ACTUALITÉS EN RÉANIMATION
Médecine Intensive, Surveillance Continue
et Urgences Graves

Ventilation Spontanée

&

SDRA

Nicolas TERZI - *MD-PhD*
Médecine Intensive et Réanimation – CHU de Grenoble
Inserm U1042

Support logistique lors de congrès:

- Maquet

Conférencier:

- Covidien
- Lilly oncology
- Boerhinger Ingelheim
- Pfizer

Consultant:

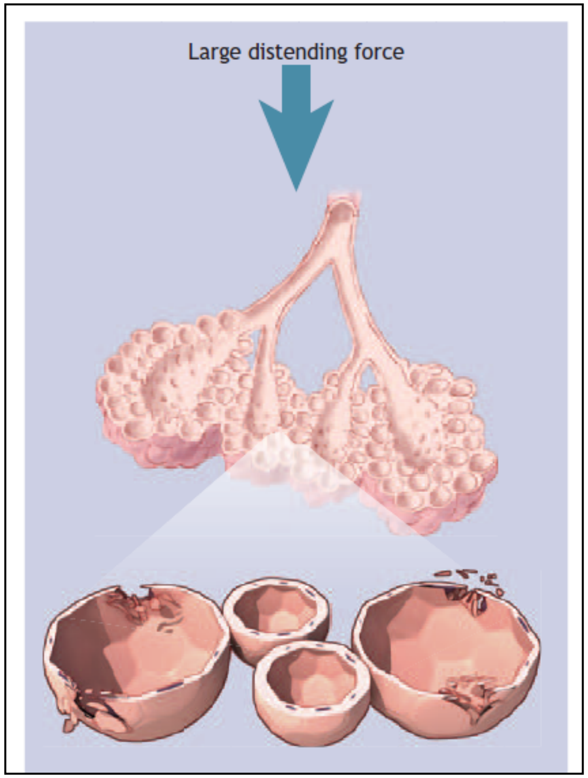
- HillRom

Quelques Notions

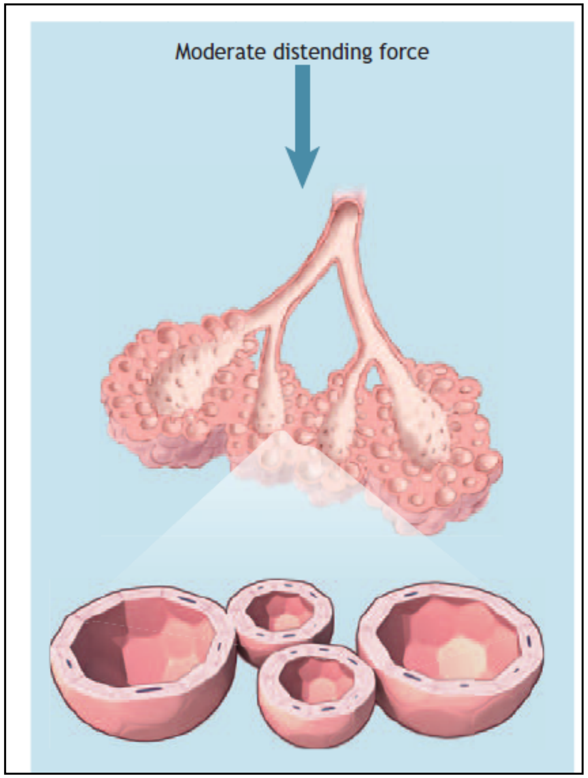
VILI
Ventilator induced lung injury

Lésions de sur-distension

Volume télé-inspiratoire



Volutrauma



Atelectrauma

Lésions à bas volume

Stress risers

Lésions d'ouverture-fermeture cycliques

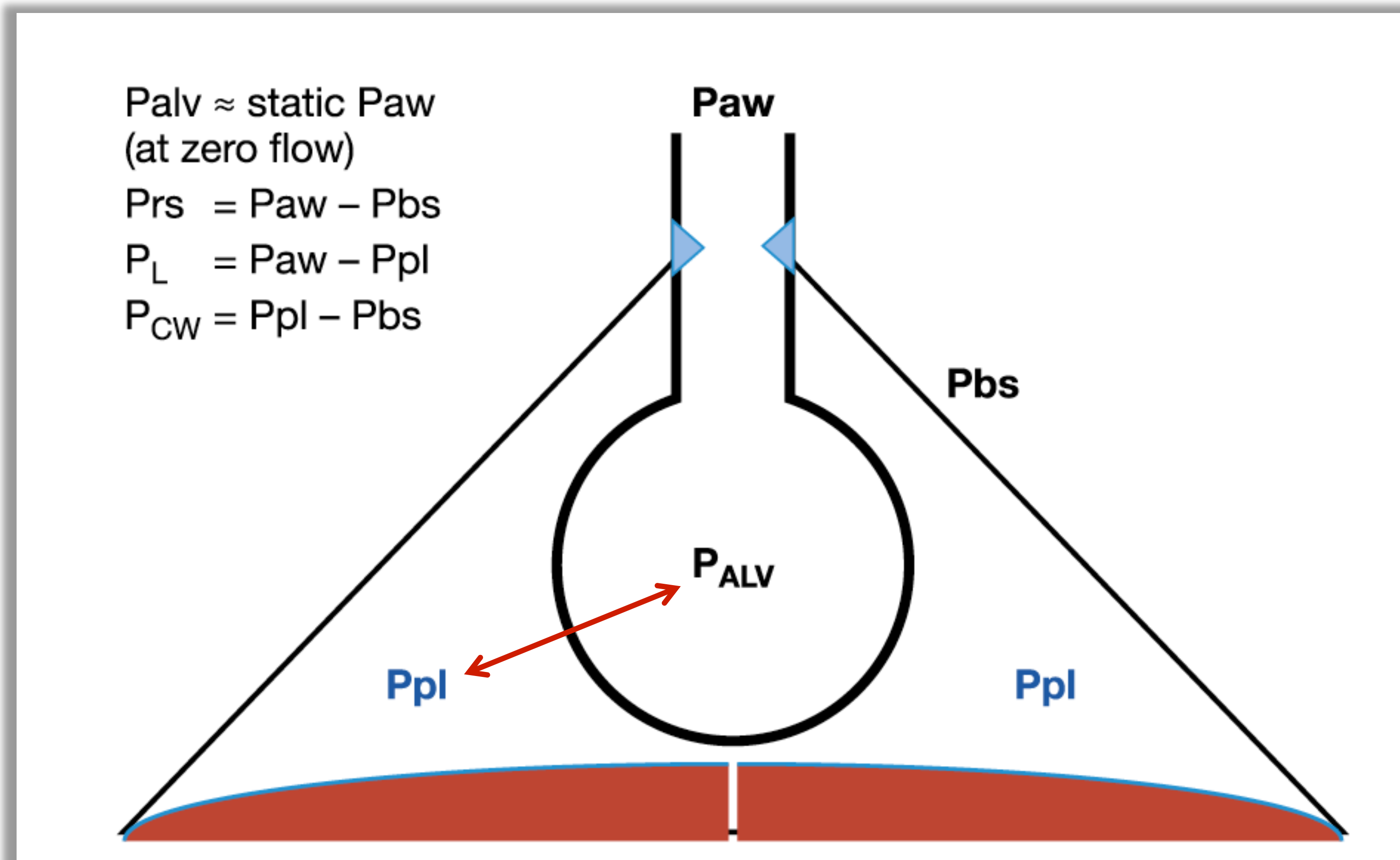
Biotrauma

IL-1β, IL-6, TNFα,…

The Application of Esophageal Pressure Measurement in Patients with Respiratory Failure

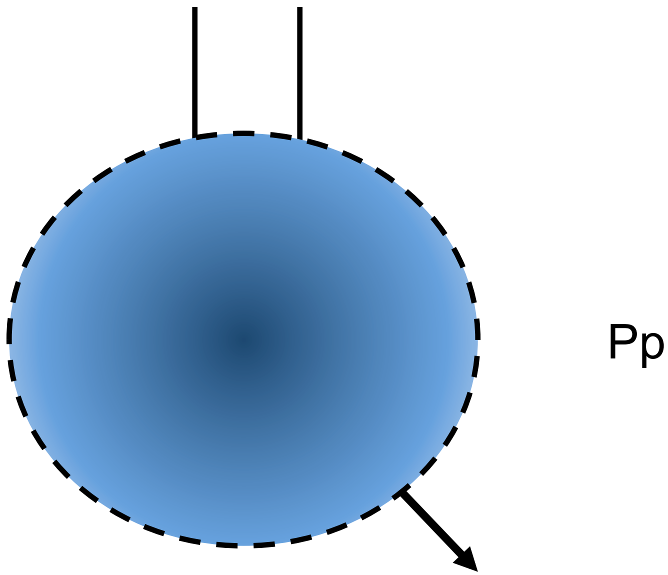
Akoumianaki E 2014

AMERICAN JOURNAL OF
Respiratory and
Critical Care Medicine®



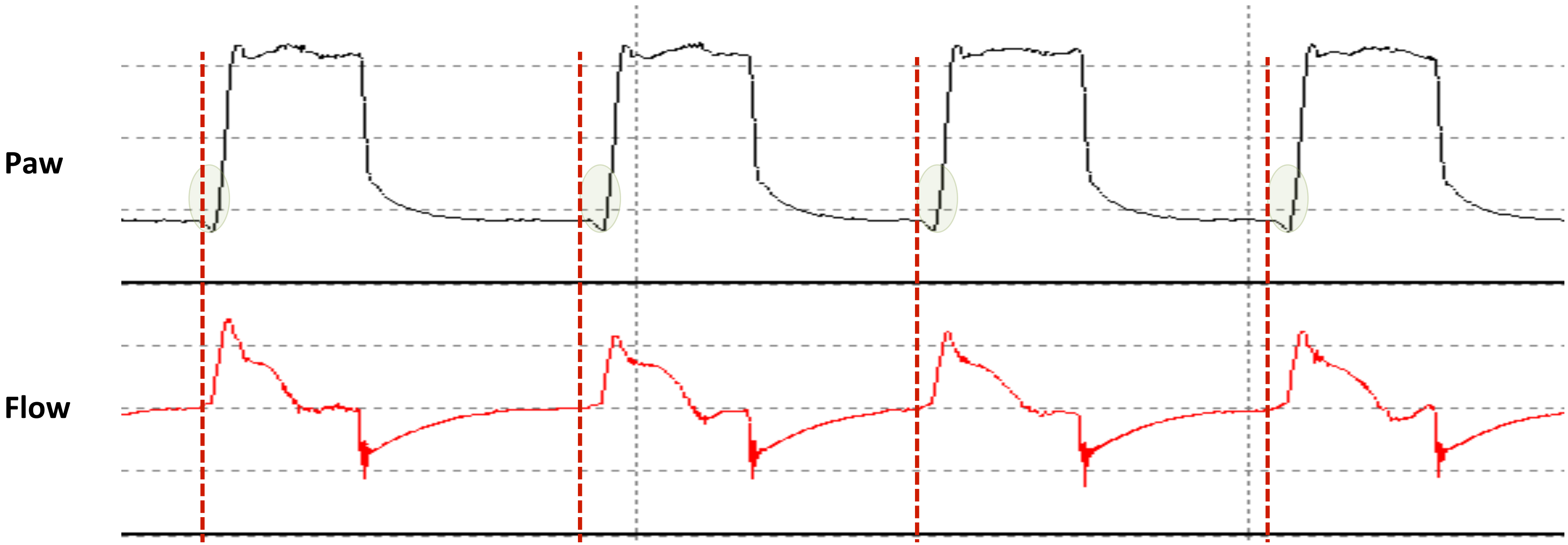
Stress / Strain

$Strain = \Delta V / CRF$

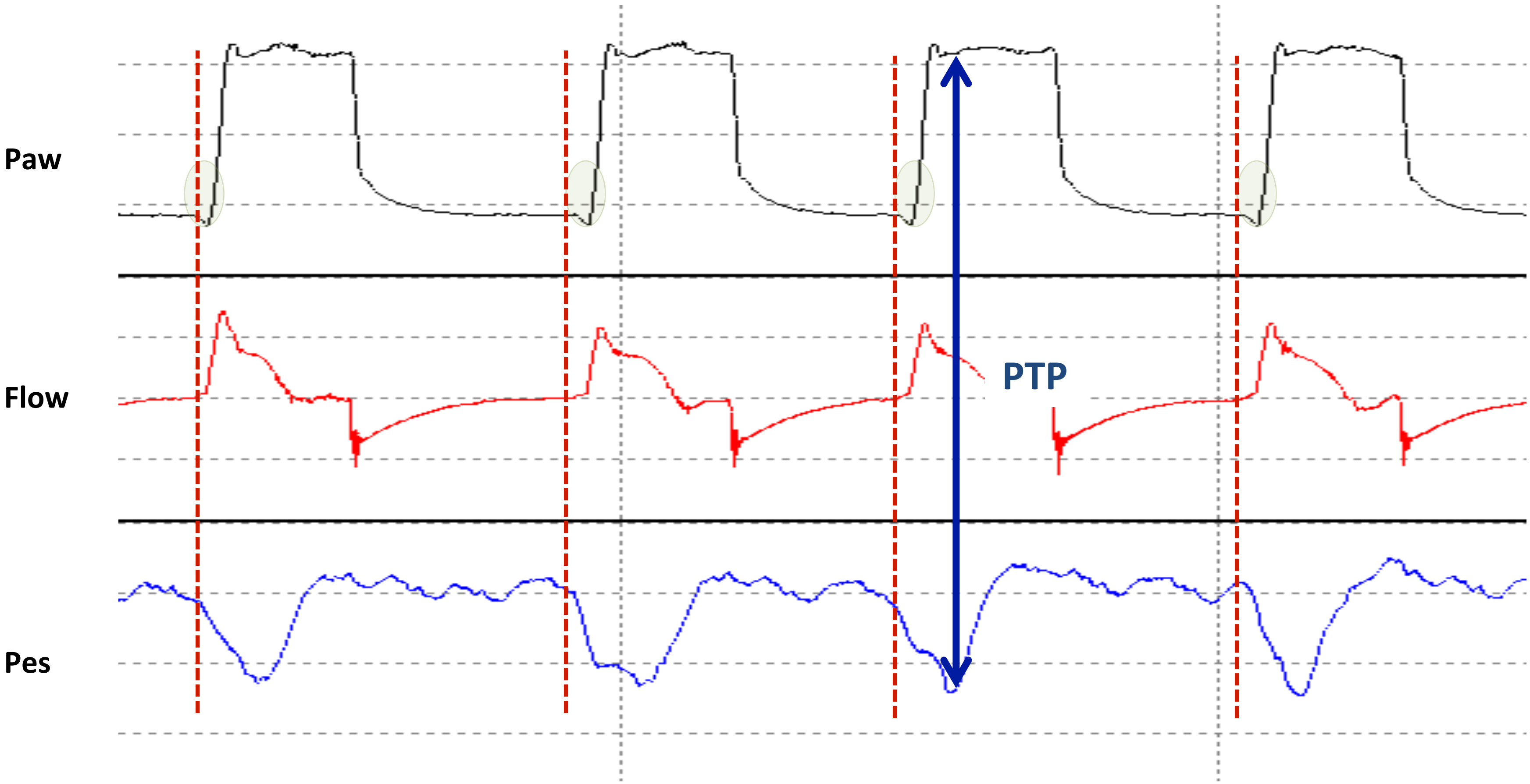


$Stress = Pression\ transpulmonaire$

La ventilation spontanée fait référence à l'activité du diaphragme

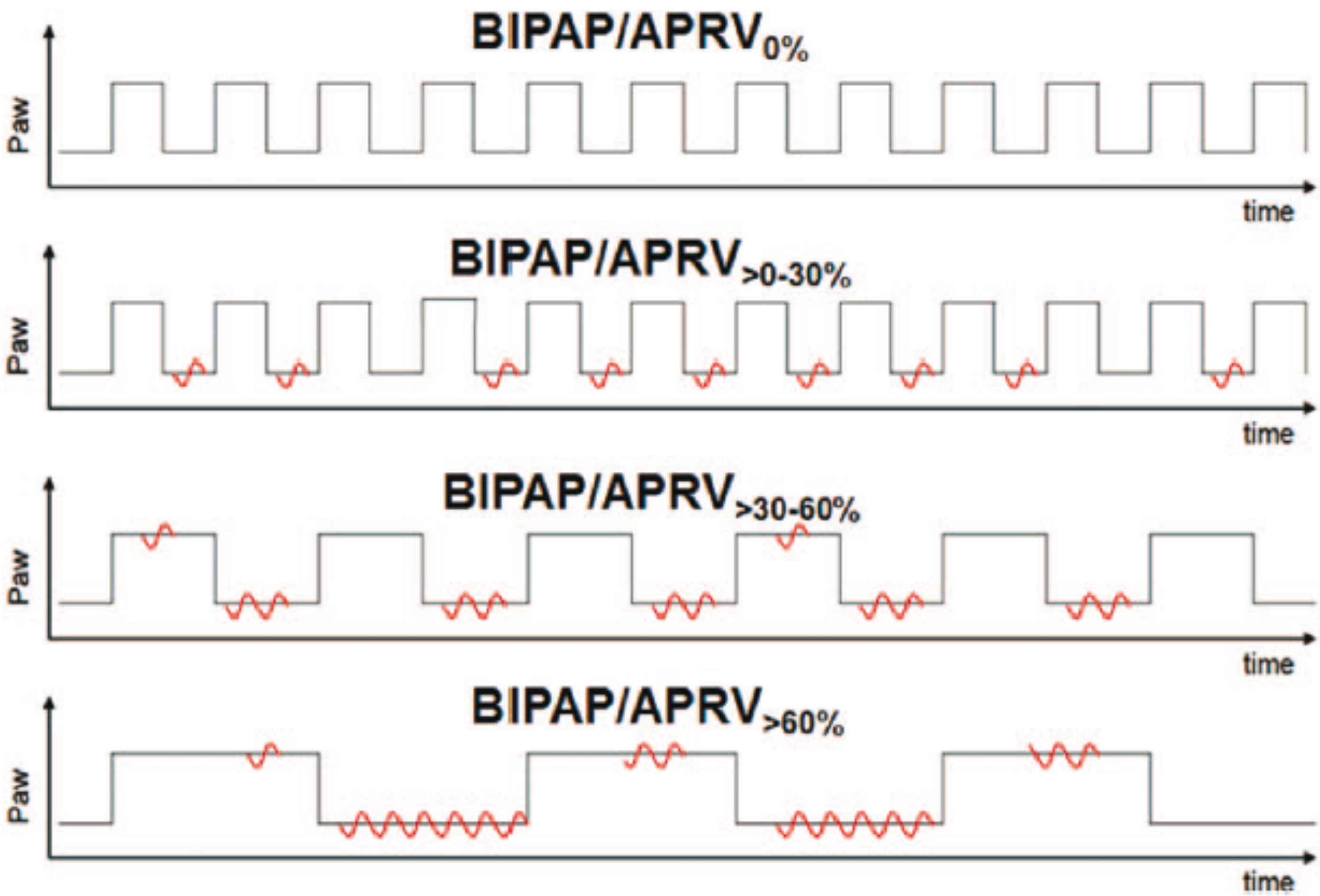


La ventilation spontanée fait référence à l'activité du diaphragme



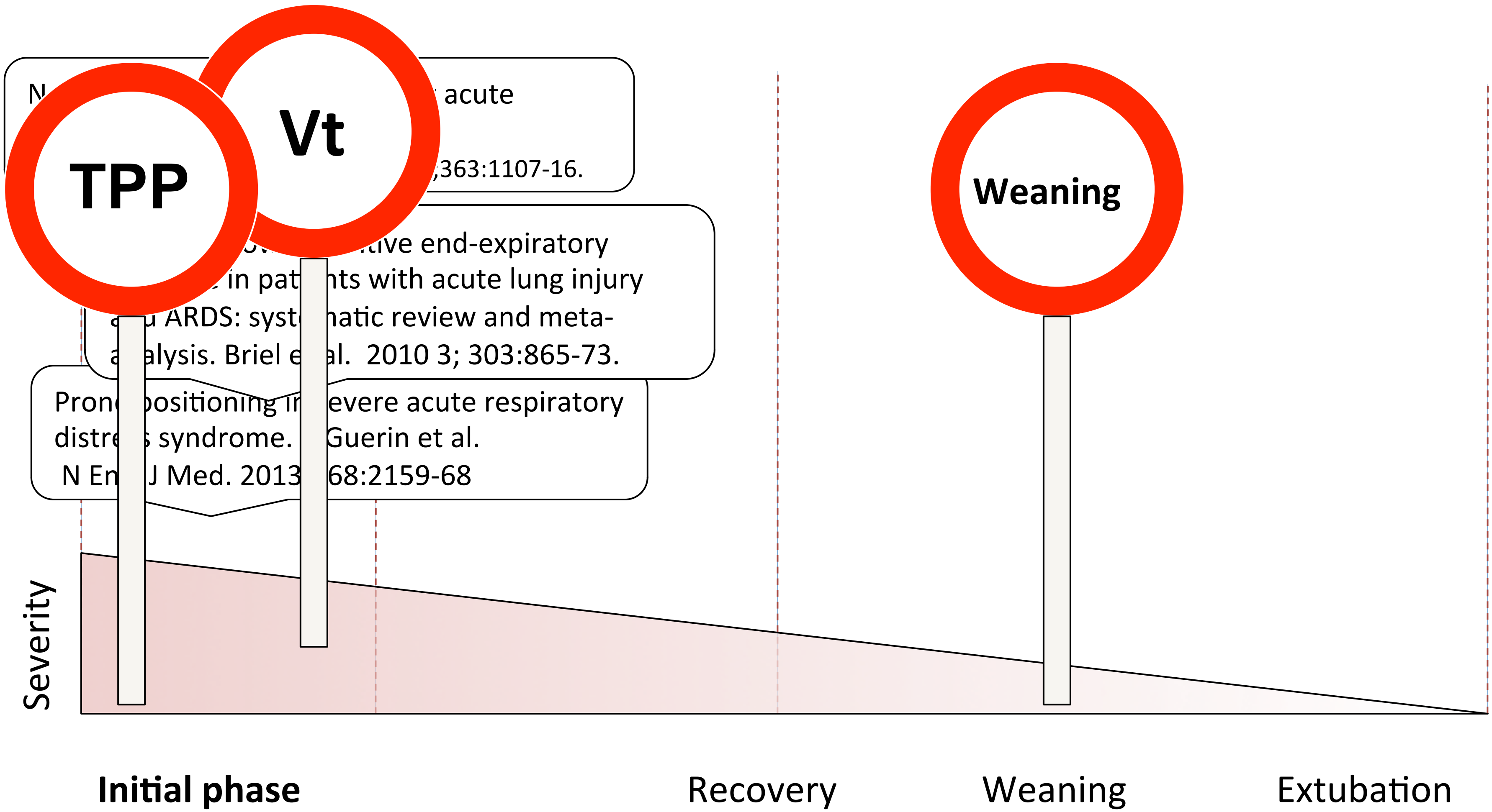
Higher Levels of Spontaneous Breathing Reduce Lung Injury in Experimental Moderate Acute Respiratory Distress Syndrome*

Carvalho N et al. 2014

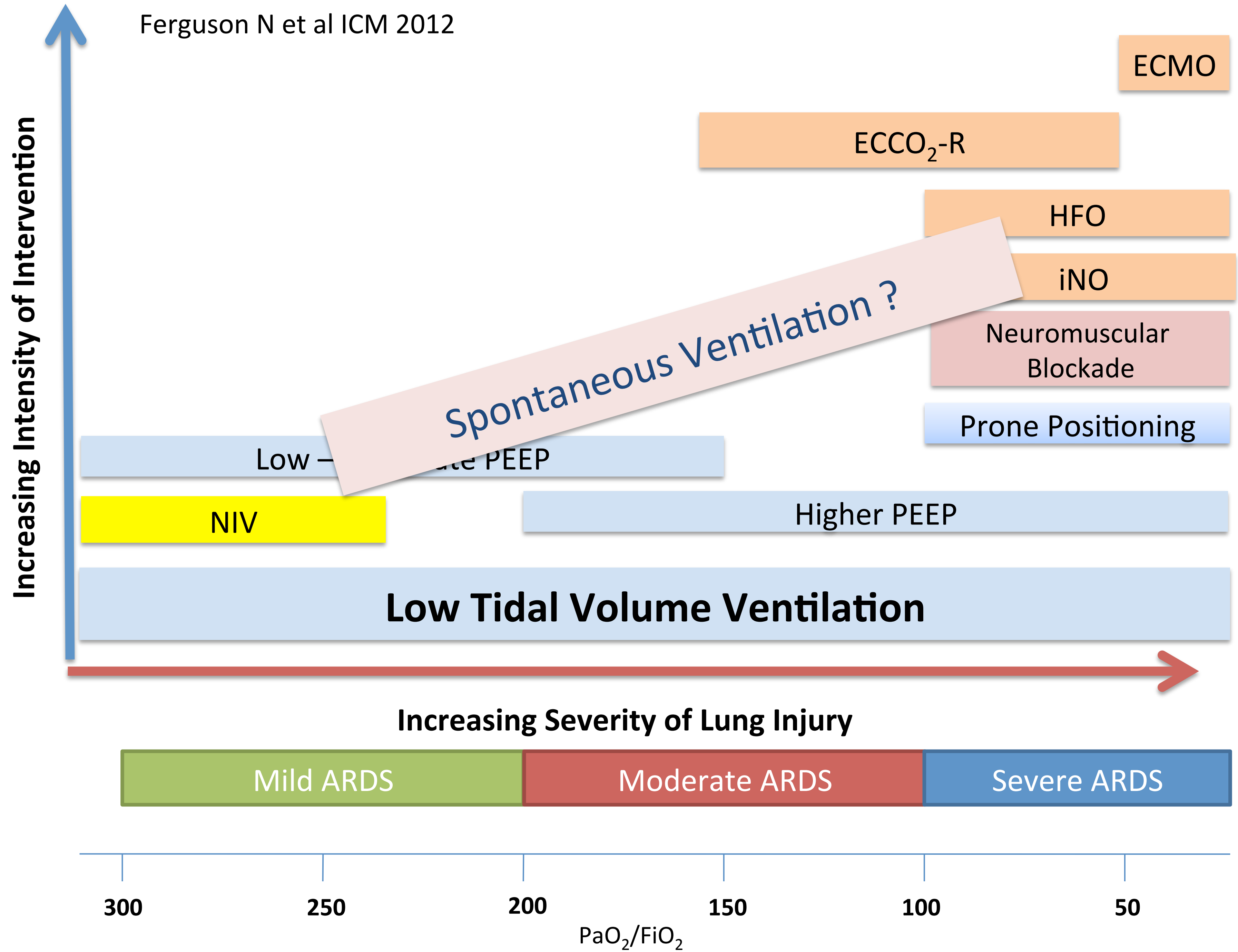


n = 36 cochons

What is already known !



Time course evolution of severe ARDS

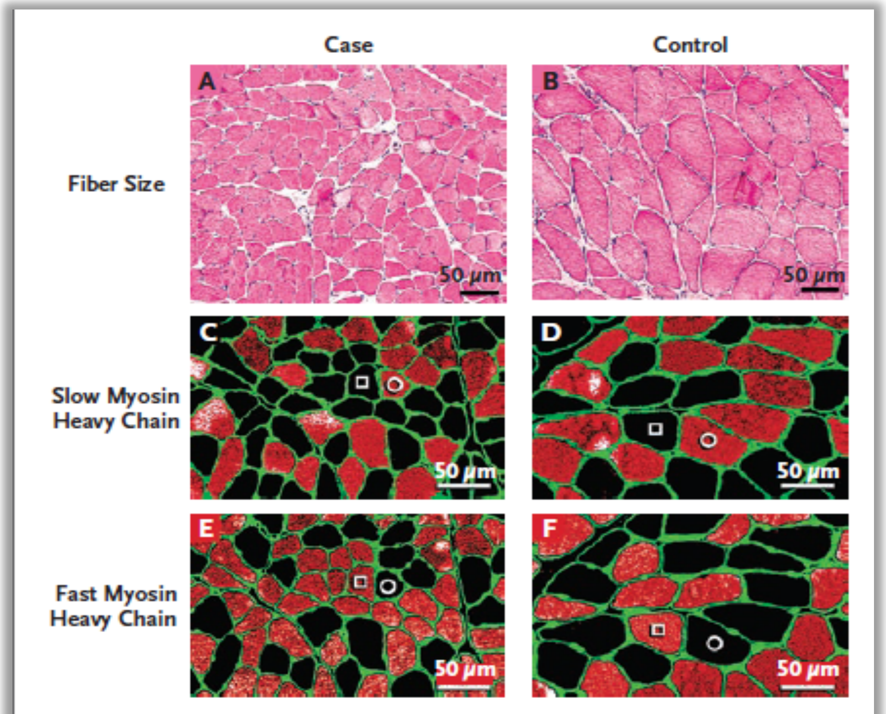

Ferguson N et al ICM 2012
Increasing Intensity of Intervention
ECMO
$ECCO_2$-R
HFO
iNO
Neuromuscular Blockade
Spontaneous Ventilation ?
Prone Positioning
Low – ... PEEP
NIV
Higher PEEP
Low Tidal Volume Ventilation
Increasing Severity of Lung Injury
Mild ARDS
Moderate ARDS
Severe ARDS
300
250
200
150
100
50
PaO_2/FiO_2

Intérêts Potentiels

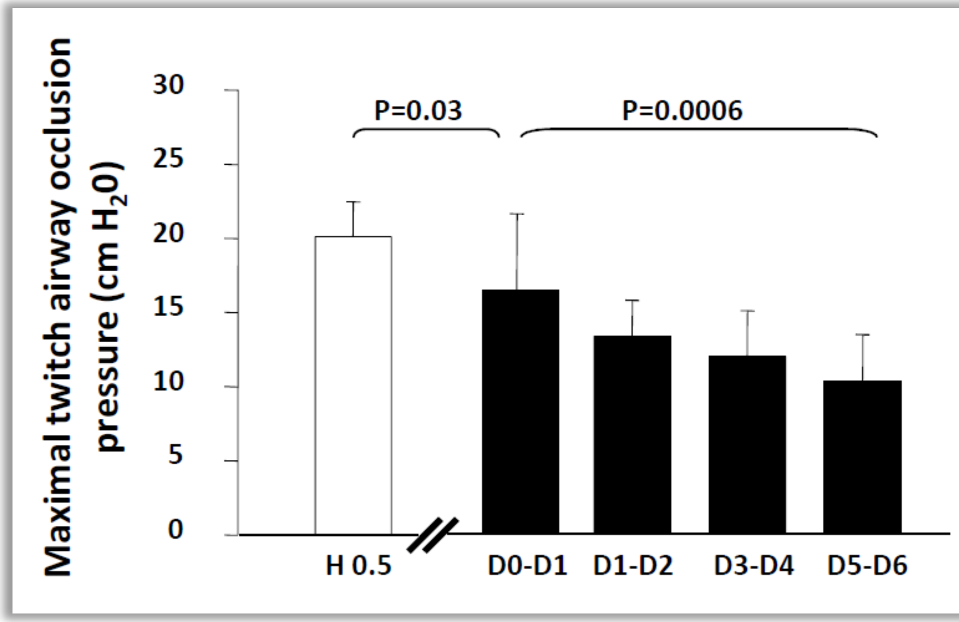
Dysfonction Diaphragmatique - VIDD

The NEW ENGLAND JOURNAL of MEDICINE

AMERICAN JOURNAL OF Respiratory and Critical Care Medicine®



Levine et al. 2008



Rapidly Progressive Diaphragmatic Weakness and Injury During Mechanical Ventilation in Humans

S. Jaber et al. 2010

Assist–Control Mechanical Ventilation Attenuates Ventilator-induced Diaphragmatic Dysfunction

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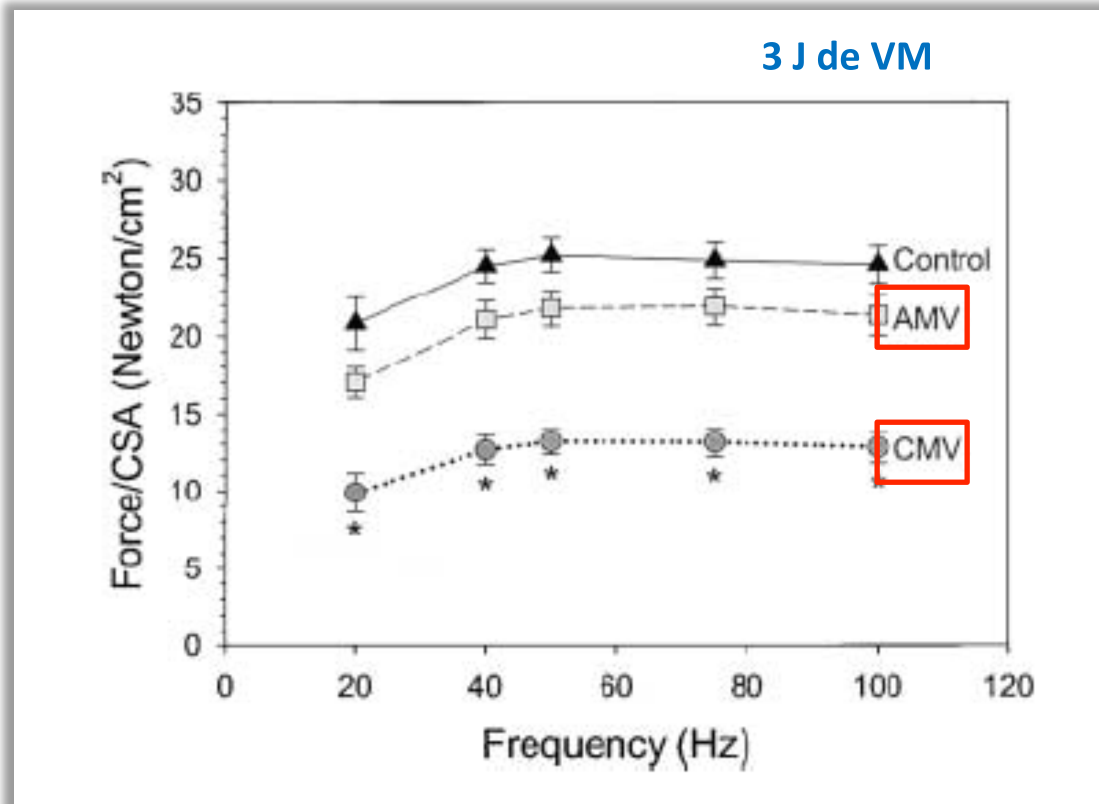
n= 30



*p 0.01, CMV versus control and AMV.
CSA cross-sectional area.

Sassoon et al. 2004

Spontaneous Breathing During Ventilatory Support Improves Ventilation–Perfusion Distributions in Patients with Acute Respiratory Distress Syndrome

Putensen C et al. 1999

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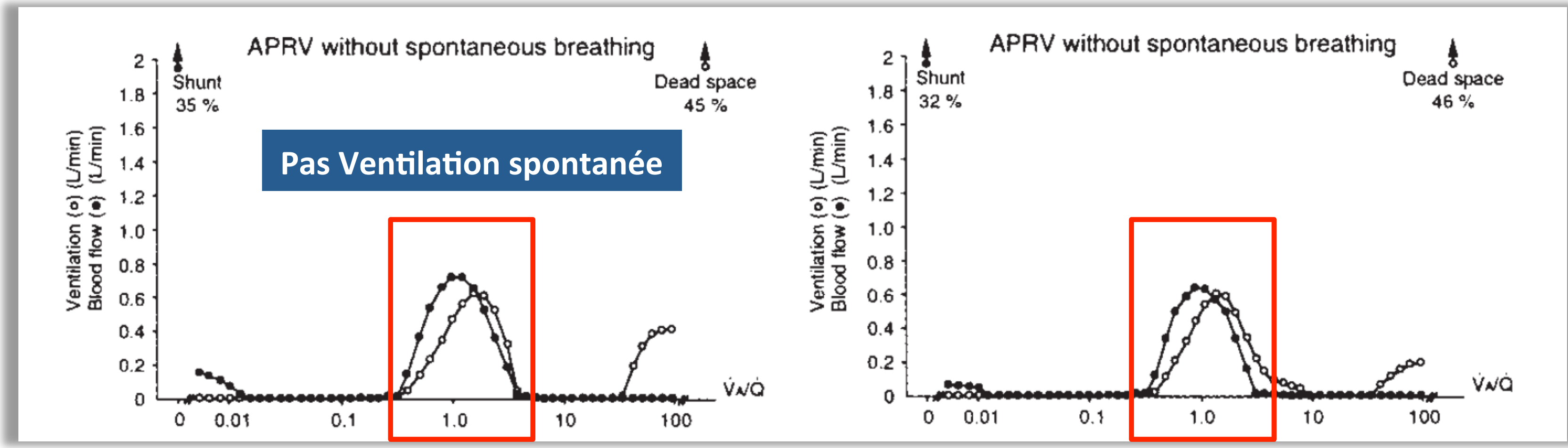
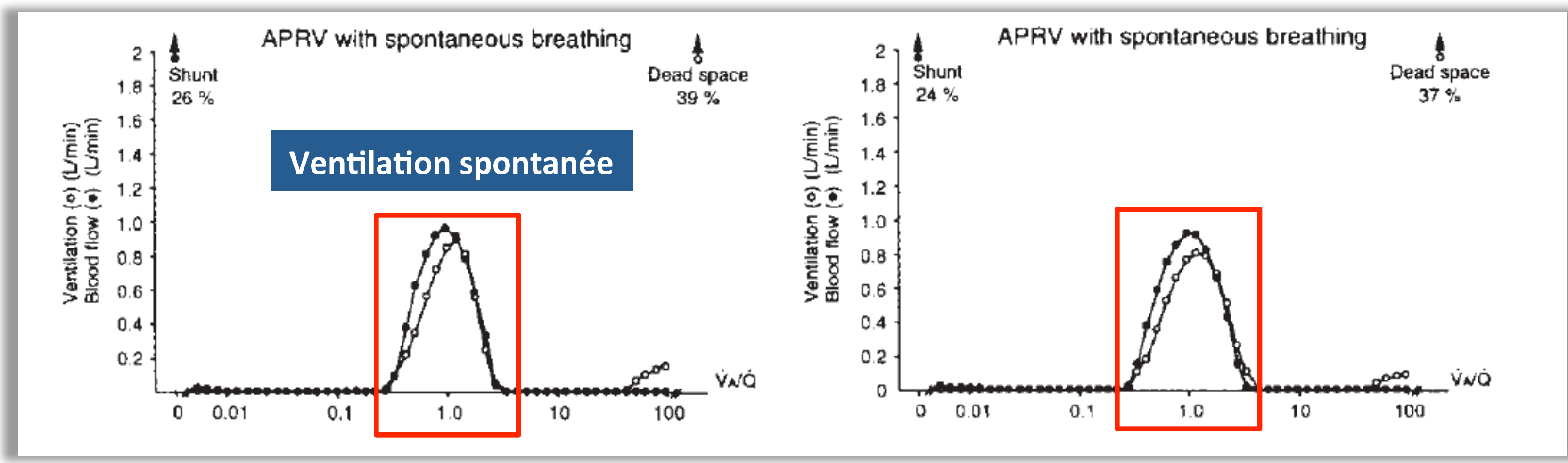
Critical Care Medicine®

n= 12 Patients

Amélioration des rapports VA/Q





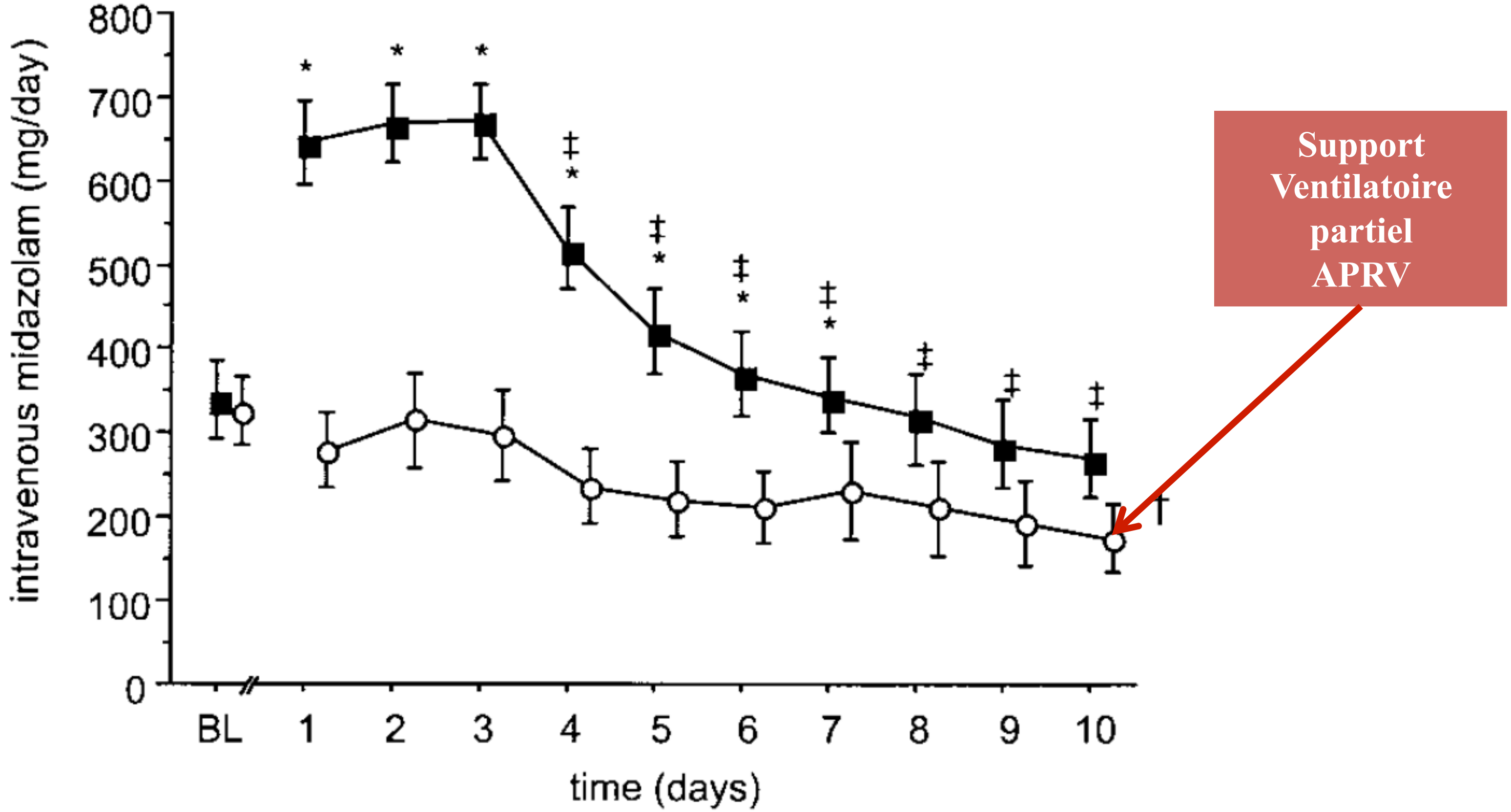
Long-Term Effects of Spontaneous Breathing During Ventilatory Support in Patients with Acute Lung Injury

CHRISTIAN PUTENSEN, SABINE ZECH, HERMANN WRIGGE, JÖRG ZINSERLING, FRANK STÜBER, TILMANN VON SPIEGEL, and NORBERT MUTZ

2001

AMERICAN JOURNAL OF Respiratory and Critical Care Medicine®

Réduction de la sédation



n= 30 Patients
Post traumatiques – 15 à 20% ARDS

Long-Term Effects of Spontaneous Breathing During Ventilatory Support in Patients with Acute Lung Injury

CHRISTIAN PUTENSEN, SABINE ZECH, HERMANN WRIGGE, JÖRG ZINSERLING, FRANK STÜBER, TILMANN VON SPIEGEL, and NORBERT MUTZ

2001

AMERICAN JOURNAL OF
Respiratory and
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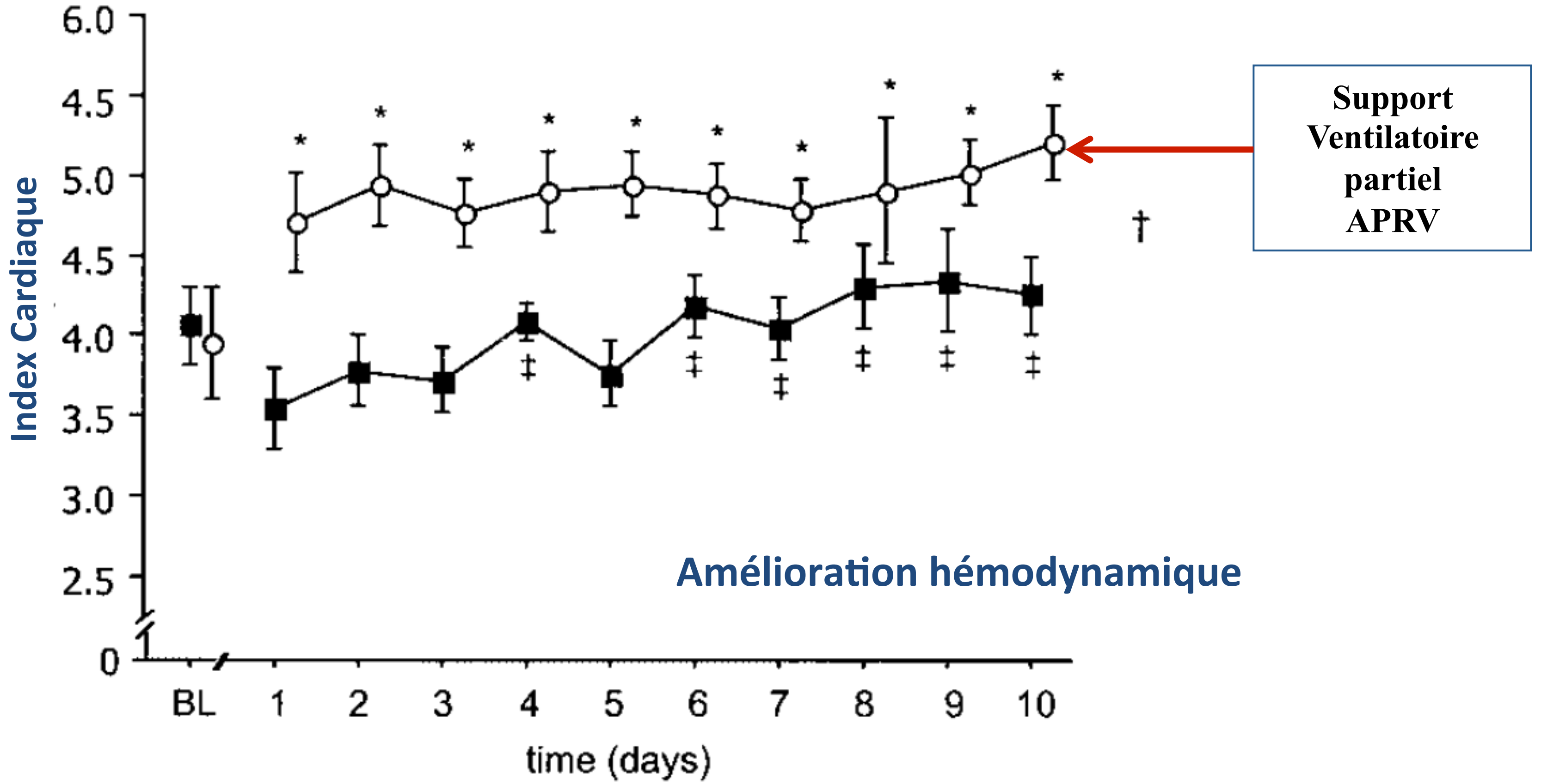
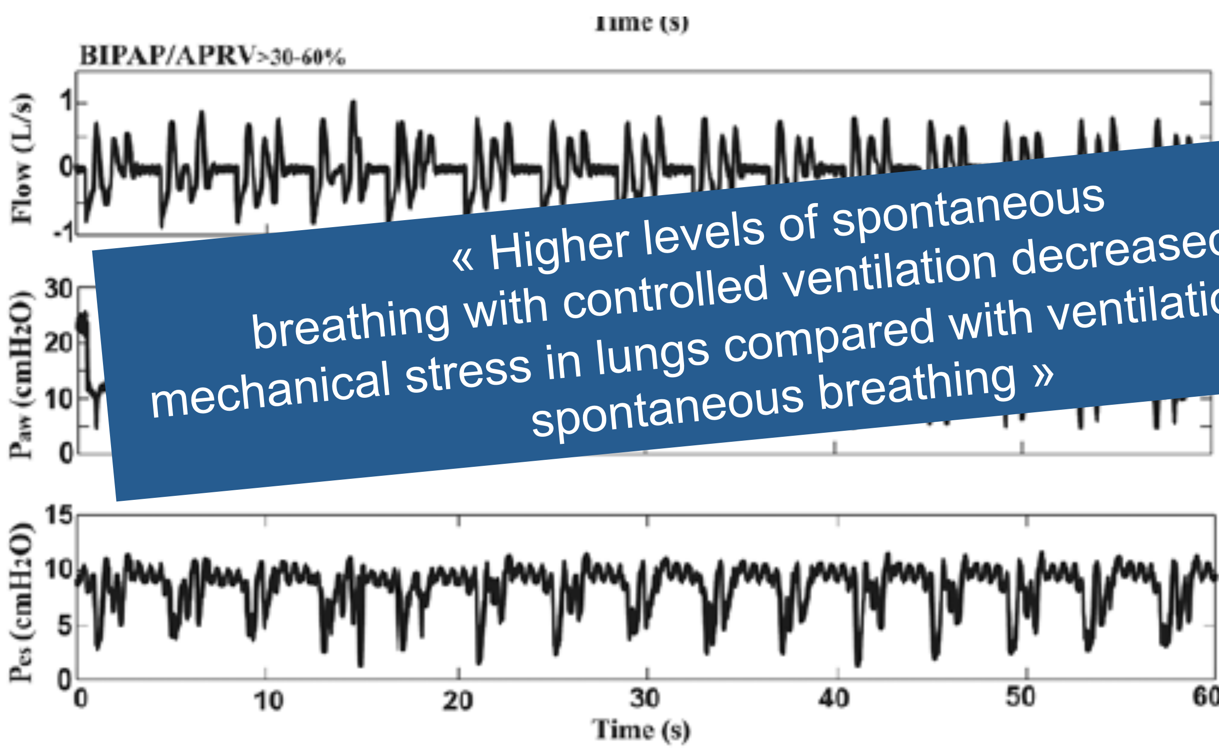
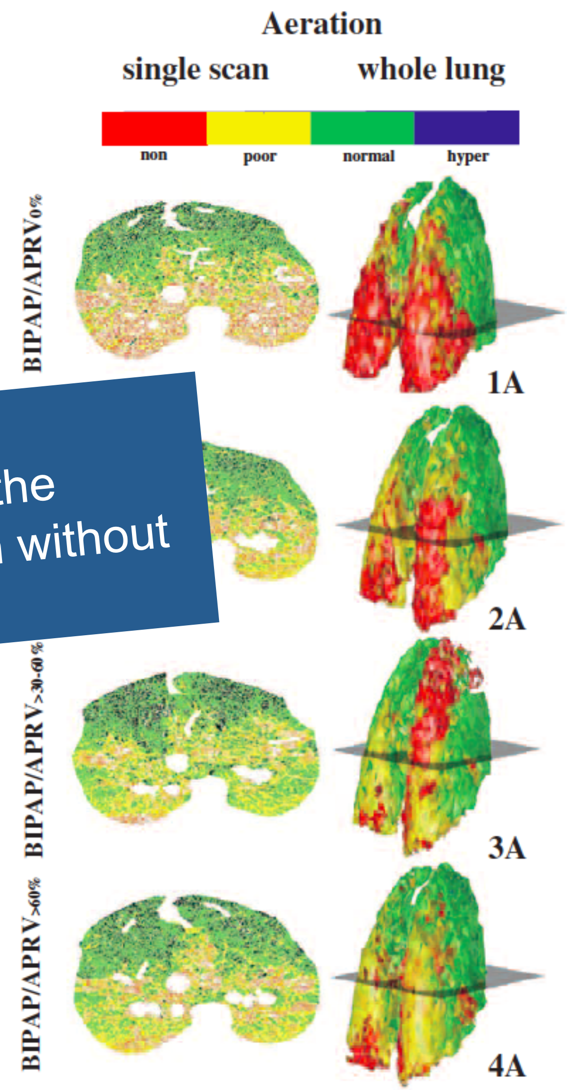


Higher Levels of Spontaneous Breathing Induce Lung Recruitment and Reduce Global Stress/Strain in Experimental Lung Injury

Andreas Güldner, M.D., Anja Braune, M.Sc., Nadja Carvalho, Ph.D., Alessandro Beda, Ph.D., Stefan Zeidler, M.S., Bärbel Wiedemann, Ph.D., Gerd Wunderlich, Ph.D., Michael Andreeff, Ph.D., Christopher Uhlig, M.D., Peter M. Spieth, M.D., Thea Koch, M.D., Ph.D., Paolo Pelosi, M.D., Jörg Kotzerke, M.D., Ph.D., Marcelo Gama de Abreu, M.D., M.Sc., Ph.D., D.E.S.A.





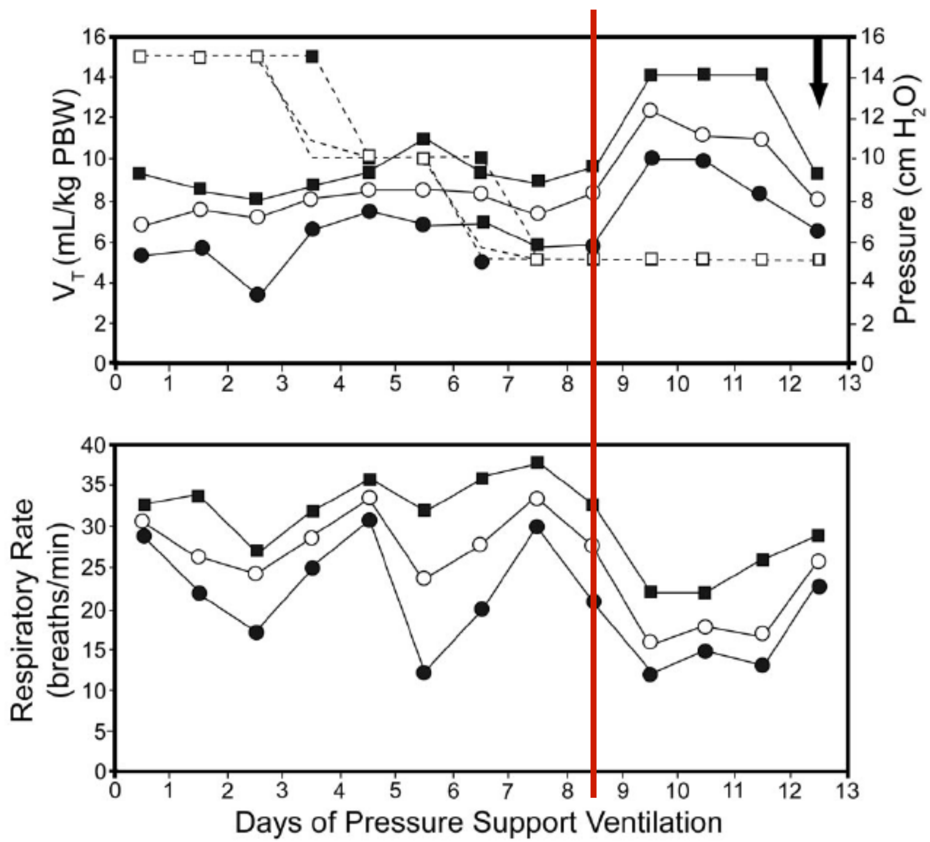
« Higher levels of spontaneous breathing with controlled ventilation decreased the mechanical stress in lungs compared with ventilation without spontaneous breathing »

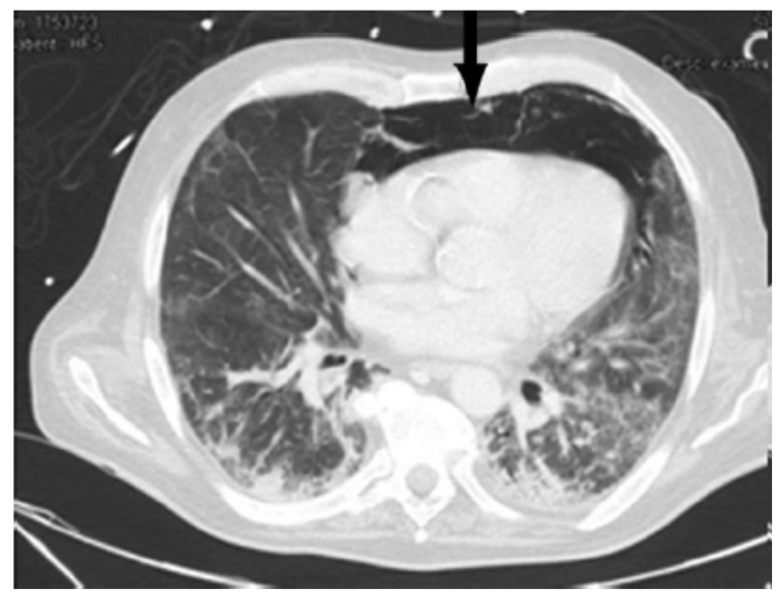
n= 12 cochons

Anesthesiology 2014

Risques Potentiels

A Case of Pneumomediastinum in a Patient With Acute Respiratory Distress Syndrome on Pressure Support Ventilation





VS – Volume courant élevé

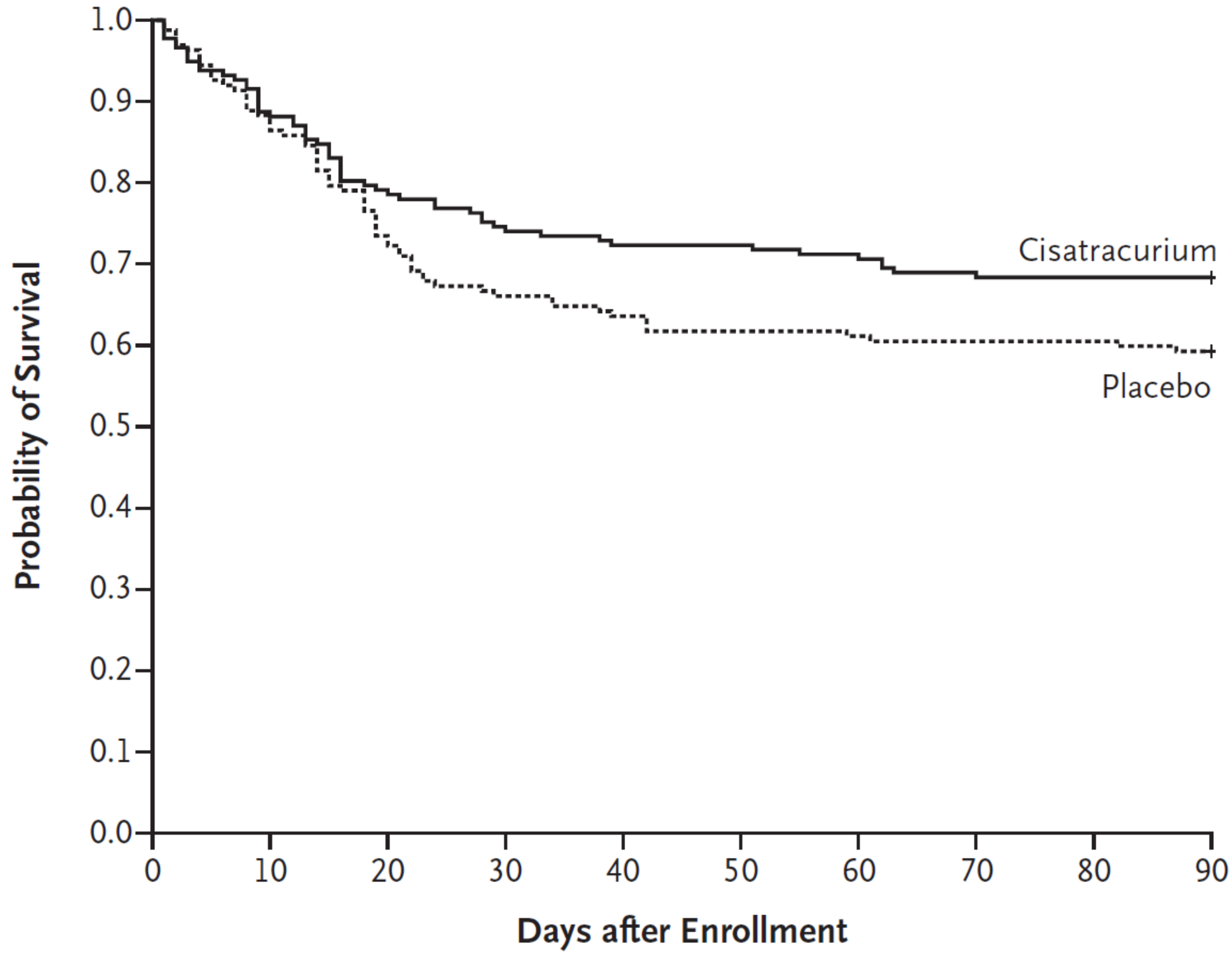
Leray V et al. Respir Care 2010

Neuromuscular Blockers in Early Acute Respiratory Distress Syndrome

NEJM

2010

n= 340 Patients



PNO 4% vs 12%

Papazian L.

Mechanisms of injury

from spontaneous breathing

REVIEW ARTICLE

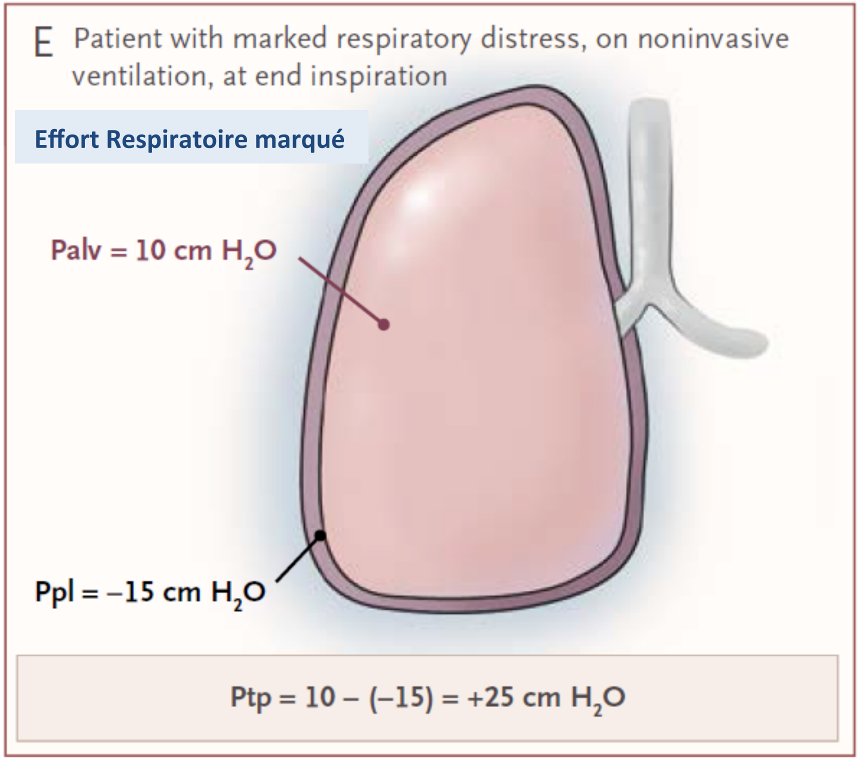
NEJM

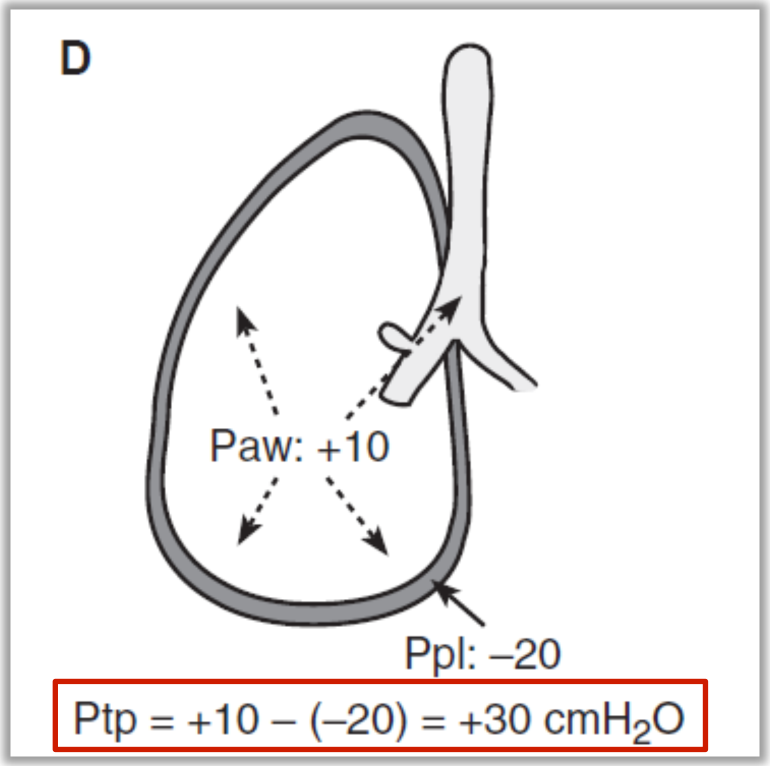
CRITICAL CARE MEDICINE

Simon R. Finfer, M.D., and Jean-Louis Vincent, M.D., Ph.D., *Editors*

Ventilator-Induced Lung Injury

Arthur S. Slutsky, M.D., and V. Marco Ranieri, M.D.

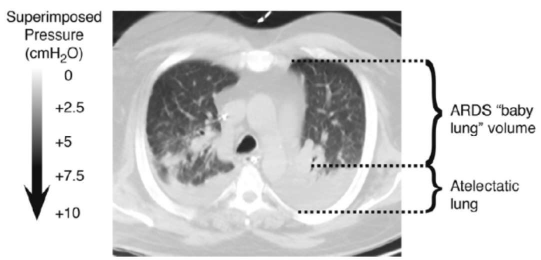


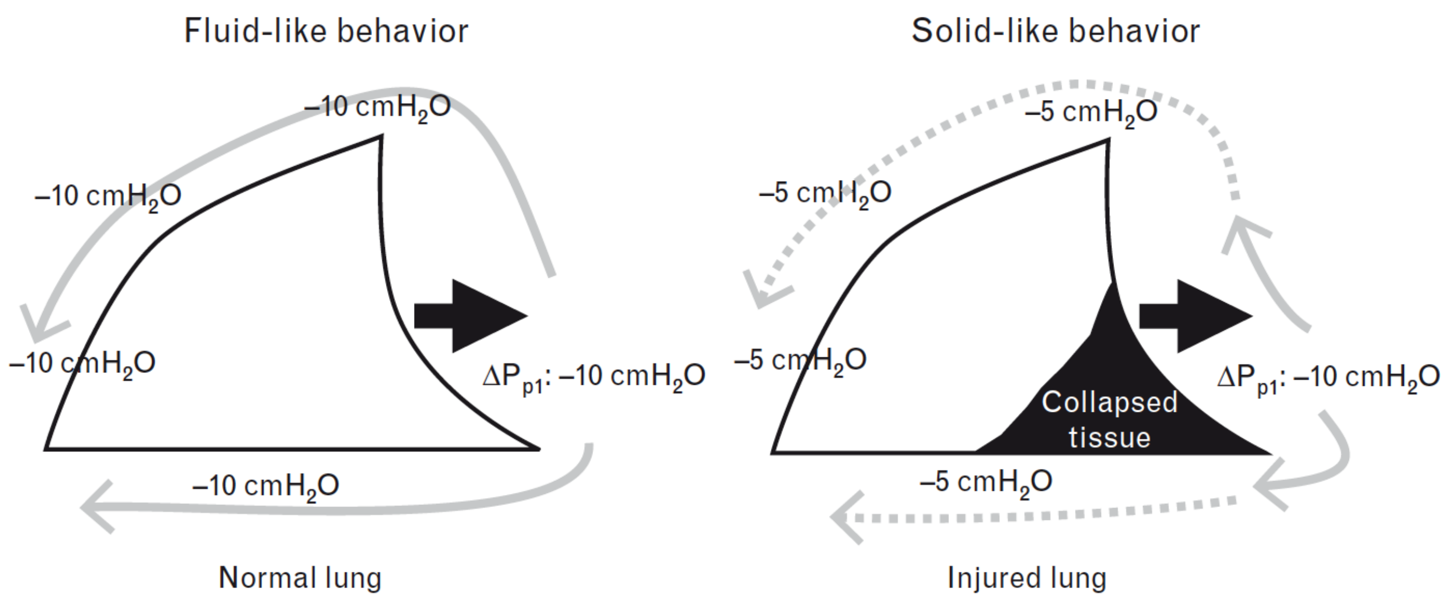


A Slutsky, M Ranieri. N Engl J Med 2013

Balancing neuromuscular blockade versus preserved muscle activity

Hraiech et al. 2015





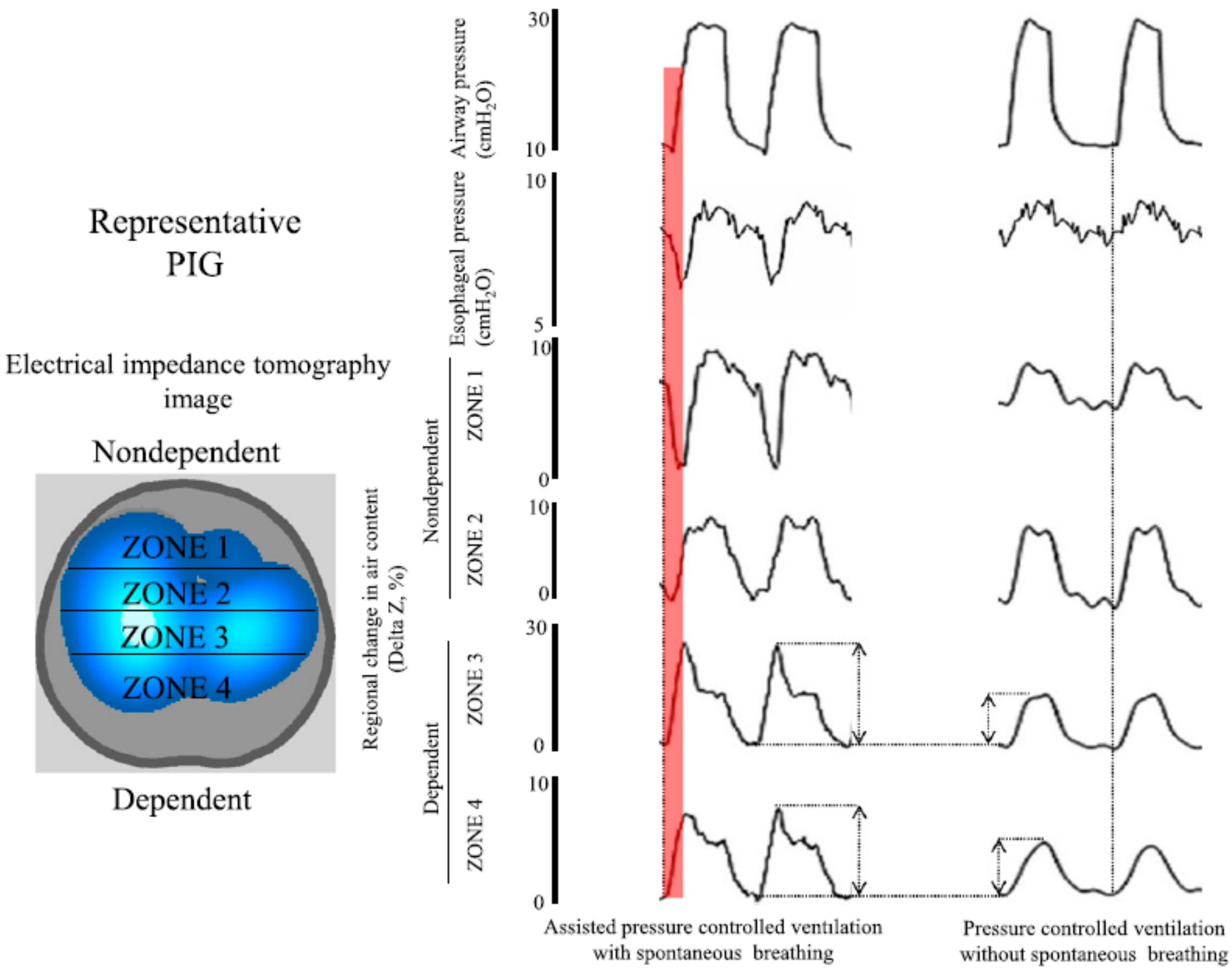
SDRA: Hétérogénéité pulmonaire

Curr Opin Crit Care 2015, 21:26–33

Spontaneous Effort Causes Occult Pendelluft during Mechanical Ventilation

Takeshi Yoshida[1,2], Vinicius Torsani[1], Susimeire Gomes[1], Roberta R. De Santis[1], Marcelo A. Beraldo[1], Eduardo L. V. Costa[1], Mauro R. Tucci[1], Walter A. Zin[3], Brian P. Kavanagh[4,5], and Marcelo B. P. Amato[1]

Am J Respir Crit Care Med Vol 188, Iss. 12, pp 1420–1427, Dec 15, 2013

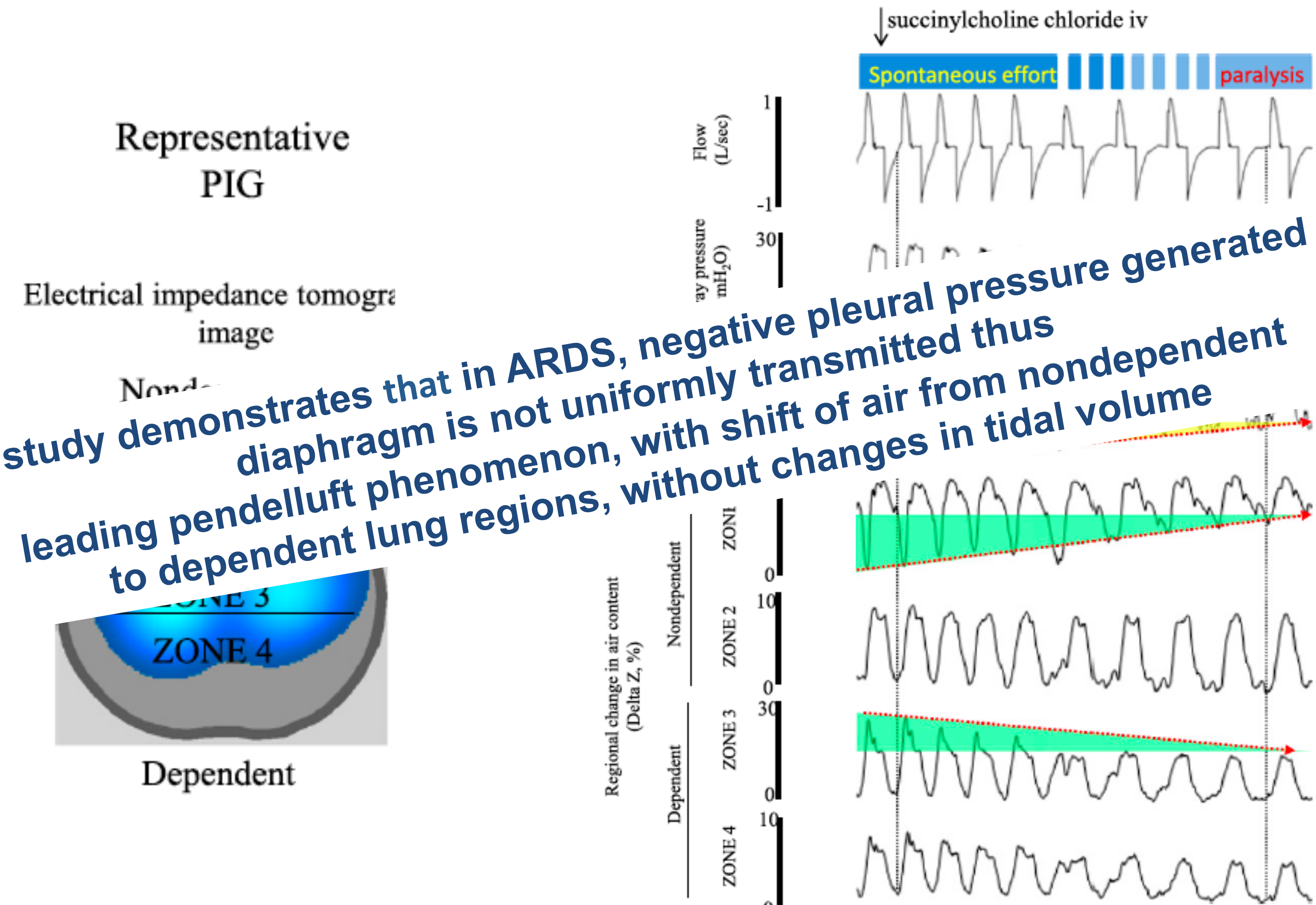


n= 7 cochons

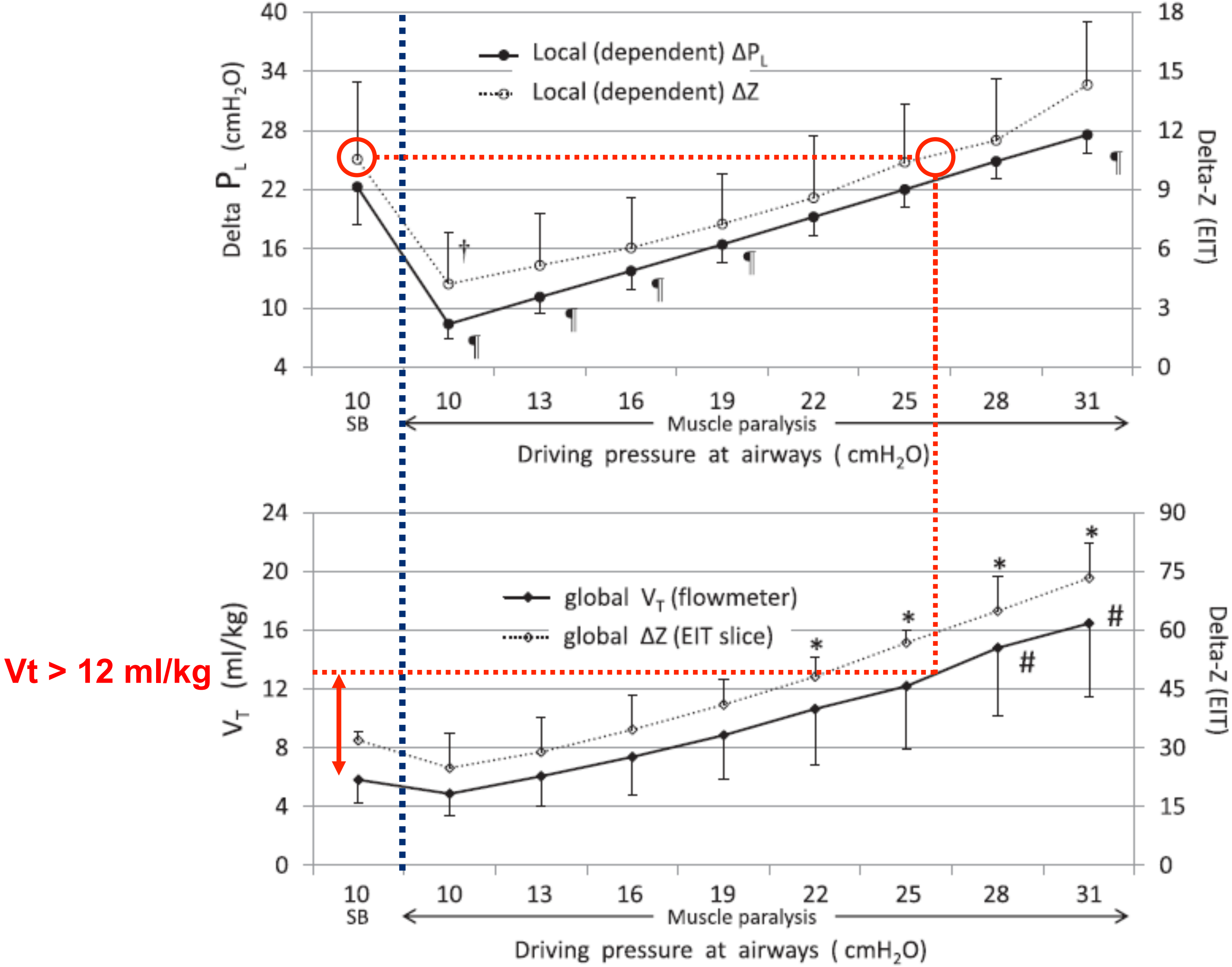
Spontaneous Effort Causes Occult Pendelluft during Mechanical Ventilation

Yoshida T et al.

Am J Respir Crit Care Med Vol 188, Iss. 12, pp 1420–1427, Dec 15, 2013



This study demonstrates that in ARDS, negative pleural pressure generated by diaphragm is not uniformly transmitted thus leading pendelluft phenomenon, with shift of air from nondependent to dependent lung regions, without changes in tidal volume

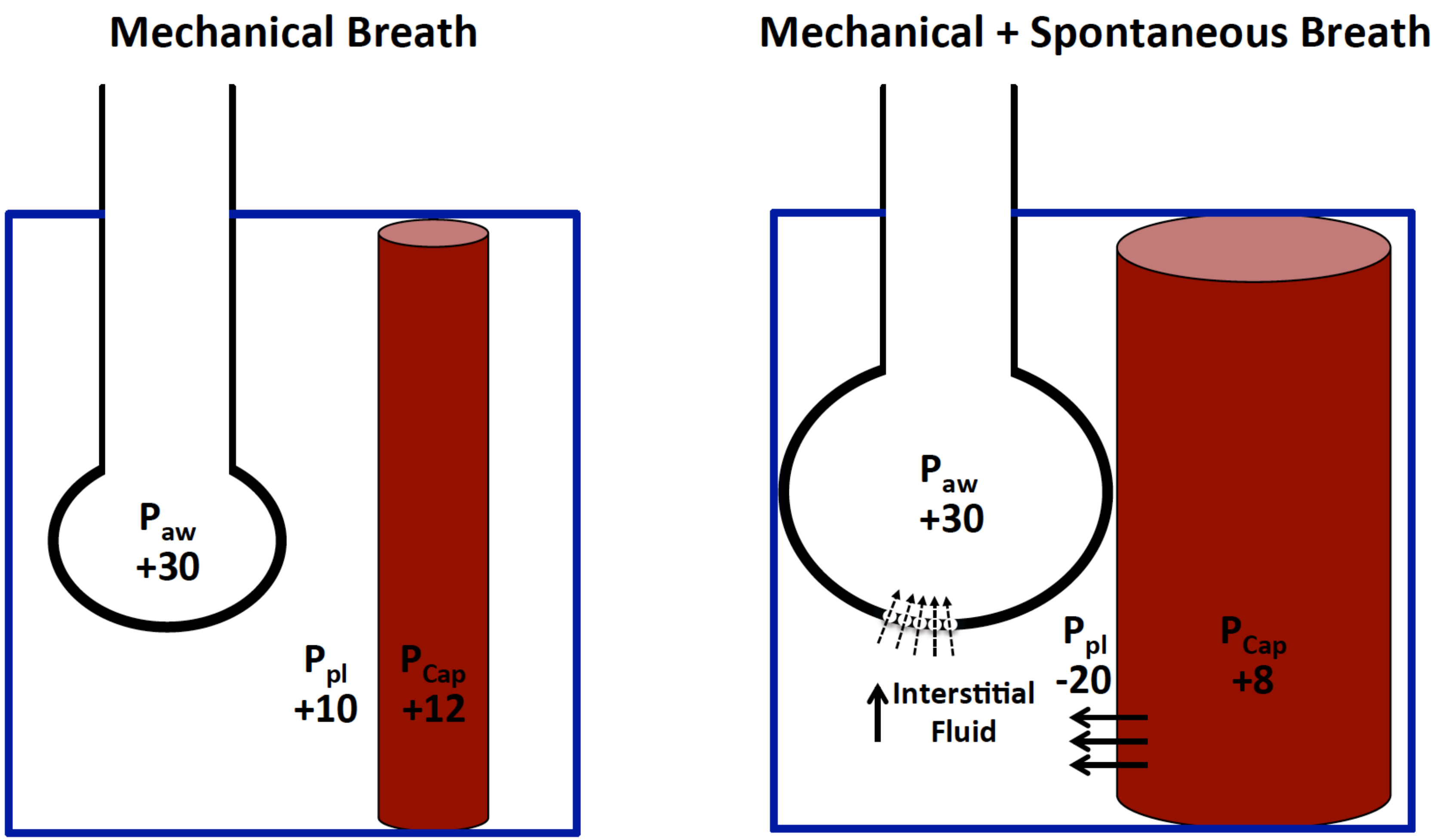


T Yoshida et coll. Am J Respir Care Med 2013

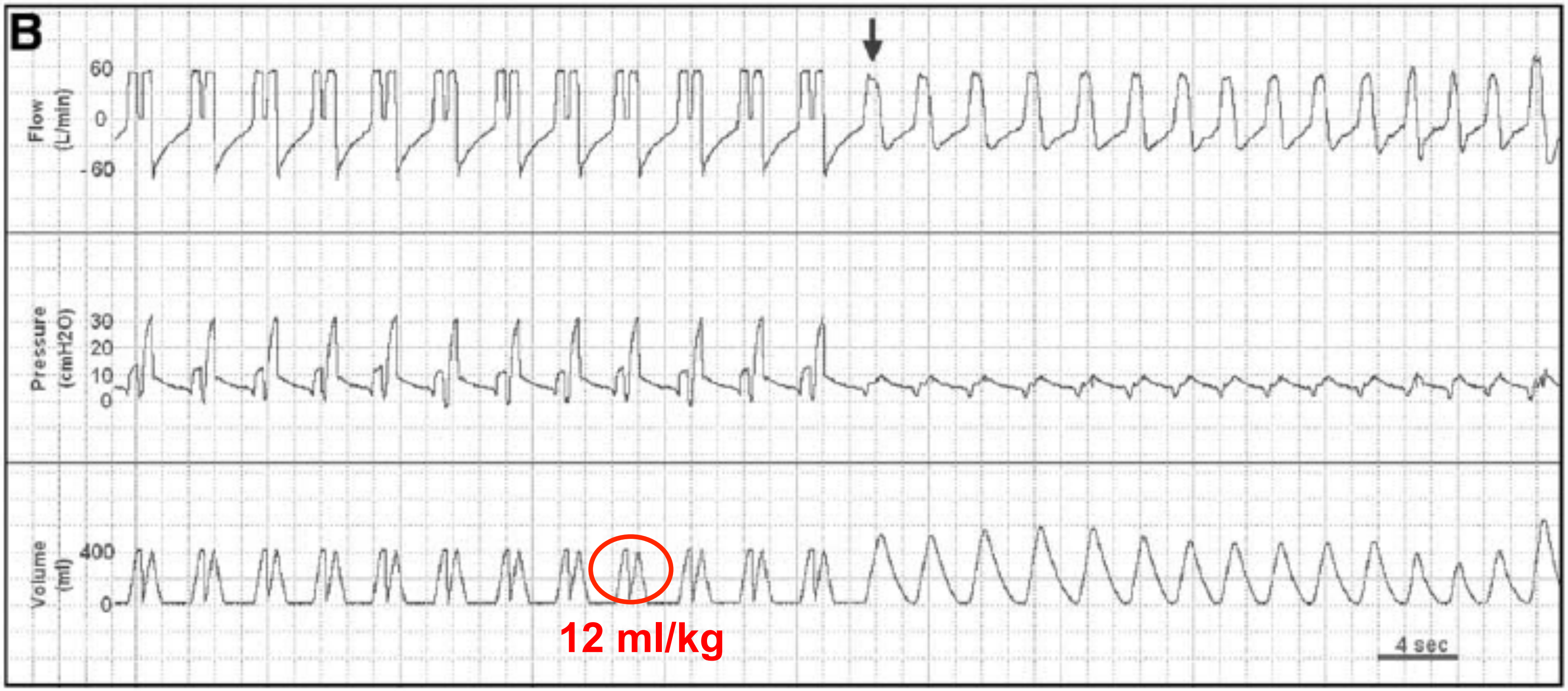
Spontaneous Breathing during Mechanical Ventilation

Risks, Mechanisms, and Management

Yoshida T et al. 2016



Impact of Ventilator Adjustment and Sedation–Analgesia Practices on Severe Asynchrony in Patients Ventilated in Assist-Control Mode*



Chanques G et al. Crit Care Med 2013

CHEST

Original Research

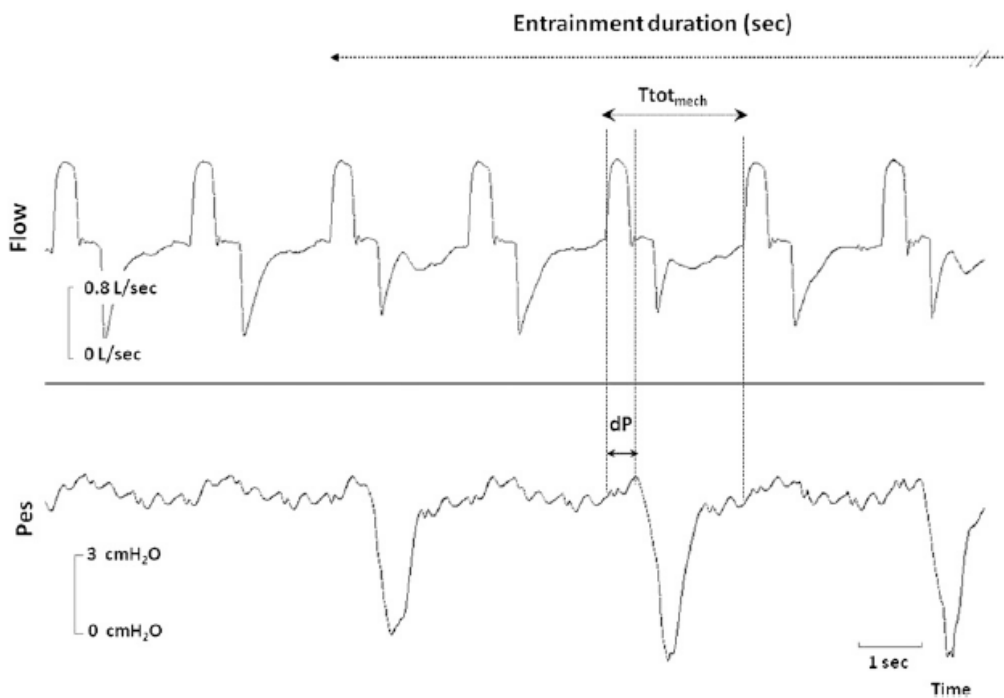
CRITICAL CARE

Mechanical Ventilation-Induced Reverse-Triggered Breaths

A Frequently Unrecognized Form of Neuromechanical Coupling

CHEST 2013; 143(4):927–938

Evangelia Akoumianaki, MD; Aissam Lyazidi, PhD; Nathalie Rey, MD; Dimitrios Matamis, MD; Nelly Perez-Martinez, MD; Raphael Giraud, MD; Jordi Mancebo, MD; Laurent Brochard, MD; and Jean-Christophe Marie Richard, MD, PhD



Risk of Injury

Spontaneous breathing during lung-protective ventilation in an experimental acute lung injury model: High transpulmonary pressure associated with strong spontaneous breathing effort may worsen lung injury*

Yoshida T et al.

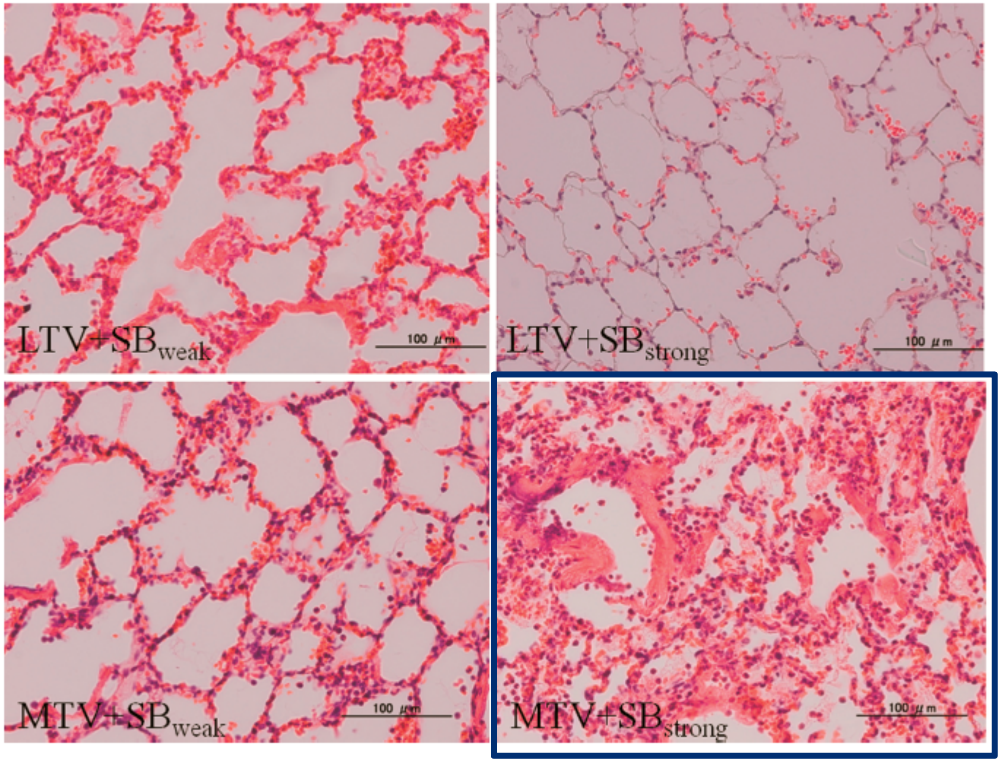
Crit Care Med 2012; 40:1578–1585

N= 32 lapins

SB_{weak} SB_{strong}

LTV = 6 ml/kg

MTV = 7-9 ml/kg



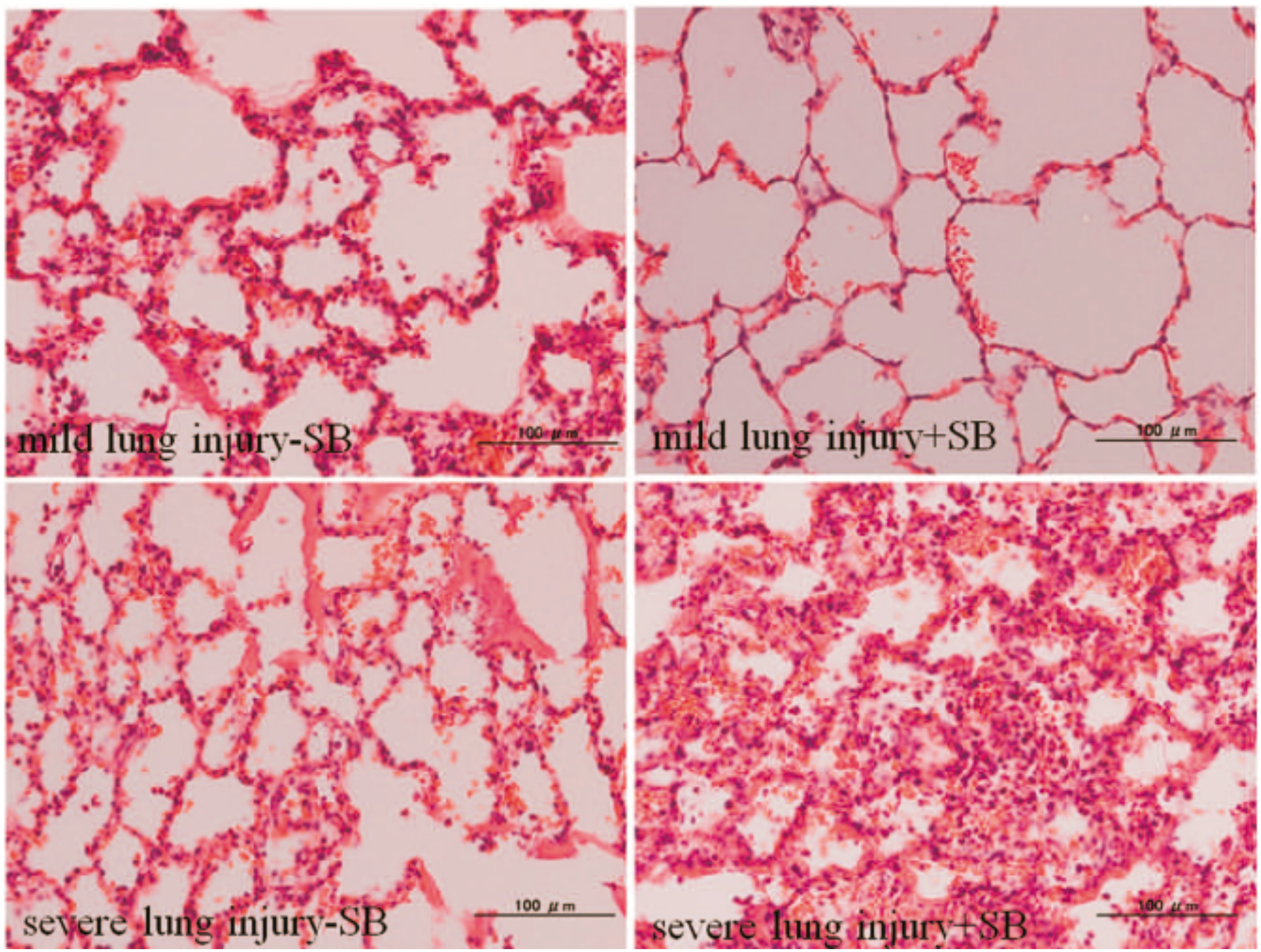
The Comparison of Spontaneous Breathing and Muscle Paralysis in Two Different Severities of Experimental Lung Injury*

Yoshida T et al. 2013

Without SB **SB**

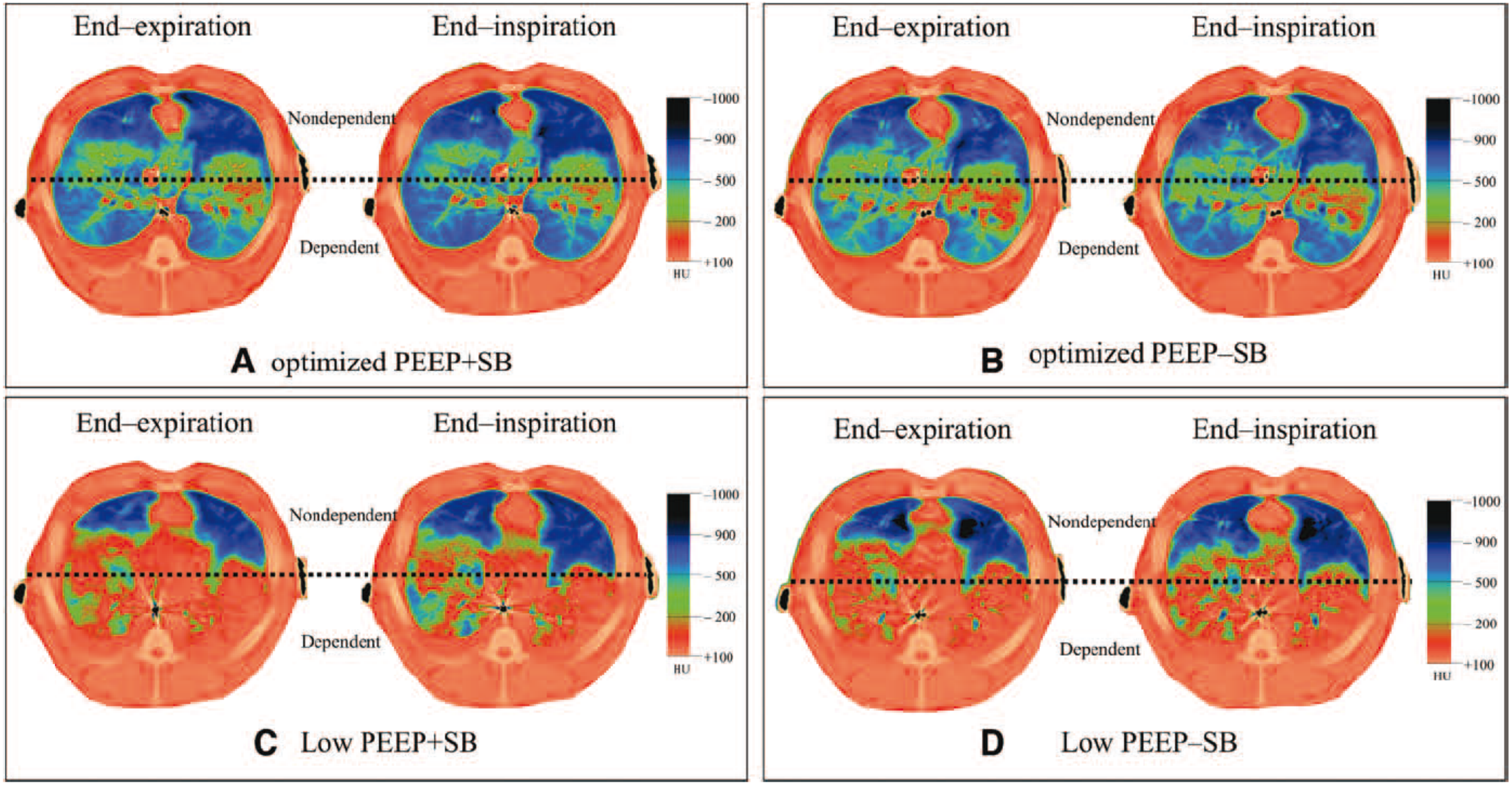
Mild

Severe



Spontaneous Effort During Mechanical Ventilation: Maximal Injury With Less Positive End-Expiratory Pressure*

Yoshida T et al. 2016



n= 7 cochons

IS SPONTANEOUS VENTILATION AND RELATED VT AFFECTED BY THE MODE OF VENTILATION ?

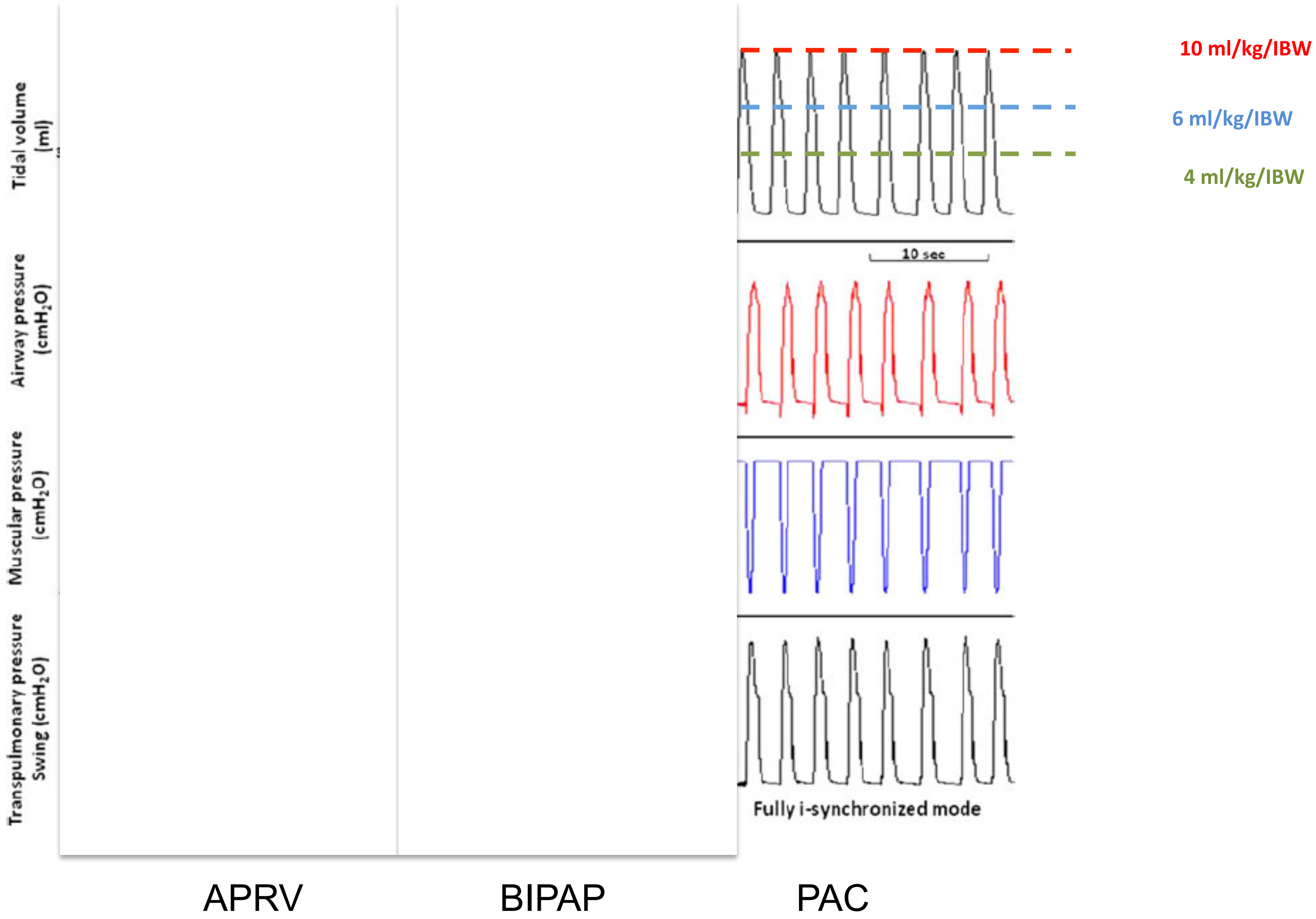
J. C. M. Richard
A. Lyazidi
E. Akoumianaki
S. Mortaza
R. L. Cordioli
J. C. Lefebvre
N. Rey
L. Piquilloud
G. F. Sferrazza-Papa
A. Mercat
L. Brochard

Potentially harmful effects of inspiratory synchronization during pressure preset ventilation

- APRV (Non inspiratory syncronized)
- BIPAP (Partially inspiratory synchronized)
- PAC (Fully inspiratory synchronized)

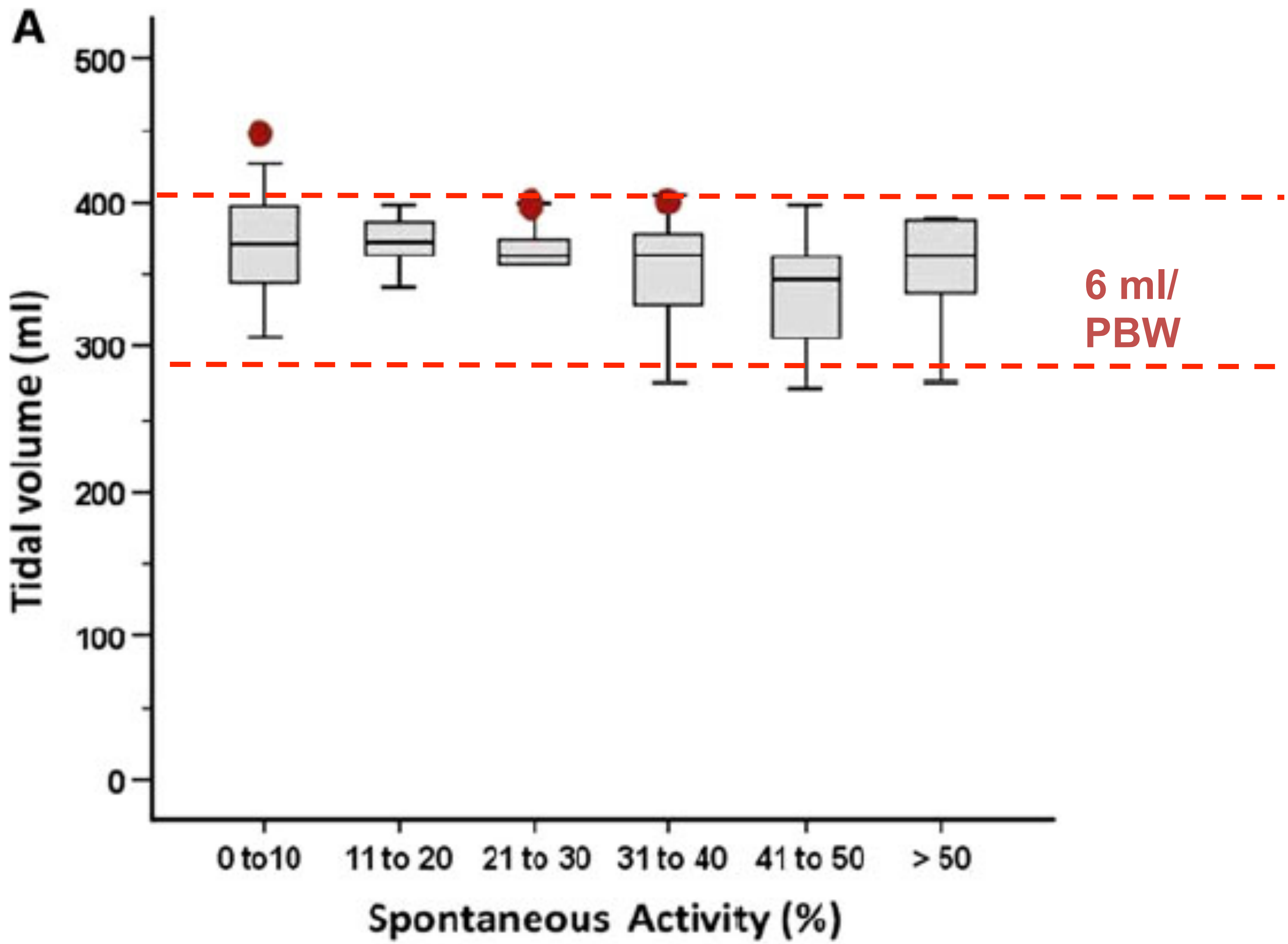
Intensive Care Med. 2013;39:2003-10

VT change in the presence of spontaneous breaths according to i-synchronization



Clinical observations :

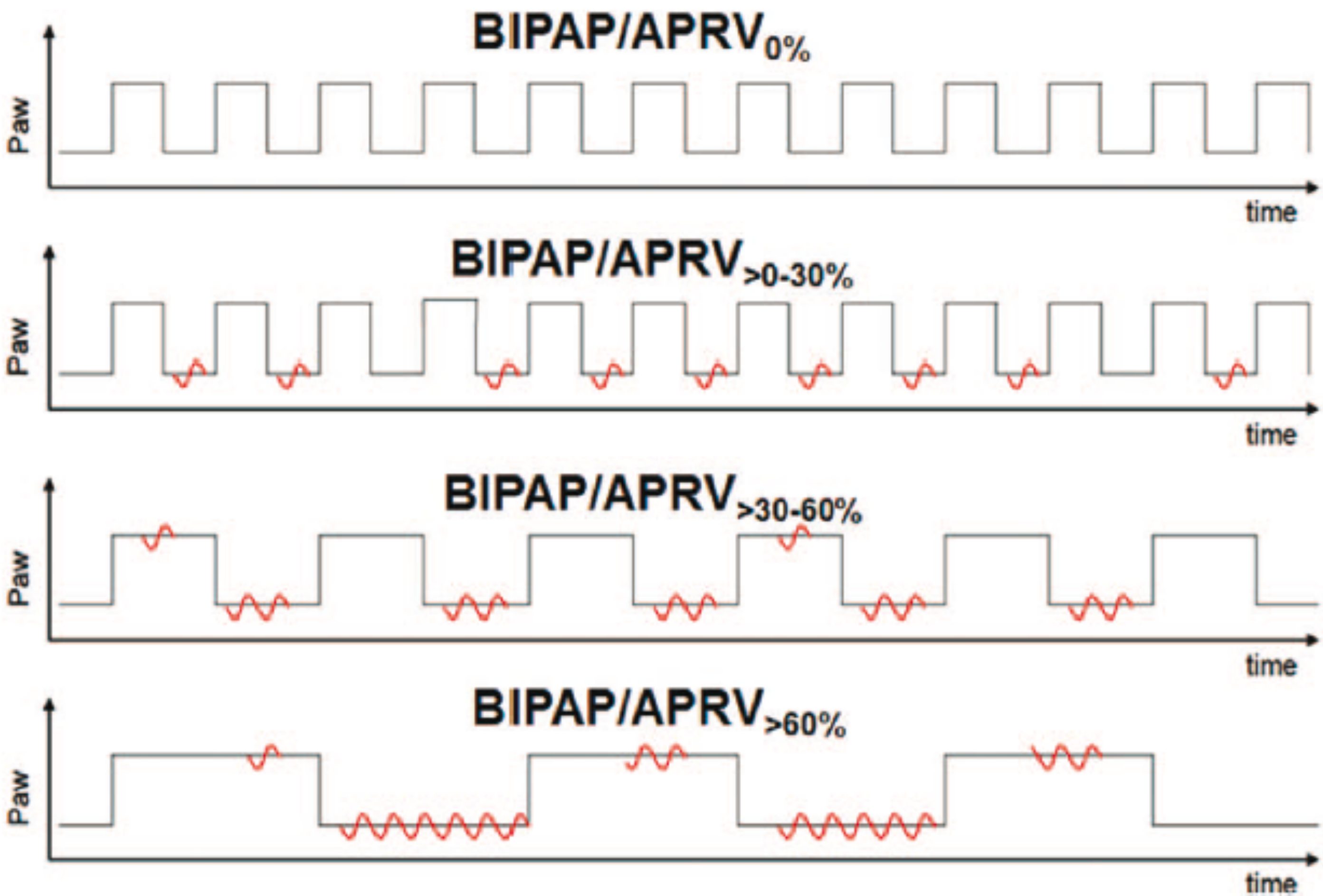
8 ARDS patients under APRV over 5 days



Intensive Care Med. 2013;39:2003-10

Higher Levels of Spontaneous Breathing Reduce Lung Injury in Experimental Moderate Acute Respiratory Distress Syndrome*

Carvalho N et al. 2014

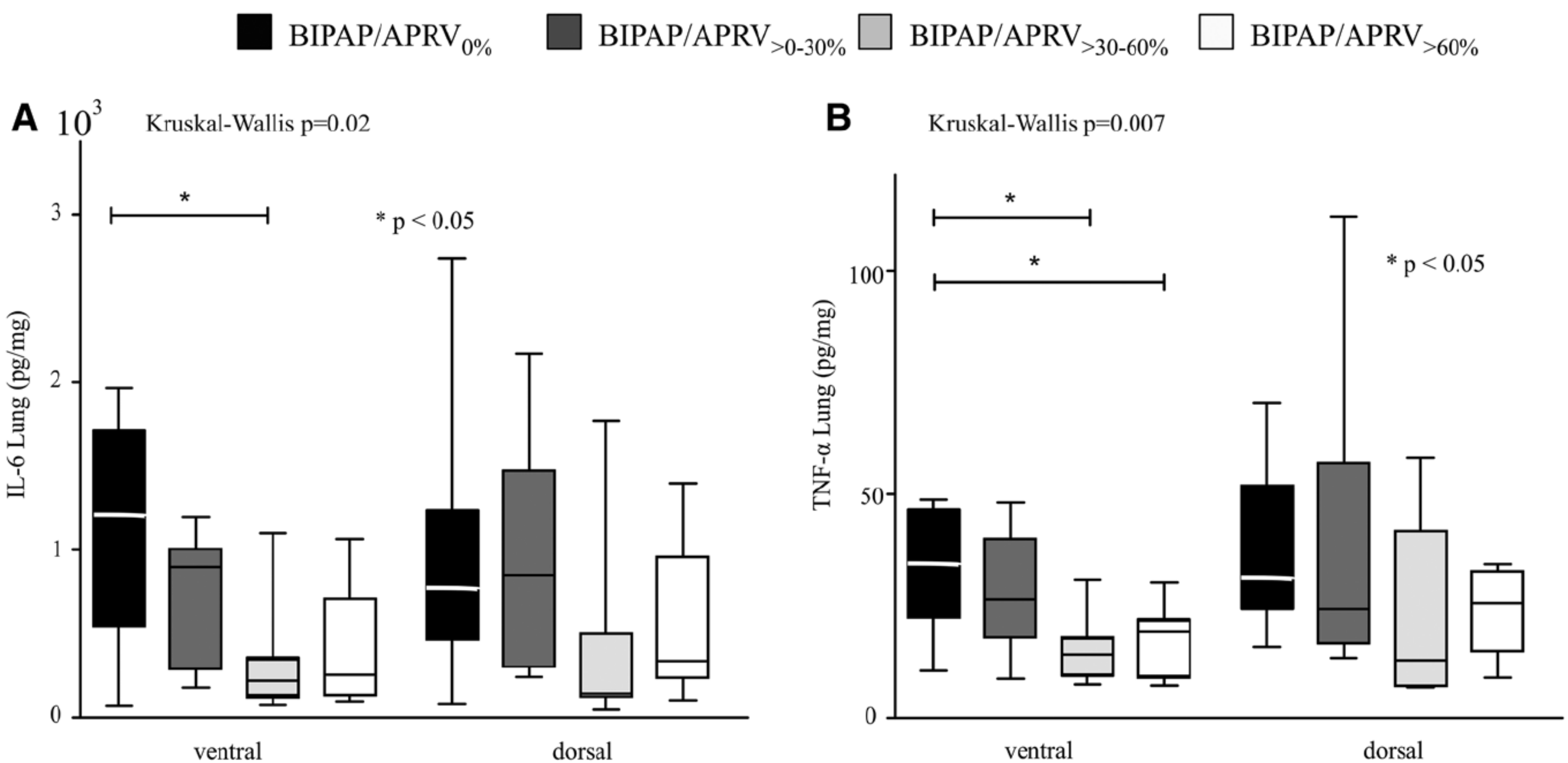


N = 36 cochons

Higher Levels of Spontaneous Breathing Reduce Lung Injury in Experimental Moderate Acute Respiratory Distress Syndrome*

Carvalho N et al. 2014

N = 36 cochons



Assisted Ventilation in Patients with Acute Respiratory Distress Syndrome

Doorduin et al. Anesthesiology 2015; 123:181-90

Table 1. Patient Characteristics at Study Inclusion

Patient	Age (yr)	Sex	BMI (kg/m²)	RASS	Days on MV	P/F Ratio (mmHg)	ARDS Etiology
1	72	M	25	–3	13	242	Pneumonia
2	71	M	27	–5	4	146	Pneumonia
3	61	F	48	–1	1	116	Urosepsis
4	49	M	26	–1	21	75	Acute pancreatitis
5	64	M	23	–4	1	150	Pneumonia
6	76	M	32	0	4	108	Pneumonia
7	48	M	27	–4	7	143	Acute pancreatitis
8	71	F	32	–4	6	175	Acute pancreatitis
9	68	M	24	–4	32	177	Pneumonia and mediastinitis
10	78	M	18	–3	5	115	Pneumonia
11	45	M	24	–4	11	165	Pneumonia
12	66	M	23	–5	10	120	Pneumonia

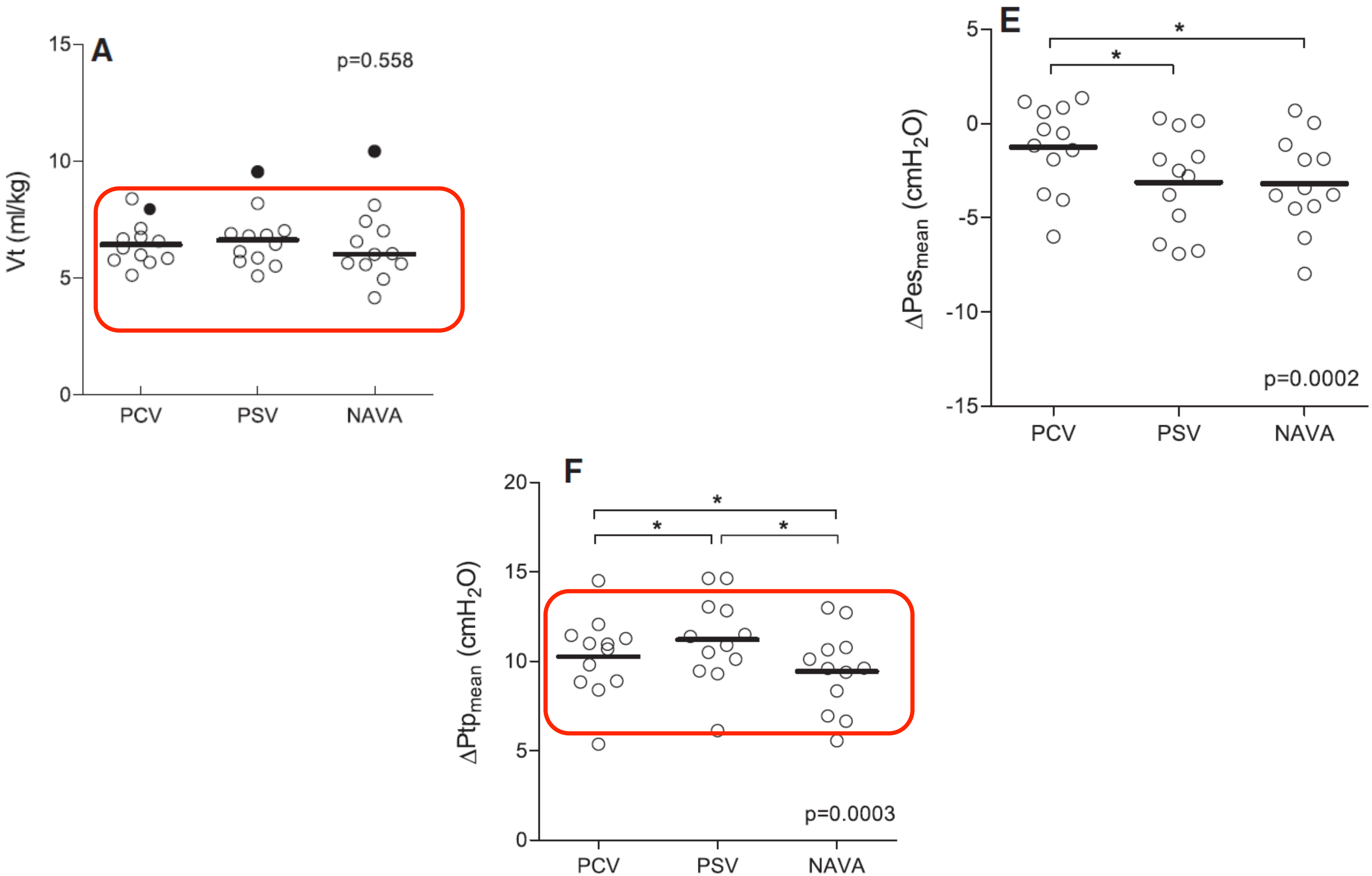
ARDS = acute respiratory distress syndrome; BMI = body mass index; F = female; M = male; MV = mechanical ventilation; P/F ratio = Pa_{O_2}/inspired oxygen fraction ratio; RASS = Richmond Agitation Sedation Scale.

Mild to moderate ARDS

Assisted Ventilation in Patients with Acute Respiratory Distress Syndrome

Doorduin et al.

Anesthesiology 2015; 123:181-90



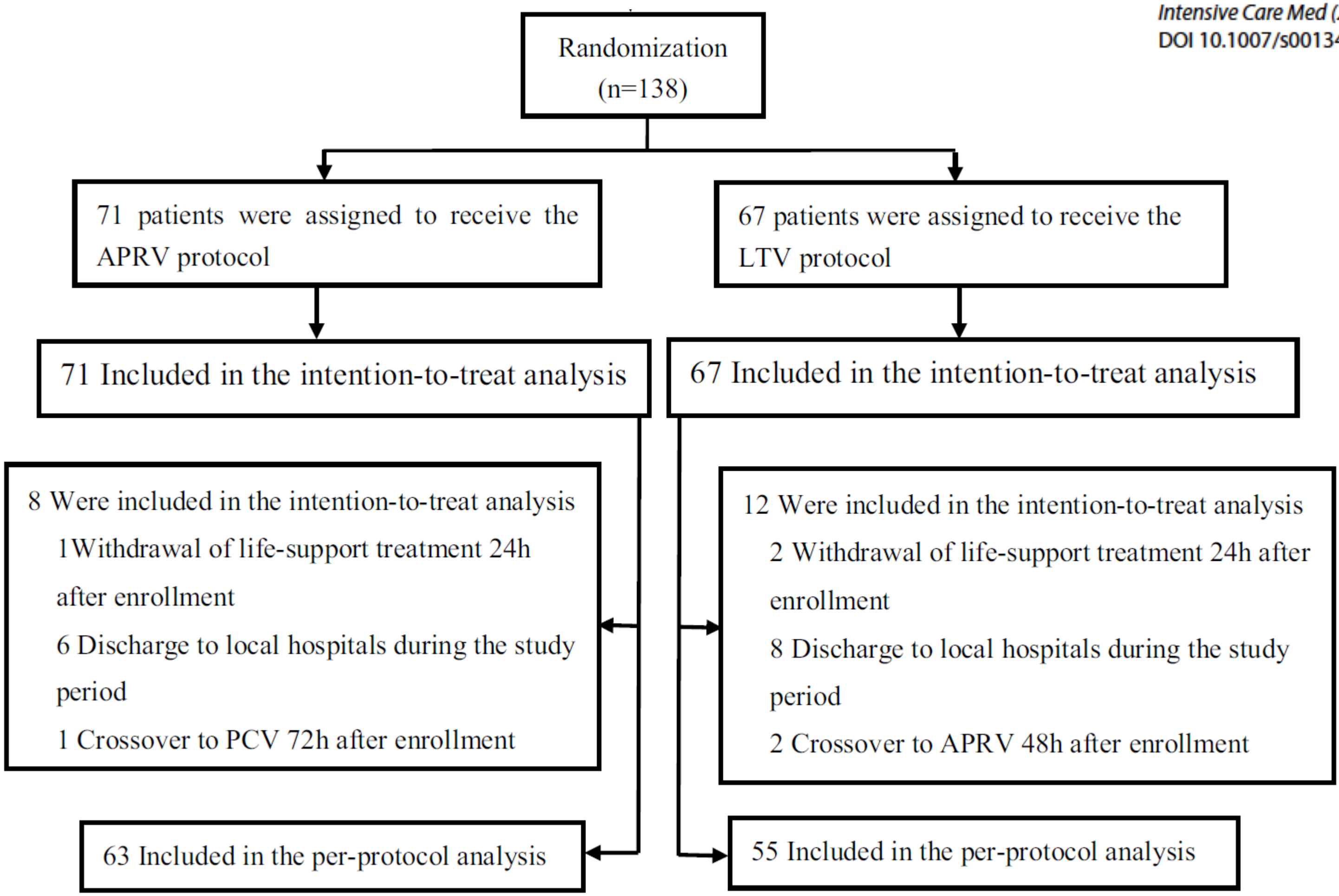
Early application of airway pressure release ventilation may reduce the duration of mechanical ventilation in acute respiratory distress syndrome

2017

Yongfang Zhou, Xiaodong Jin, Yinxia Lv, Peng Wang, Yunqing Yang, Guopeng Liang, Bo Wang and Yan Kang*

Intensive Care Med (2017) 43:1648–1659
DOI 10.1007/s00134-017-4912-z

N =138



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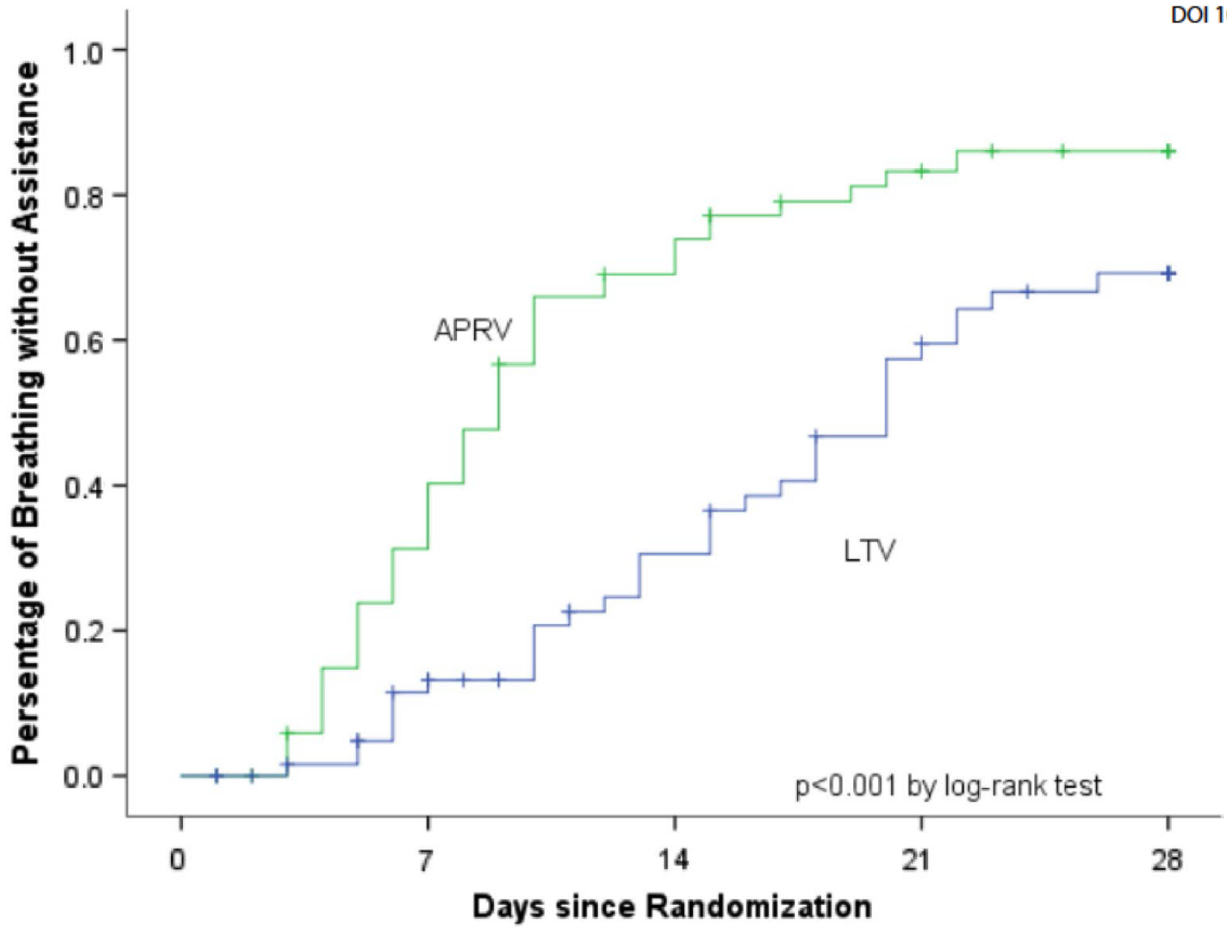

Early application of airway pressure release ventilation may reduce the duration of mechanical ventilation in acute respiratory distress syndrome

2017

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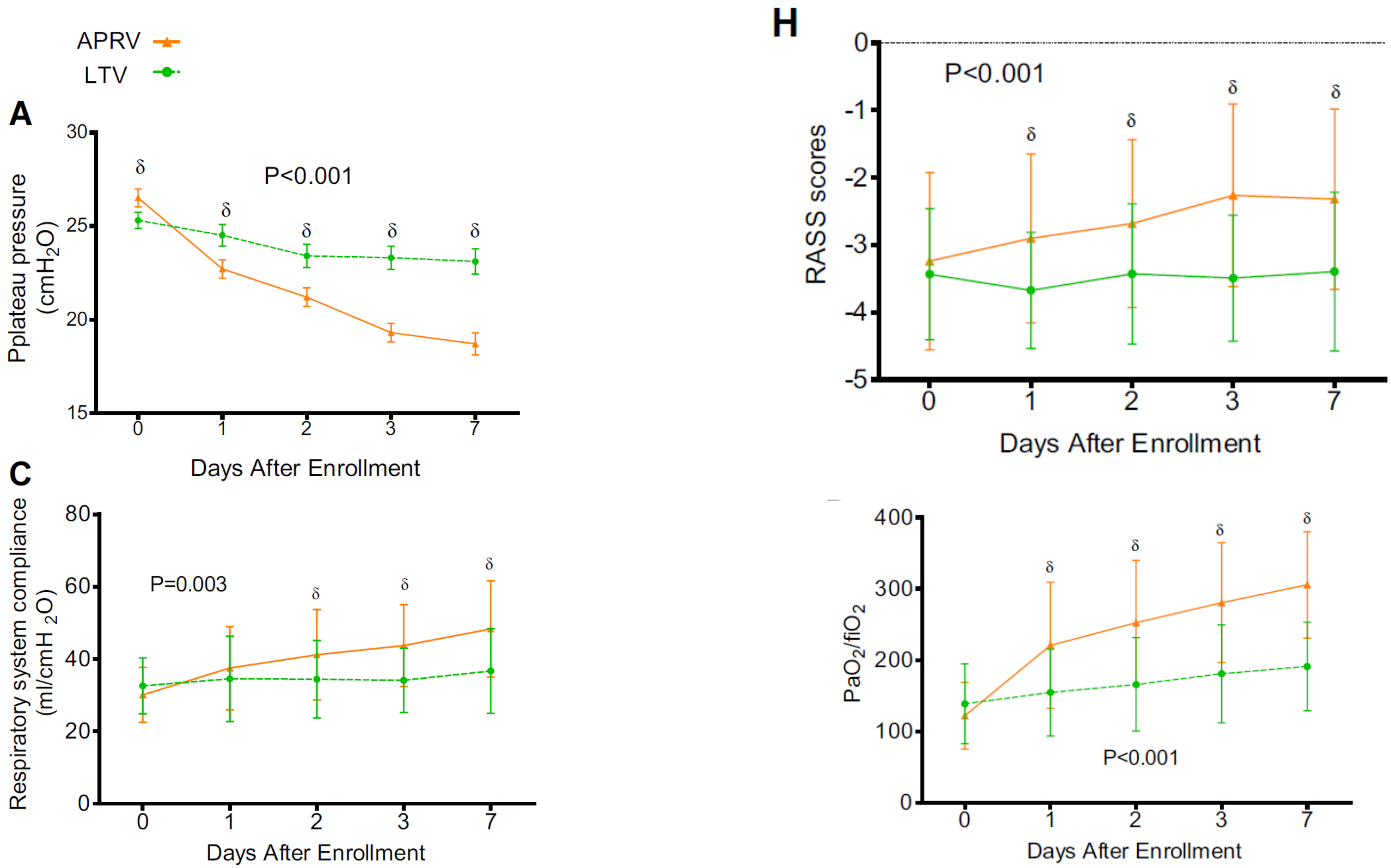
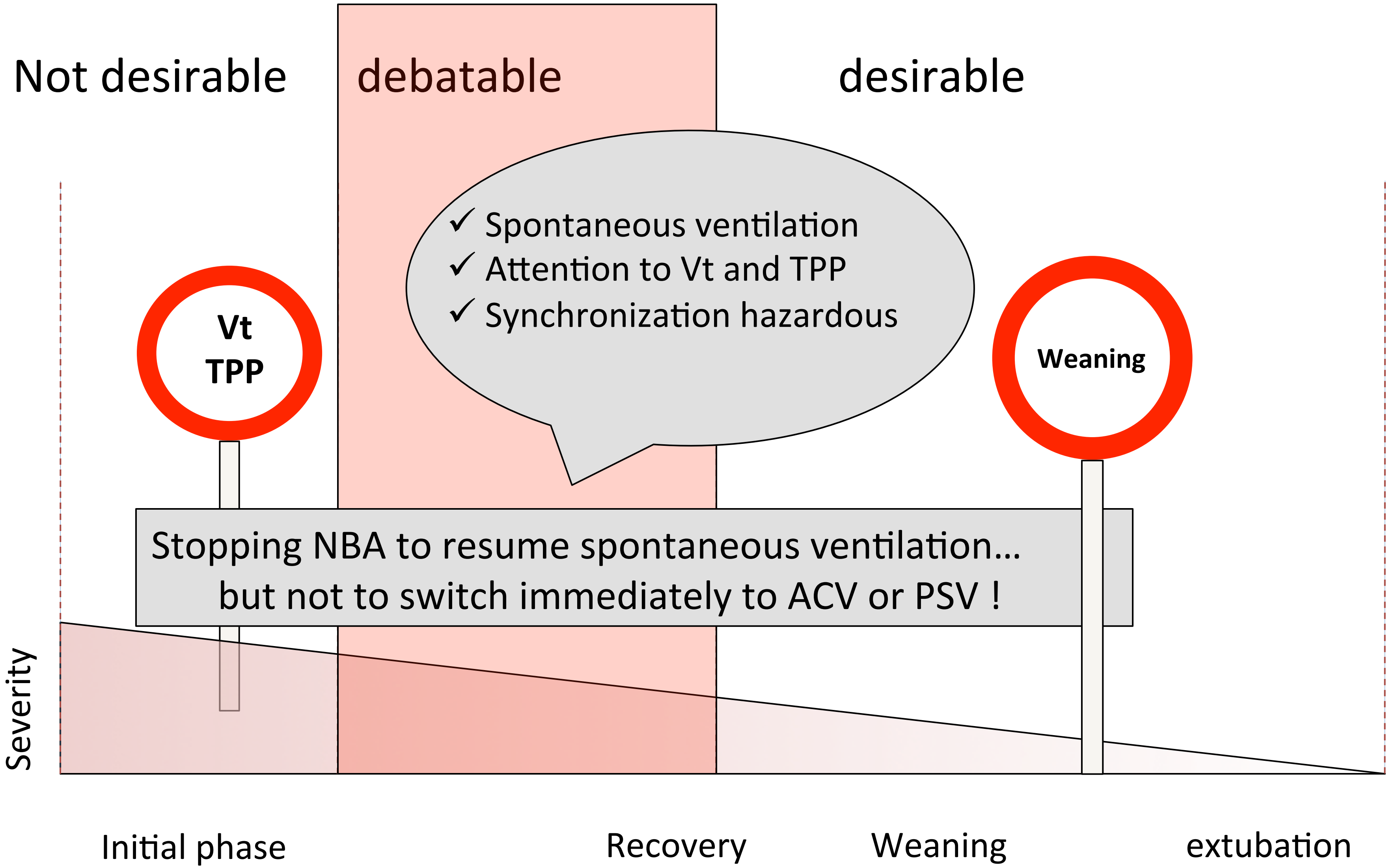


Synchronization (Assist Control, PSV etc…)



Time course evolution of severe ARDS

Conclusion

- A la phase initiale d'un ARDS: Contrôle du VT et de la Pression trans-pulmonaire = Priorité
- Eléments à prendre en compte: le degré de gravité du SDRA – le Timing – l'intensité de l'activité diaphragmatique…
- Modalité de réalisation de la ventilation spontanée à déterminer

Ventilation settings

H0-H3: ACV Vt = 6 ml/kg PBW and PEP : pour Pplat = 28 cmH2O

ACV → BIPAP-APRV

ACV

- **Mode : VAC**
- Vt = 6 ml/kg PBW
- Insp flow. : 50 à 70 L/mn
- PEP : pour Pplat = 28 cmH2O

BIPAP-APRV

- **Mode : APRV**
- Thigh : 1s
- Tlow : for FR = FR during VAC
- Plow : idem PEEP en ACV
- Phigh : for Vt=6ml/kg PBW and Pplat max = 28 cmH2O