilla[3], Andrea Costamagna[1], Marco Gaudiosi[1] and Alain Combes[6]

15 ARDS patients

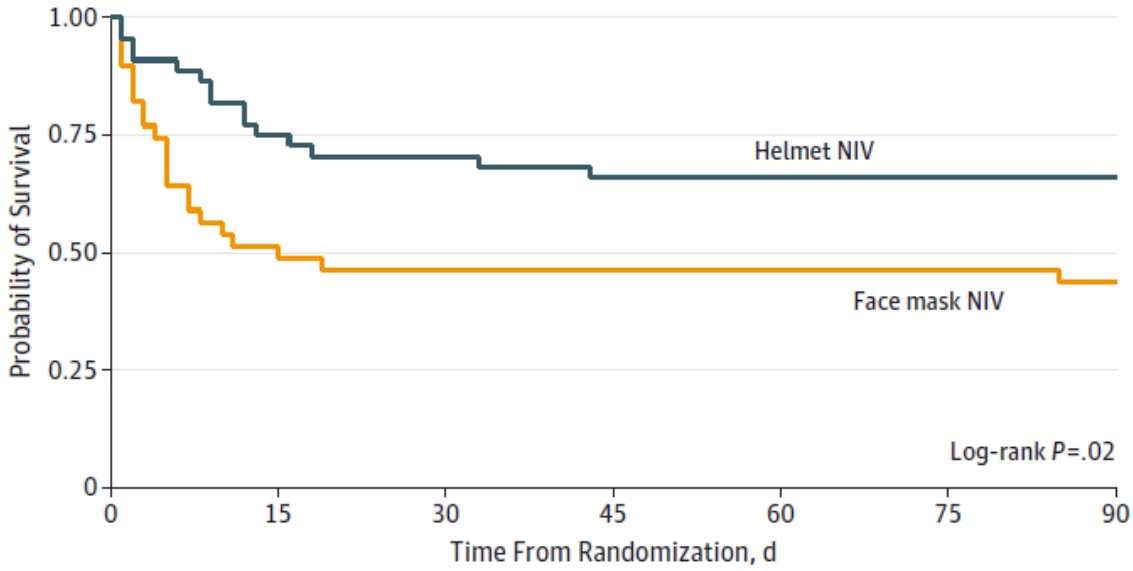
Ph	7.36 ± 0.1
PaO2 (mmHg)	95 ± 29
PaCO2 (mmHg)	51 ± 15
Arterial partial pressure of oxygen/inspired oxygen fraction	159 ± 34

Preliminary Communication | CARING FOR THE CRITICALLY ILL PATIENT

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

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



No. at risk							
Face mask	39	20	18	18	18	18	17
Helmet	44	33	31	29	29	29	29

JAMA 2016

Thank You

brochardl@smh.ca

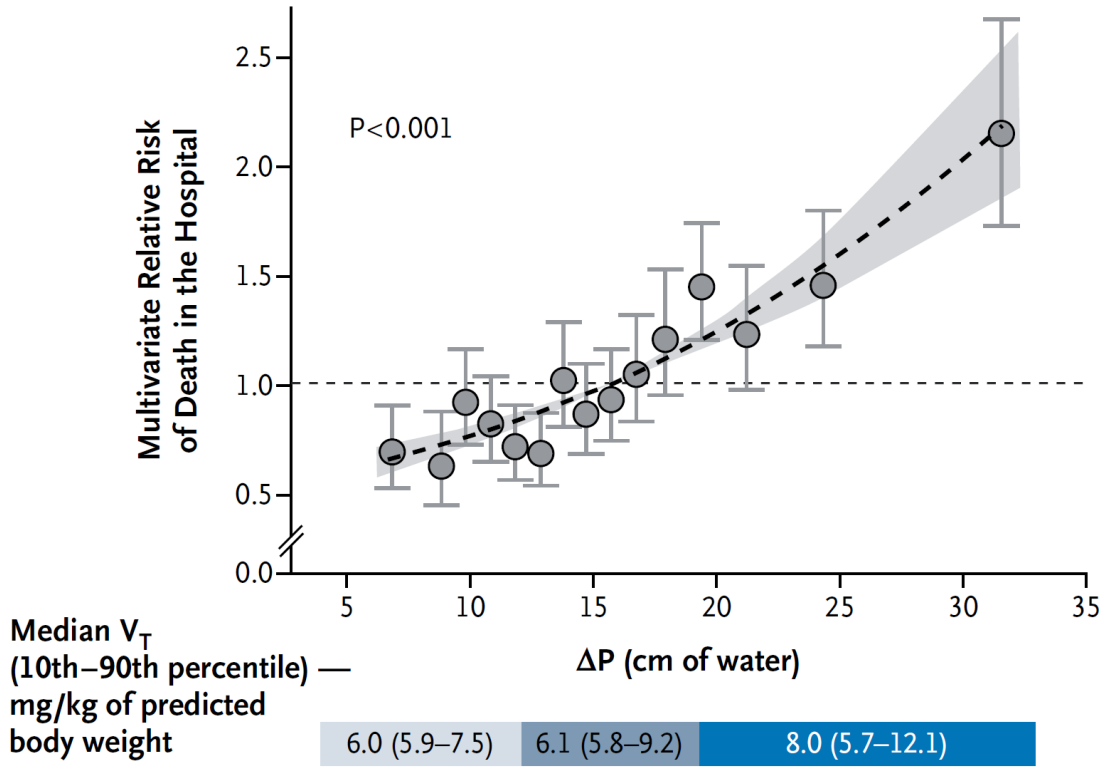
Intensive Care Med (2005) 31:776–784
DOI 10.1007/s00134-005-2627-z

SEMINAL STUDY

Luciano Gattinoni
Antonio Pesenti

The concept of "baby lung"

baro- and volutrauma. *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.


Multivariate Relative Risk of Death in the Hospital
2.5
2.0
1.5
1.0
0.5
0.0
P<0.001
5
10
15
20
25
30
35
ΔP (cm of water)
Median V_T (10th–90th percentile) — mg/kg of predicted body weight
6.0 (5.9–7.5)
6.1 (5.8–9.2)
8.0 (5.7–12.1)