ARDS: WHEN CAN WE ALLOW SPONTANEOUS BREATHING?

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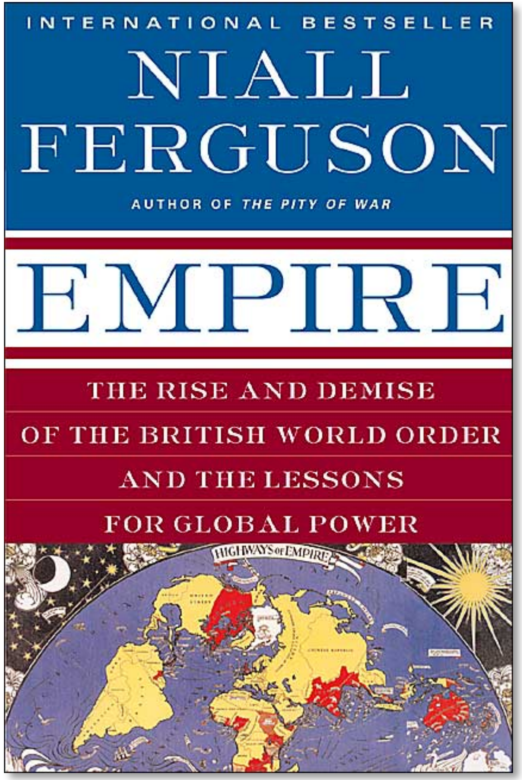
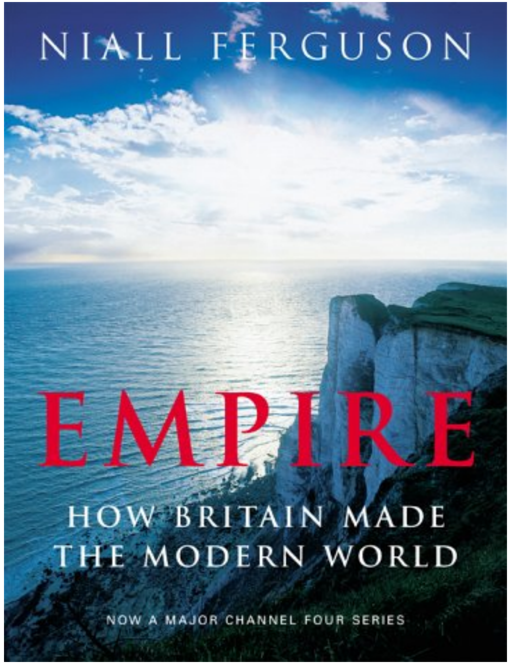
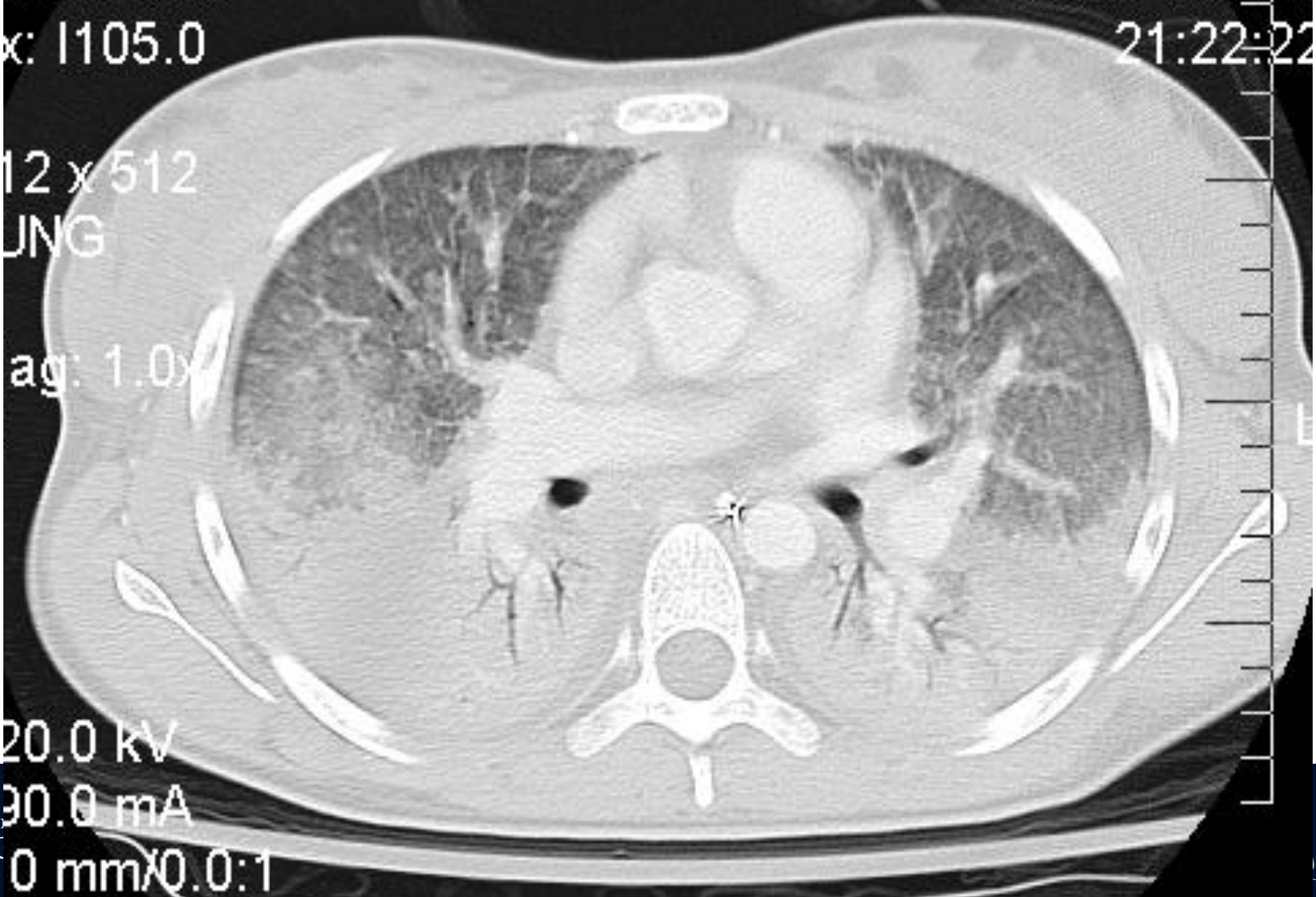
Disclosures

- Consultant for Xenios
- Speaker fees from Getinge



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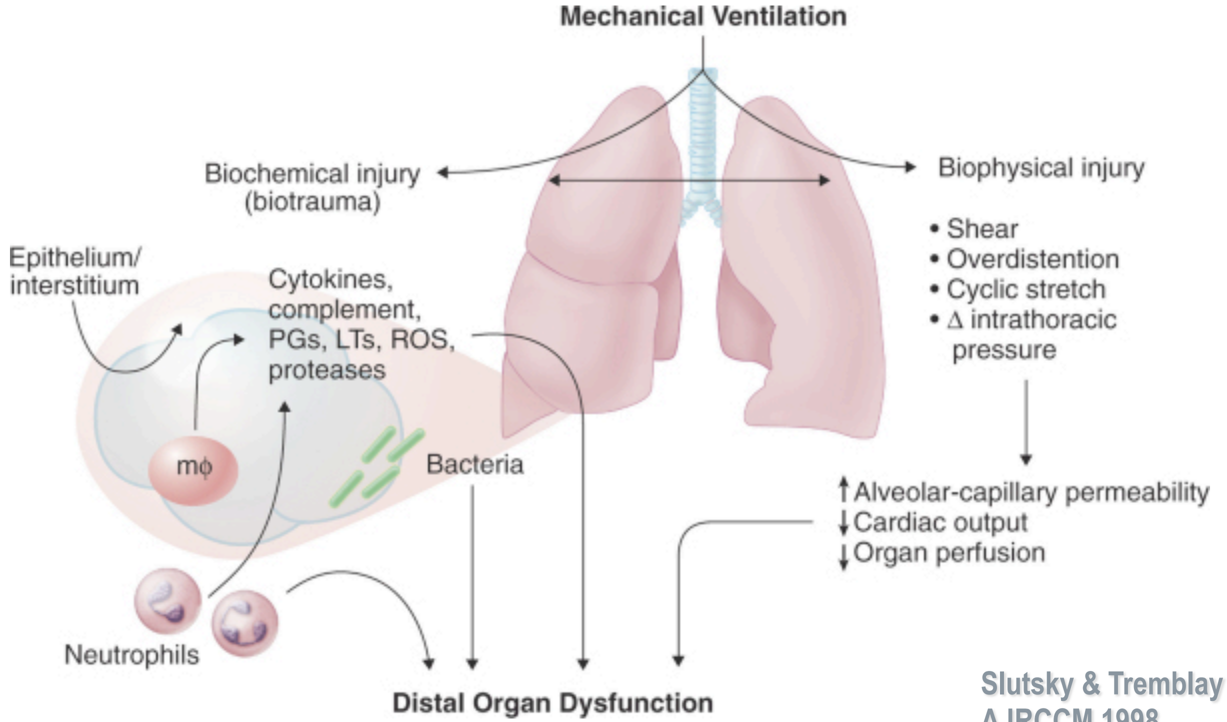
Ventilator-Induced Lung Injury



Slutsky & Tremblay
AJRCCM 1998

VOLUME 342 | MAY 4, 2000 | NUMBER 18

VENTILATION WITH LOWER TIDAL VOLUMES AS COMPARED WITH TRADITIONAL TIDAL VOLUMES FOR ACUTE LUNG INJURY AND THE ACUTE RESPIRATORY DISTRESS SYNDROME

THE ACUTE RESPIRATORY DISTRESS SYNDROME NETWORK*

High Stretch

- V_T: 11.8
- P_{PLAT}: 32–34
- RR: 18
- V_{MIN}: 13
- PEEP: 8

Mortality 40%

Low Stretch

- V_T: 6.2 ml/kg
- P_{PLAT}: 25 cm H_2O
- RR: 29
- V_{MIN}: 13 L/min
- PEEP: 9 cm H_2O

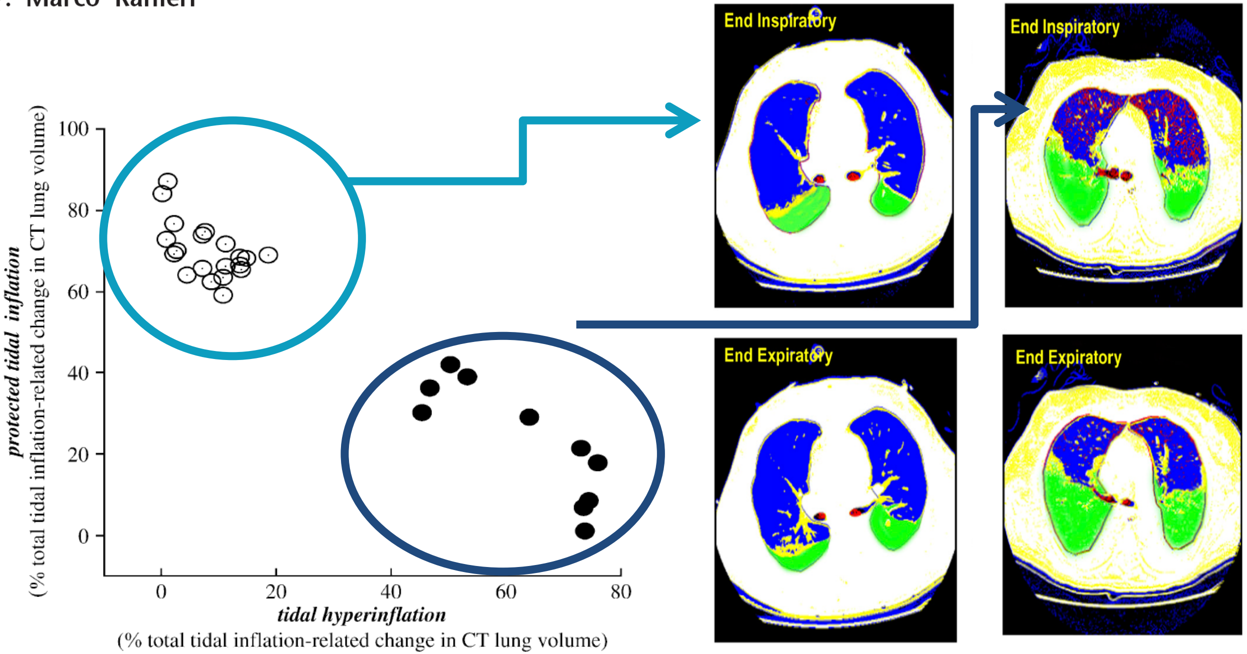
Mortality 31%*

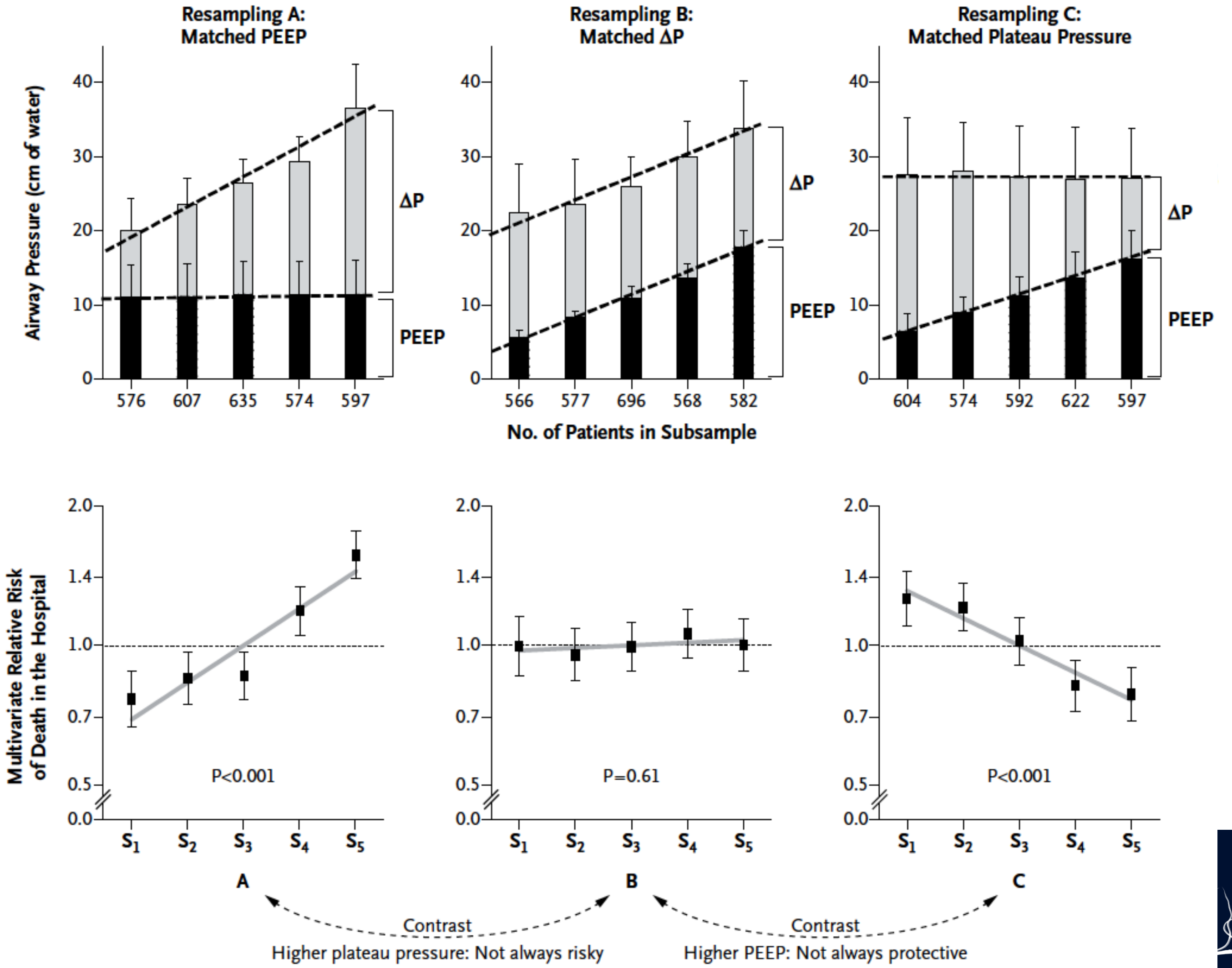
*p=0.005

Tidal Hyperinflation during Low Tidal Volume Ventilation in Acute Respiratory Distress Syndrome

Am J Respir Crit Care Med Vol 175. pp 160–166, 2007

Pier Paolo Terragni, Giulio Rosboch, Andrea Tealdi, Eleonora Corno, Eleonora Menaldo, Ottavio Davini, Giovanni Gandini, Peter Herrmann, Luciana Mascia, Michel Quintel, Arthur S. Slutsky, Luciano Gattinoni, and V. Marco Ranieri





Resampling A: Matched PEEP
Resampling B: Matched ΔP
Resampling C: Matched Plateau Pressure
Airway Pressure (cm of water)
ΔP
PEEP
No. of Patients in Subsample
576 607 635 574 597
566 577 696 568 582
604 574 592 622 597
Multivariate Relative Risk of Death in the Hospital
P<0.001
P=0.61
P<0.001
A
B
C
Contrast
Higher plateau pressure: Not always risky
Contrast
Higher PEEP: Not always protective

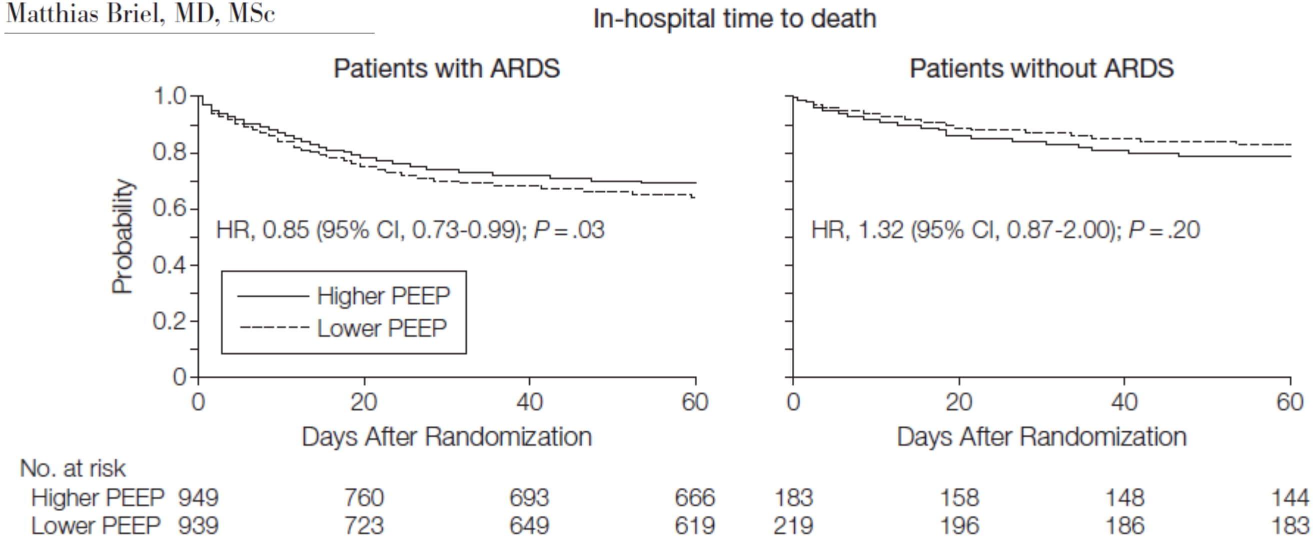
What

Higher vs Lower Positive End-Expiratory Pressure in Patients With Acute Lung Injury and Acute Respiratory Distress Syndrome

Systematic Review and Meta-analysis

JAMA. 2010;303(9):865-873

Matthias Briel, MD, MSc



ICU Mortality: RR 0.85 (0.76-0.94)

Hosp Mortality: RR 0.90 (0.81-1.0)

Vent… mes,
Recr… e
End-… ury
and
A Ra… 537-645

Table 4. Respiratory Data[a]

Variables	Day 1 Lung Open Ventilation	Day 1 Control	Day 1 *P* Value	Day 3 Lung Open Ventilation	Day 3 Control	Day 3 *P* Value	Day 7 Lung Open Ventilation	Day 7 Control	Day 7 *P* Value
Tidal volume, mean (SD), mL/kg predicted body weight	6.8 (1.4)	6.8 (1.3)	.76	6.9 (1.5)	6.7 (1.5)	.02	6.9 (1.3)	7.0 (1.6)	.53
No. of patients	436	469		337	395		177	243	
Total respiratory rate, mean (SD), /min	25.2 (6.6)	26.0 (6.5)	.08	25.1 (6.6)	27.1 (8.0)	<.001	25.5 (8.0)	26.1 (7.6)	.26
No. of patients	471	507		447	479		316	351	
Plateau pressure, mean (SD), cm H_2O	30.2 (6.3)	24.9 (5.1)	<.001	28.6 (6.0)	24.7 (5.7)	<.001	28.8 (6.3)	25.1 (6.8)	<.001
No. of patients	435	424		334	380		174	232	
30.1-35.0	112	33		76	38		37	27	
35.1-40.0	88	4		41	12		27	13	
>40.0	8	1		8	3		4	4	
FiO_2, mean (SD)	0.50 (0.16)	0.58 (0.17)	<.001	0.41 (0.12)	0.52 (0.16)	<.001	0.39 (0.12)	0.48 (0.17)	<.001
No. of patients	471	507		447	482		319	356	
Set PEEP, mean (SD), cm H_2O All patients	15.6 (3.9)	10.1 (3.0)	<.001	11.8 (4.1)	8.8 (3.0)	<.001	10.3 (4.3)	8.0 (3.1)	<.001
No. of patients	471	507		447	479		316	348	
First 161 patients	15.3 (3.6)	10.6 (2.9)	<.001	12.1 (4.1)	9.3 (3.0)	<.001	10.4 (4.3)	8.2 (3.1)	.005
No. of patients	77	82		72	79		47	63	
Subsequent 822 patients	15.7 (4.0)	10.0 (3.0)	<.001	11.8 (4.1)	8.7 (3.0)	<.001	10.3 (4.3)	8.0 (3.1)	<.001
No. of patients	394	425		375	400		269	285	
I:E ratio, mean (SD)	0.62 (0.19)	0.56 (0.19)	<.001	0.64 (0.21)	0.56 (0.21)	<.001	0.64 (0.19)	0.59 (0.22)	.02
No. of patients	410	420		329	373		170	212	
PaO_2/FiO_2, mean (SD)	187.4 (68.8)	149.1 (60.6)	<.001	196.8 (60.6)	164.1 (63.5)	<.001	212.7 (70.5)	180.8 (73.0)	<.001
pH, mean (SD)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
No. of patients	464	498		444	472		314	342	
24-h fluid balance, mean (SD), mL	2131.4 (2506.6)	2110.6 (2641.7)	.90	1029.0 (2222.9)	722.9 (2201.4)	.04	270.6 (2078.2)	102.4 (1808.4)	.26
No. of patients	465	500		445	473		326	363	

Abbreviations: FiO_2, fraction of inspired oxygen; I:E, inspiration:expiration; PEEP, positive end-expiratory pressure; PaO_2, partial pressure of arterial oxygen; $PaCO_2$, partial pressure of arterial carbon dioxide.

[a] Data shown were derived from the average value obtained for each patient over 3 measurements each day. Values were recorded on days 1, 3, and 7 after enrollment. For tidal volume and plateau airway pressure measurements, data exclude patients weaning in pressure support mode, with FiO_2 less than or equal to 0.40 and PEEP less than or equal to 10 cm H_2O.

For tidal volume, data exclude patients weaning in pressure support mode, with $FiO_2 \leq 0.4$ and PEEP≤10

UNIVERSITY OF TORONTO

Intensive Care Med (2010) 36:585–599
DOI 10.1007/s00134-009-1748-1

REVIEW

Sachin Sud
Jan O. Friedrich
Paolo Taccone
Federico Polli
Neill K. J. Adhikari
Roberto Latini
Antonio Pesenti
Claude Guérin
Jordi Mancebo
Martha A. Q. Curley
Rafael Fernandez
Ming-Cheng Chan
Pascal Beuret
Gregor Voggenreiter
Maneesh Sud
Gianni Tognoni
Luciano Gattinoni

Prone ventilation reduces mortality in patients with acute respiratory failure and severe hypoxemia: systematic review and meta-analysis

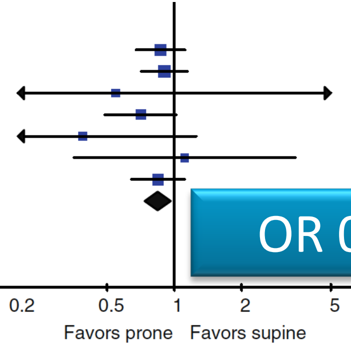
Prone vs. Supine Position

- ARDS with P/F < 100

PaO_2/FiO_2 < 100 Subgroup

Gattinoni 2001	35/53	35/46	28.31	0.87 [0.67, 1.12]
Guerin 2004	53/90	49/75	31.56	0.90 [0.71, 1.14]
Curley 2005	1/21	2/23	0.33	0.55 [0.05, 5.61]
Mancebo 2006	22/43	21/29	13.25	0.71 [0.49, 1.02]
Chan 2007	2/6	6/7	1.31	0.39 [0.12, 1.25]
Fernandez 2008	5/9	2/4	1.38	1.11 [0.36, 3.48]
Taccone 2009	39/73	48/76	23.86	0.85 [0.64, 1.11]
Subtotal (95% CI)	157/295	163/260		

Test for Overall Effect: p=0.01
Heterogeneity: I^2 = 0%



OR 0.84 (0.74-0.96)

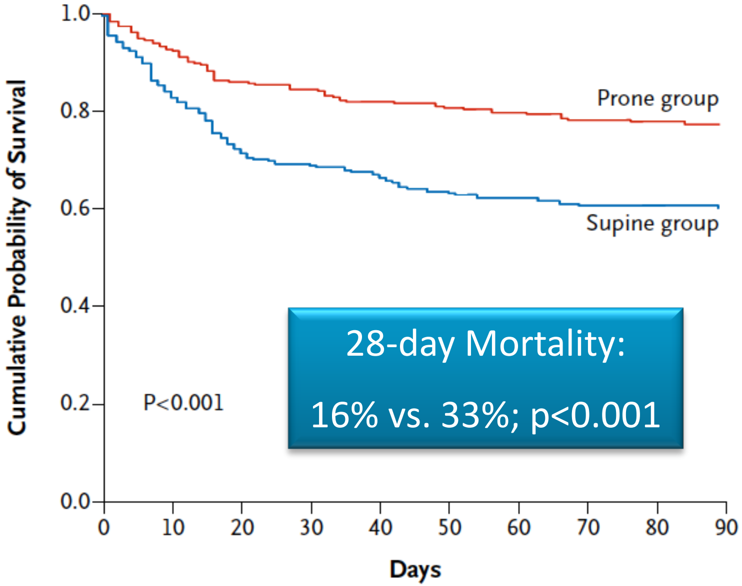
Prone Positioning in Severe Acute Respiratory Distress Syndrome


The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Prone Positioning in Severe Acute Respiratory Distress Syndrome

ABSTRACT



No. at Risk					
Prone group	237	202	191	186	182
Supine group	229	163	150	139	136

N Engl J Med 2013.
DOI: 10.1056/NEJMoa1214103

Neuromuscular Blockers in Early Acute Respiratory Distress Syndrome

Laurent Papazian, M.D., Ph.D., Jean-Marie Forel, M.D., Arnaud Gacouin, M.D., Christine Penot-Ragon, Pharm.D., Gilles Perrin, M.D., Anderson Loundou, Ph.D., Samir Jaber, M.D., Ph.D., Jean-Michel Arnal, M.D., Didier Perez, M.D., Jean-Marie Seghboyan, M.D., Jean-Michel Constantin, M.D., Ph.D., Pierre Courant, M.D., Jean-Yves Lefrant, M.D., Ph.D., Claude Guérin, M.D., Ph.D., Gwenaël Prat, M.D., Sophie Morange, M.D., and Antoine Roch, M.D., Ph.D., for the ACURASYS Study Investigators*

N Engl J Med 2010;363:1107-16

28-day Mortality:

24% - Nimbex

33% - Placebo

p=0.05


The NEW ENGLAND JOURNAL of MEDICINE

Neuromuscular Blockers in Early Acute Respiratory Distress Syndrome

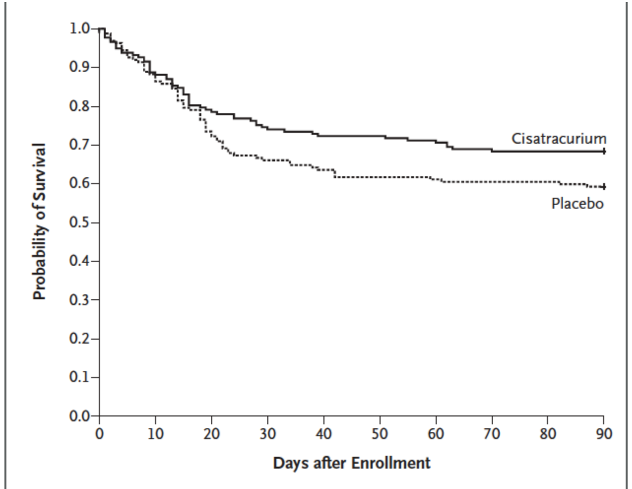


Figure 2. Probability of Survival through Day 90, According to Study Group.

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Spontaneous Ventilation in ARDS

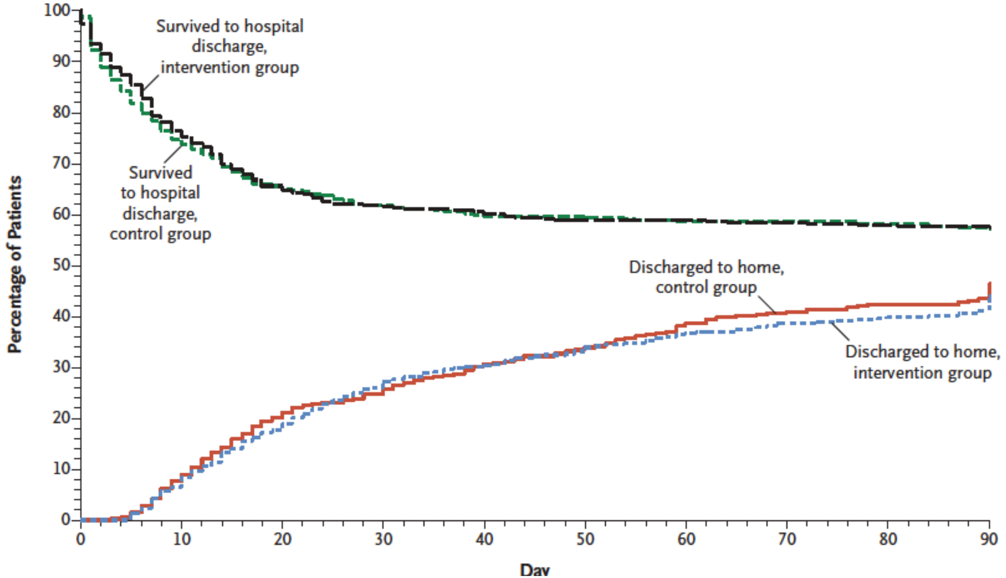
- ROSE Trial Results

Early Neuromuscular Blockade in the Acute Respiratory Distress Syndrome

N ENGL J MED NEJM.ORG

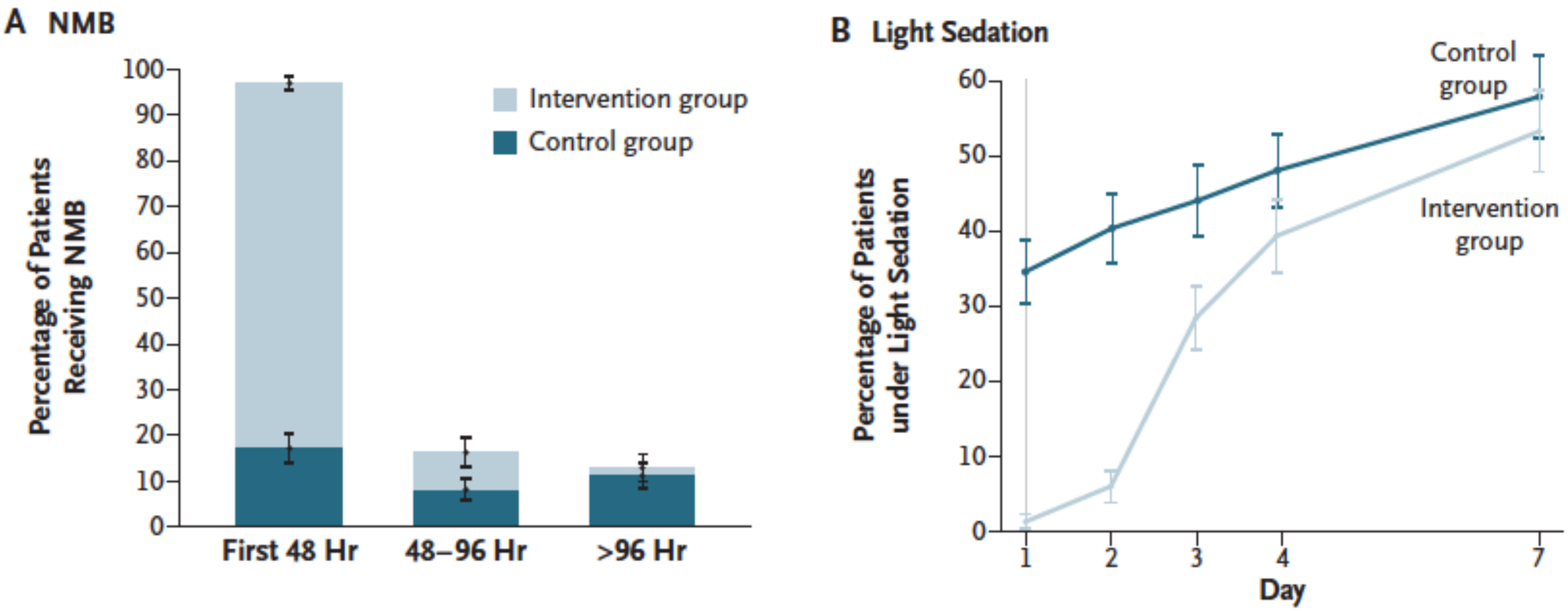
The National Heart, Lung, and Blood Institute PETAL Clinical Trials Network*

- 1006 early ARDS P/F < 150
- 48h cisatricurium & deep sedation *vs.* lighter sedation
- Higher PEEP in both groups
- 15% prone in both groups
- Primary: 90-day mortality
- Stopped for futility



Early Neuromuscular Blockade in the Acute Respiratory Distress Syndrome

N ENGL J MED NEJM.ORG



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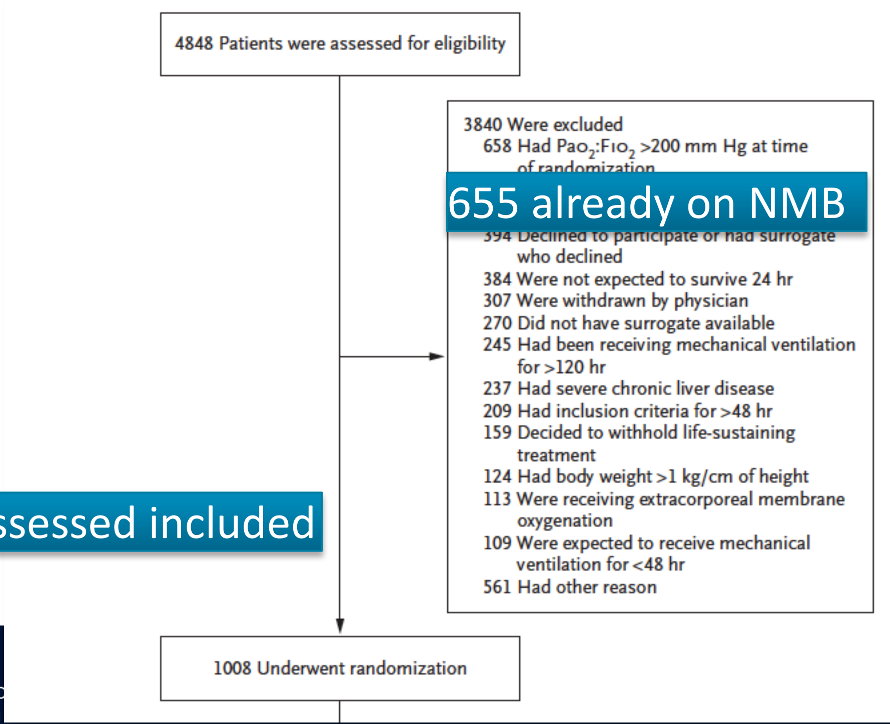
Early Neuromuscular Blockade in the Acute Respiratory Distress Syndrome

N ENGL J MED NEJM.ORG

The National Heart, Lung, and Blood Institute PETAL Clinical Trials Network*



655 already on NMB

~ 1/5 assessed included

Early Neuromuscular Blockade in the Acute Respiratory Distress Syndrome

N ENGL J MED NEJM.ORG

Table 1. Baseline Characteristics of the Patients.*

Characteristic	Intervention Group (N=501)	Control Group (N=505)
Age — yr	56.6±14.7	55.1±15.9
Female sex — no. (%)†	210 (41.9)	236 (46.7)
White race — no. (%)†	361 (72.1)	344 (68.1)
Shock at baseline — no. (%)	276 (55.1)	309 (61.2)
Median time from enrollment to randomization (IQR) — hr	8.2 (4.0–16.4)	6.8 (3.3–14.5)
Assessments and measurements		
APACHE III score‡	103.9±30.1	104.9±30.1
Total SOFA score§	8.7±3.6	8.8±3.6
Tidal volume — ml/kg of predicted body weight¶	6.3±0.9	6.3±0.9
FiO_2‖	0.8±0.2	0.8±0.2
Inspiratory plateau pressure — cm of water**	25.5±6.0	25.7±6.1
PEEP — cm of water††	12.6±3.6	12.5±3.6
PaO_2:FiO_2 — mm Hg‡‡	98.7±27.9	99.5±27.9
Imputed PaO_2:FiO_2 — mm Hg§§	94.8±26.7	93.2±28.9

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Early Neuromuscular Blockade in the Acute Respiratory Distress Syndrome

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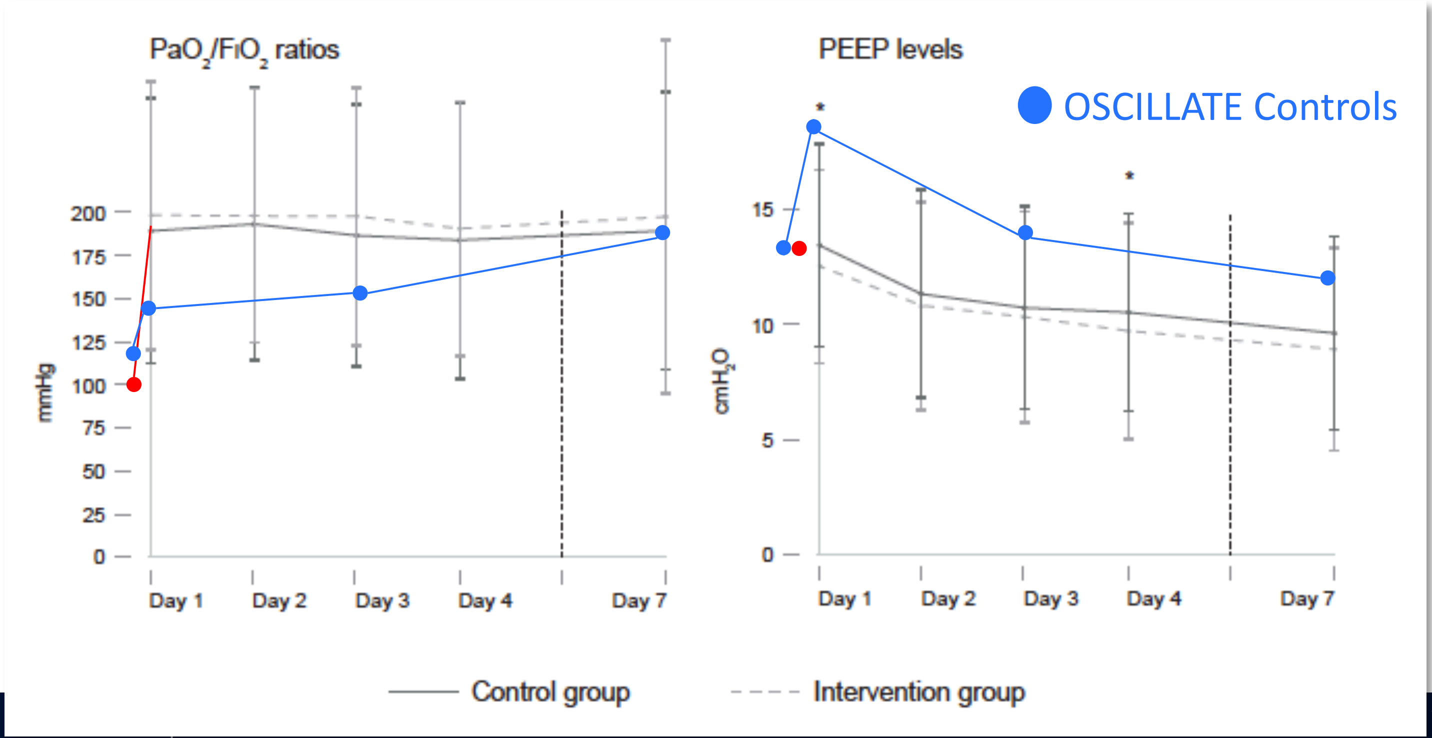


Early Neuromuscular Blockade in the Acute Respiratory Distress Syndrome

N ENGL J MED NEJM.ORG

The National Heart, Lung, and Blood Institute PETAL Clinical Trials Network*

Why are ROSE and ACURASYS results different?

- Higher PEEP?
- Lighter sedation comparator?
- Lower use of proning (15% vs. ~50%)
- Less sick patients

Spontaneous Ventilation in ARDS

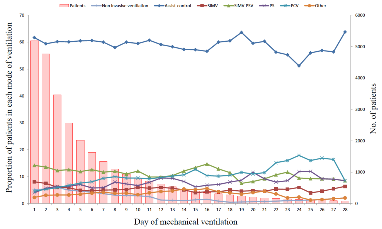
- Rose Trial Results
- Spontaneous is not always better

Evolution of Mortality Over Time in Patients Receiving Mechanical Ventilation

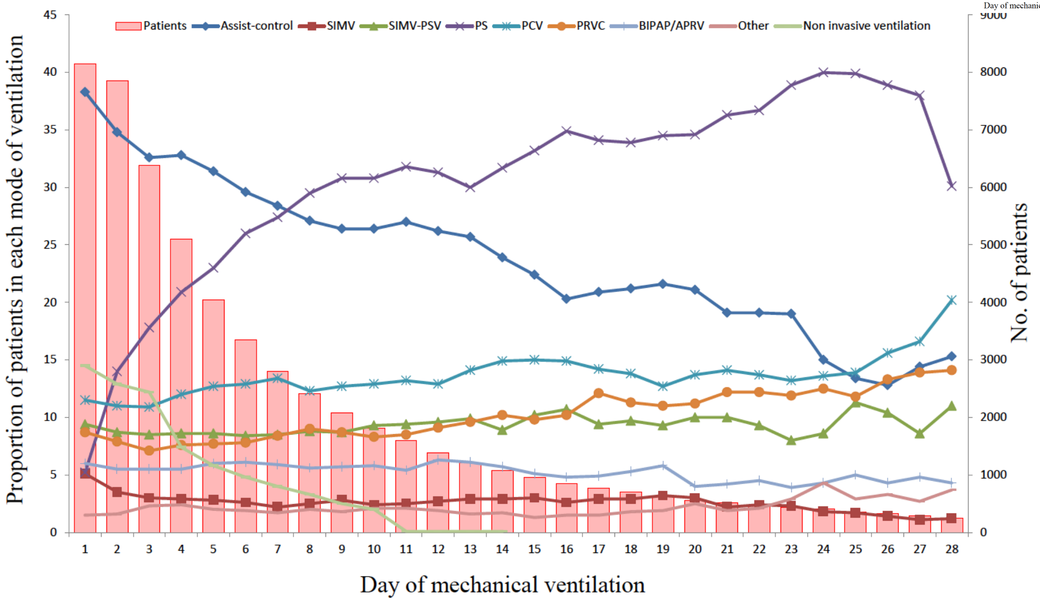
A Esteban, F Frutos Vivar, A Muriel, ND Ferguson, et al.

Am J Respir Crit Care Med 2013

1998



2010



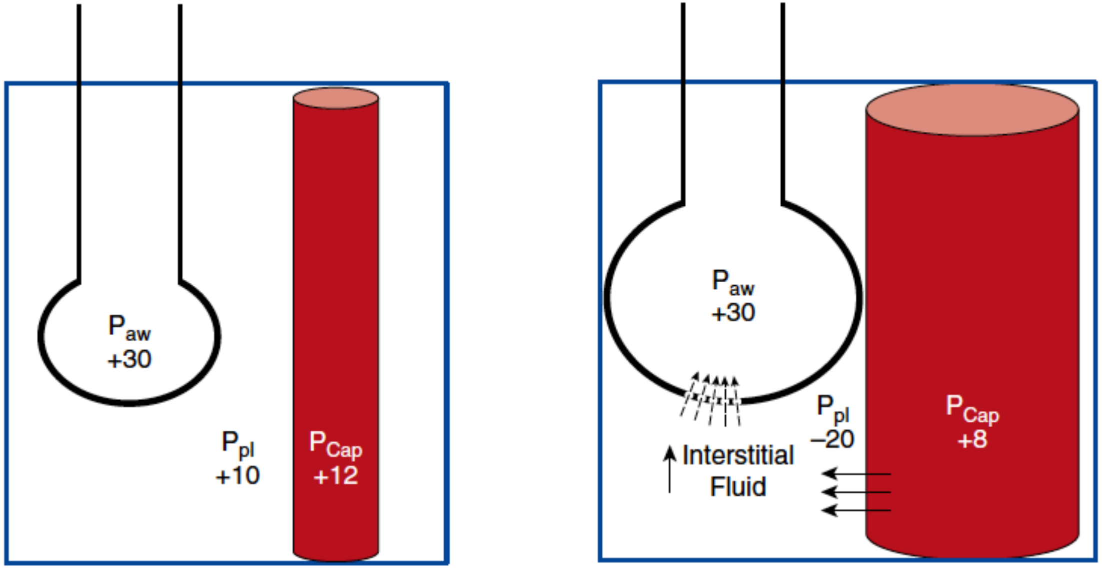
Fifty Years of Research in ARDS

Spontaneous Breathing during Mechanical Ventilation

Risks, Mechanisms, and Management

Am J Respir Crit Care Med Vol 195, Iss 8, pp 985–992, Apr 15, 2017

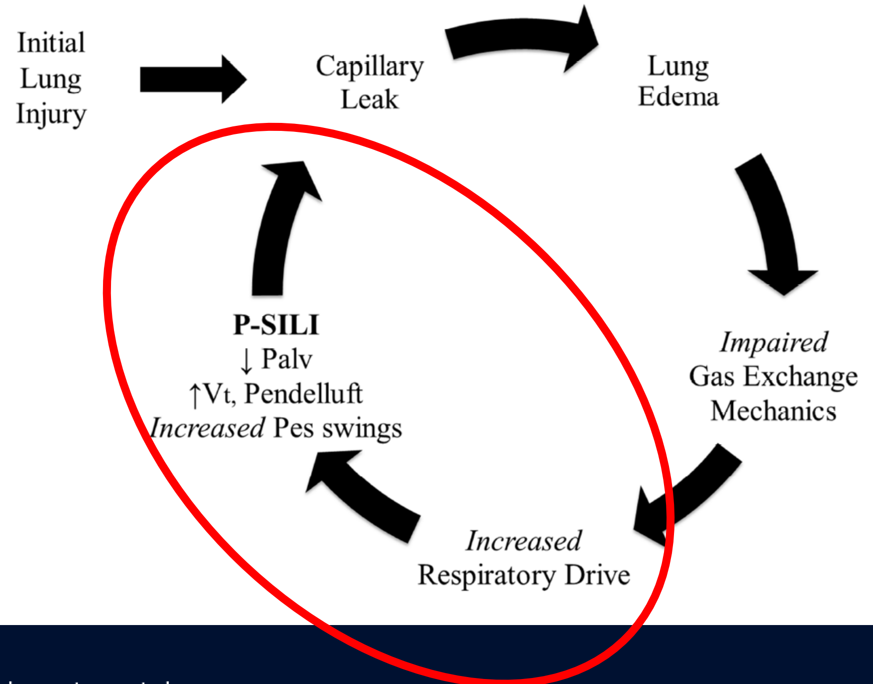
Takeshi Yoshida[1,2,3,4], Yuji Fujino[4], Marcelo B. P. Amato[5], and Brian P. Kavanagh[1,2,3]



Mechanical Ventilation to minimize progression of Lung Injury in Acute Respiratory Failure

AJRCCM Articles in Press. Published on 14-September-2016 as 10.1164/rccm.201605-1081CP

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



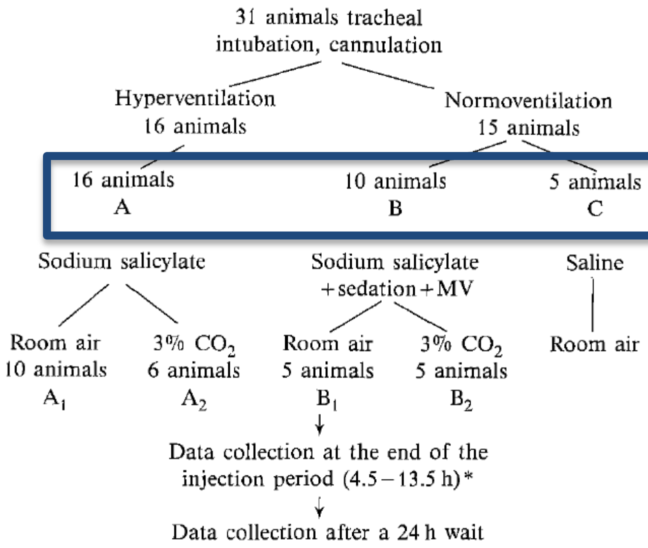
Original articles

Intensive Care Med (1988) 15:8–14

Intensive Care Medicine

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

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



RR 25 then 70/min

V_T 7 then 9-15ml/kg

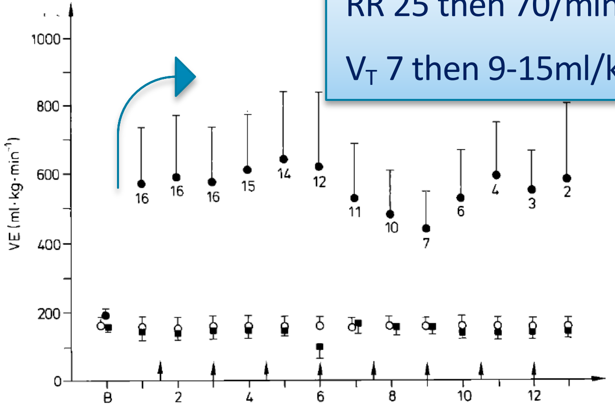


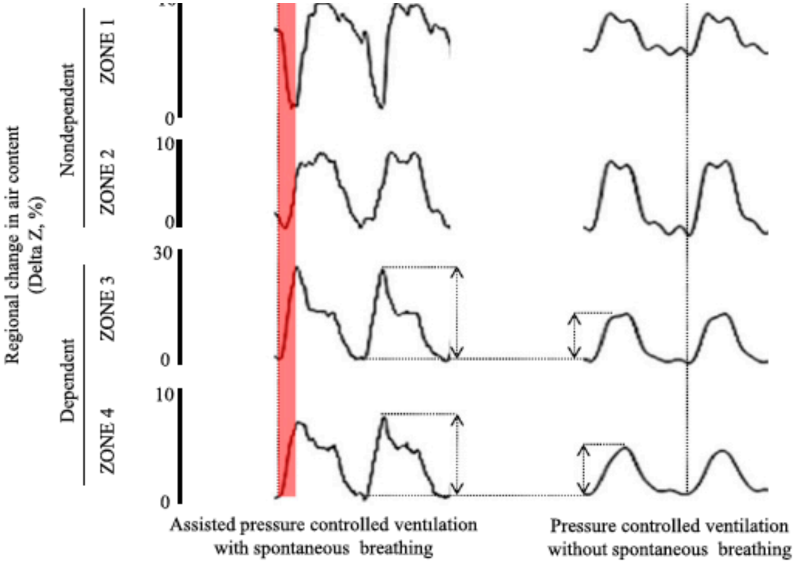
Table 1. Gross pathologic findings

Group	Normal lungs	Mild lesions	Severe lesions
A	2	5[a]	9†
B	10	0	0
C	5	0	0

Spontaneous Effort Causes Occult Pendelluft during Mechanical Ventilation

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

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]

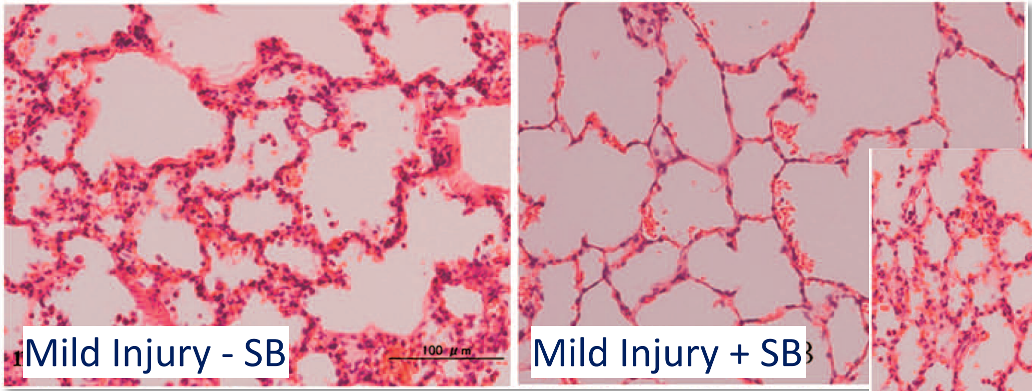


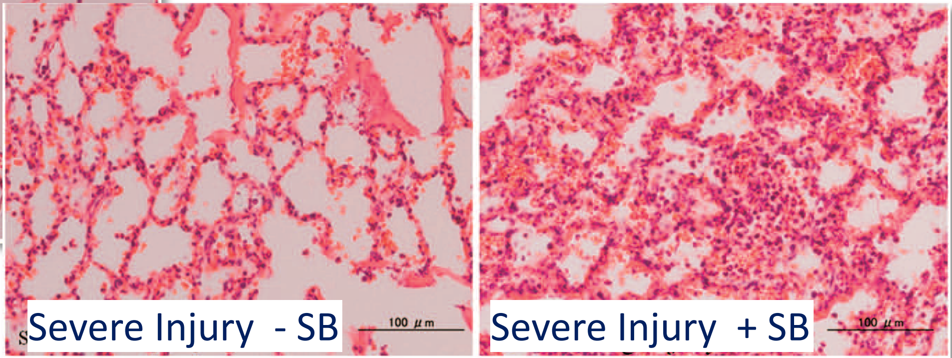
The Comparison of Spontaneous Breathing and Muscle Paralysis in Two Different Severities of Experimental Lung Injury*

Crit Care Med 2013; 41:536–545

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]

Rabbits with mild (saline lavage) or severe (saline lavage + VILI) lung injury

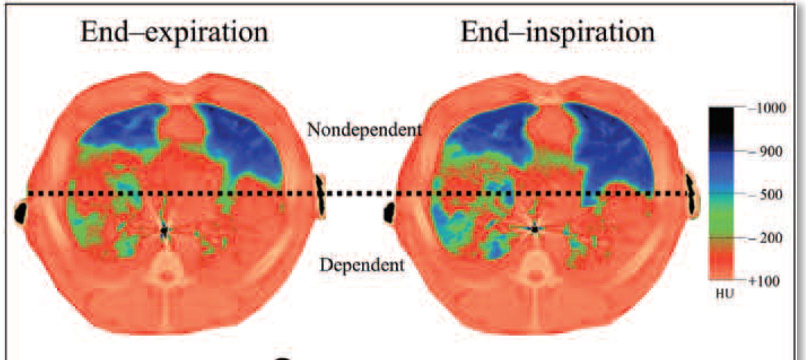




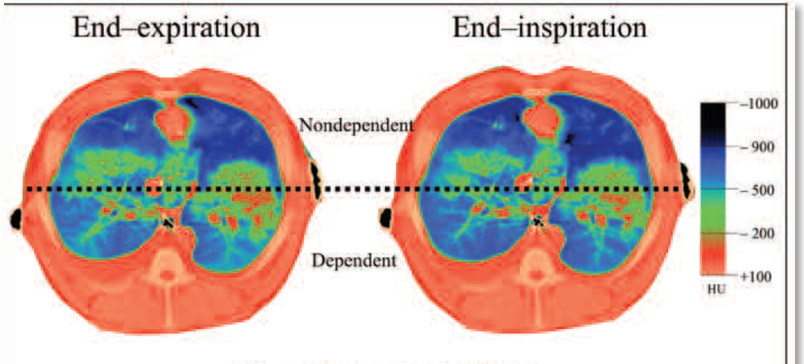
Spontaneous Effort During Mechanical Ventilation: Maximal Injury With Less Positive End-Expiratory Pressure*

Crit Care Med 2016; 44:e678–e688

Takeshi Yoshida, MD, PhD[1,2]; Rollin Roldan, MD[1,3]; Marcelo A. Beraldo, PhD[1,4]; Vinicius Torsani, PhD[1]; Susimeire Gomes, PhD[1]; Roberta R. De Santis, MD[1]; Eduardo L. V. Costa, MD[1,5]; Mauro R. Tucci, MD[1]; Raul G. Lima, PhD[6]; Brian P. Kavanagh, MD[7]; Marcelo B. P. Amato, MD, PhD[1]



C Low PEEP+SB



A optimized PEEP+SB

Spontaneous Breathing in ARDS

When to allow any?

How much to allow?

Consider maintaining normal effort levels – implies measuring effort

Spontaneous Breathing in ARDS

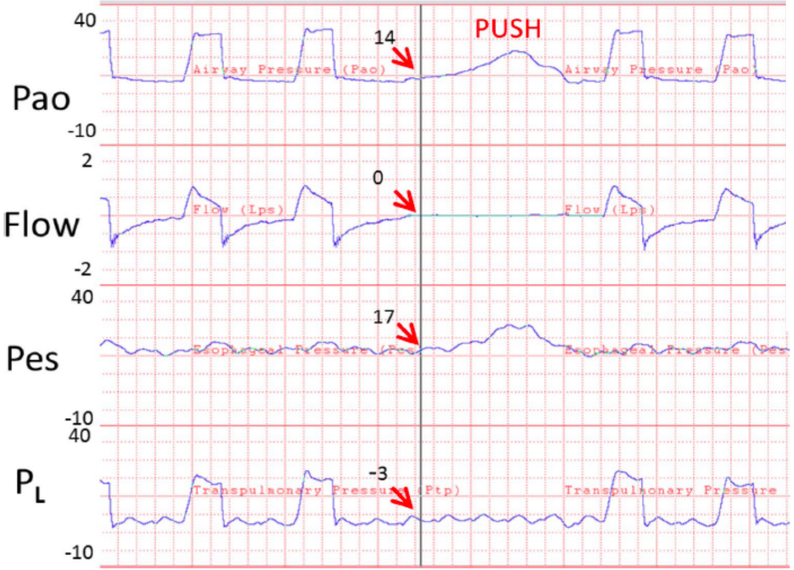
- PRO
  - Prevent diaphragm atrophy (overassist myotrauma)
  - Improved hemodynamics
  - Less sedation and associated adverse effects
  - Progress patients towards liberation
- CONs
  - Direct overdistention injury
  - Pendelluft injury
  - Increased lung perfusion
  - Dyssynchrony – double-trigger
  - Expiratory muscle activation leading to decreased EELV

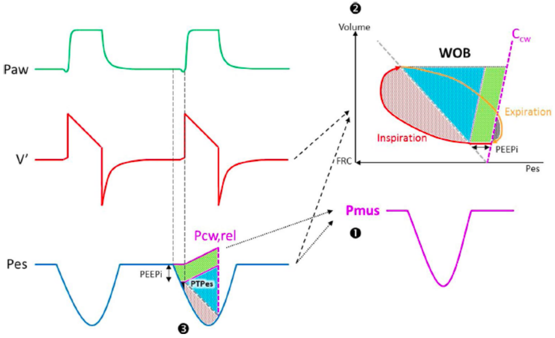
Effect Modifiers:

ARDS Severity; Smaller Baby Lung; High Drive; Injurious Settings

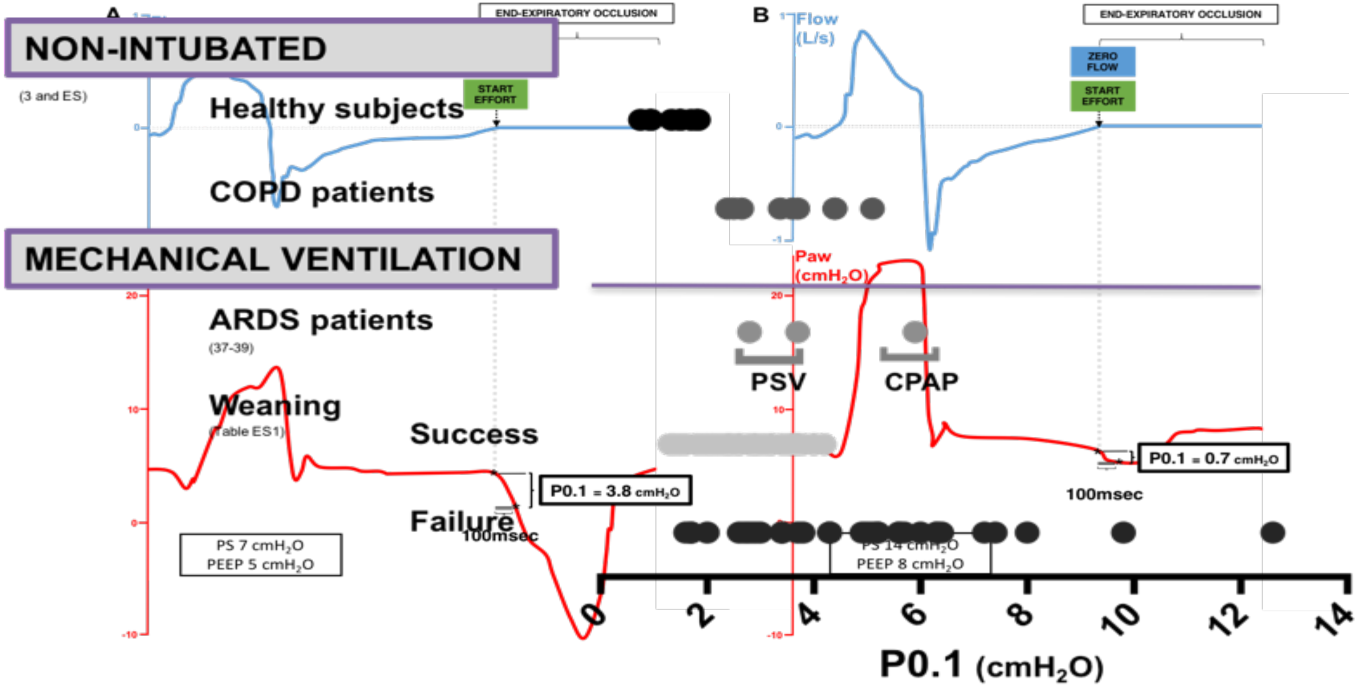
REVIEW

Esophageal and transpulmonary pressure in the clinical setting: meaning, usefulness and perspectives





Airway Occlusion Pressure – P0.1



End-Expiratory Exclusion Manoeuvre

Perform 3 single breath end-expiratory airway occlusions to measure ΔP_{occ} every 4-8 hours

↓

Estimate P_{mus}
If $\Delta P_{occ} < 0$ cm H_2O,
estimate ΔP_L

↓

Predicted $P_{mus} > 13\text{-}15$ cm H_2O
OR
Predicted $\Delta P_L \geq 16\text{-}17$ cm H_2O

Yes →

Consider P_{es} monitoring to guide clinical management
or
consider modifying sedation and ventilation to achieve predicted Pmus and ΔP_L within acceptable limits

No ↓

Target achieved

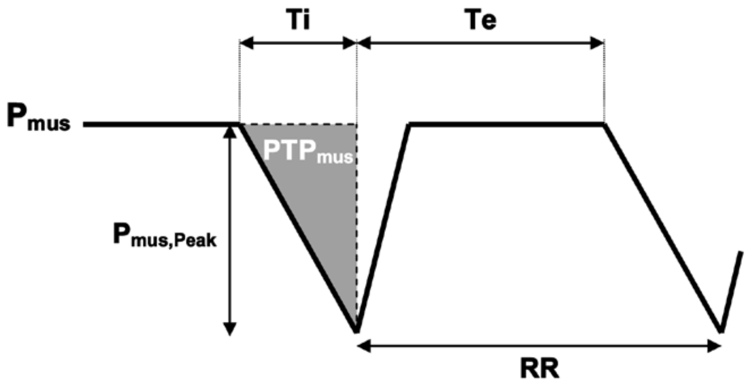
Predicted Pmus = $-0.7 \times \Delta P_{occ}$

Predicted ΔP_L = (Peak Paw– PEEP) – $0.6 \times \Delta P_{occ}$

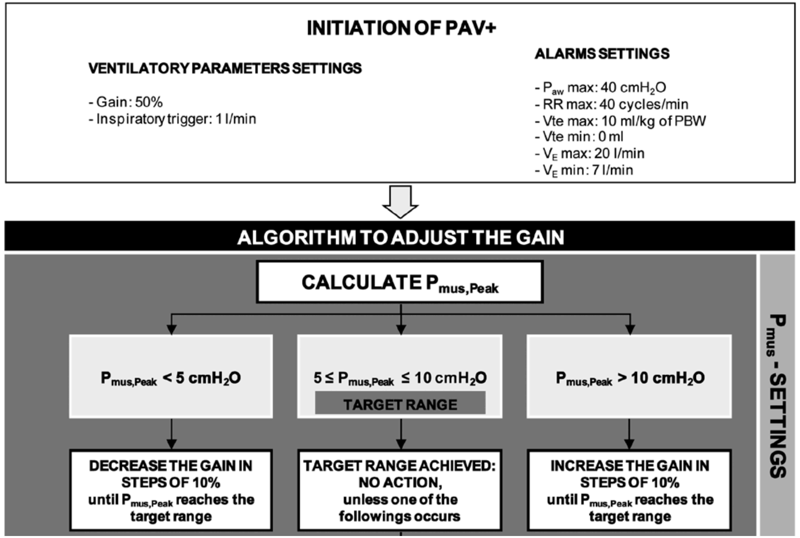
Bedside Adjustment of Proportional Assist Ventilation to Target a Predefined Range of Respiratory Effort*

Guillaume Carteaux, MD[1,2]; Jordi Mancebo, MD, PhD[3]; Alain Mercat, MD, PhD[4]; Jean Dellamonica, MD, PhD[5,6]; Jean-Christophe M. Richard, MD, PhD[7,8]; Hernan Aguirre-Bermeo, MD[3]; Achille Kouatchet, MD[4]; Gaetan Beduneau, MD[7,9]; Arnaud W. Thille, MD, PhD[8]; Laurent Brochard, MD[10,11]

Crit Care Med 2013;41:2125–2132



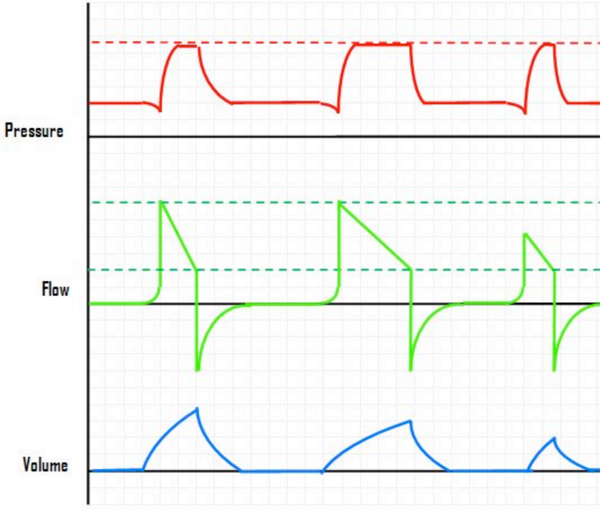
$$PTP_{mus} = \frac{P_{mus,Peak} \times Ti}{2} \times RR$$



Pressure Support Ventilation

Ventilator's mission is to regulate pressure

- Set PS level; C_{RS} ; AND Patient Effort determine V_T



PS 8; PEEP 5

V_T = 750 mL

How do control V_T in this patient???

Decreasing spontaneous effort levels

Increase inspiratory assist – but be careful with V_T

Increase PEEP

Consider NMB – but trade Under for Over-assist

Consider partial NMB

Consider ECLS

Intensive Care Med (2006) 32:1515–1522
DOI 10.1007/s00134-006-0301-8

ORIGINAL

Arnaud W. Thille
Pablo Rodriguez
Belen Cabello
François Lellouche
Laurent Brochard

Patient-ventilator asynchrony during assisted mechanical ventilation

	Asynchrony index < 10% ($n = 47$)	Asynchrony index ≥ 10% ($n = 15$)	p
Duration of mechanical ventilation (days; IQR)	7 (3–20)	25 (9–42)	0.005
Duration of mechanical ventilation ≥ 7 days	23 (49%)	13 (87%)	0.01
Tracheostomy	2 (4%)	5 (33%)	0.007
Mortality	15 (32%)	7 (47%)	0.36

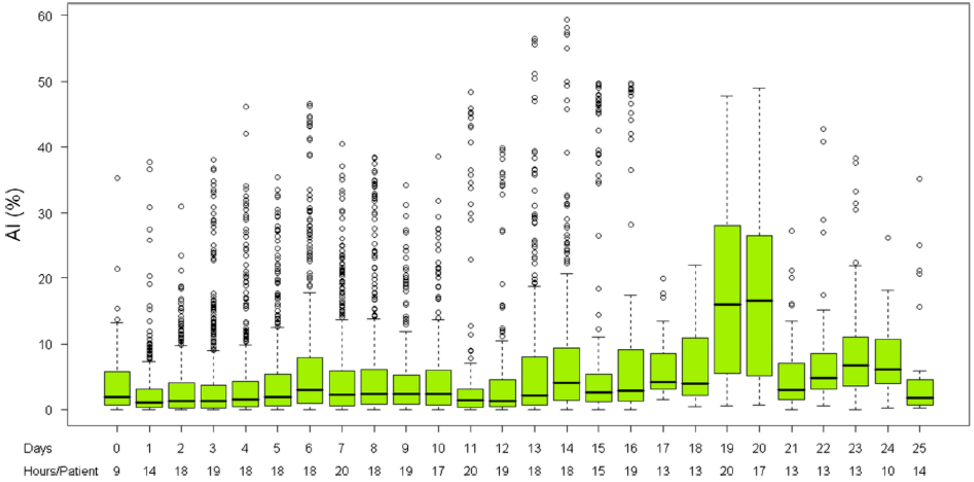
25% of patients showed significant asynchrony

Intensive Care Med
DOI 10.1007/s00134-015-3692-6

ORIGINAL

Lluís Blanch
Ana Villagra
Bernat Sales
Jaume Montanya
Umberto Lucangelo
Manel Luján
Oscar García-Esquirol
Encarna Chacón
Anna Estruga
Joan C. Oliva
Alberto Hernández-Abadia
Guillermo M. Albaiceta
Enrique Fernández-Mondejar
Rafael Fernández
Josefina Lopez-Aguilar
Jesús Villar
Gastón Murias
Robert M. Kacmarek

Asynchronies during mechanical ventilation are associated with mortality



	AI ≤ 10 % (*n* = 44)	AI > 10 % (*n* = 6)	*p* value
Length of MV (days)	6 [5.0; 15.0]	16 [9.7; 20.0]	0.061
Reintubation	9 (20 %)	0 (0 %)	0.57
Tracheostomy	14 (32 %)	2 (33 %)	0.999
ICU mortality	6 (14 %)	4 (67 %)	0.011*
Hospital mortality	10 (23 %)	4 (67 %)	0.044*

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Types of Asynchrony

Ineffective Efforts / Delayed Triggering

- Trigger too insensitive / weak efforts
- Auto PEEP
- Cycle-off Asynchrony (prolonged inspiration)

Cycle-off Asynchrony

- Prolonged inspiration
- Premature termination

Double Triggering

- High respiratory drive
- Short set inspiratory time

Auto Triggering

- Cardiac oscillations
- Trigger too sensitive

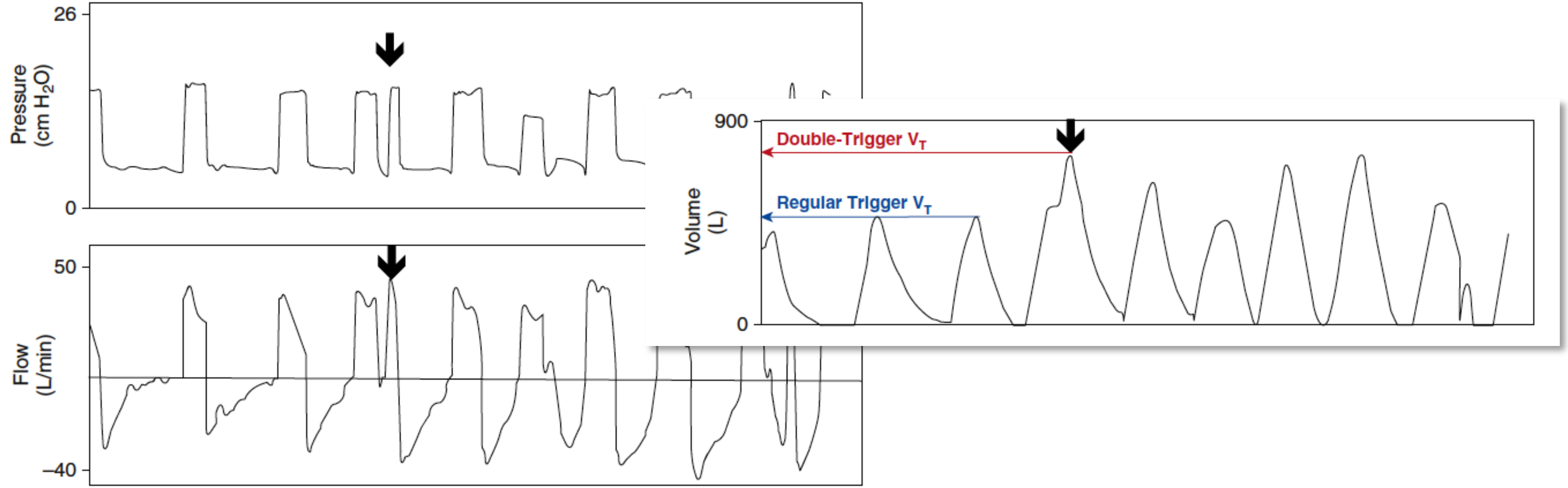
Fifty Years of Research in ARDS

Spontaneous Breathing during Mechanical Ventilation

Risks, Mechanisms, and Management

Am J Respir Crit Care Med Vol 195, Iss 8, pp 985–992, Apr 15, 2017

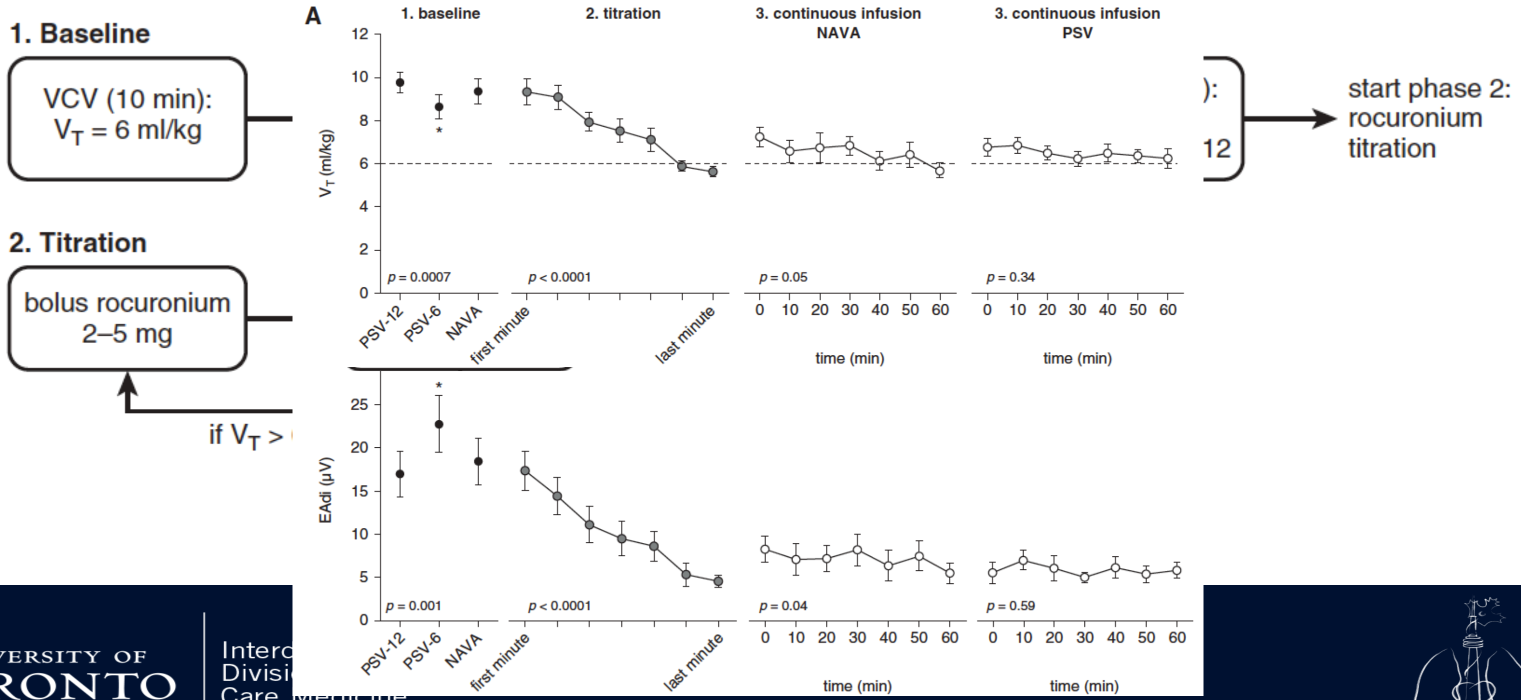
Takeshi Yoshida[1,2,3,4], Yuji Fujino[4], Marcelo B. P. Amato[5], and Brian P. Kavanagh[1,2,3]



Partial Neuromuscular Blockade during Partial Ventilatory Support in Sedated Patients with High Tidal Volumes

Jonne Doorduin[1], Joeke L. Nollet[1], Lisanne H. Roesthuis[1], Hieronymus W. H. van Hees[2], Laurent J. Brochard[3,4], Christer A. Sinderby[3,4], Johannes G. van der Hoeven[1], and Leo M. A. Heunks[1]

Am J Respir Crit Care Med Vol 195, Iss 8, pp 1033–1042, Apr 15, 2017

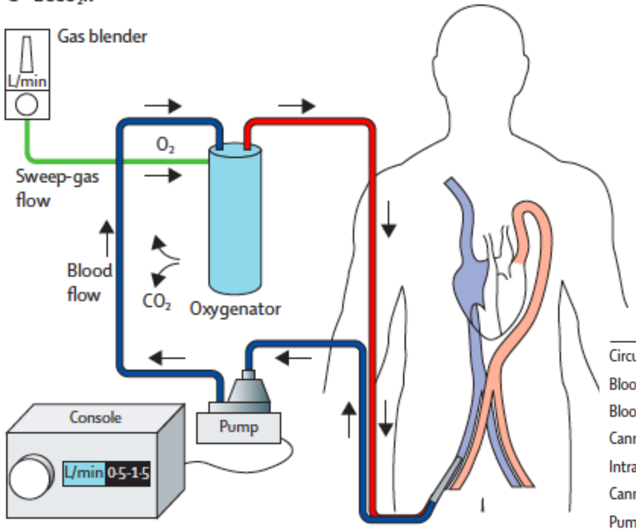


Extracorporeal life support for adults with severe acute respiratory failure

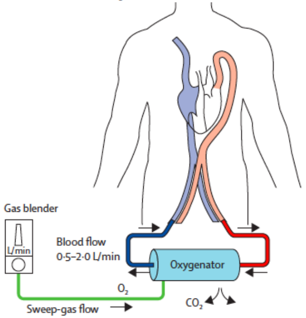
Lorenzo Del Sorbo, Marcelo Cypel, Eddy Fan

Lancet Respir Med 2014;
2: 154–64

C ECCO$_2$R



D Arteriovenous ECCO$_2$R



	ECCO$_2$R
Circuit/bypass	Venovenous bypass or arteriovenous bypass
Blood drainage	From central vein (IJ, FV, SV) or femoral artery in arteriovenous configuration
Blood return	Into central vein (IJ, FV, SV)
Cannula dimension	8–29 Fr
Intravascular access	Single or double
Cannula type	Two single cannulas or dual-lumen cannula
Pump	Centrifugal or peristaltic (absent in arteriovenous configuration)
Extracorporeal blood flow	0·2–2·0 L/min
CO_2 clearance	10–100% VCO_2, dependent mainly on sweep-gas flow
Oxygen delivery capacity	Not significant
Anticoagulation target	ACT 1·5 times normal, aPTT 1·5 times normal

Anesthesiology
46:138–141, 1977

Laboratory Report

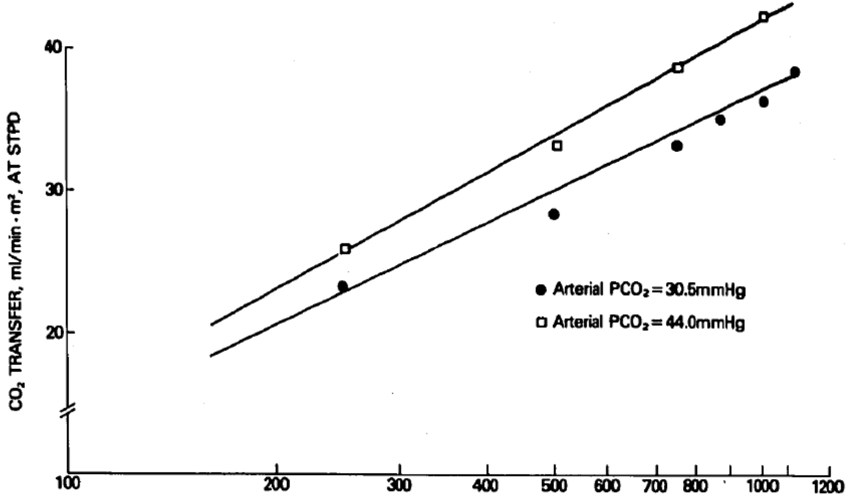
Control of Breathing Using an Extracorporeal Membrane Lung

Theodor Kolobow, M.D., Luciano Gattinoni, M.D.,* Timothy A. Tomlinson, B.S.,* Joseph E. Pierce, D.V.M.†*

7 lambs

No anaesthesia or sedation

$ECCO_2R$



CO_2 Removal Increases with Blood Flow 200-1000 mL

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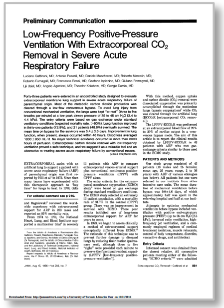
Interdepartmental Division of Critical Care Medicine

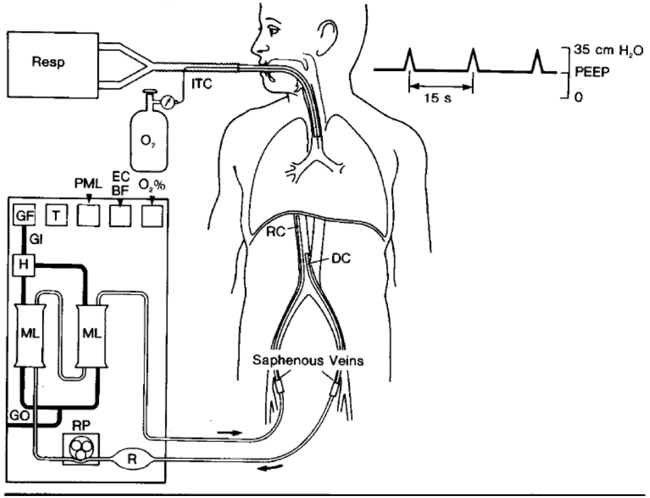
Low-Frequency Positive-Pressure Ventilation With Extracorporeal CO_2 Removal in Severe Acute Respiratory Failure

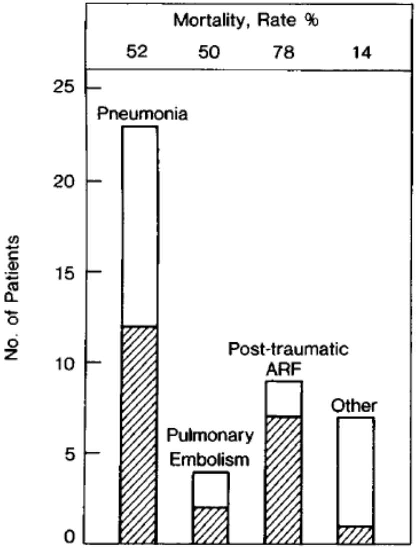
(*JAMA* 1986;256:881-886)

Luciano Gattinoni, MD; Antonio Pesenti, MD; Daniele Mascheroni, MD; Roberto Marcolin, MD; Roberto Fumagalli, MD; Francesca Rossi, MD; Gaetano Iapichino, MD; Giuliano Romagnoli, MD; Ljli Uziel, MD; Angelo Agostoni, MD; Theodor Kolobow, MD; Giorgio Damia, MD


Preliminary Communication

Low-Frequency Positive-Pressure Ventilation With Extracorporeal CO_2 Removal in Severe Acute Respiratory Failure





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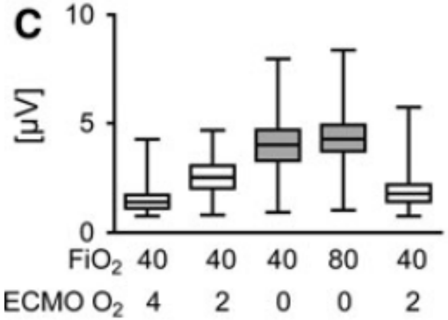
Intensive Care Med (2010) 36:2038–2044
DOI 10.1007/s00134-010-1982-6

ORIGINAL

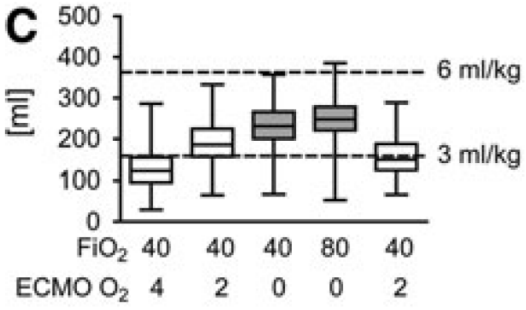
Christian Karagiannidis
Matthias Lubnow
Alois Philipp
Guenter A. J. Riegger
Christof Schmid
Michael Pfeifer
Thomas Mueller

Autoregulation of ventilation with neurally adjusted ventilatory assist on extracorporeal lung support

6 patients in recovery phase of ARDS on ECMO and NAVA



E_{DI}



V_T

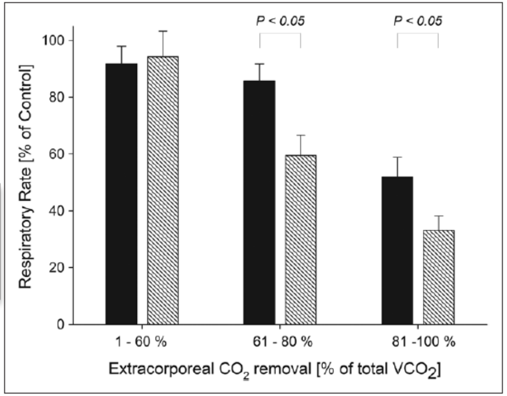
ECMO can Modulate Respiratory Drive

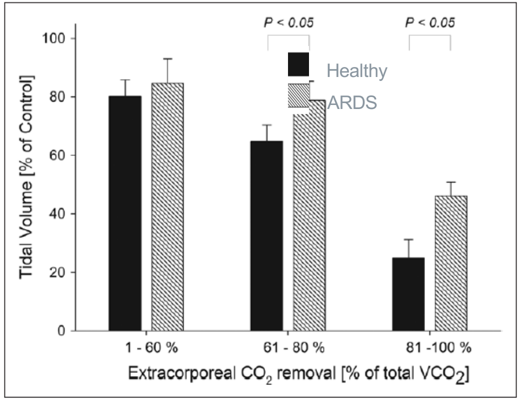
Extracorporeal Gas Exchange and Spontaneous Breathing for the Treatment of Acute Respiratory Distress Syndrome: An Alternative to Mechanical Ventilation?*

Crit Care Med 2014; 42:e211–e220

Thomas Langer, MD[1,2,3]; Vittoria Vecchi, MD[1,3,4]; Slava M. Belenkiy, MD[1]; Jeremy W. Cannon, MD[1,5]; Kevin K. Chung, MD[1,6]; Leopoldo C. Cancio, MD[1]; Luciano Gattinoni, MD[2,7]; Andriy I. Batchinsky, MD[1]

Sheep Model:
Cardiohelp w Avalon
2L/min blood flow



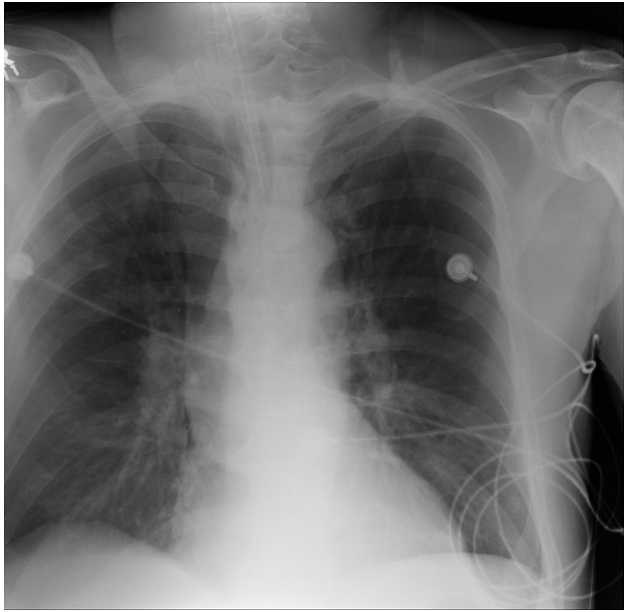


- ΔP_{es} 6 vs. 35 cmH_2O (baseline)
- V_T and P_{es} variations only reduced when >80% of VCO_2 removed (ARDS)

Opinion Based Medicine…

Set V_T=6 ml/kg (or lower)
Control breath size if mod-severe ARDS

Set V_T=6-8 ml/kg
Tolerate larger spontaneous breaths
Consider check for pendeluft



Take Home Points

Impact of spontaneous breathing during ARDS depends on timing and severity

Measuring patient effort is important

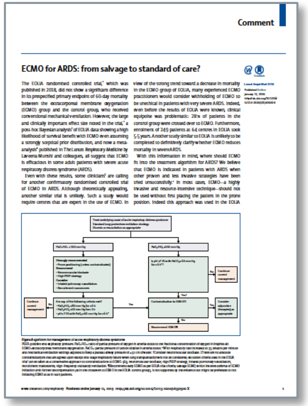
When allowing spontaneous breathing – consider normalizing efforts to protect both lung and diaphragm

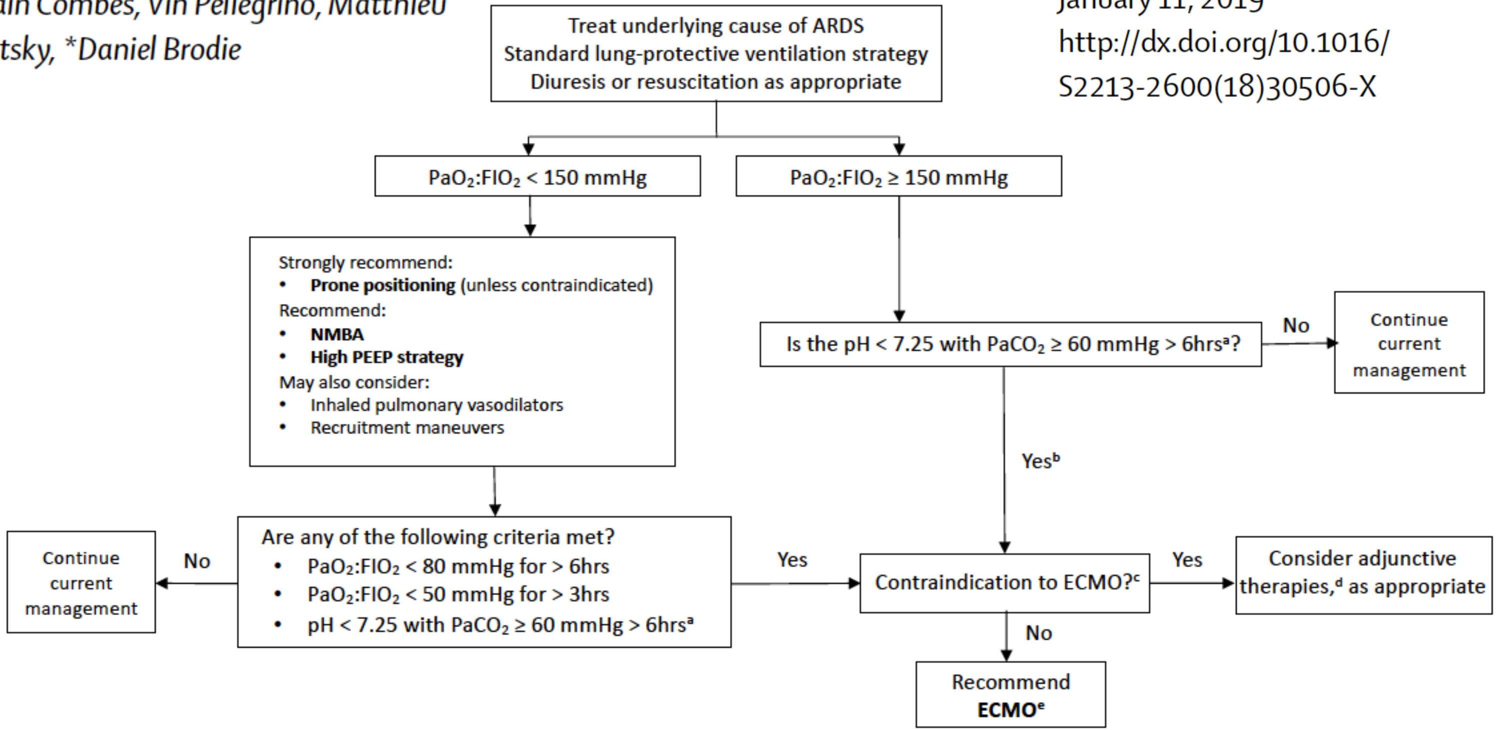
ECMO for ARDS: from salvage to standard of care?

*Darryl Abrams, Niall D Ferguson, Laurent Brochard, Eddy Fan, Alain Mercat, Alain Combes, Vin Pellegrino, Matthieu Schmidt, Arthur S Slutsky, *Daniel Brodie*

Lancet Respir Med 2019

Published Online
January 11, 2019
http://dx.doi.org/10.1016/
S2213-2600(18)30506-X





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