Beademing: wat is nieuw ?

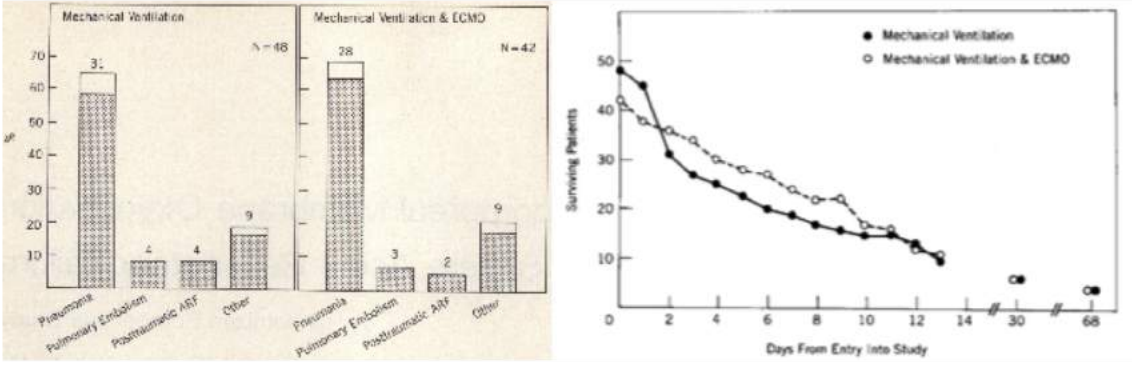
Diederik Gommers
IC-volwassenen
Rotterdam

Erasmus MC

Extracorporeal Membrane Oxygenation in Severe Acute Respiratory Failure

A Randomized Prospective Study

Warren M. Zapol, MD; Michael T. Snider, MD, PhD; J. Donald Hill, MD; Robert J. Fallat, MD; Robert H. Bartlett, MD; L. Henry Edmunds, MD; Alan H. Morris, MD; E. Converse Peirce II, MD; Arthur N. Thomas, MD; Herbert J. Proctor, MD; Philip A. Drinker, PhD; Philip C. Pratt, MD; Anna Bagniewski, MA; Rupert G. Miller, Jr, PhD



[*JAMA* 242:2193-2196, 1979]

Tidal volume: 10-15 ml/kg en PEEP 20-25 cmH_2O, peak pressure 40-50 cmH_2O

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The New England
Journal of Medicine

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*

VARIABLE	GROUP RECEIVING TRADITIONAL TIDAL VOLUMES	GROUP RECEIVING LOWER TIDAL VOLUMES
Ventilator mode	Volume assist–control	Volume assist–control
Initial tidal volume (ml/kg of predicted body weight)†	12	6
Plateau pressure (cm of water)	≤50	≤30
Death before discharge home and breathing without assistance (%)	39.8	31.0

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The New England
Journal of Medicine

VOLUME 342 MAY 4, 2000 NUMBER 18

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Death bef and	39.8	31.0

Driving Pressure (day 1): 30,4 vs. 15,6

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Alveoli, LOV and ExPress trials:

	Patients (n)	Low PEEP (cmH_2O)	High PEEP (cmH_2O)	Mortality low PEEP (%)	Mortality high PEEP (%)	Mortality *p*-value
ALVEOLI [12]	549	8.3±3.2	13.2±3.5	24.9	27.5	0.48
LOV [13]	983	9.8±2.7	14.6±3.4	40.4	36.4	0.19
ExPress [14]	767	7.1±1.8	14.6±3.2	31.2	27.8	0.31

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Alveoli, LOV and ExPress trials:

Driving pressure day 1 (low vs. high PEEP):

Alveoli: 15,1 vs. 12,3

Express: 12,7 vs. 11,7

OLV: 14,8 vs. 14,6

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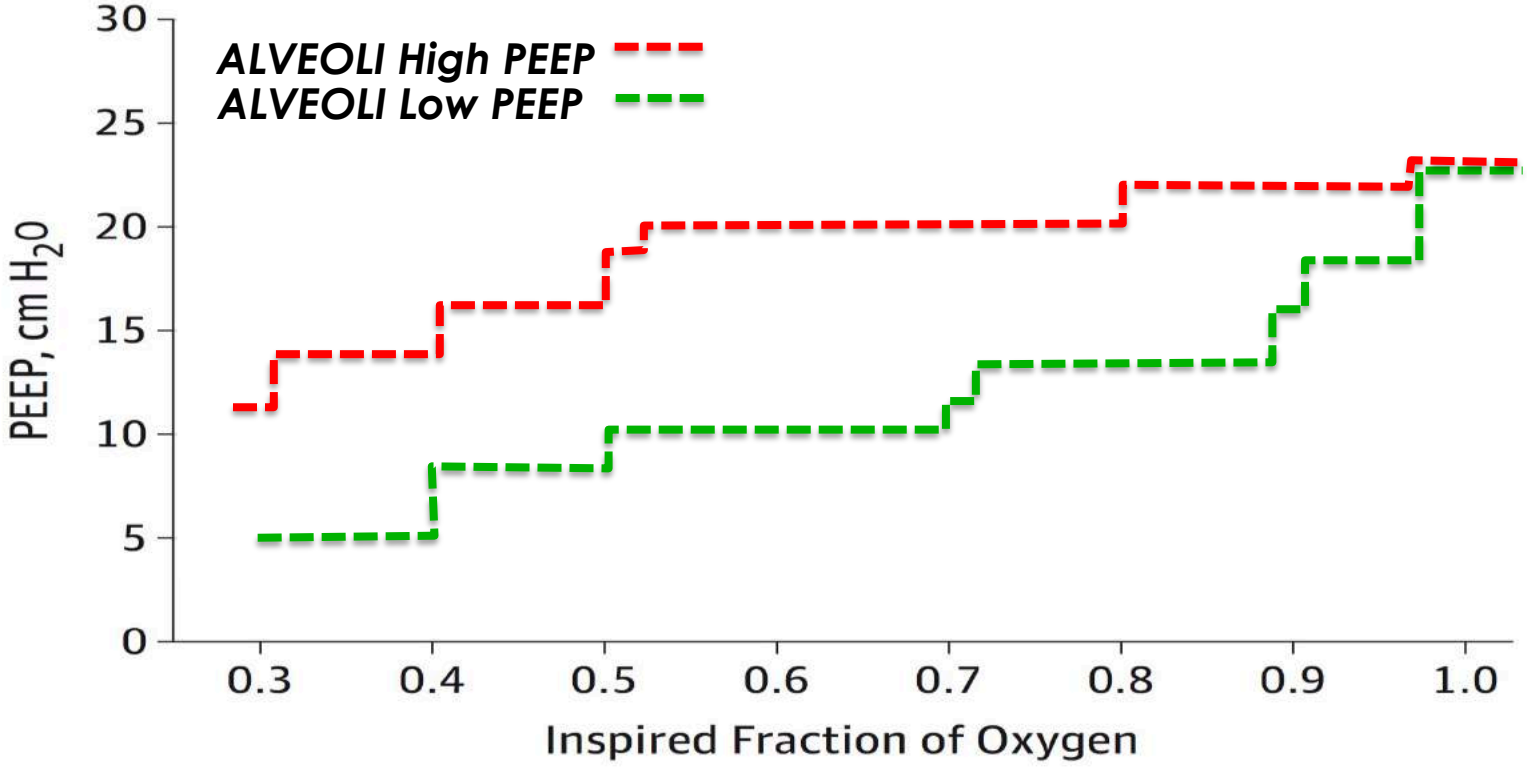
JAMA. 2016;315(8):788-800.

Epidemiology, Patterns of Care, and Mortality for Patients With Acute Respiratory Distress Syndrome in Intensive Care Units in 50 Countries

Giacomo Bellani, MD, PhD; John G. Laffey, MD, MA; Tài Pham, MD; Eddy Fan, MD, PhD; Laurent Brochard, MD, HDR; Andres Esteban, MD, PhD; Luciano Gattinoni, MD, FRCP; Frank van Haren, MD, PhD; Anders Larsson, MD, PhD; Daniel F. McAuley, MD, PhD; Marco Ranieri, MD; Gordon Rubenfeld, MD, MSc; B. Taylor Thompson, MD, PhD; Hermann Wrigge, MD, PhD; Arthur S. Slutsky, MD, MASc; Antonio Pesenti, MD; for the LUNG SAFE Investigators and the ESICM Trials Group

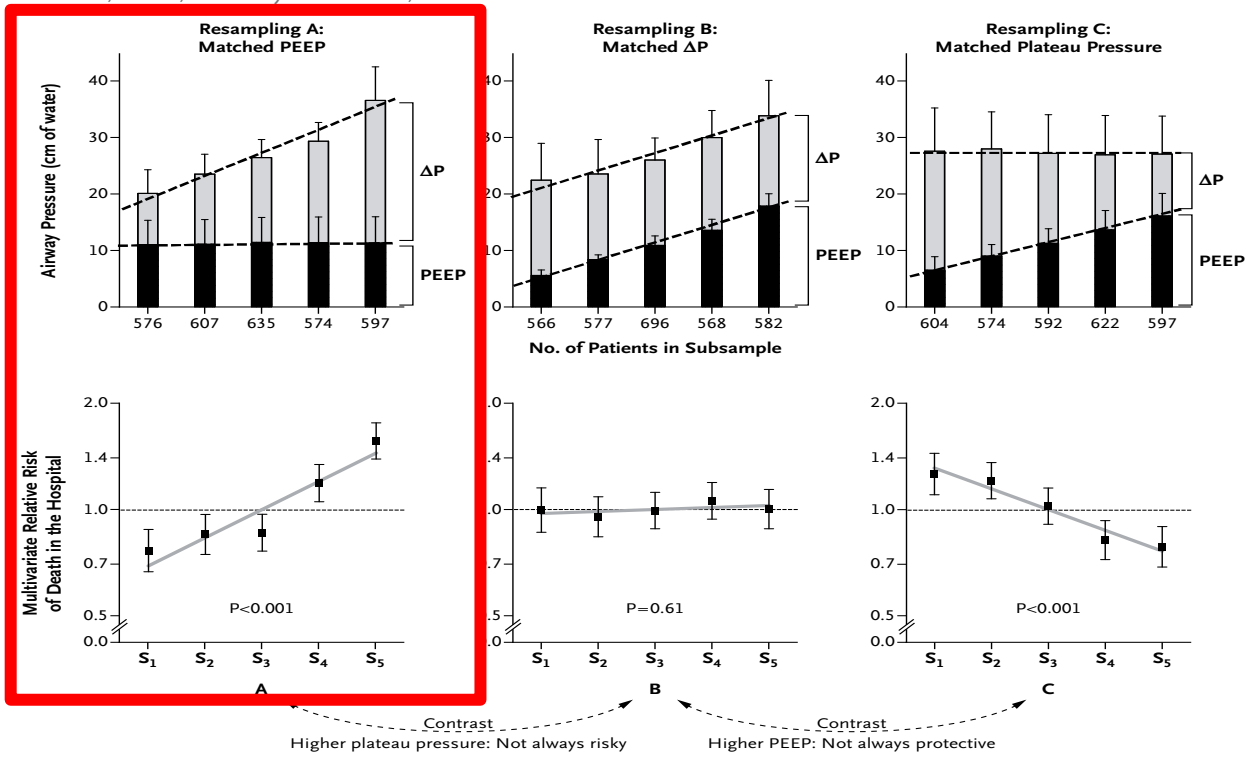


The NEW ENGLAND JOURNAL of MEDICINE

Driving Pressure and Survival in the Acute Respiratory Distress Syndrome

N Engl J Med 2015;372:747-55.

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.



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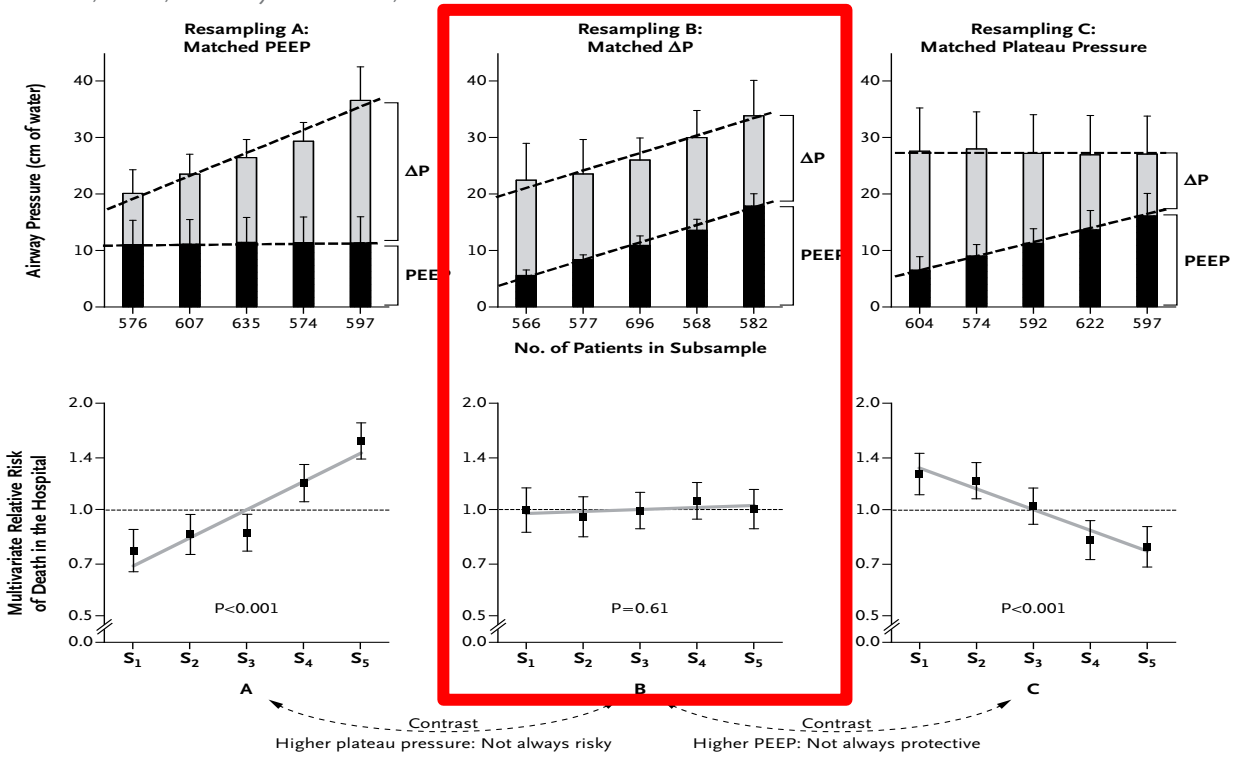

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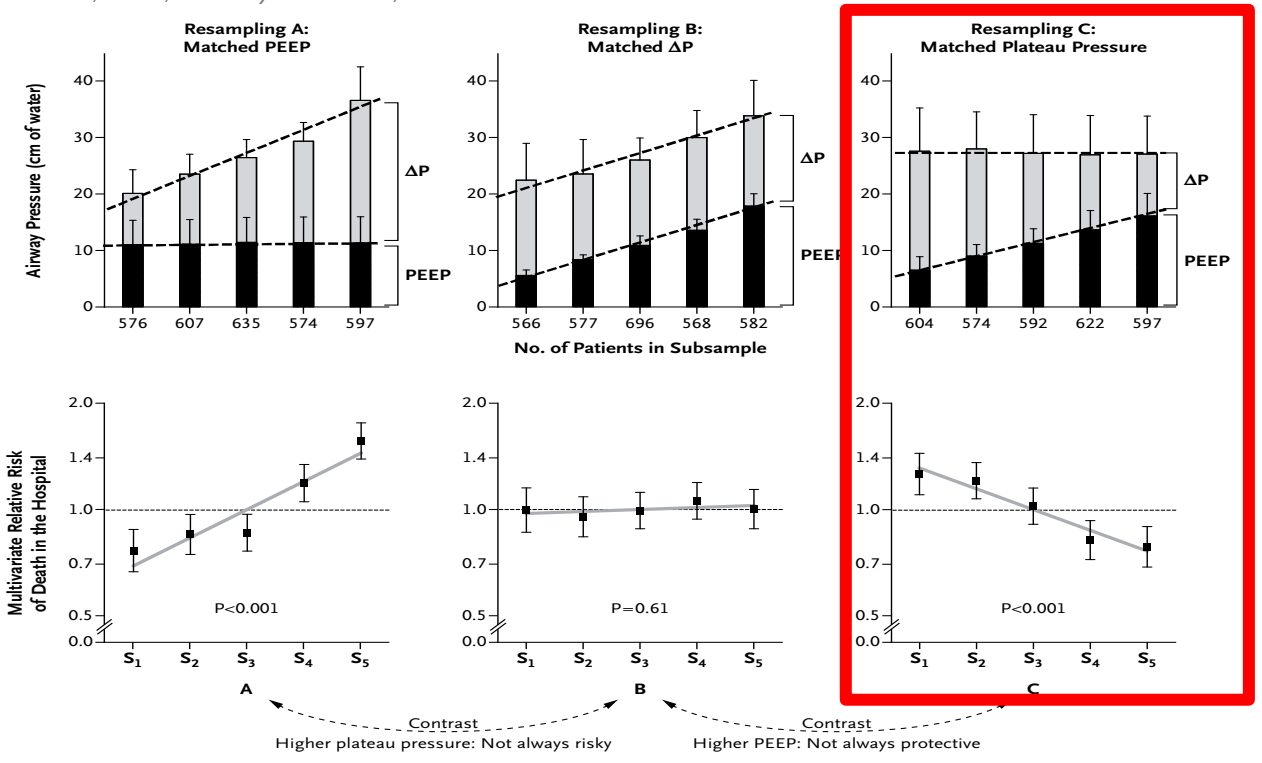

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N Engl J Med 2015;372:747-55.

DISCUSSION

Our findings might also explain why studies of higher PEEPs did not show consistent survival benefits; PEEP increments might be protective only when the increased PEEP values result in a change in lung mechanics so that the same V_T can be delivered with a lower ΔP.

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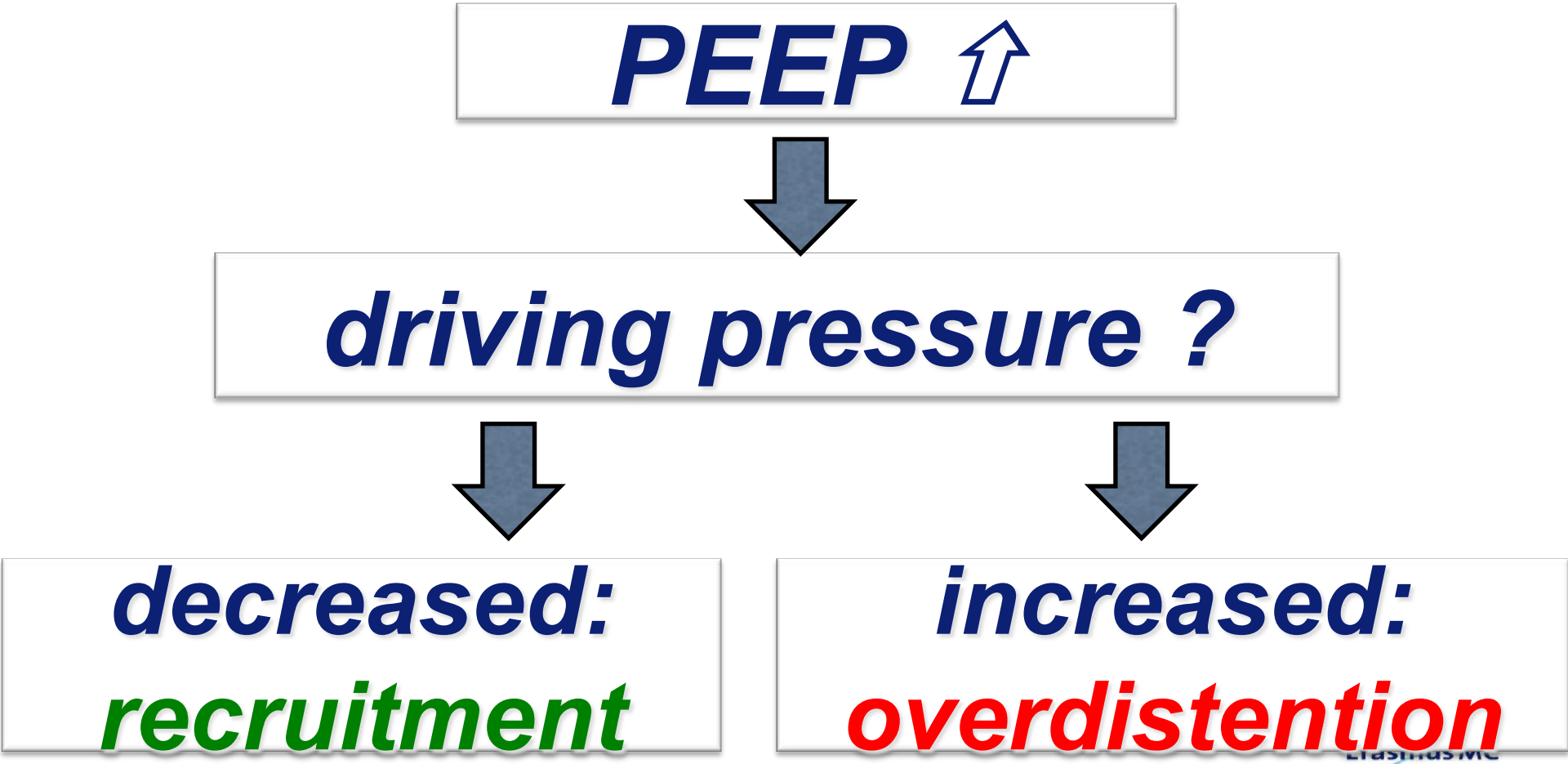
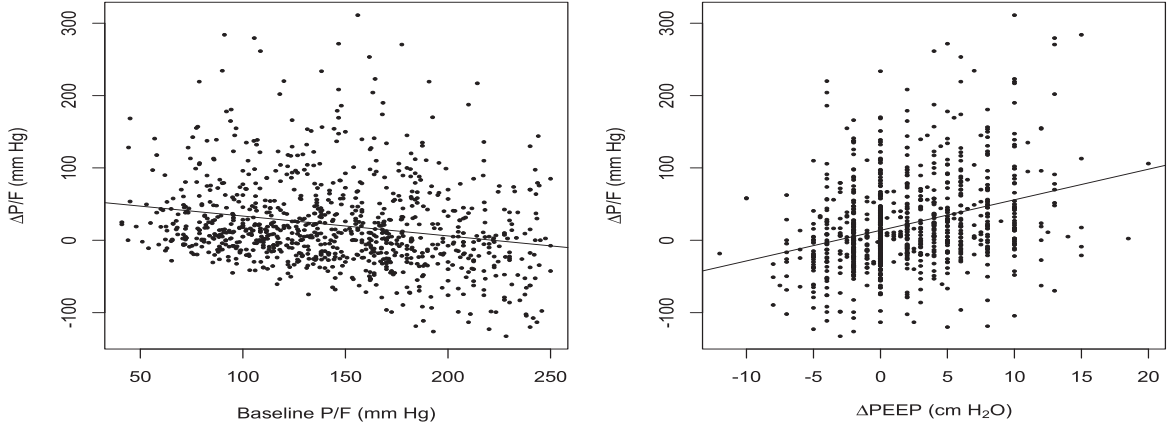

PEEP ⇧
driving pressure ?
decreased:
recruitment
increased:
overdistention

ORIGINAL ARTICLE

Oxygenation Response to Positive End-Expiratory Pressure Predicts Mortality in Acute Respiratory Distress Syndrome

A Secondary Analysis of the LOVS and ExPress Trials

Ewan C. Goligher[1,2,3,4], Brian P. Kavanagh[1,5,6], Gordon D. Rubenfeld[1,2,7], Neill K. J. Adhikari[1,2,7], Ruxandra Pinto[7], Eddy Fan[1,2,4], Laurent J. Brochard[1,2,8], John T. Granton[1,2,4], Alain Mercat[9], Jean-Christophe Marie Richard[10], Jean-Marie Chretien[11], Graham L. Jones[12], Deborah J. Cook[12,13], Thomas E. Stewart[1,2,4], Arthur S. Slutsky[1,2,4], Maureen O. Meade[12,13], and Niall D. Ferguson[1,2,3,4]



Conclusions: Patients with ARDS who respond to increased PEEP by improved oxygenation have a lower risk of death. The oxygenation response to PEEP might be used to predict whether patients will benefit from higher versus lower PEEP.

A future higher-versus-lower PEEP trial randomizing patients with a positive oxygenation response after a test dose of PEEP should be conducted to confirm these findings.

Am J Respir Crit Care Med Vol 190, Iss 1, pp 70–76, Jul 1, 2014

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Conclusion:

Higher PEEP only in responders !!!!

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Intensive Care Med (1992) 18:319–321

Intensive Care Medicine

Editorial

Open up the lung and keep the lung open

B. Lachmann

Department of Anesthesiology, Erasmus University Rotterdam, The Netherlands

Open lung concept:

- Recruitment maneuver:
  'open up the lung'
- High PEEP:
  'keep the lung open'
- Lowest pressure amplitude:
  low tidal volume

Open up the lung and keep the lung open
B Lachmann - Intensive care medicine, 1992 - Springer
As shown in the results from SjOstrand's group, if one opens the lungs (by applying a peak inspiratory pressure of 55 cmH20 with an end-expiratory alveolar pressure of 16cmH20 for about 10min) only about 20cmH20 (range 16-23 cmH20) pressure amplitude is required ...
Geciteerd door 953 Verwante artikelen Alle 8 versies Citeren Opslaan

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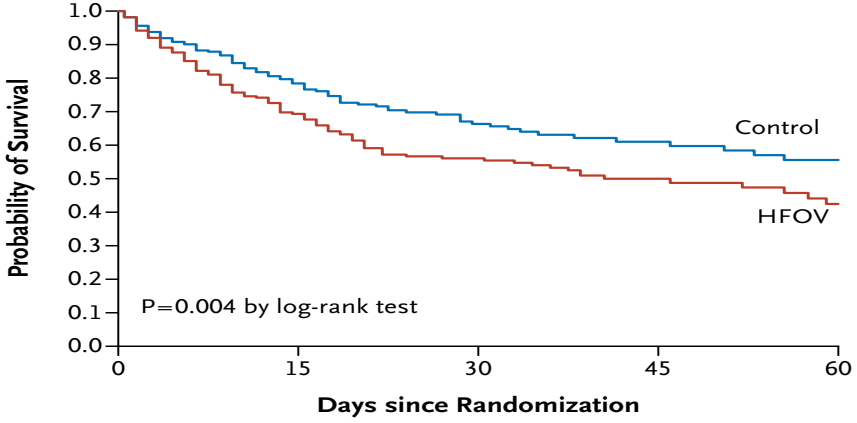
The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

High-Frequency Oscillation in Early Acute Respiratory Distress Syndrome

Niall D. Ferguson, M.D., Deborah J. Cook, M.D., Gordon H. Guyatt, M.D., Sangeeta Mehta, M.D., Lori Hand, R.R.T., Peggy Austin, C.C.R.A., Qi Zhou, Ph.D., Andrea Matte, R.R.T., Stephen D. Walter, Ph.D., Francois Lamontagne, M.D., John T. Granton, M.D., Yaseen M. Arabi, M.D., Alejandro C. Arroliga, M.D., Thomas E. Stewart, M.D., Arthur S. Slutsky, M.D., and Maureen O. Meade, M.D., for the OSCILLATE Trial Investigators and the Canadian Critical Care Trials Group*



No. at Risk					
HFOV	275	169	98	54	26
Control	273	181	92	54	39

Figure 2. Probability of Survival from the Day of Randomization to Day 60 in the HFOV and Control Groups.

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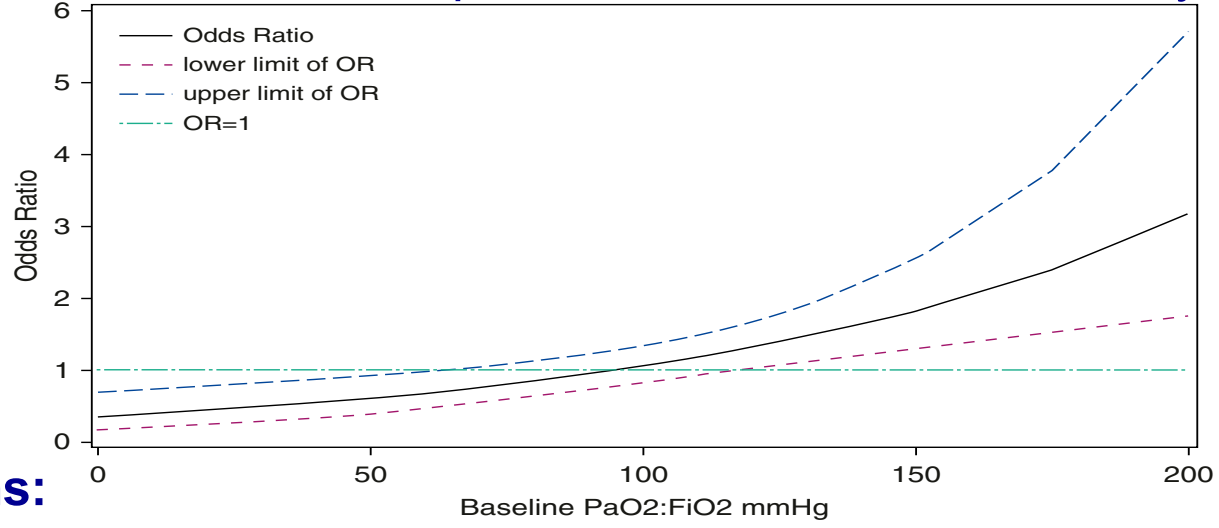
Severity of Hypoxemia and Effect of High-Frequency Oscillatory Ventilation in Acute Respiratory Distress Syndrome

Maureen O. Meade[1,2], Duncan Young[3], Steven Hanna[1,2], Qi Zhou[1,2], Thomas E. Bachman[4], Casper Bollen[5], Arthur S. Slutsky[6,7,8], Sarah E. Lamb[3], Neill K. J. Adhikari[6,8,9], Spyros D. Mentzelopoulos[10], Deborah J. Cook[1,2], Sachin Sud[11], Roy G. Brower[12], B. Taylor Thompson[13], Sanjoy Shah[14], Alex Stenzler[15], Gordon Guyatt[1,2], and Niall D. Ferguson[6,8,16,17]

Data from 1,552 patients in four trials were analyzed



Conclusions:

HFOV increases mortality for most patients with ARDS but may improve survival among patients with severe hypoxemia on conventional mechanical ventilation.

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Open Lung Approach for the Acute Respiratory Distress Syndrome: A Pilot, Randomized Controlled Trial*

Robert M. Kacmarek, PhD, RRT, FCCM[1,2]; Jesús Villar, MD, PhD, FCCM[3,4]; Demet Sulemanji, MD[1,2]; Raquel Montiel, MD[5]; Carlos Ferrando, MD, PhD[6]; Jesús Blanco, MD, PhD[3,7]; Younsuck Koh, MD, PhD, FCCM[8]; Juan Alfonso Soler, MD, PhD[9]; Domingo Martínez, MD[10]; Marianela Hernández, MD[11]; Mauro Tucci, MD, PhD[12]; Joao Batista Borges, MD, PhD[12]; Santiago Lubillo, MD, PhD[5]; Arnoldo Santos, MD, PhD[13]; Juan B. Araujo, MD[14]; Marcelo B. P. Amato, MD, PhD[12]; Fernando Suárez-Sipmann, MD, PhD[3,13]; the Open Lung Approach Network

- *200 ARDS patients (P/F ratio < 200 mmHg) in 20 ICUs*
- *ARDSnet vs OLC*
- *RCM (50-60 cmH2O) and decremental PEEP trial for best compliance*

Outcomes	Open Lung Approach	Acute Respiratory Distress Syndrome Network Protocol	*p*
28-d mortality, *n* (%)	22 (22)	27 (27)	0.51 F
60-d mortality, *n* (%)	28 (29)	33 (33)	0.54 F
ICU mortality, *n* (%)	25 (25)	30 (30)	0.53 F
Hospital mortality, *n* (%)	29 (30)	35 (35)	0.45 F
Length of ICU stay, d, median (IQR)	18 (10–28)	16 (11–28)	0.79 W
Length of hospital stay, d, median (IQR)	27 (16–46)	23 (14–41)	0.49 W
Ventilator-free days, d, median (IQR)	8 (0–20)	7 (0–20)	0.53 W
Primary cause of death in ICU—univariate analysis			
Progressive respiratory failure, *n* (% nonsurvivors)	3 (12)	10 (33)	0.11 F
Septic shock, *n* (% of nonsurvivors)	10 (40)	3 (10)	0.01 F
Multiple organ failure, *n* (% of nonsurvivors)	4 (16)	10 (33)	0.22 F

Crit Care Med 2016; 44: 32-42

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JAMA | Original Investigation | CARING FOR THE CRITICALLY ILL PATIENT

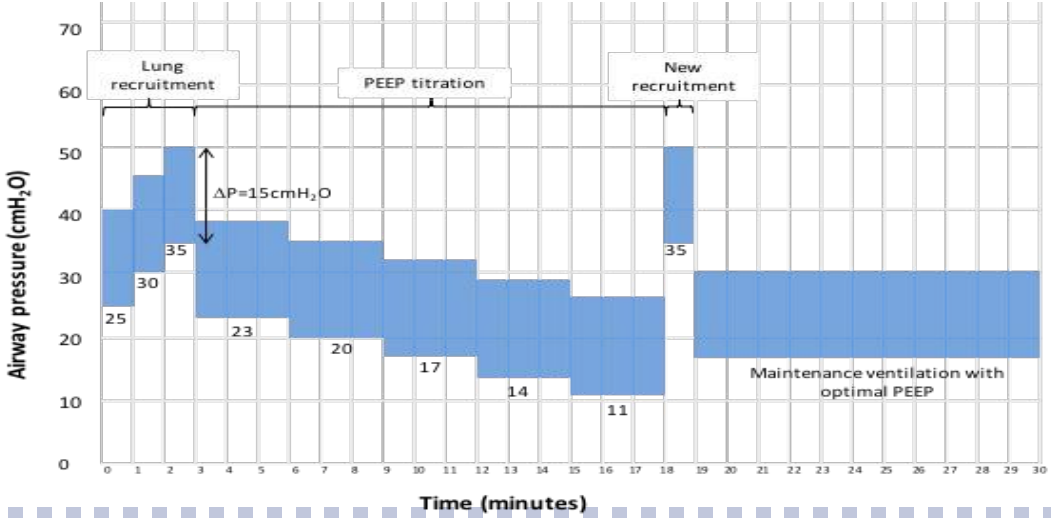
Effect of Lung Recruitment and Titrated Positive End-Expiratory Pressure (PEEP) vs Low PEEP on Mortality in Patients With Acute Respiratory Distress Syndrome

A Randomized Clinical Trial

Writing Group for the Alveolar Recruitment for Acute Respiratory Distress Syndrome Trial (ART) Investigators

JAMA. doi:10.1001/jama.2017.14171
Published online September 27, 2017.

- *1010 ARDS patients (P/F ratio < 200 mmHg) in 120 ICUs in 9 countries*
- *ARDSnet vs OLC*
- *RCM (50-60 cmH2O) and decremental PEEP trial for best compliance*



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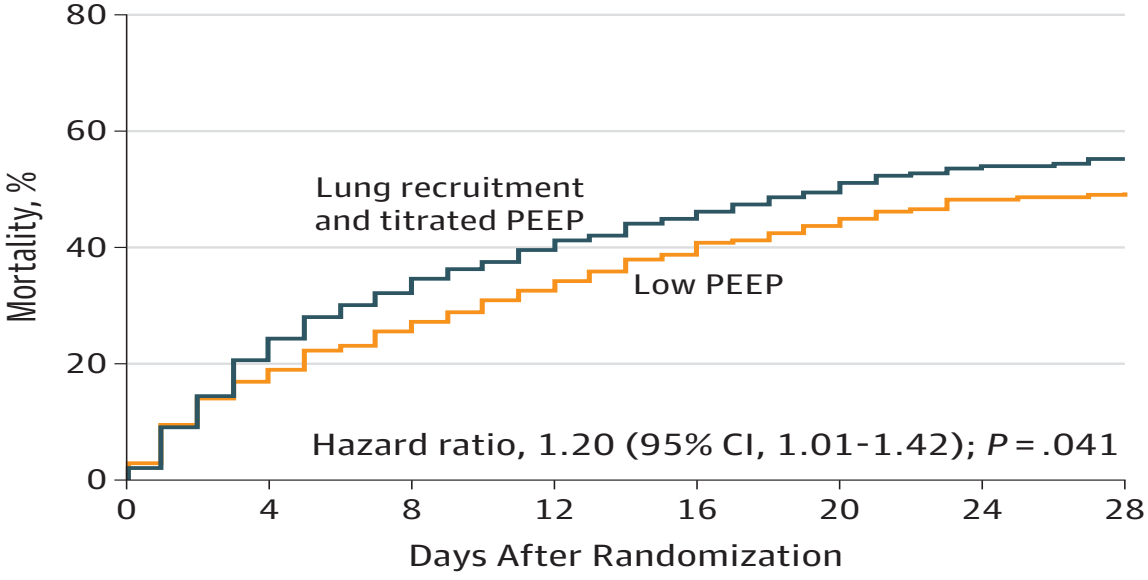

CONCLUSION:

In patients with moderate to severe ARDS,a strategy with lung recruitment and titrated PEEP compared with low PEEP increased 28-day mortality.

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How to set PEEP:
Esophageal pressure ?

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The NEW ENGLAND JOURNAL of MEDICINE

ESTABLISHED IN 1812 NOVEMBER 13, 2008 VOL. 359 NO. 20

Mechanical Ventilation Guided by Esophageal Pressure in Acute Lung Injury

Daniel Talmor, M.D., M.P.H., Todd Sarge, M.D., Atul Malhotra, M.D., Carl R. O'Donnell, Sc.D., M.P.H., Ray Ritz, R.R.T., Alan Lisbon, M.D., Victor Novack, M.D., Ph.D., and Stephen H. Loring, M.D.

- 61 pats. with ALI/ARDS
- 1 ICU in Boston
- 2 groups: esophageal pressure vs. ARDSnet controls

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Transpulmonary pressure

Esophageal balloon catheter

The NEW ENGLAND JOURNAL of MEDICINE

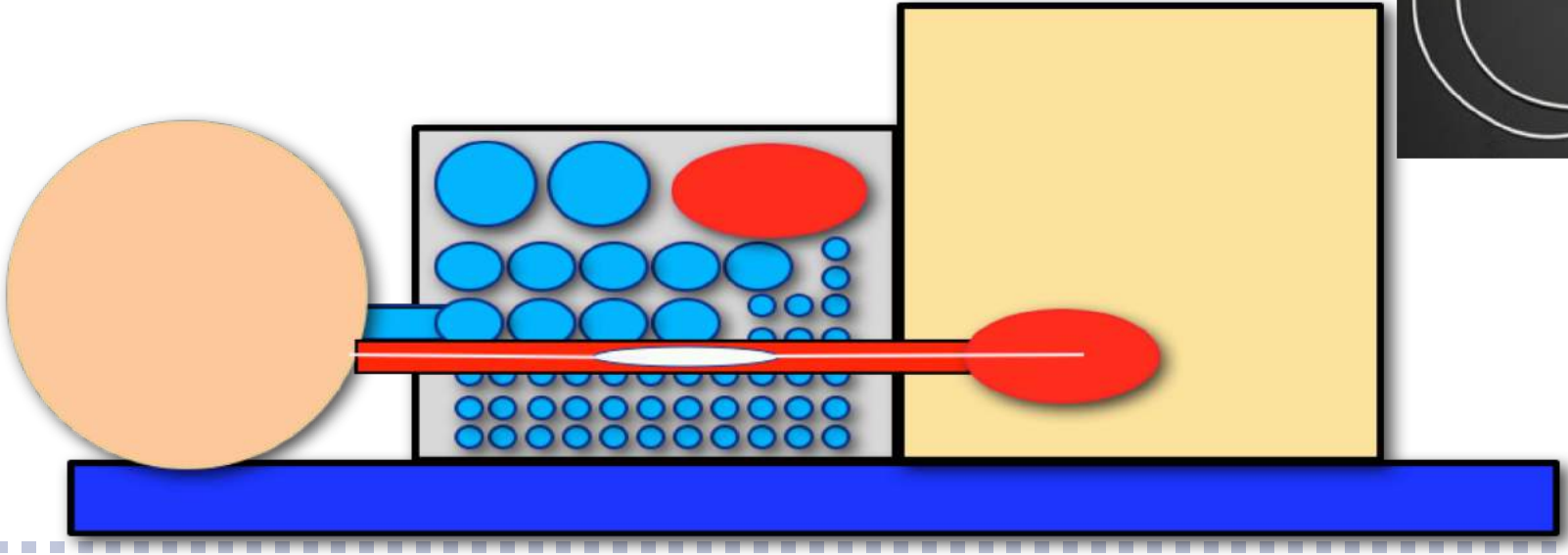
REVIEW ARTICLE

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.



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JAMA | Original Investigation | CARING FOR THE CRITICALLY ILL PATIENT

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A Randomized Clinical Trial

Jeremy R. Beitler, MD, MPH; Todd Sarge, MD; Valerie M. Banner-Goodspeed, MPH; Michelle N. Gong, MD, MSc; Deborah Cook, MD; Victor Novack, MD, PhD; Stephen H. Loring, MD; Daniel Talmor, MD, MPH; for the EPVent-2 Study Group

Table 1. Summary of Ventilator Protocols

Protocol Variable	P_{ES}-Guided PEEP		Empirical PEEP-FIO_2	
Ventilator mode	Volume or pressure assist control		Volume or pressure assist control	
Tidal volume, mL/kg PBW	6 (range, 4-8)		6 (range, 4-8)	
End-inspiratory pressure limit, cm H_2O	$P_L \leq 20$		$P_{PLAT} \leq 35$	
Respiratory rate set to attain target pH 7.30-7.45, breaths/min	6-35		6-35	
Inspiratory to expiratory time ratio	1.1-1.3		1.1-1.3	
Goal oxygenation	Pao_2: 55-80 mm Hg or Spo_2: 88%-93%		Pao_2: 55-80 mm Hg or Spo_2: 88%-93%	
Allowable combinations of FIO_2 and either end-expiratory P_L or PEEP to attain goal oxygenation[a]	FIO_2	P_L, cm H_2O	FIO_2	PEEP, cm H_2O
	0.3	0	0.3	5
	0.4	0	0.3	8
	0.5	0	0.3	10
	0.5	2	0.4	10
	0.6	2	0.4	12
	0.6	3	0.4	14
	0.7	3	0.4	16
	0.7	4	0.4	18
	0.8	4	0.5	18
	0.8	5	0.5	20
	0.9	5	0.6	20
	0.9	6	0.7	20
	1.0	6	0.8	20
			0.8	22
			0.9	22
			1.0	22
			1.0	24

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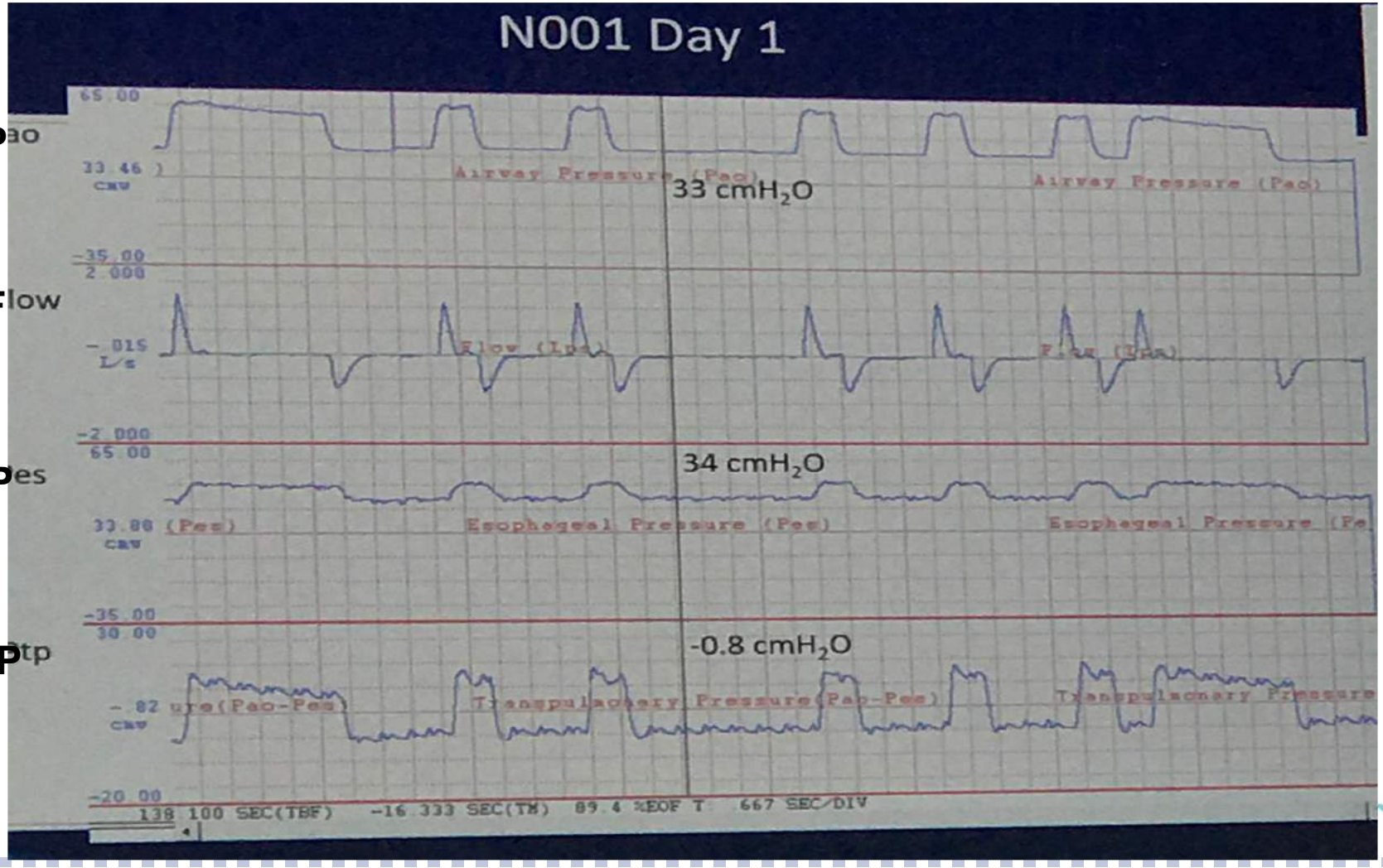
JAMA. 2019;321(9):846-857. doi:10.1001/jama.2019.0555


N001 Day 1
Pao
Flow
Pes
Ptp
33 cmH2O
34 cmH2O
-0.8 cmH2O
Airway Pressure (Pao)
Esophageal Pressure (Pes)
Transpulmonary Pressure(Pao-Pes)
138 100 SEC(TBF) -16 333 SEC(TE) 89.4 %EOF T 667 SEC/DIV

JAMA | Original Investigation | CARING FOR THE CRITICALLY ILL PATIENT

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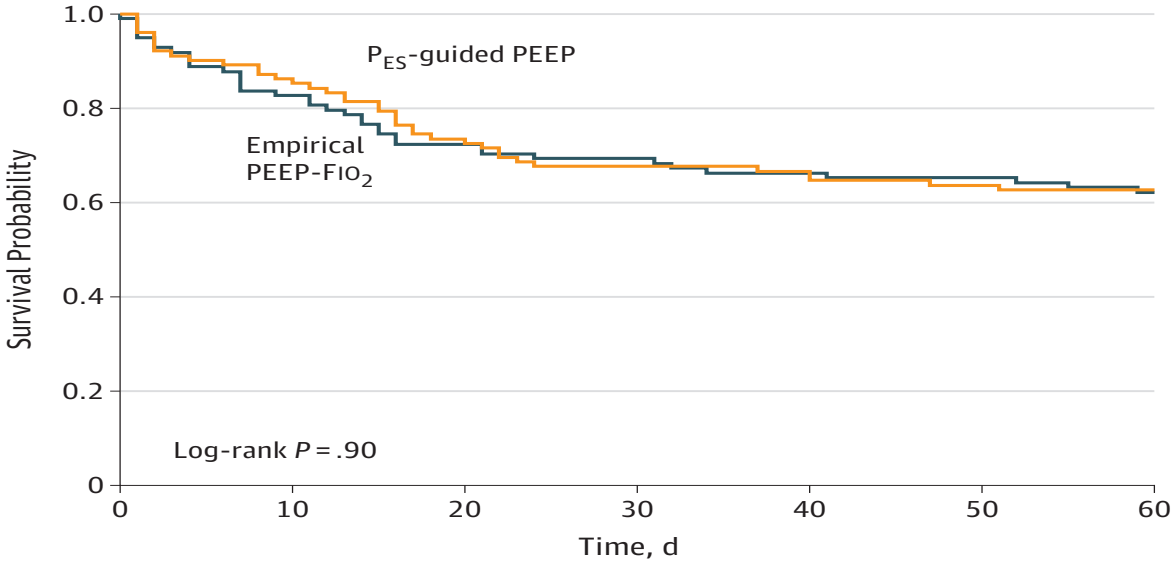

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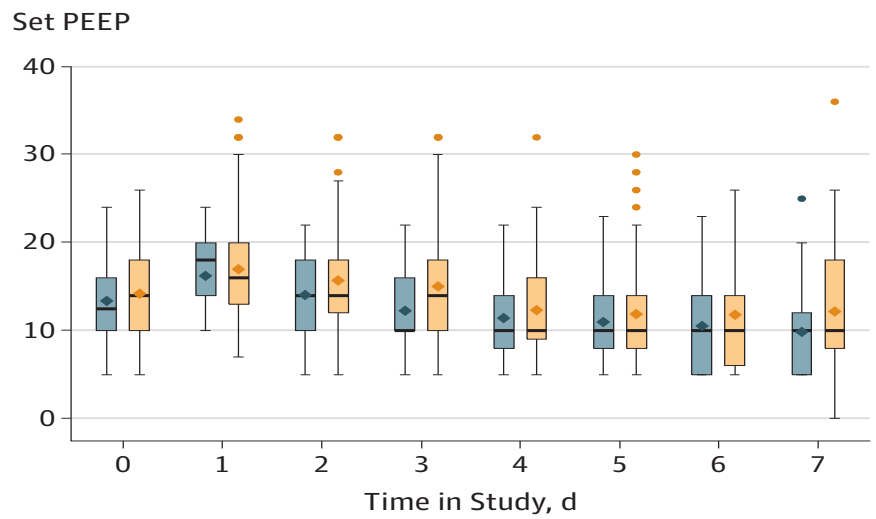

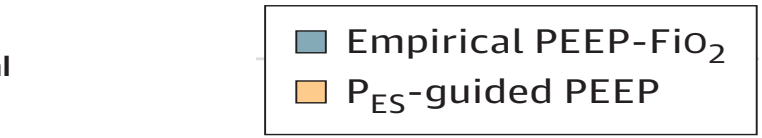

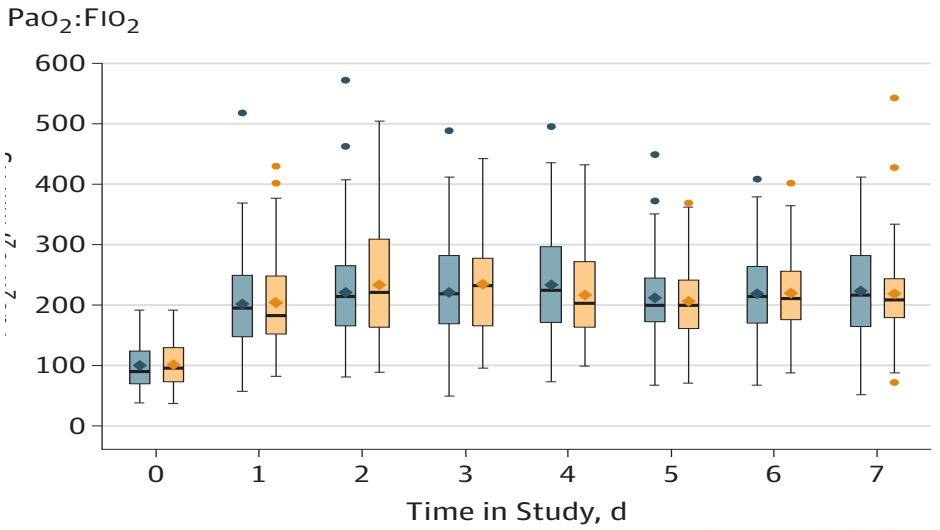

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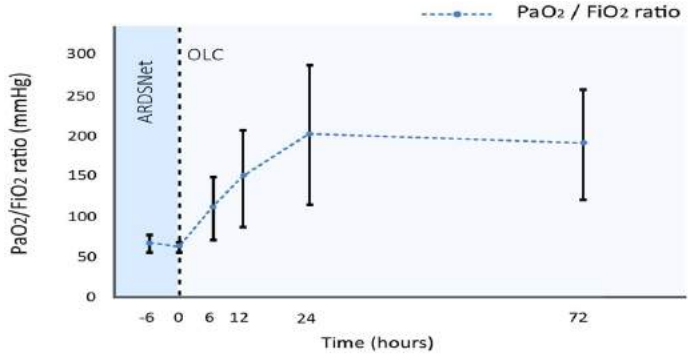
JAMA. 2019;321(9):846-857. doi:10.1001/jama.2019.0555

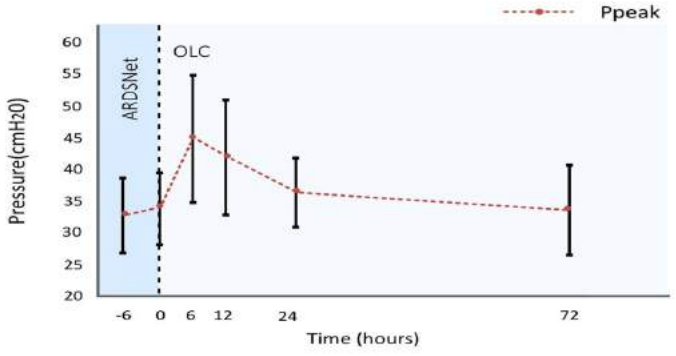
Zee et al. Critical Care (2019) 23:133
https://doi.org/10.1186/s13054-019-2421-x

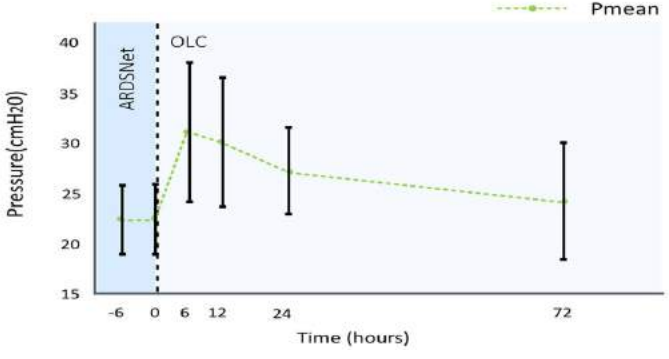
LETTER Open Access

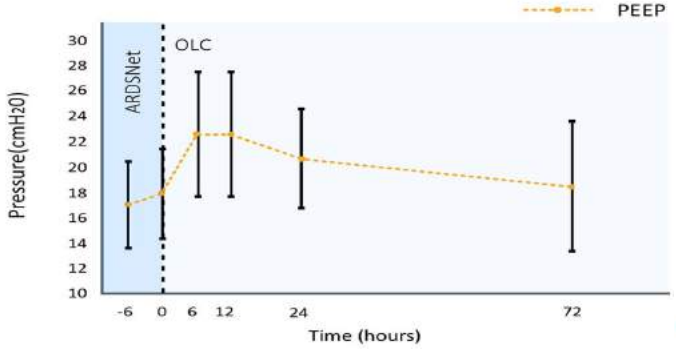
vvECMO can be avoided by a transpulmonary pressure guided open lung concept in patients with severe ARDS

Philip van der Zee*, Dinis Dos Reis Miranda, Han Meeder, Henrik Endeman and Diederik Gommers









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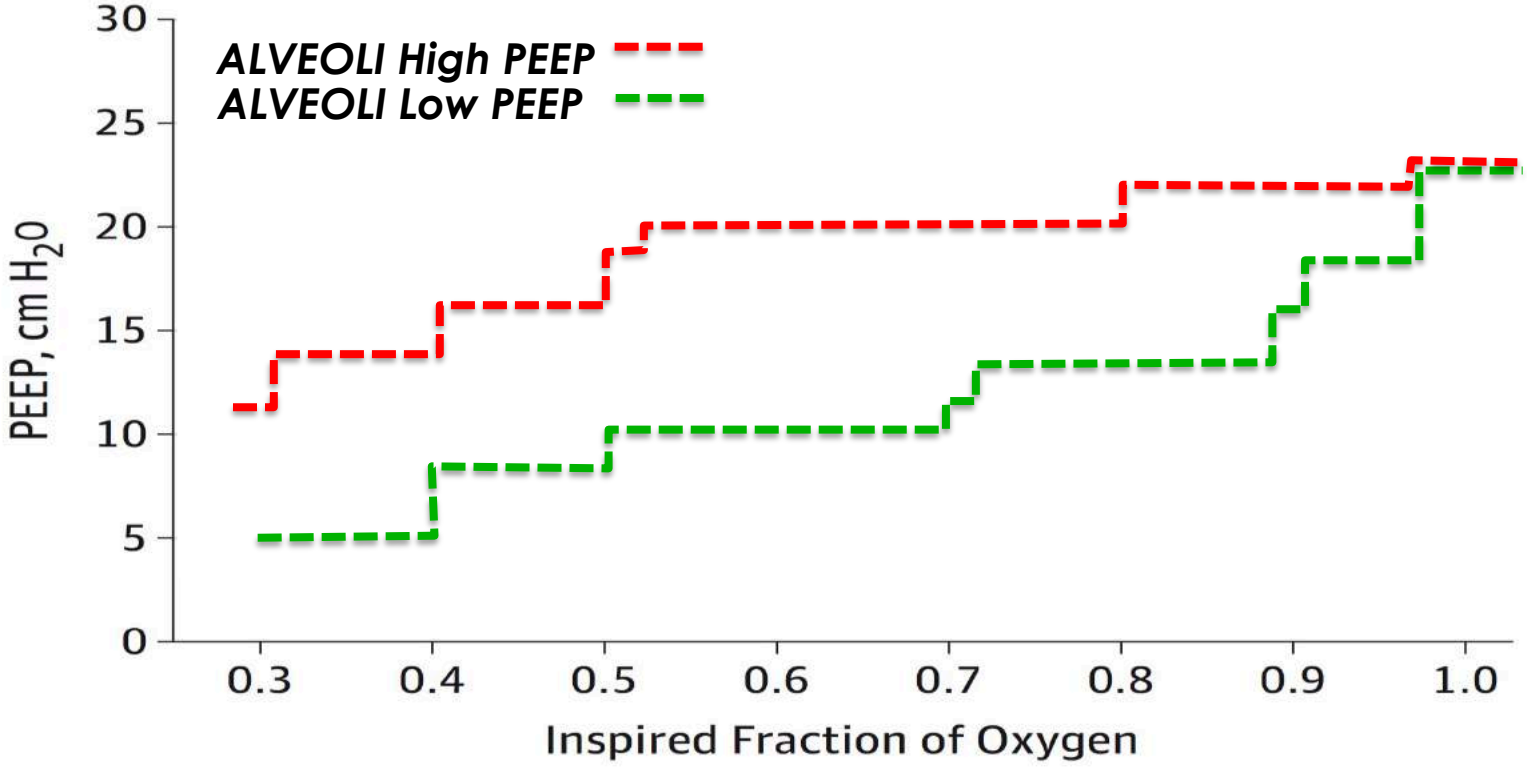
JAMA. 2016;315(8):788-800.

Epidemiology, Patterns of Care, and Mortality for Patients With Acute Respiratory Distress Syndrome in Intensive Care Units in 50 Countries

Giacomo Bellani, MD, PhD; John G. Laffey, MD, MA; Tài Pham, MD; Eddy Fan, MD, PhD; Laurent Brochard, MD, HDR; Andres Esteban, MD, PhD; Luciano Gattinoni, MD, FRCP; Frank van Haren, MD, PhD; Anders Larsson, MD, PhD; Daniel F. McAuley, MD, PhD; Marco Ranieri, MD; Gordon Rubenfeld, MD, MSc; B. Taylor Thompson, MD, PhD; Hermann Wrigge, MD, PhD; Arthur S. Slutsky, MD, MASc; Antonio Pesenti, MD; for the LUNG SAFE Investigators and the ESICM Trials Group



The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Prone Positioning in Severe Acute Respiratory Distress Syndrome

Claude Guérin, M.D., Ph.D., Jean Reignier, M.D., Ph.D., Jean-Christophe Richard, M.D., Ph.D., Pascal Beuret, M.D., Arnaud Gacouin, M.D., Thierry Boulain, M.D., Emmanuelle Mercier, M.D., Michel Badet, M.D., Alain Mercat, M.D., Ph.D., Olivier Baudin, M.D., Marc Clavel, M.D., Delphine Chatellier, M.D., Samir Jaber, M.D., Ph.D., Sylvène Rosselli, M.D., Jordi Mancebo, M.D., Ph.D., Michel Sirodot, M.D., Gilles Hilbert, M.D., Ph.D., Christian Bengler, M.D., Jack Richecoeur, M.D., Marc Gainnier, M.D., Ph.D., Frédérique Bayle, M.D., Gael Bourdin, M.D., Véronique Leray, M.D., Raphaele Girard, M.D., Loredana Baboi, Ph.D., and Louis Ayzac, M.D., for the PROSEVA Study Group

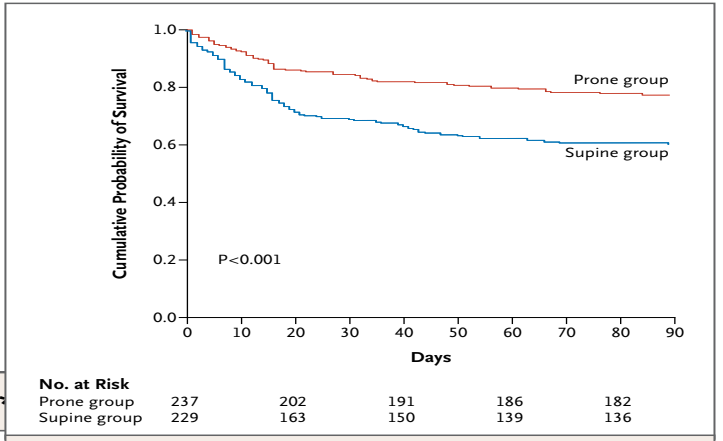


Figure 2. Kaplan–Meier Plot of the Probability of Survival from Randomization to Day 90.

Table 3. Primary and Secondary Outcomes According to Study Group.

Outcome	Supine Group (N=229)	Prone Group (N=237)	with the Prone Position (95% CI)	P Value
Mortality — no. (% [95% CI])				
At day 28				
Not adjusted	75 (32.8 [26.4–38.6])	38 (16.0 [11.3–20.7])	0.39 (0.25–0.63)	<0.001
Adjusted for SOFA score†			0.42 (0.26–0.66)	<0.001
At day 90				
Not adjusted	94 (41.0 [34.6–47.4])	56 (23.6 [18.2–29.0])	0.44 (0.29–0.67)	<0.001
Adjusted for SOFA score†			0.48 (0.32–0.72)	<0.001
Successful extubation at day 90 — no./total no. (% [95% CI])	145/223 (65.0 [58.7–71.3])	186/231 (80.5 [75.4–85.6])	0.45 (0.29–0.70)	<0.001

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TABLE 1] Major Trials of Prone Ventilation in ARDS

Variable	Gattinoni et al[10]	Guérin et al[8]	Mancebo et al[7]	Taccone et al[11]	Guérin et al[9] (PROSEVA)
Prone group mortality, %	50.7 (ICU mortality)	32.4 (28 d)	43 (ICU mortality)	31 (28 d)	**16 (28 d)**
Control group mortality, %	48 (ICU mortality)	31.5 (28 d)	58 (ICU mortality)	32.8 (28 d)	**32.8 (28 d)**
RR of mortality (prone/control)	1.05 ($P = .65$)	1.02 ($P = .77$)	0.74 ($P = .12$)	0.97 ($P = .72$)	**0.48 ($P < .001$)**
Patients, No.	304	**802**	142	342	466
Targeted disease	ALI[a] and ARDS[a]	Respiratory failure with $Pao_2/Fio_2 < 300$ mm Hg	ARDS[a]	ARDS[a]	**ARDS[a] with $Pao_2/Fio_2 < 150$ mm Hg**
Pao_2/Fio_2 at enrollment, mm Hg	128	153	139	113	**100**
Enrollment early in disease course?	No	No	Yes, < 2 d of intubation	Yes, < 3 d	**Yes, < 1.5 d**
SAPS II	40	**46**	43	41	**46**
V_T delivered, mL/kg	10.3	7.9	8.5	8	**6.1**
Patients paralyzed, %	Not reported	21	45	Not reported	**87**
Mean increase in Pao_2/Fio_2 on prone positioning, mm Hg	19	18	32[b]	44	**59**
Average time prone, hr/d	7	8	17	**18**	17
Average days prone	**10**	4	**10**	8.4	4
Significant reduction in ventilator days?[c]	No	No	No	No	**Yes**
Difficulty enrolling?	**Yes**	No	**Yes**	No	No
Crossover (supine to prone), %	8	**21**	8	12	7

CHEST 2017; 151(1):215-224

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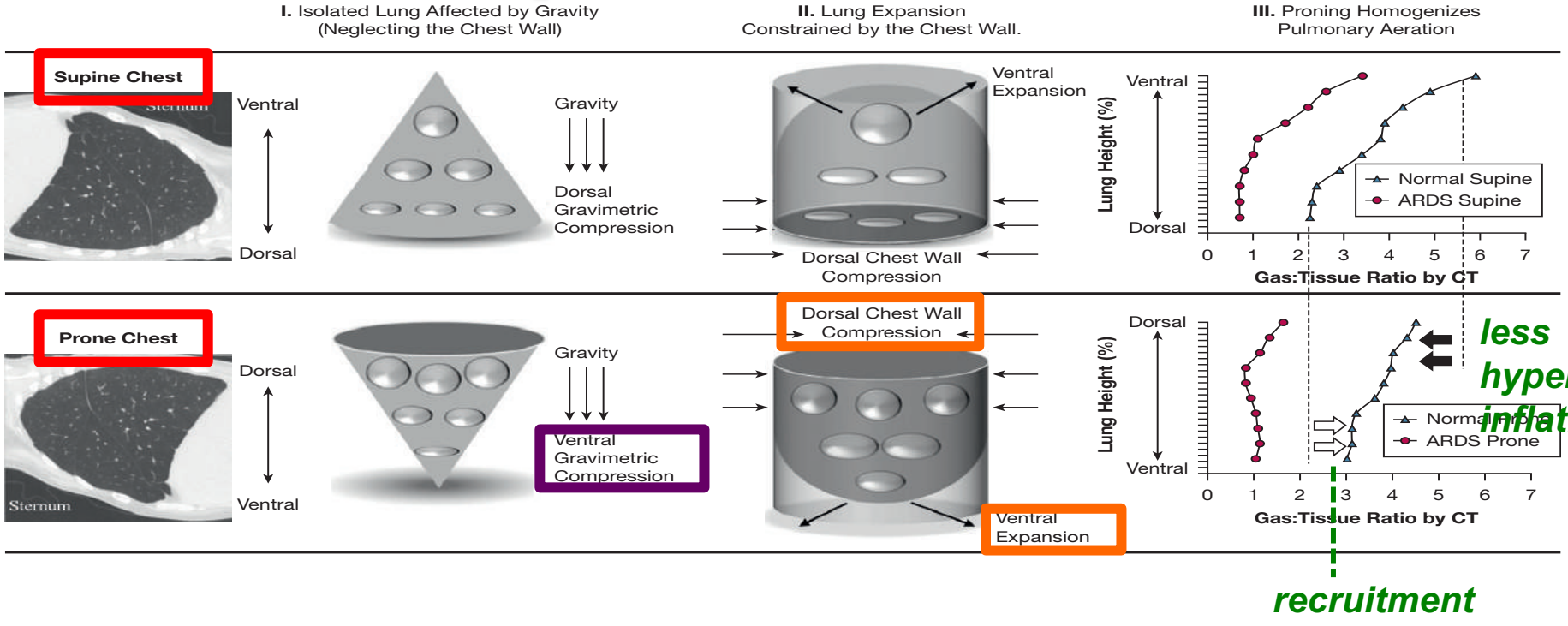
Supine vs. Prone



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Conclusion:

Early proning should be done in all severe ARDS patients (P/F < 150 mmHg) (also 5 days of MMB ?)

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