L'angolo della clinica:
ARDS e prono-supinazione

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28° Meeting GiViTI
13-14-15 Novembre 2019
Hotel Baia Flaminia, Pesaro

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Sistema Socio Sanitario
Regione Lombardia
ASST Monza

UNIVERSITÀ DEGLI STUDI DI MILANO BICOCCA

Conflicts of Interest

- INSTITUTIONAL:
  - Research grants from: Draeger

- PERSONAL
  - Consultancy fee from: Draeger, Dimar, Medtronic
  - Lecturing fees: Draeger, GE Healthcare, Getinge, Intersurgical, SEDA, Hamilton
  - Co-owner and president of ReviewerCredits.com

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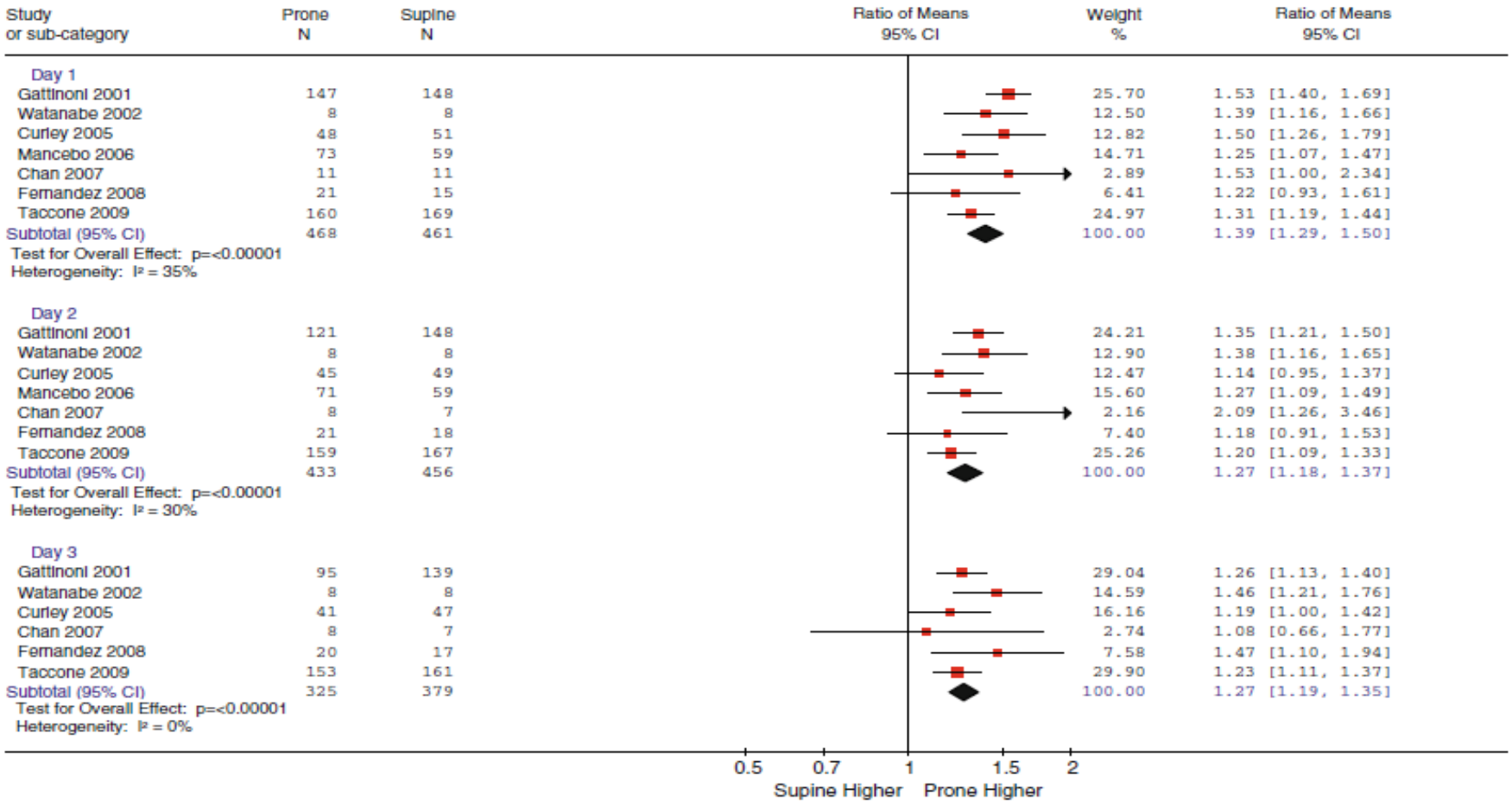
Outline

- Theoretical aspects
  - **Mechanisms of oxygenation improvement**
  - VILI prevention
  - Haemodynamic effects
  - Effect on Survival
- Pratical aspects

Prone position improves oxygenation



Sud et al. ICM 2010

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How does Prone position improve oxygenation?

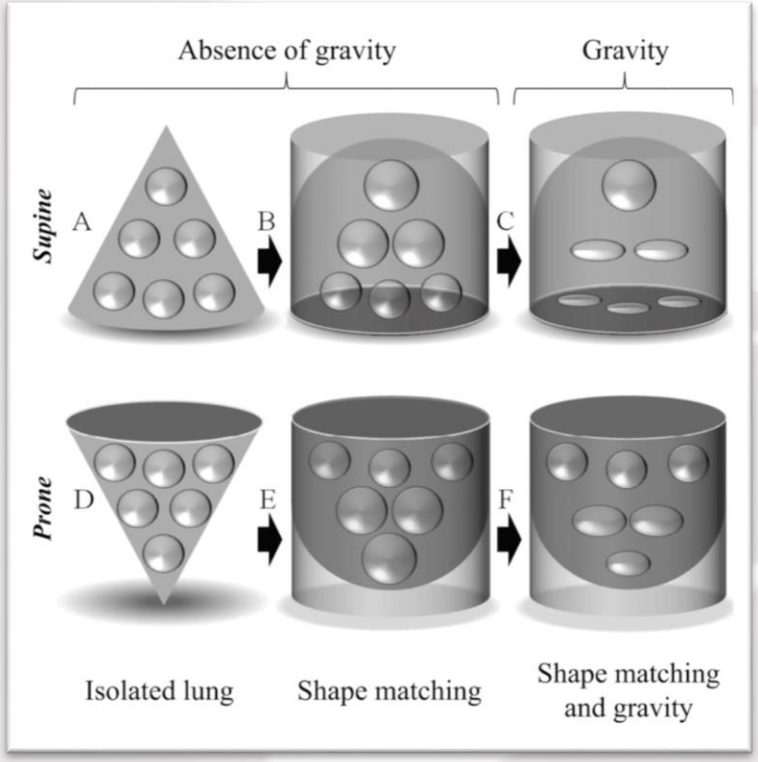
Anesthesiology
74:15–23, 1991

Body Position Changes Redistribute Lung Computed-Tomographic Density in Patients with Acute Respiratory Failure

Luciano Gattinoni, M.D.,* Paolo Pelosi, M.D.,† Giovanni Vitale, M.D.,† Antonio Pesenti, M.D.,‡
Luca D'Andrea,§ Daniele Mascheroni, M.D.†

Supine

Prone



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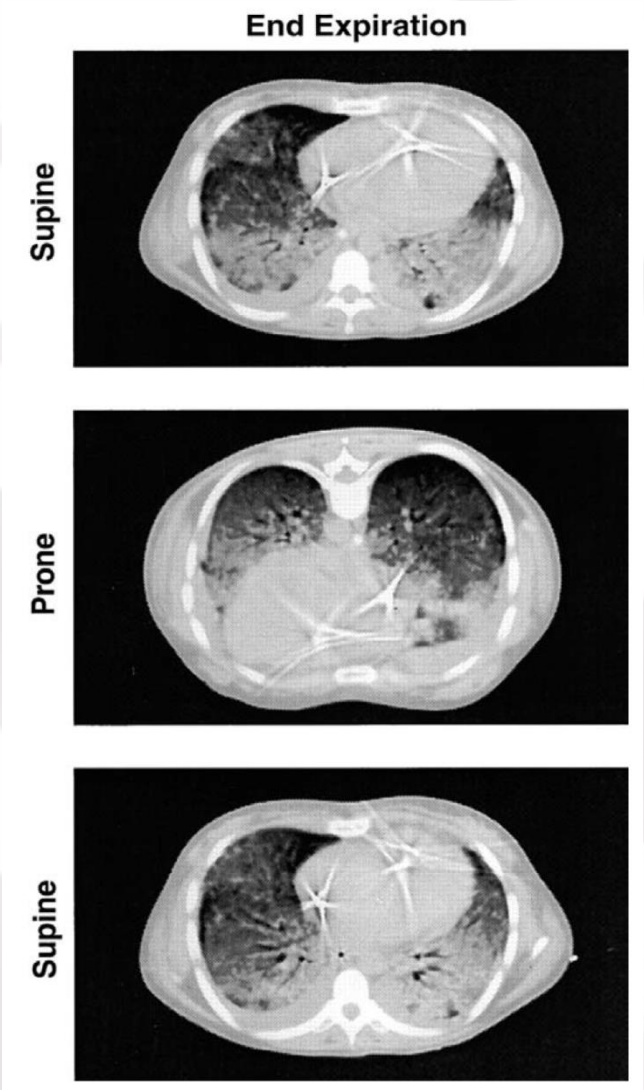
From baby lung to sponge lung



Anesthesiology
74:15–23, 1991

Body Position Changes Redistribute Lung Computed-Tomographic Density in Patients with Acute Respiratory Failure

Luciano Gattinoni, M.D., Paolo Pelosi, M.D.,† Giovanni Vitale, M.D.,† Antonio Pesenti, M.D.,‡ Luca D'Andrea,§ Daniele Mascheroni, M.D.†*

- Gravity-dependent densities shift *within minutes* when the patient is turned prone and then returned in supine position
- Gas in the dependent zones is squeezed out by the heavy lung parenchima above

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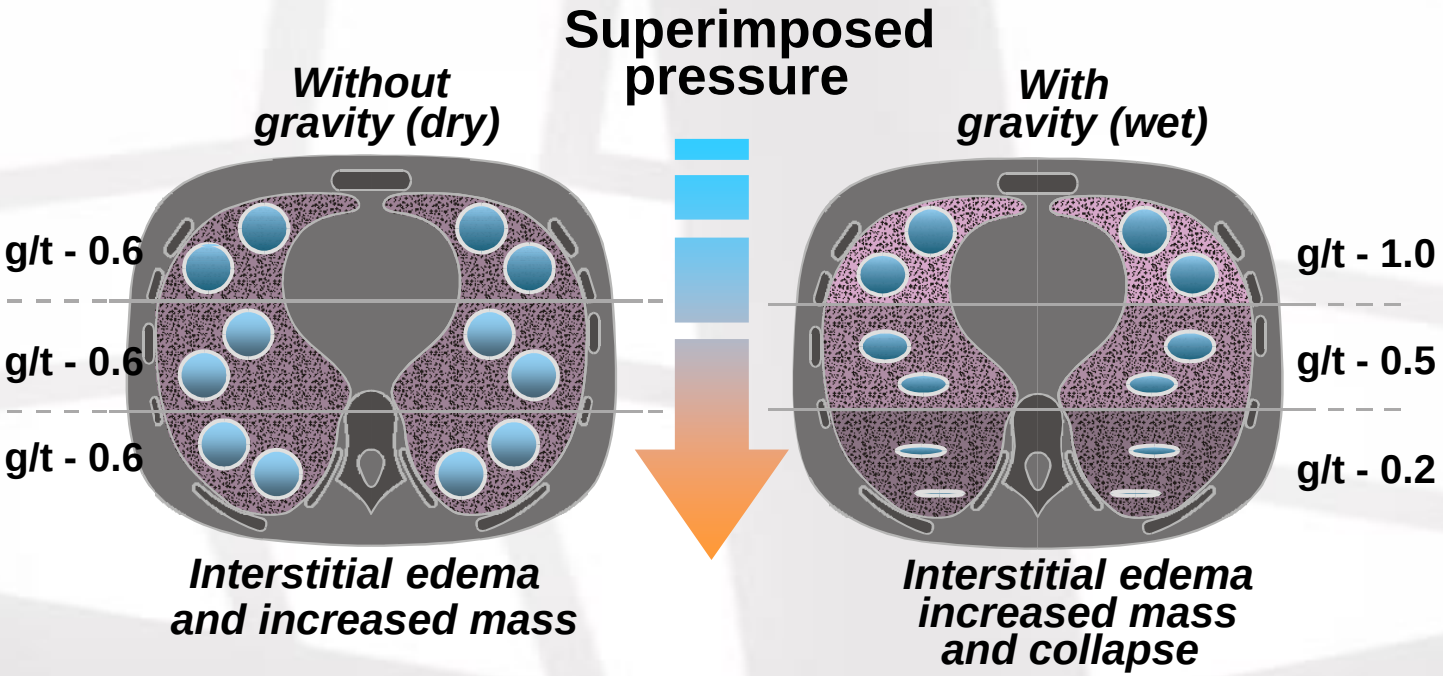
The Sponge Model



- Increased weight of non-dependent regions (superimposed pressure) compresses the dependent regions along a gravitational axis (role of heart, abdomen and effusion?)
- Size of the holes decreases along the vertical axis when the sponge is wet compared to dry

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Effect of prone position by EIT

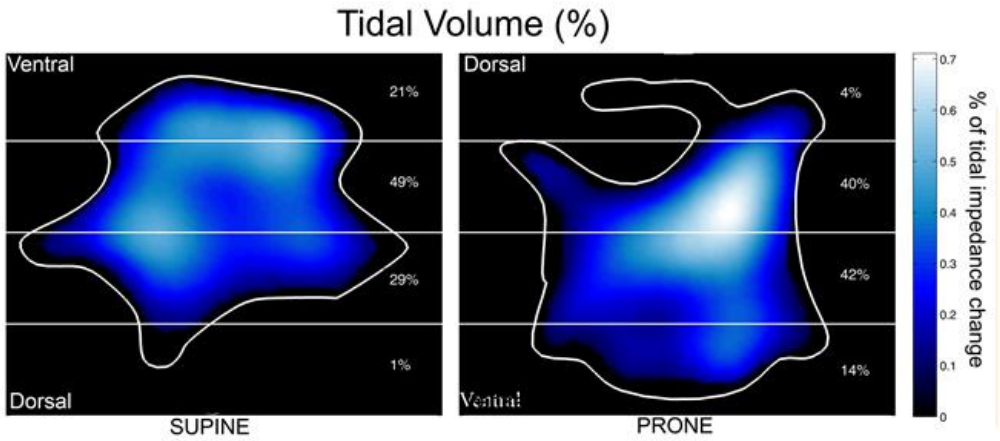
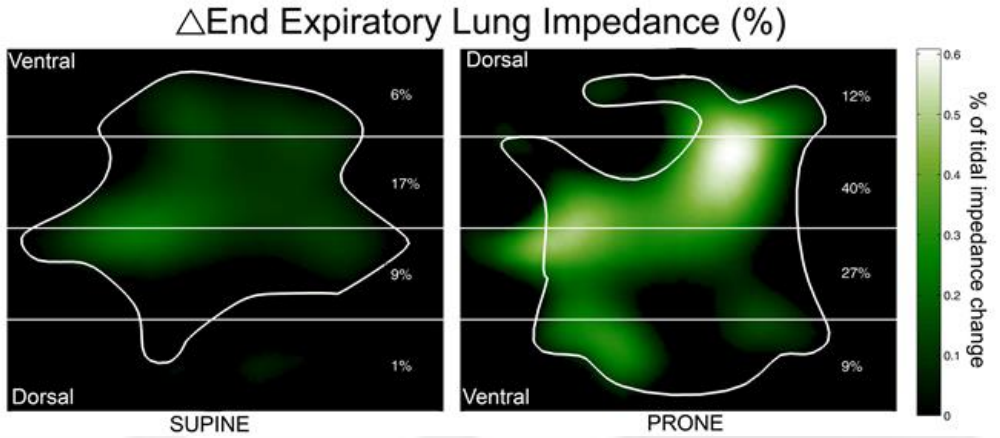


Figure 1.



Grasselli et al submitted.

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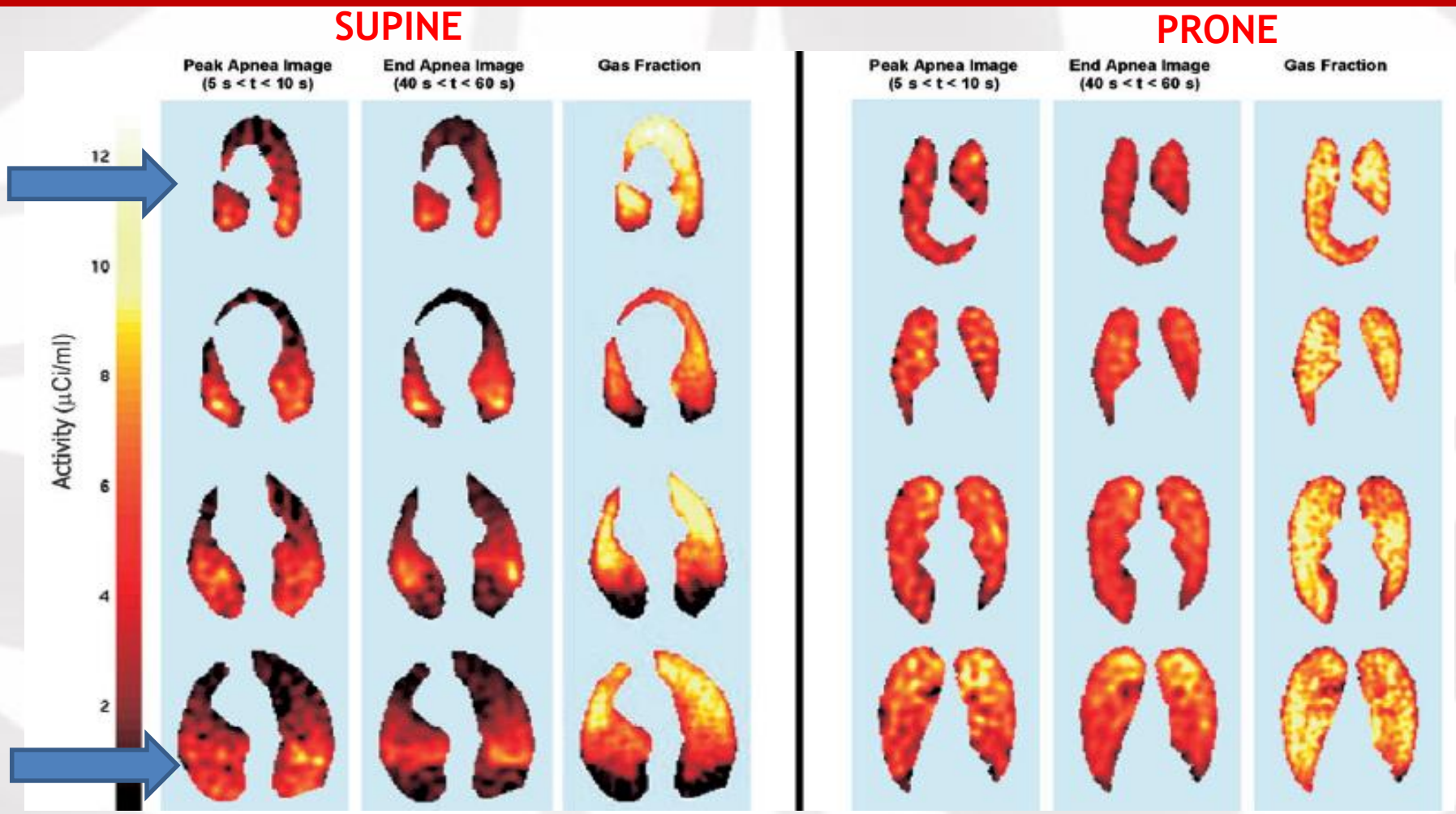
Regional shunt



Richter, Bellani et al AJRCCM 2005

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In summary

Dorsal recruitment > ventral derecruitment

+

Lung perfusion still prevalent in the dorsal regions

=

More ventilation in perfused lung areas

↓

↙ Intra-pulmonary shunt

Supine

- FiO2 100%
- PaO2=75
- PaCO2=52
- pH=7.44
- Driving Pressure=14

What would you prefer in prone?

Condition 1

- FiO2 100%
- PaO2=180
- PaCO2=53
- pH=7.44
- Driving Pressure=14

Condition 2

- FiO2 100%
- PaO2=300
- PaCO2=52
- pH=7.44
- Driving Pressure=16

Condition 3

- FiO2 100%
- PaO2=80
- PaCO2=49
- pH=7.46
- Driving Pressure=14

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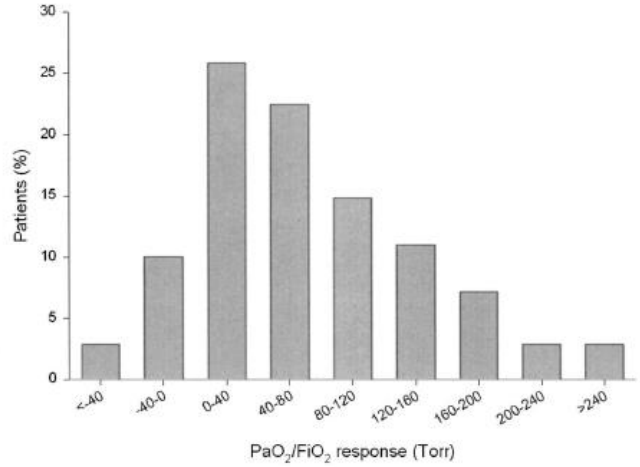
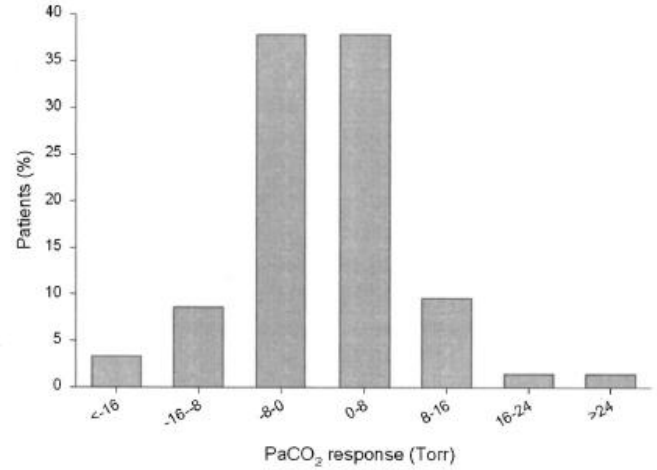
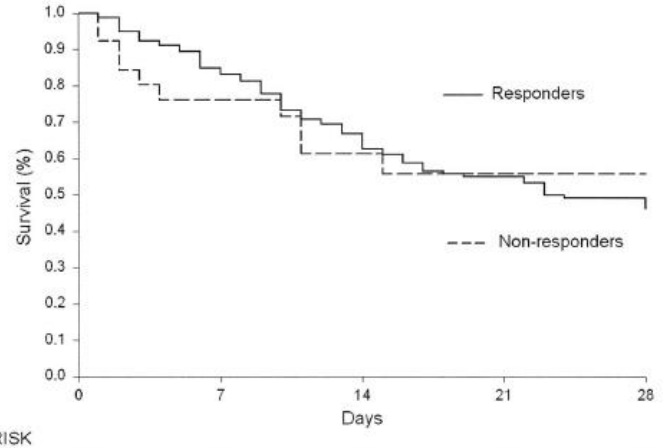
Decrease in $Paco_2$ with prone position is predictive of improved outcome in acute respiratory distress syndrome*

Luciano Gattinoni, MD, FRCP; Federica Vagginelli, MD; Eleonora Carlesso, MSC; Paolo Taccone, MD; Valeria Conte, MD; Davide Chiumello, MD; Franco Valenza, MD; Pietro Caironi, MD; Antonio Pesenti, MD; for the Prone-Supine Study Group

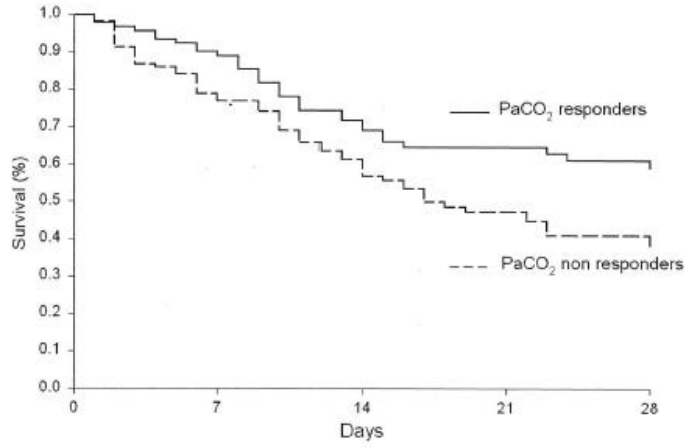
Crit Care Med 2003 Vol. 31, No. 12







AT RISK
ponders: 150 117 73 54 42
responders: 58 44 27 19 15



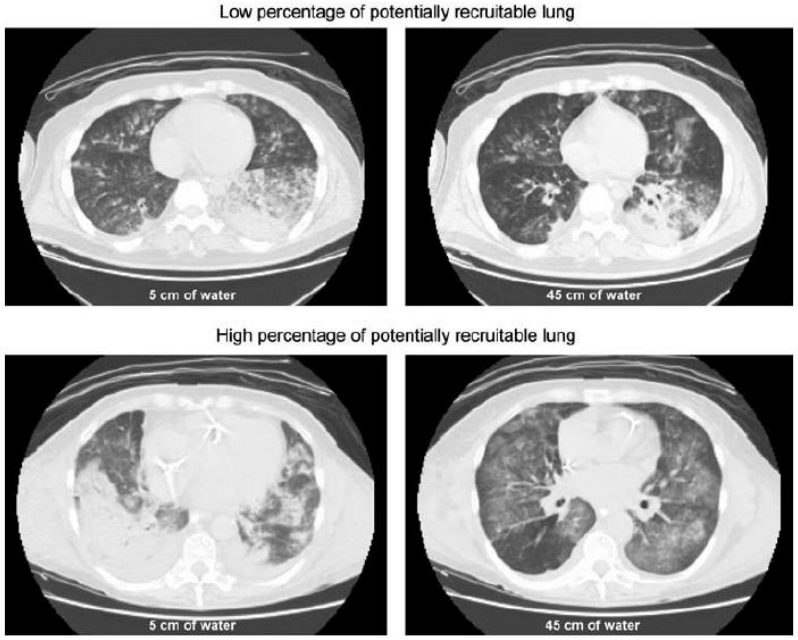
RISK
sponders: 115 81 49 36 25
nders: 93 77 47 37 31

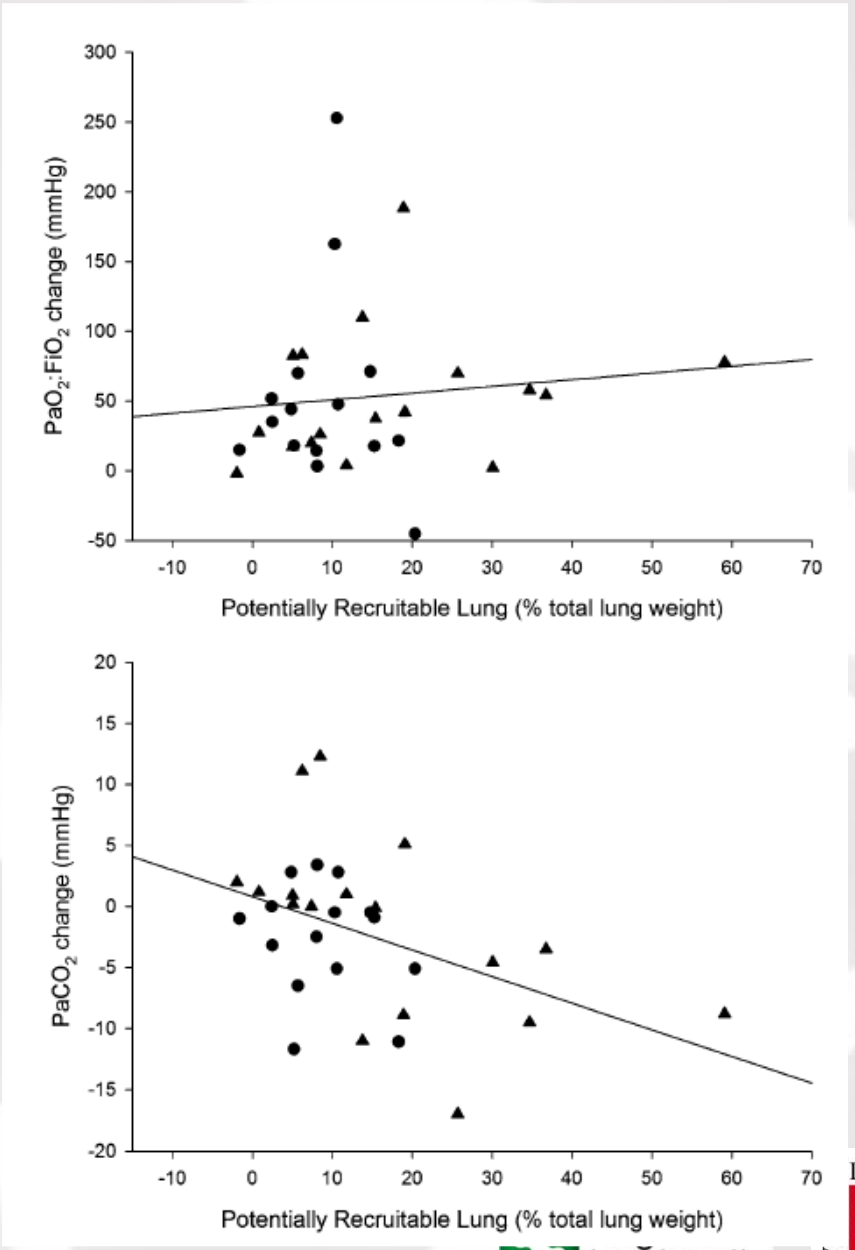
Intensive Care Med (2009) 35:1011–1017
DOI 10.1007/s00134-009-1411-x

ORIGINAL

Alessandro Protti
Davide Chiumello
Massimo Cressoni
Eleonora Carlesso
Cristina Mietto
Virna Berto
Marco Lazzerini
Michael Quintel
Luciano Gattinoni

Relationship between gas exchange response to prone position and lung recruitability during acute respiratory failure





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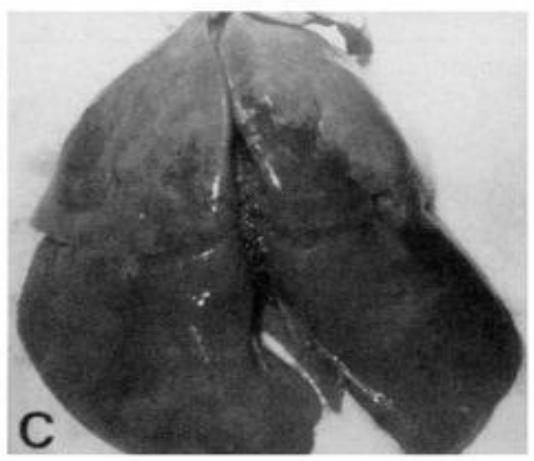
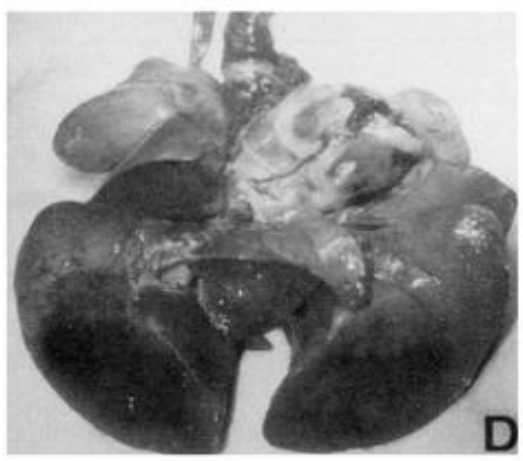
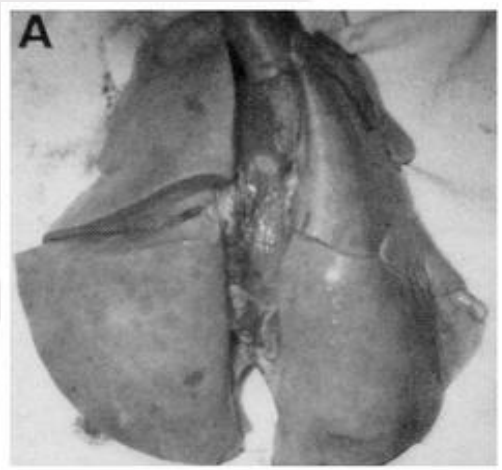
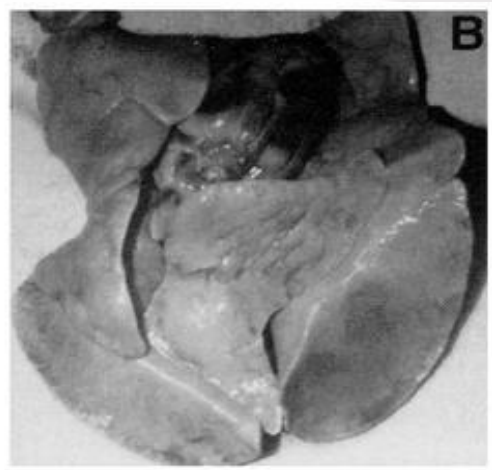
Direct evidence in normal dogs

Normal dogs, V_T = 77 ml/kg, Pplat,L = 35 cm H_2O



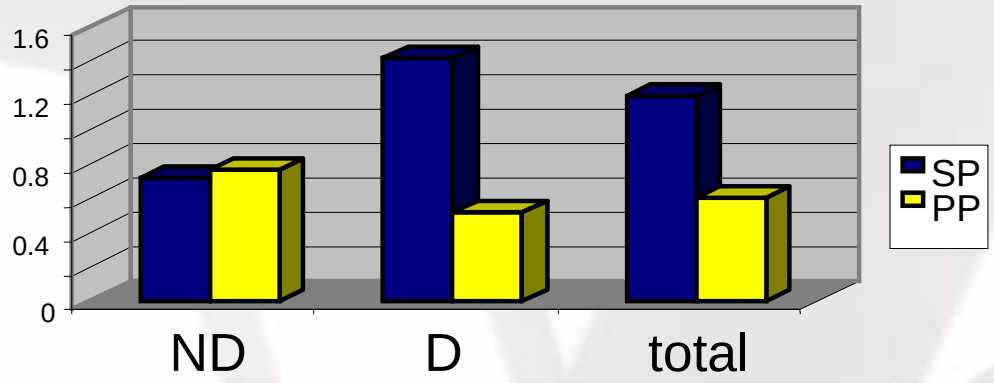






Supine 6 hours

Prone 6 hours



Broccard et al.
CCM 2000

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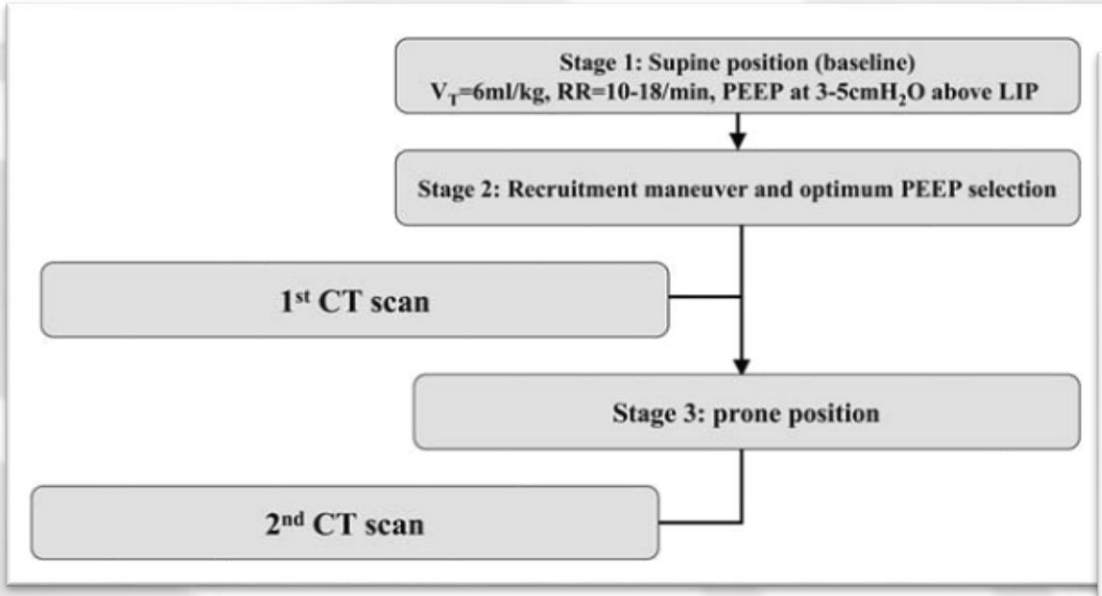
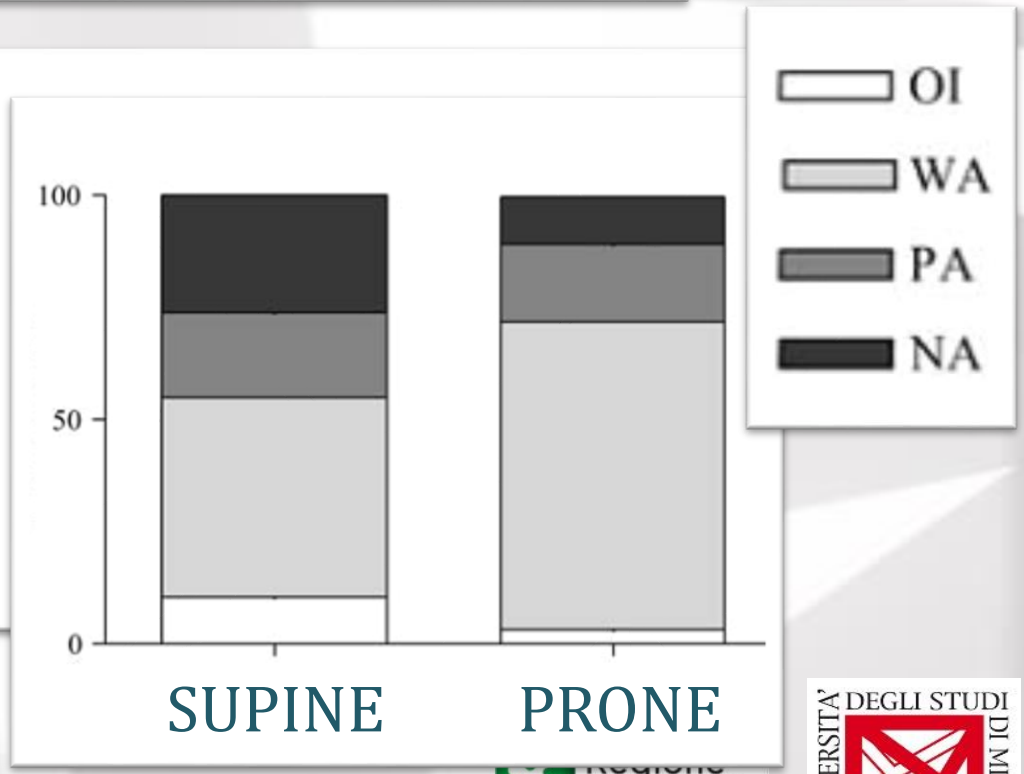
Prone Position Augments Recruitment and Prevents Alveolar Overinflation in Acute Lung Injury

Eftichia Galiatsou, Eleonora Kostanti, Eugenia Svarna, Athanasios Kitsakos, Vasilios Koulouras, Stauros C. Efremidis, and Georgios Nakos

AMERICAN JOURNAL OF RESPIRATORY AND CRITICAL CARE MEDICINE VOL 174 2006





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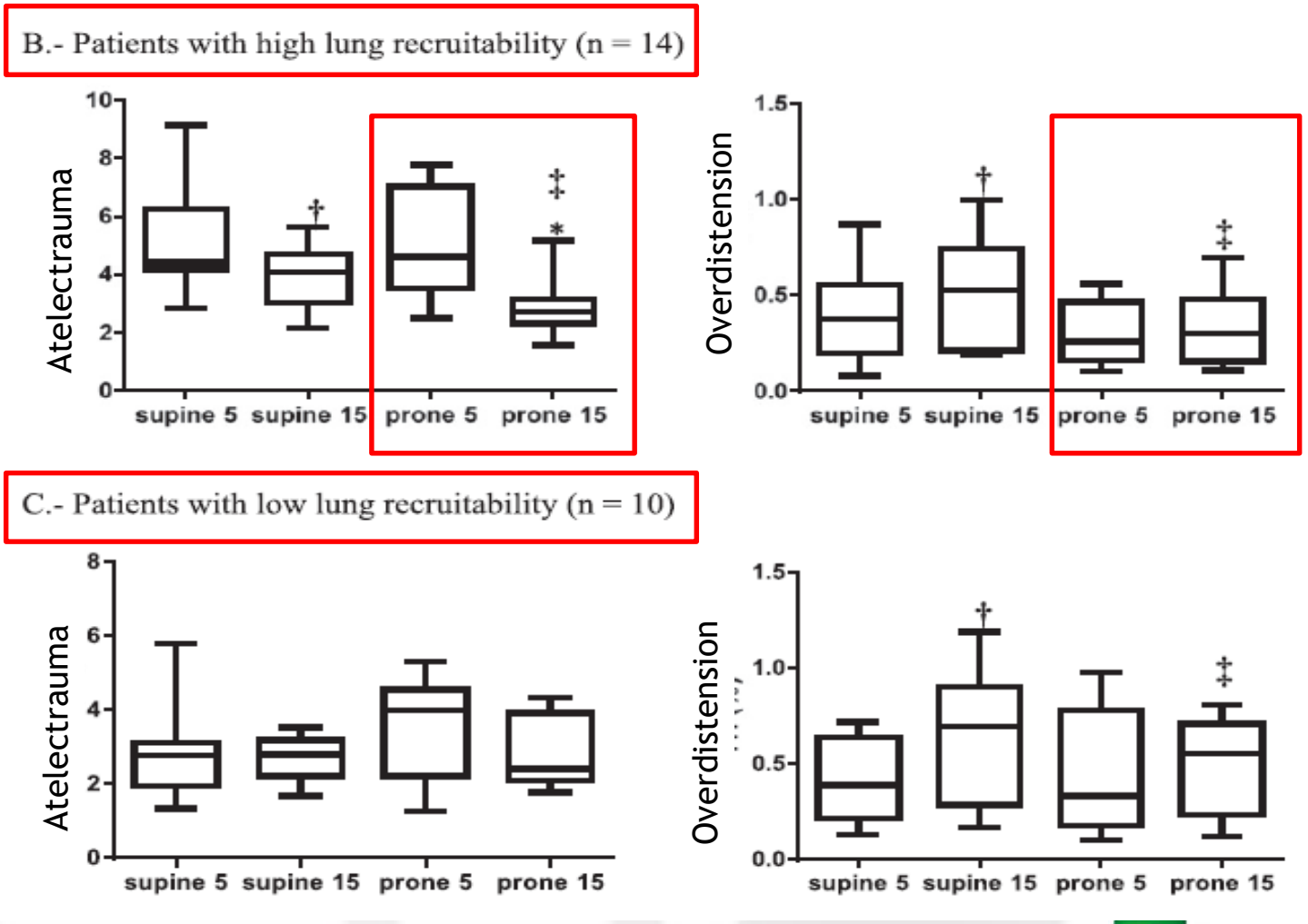
Recruitement/derecruitment
Tidal hyperinflation



Cornejo et al. AJRCCM 2013

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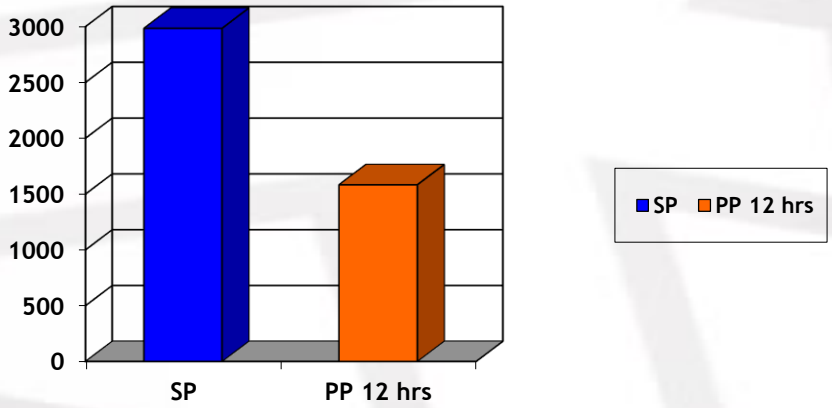
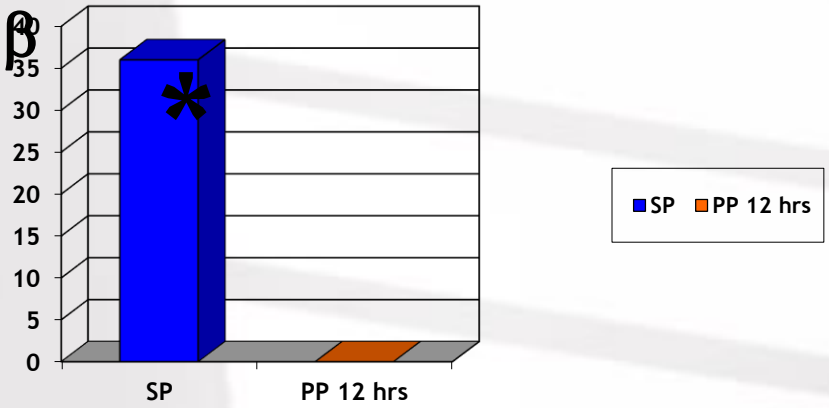
BAL cytokines (pg/ml)

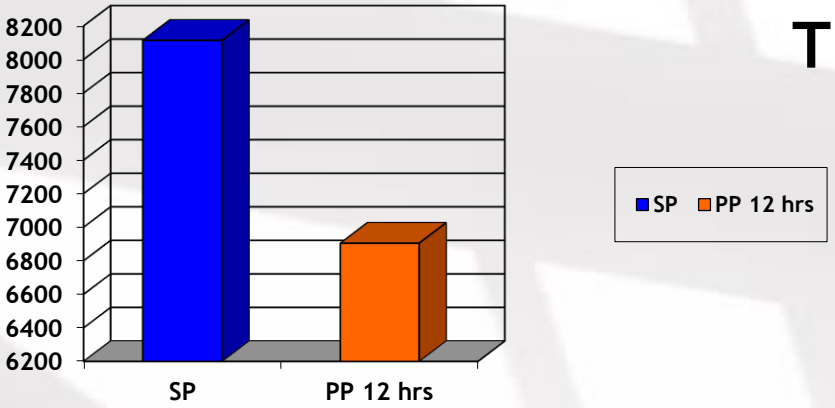
IL-8



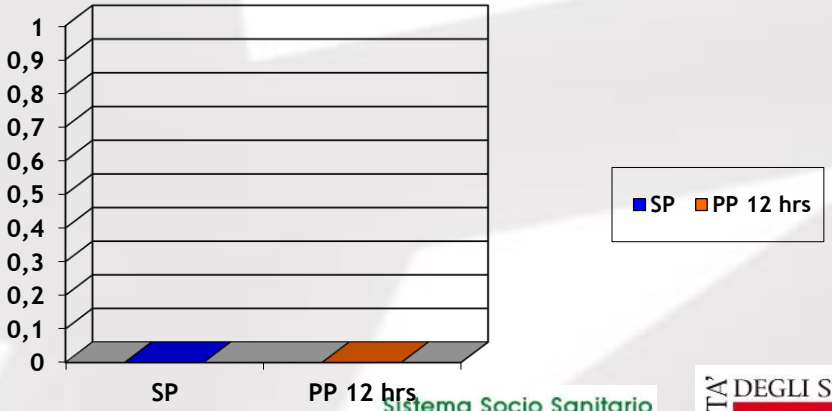
IL-1β



IL-6



TNF-α



Papazian et al. CCM 2005

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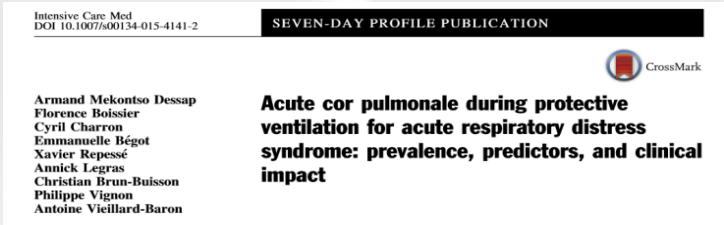
Risk factors of hospital mortality

Variable	Odds ratio (95 % CI)	
	Univariate logistic regression	Multivariable logistic regression[a]
Male gender	1.35 (0.99–1.84), $p = 0.06$	1.46 (1.01–2.11), $p = 0.045$
Age ≥58 years	2.33 (1.73–3.14), $p < 0.01$	2.42 (1.71–3.45), $p < 0.01$
SAPS II ≥56 points	2.79 (2.06–3.76), $p < 0.01$	1.88 (1.32–2.69), $p < 0.01$
Respiratory settings on TEE day		
Respiratory rate ≥30 cycles/min	2.06 (1.41–3.02), $p < 0.01$	3.29 (2.07–5.22), $p < 0.01$
PEEP ≥12 cmH_2O	0.64 (0.45–0.91), $p = 0.01$	I/NR
Plateau pressure ≥25 cmH_2O	1.40 (1.04–1.89), $p = 0.03$	I/NR
Compliance <35 ml/cmH_2O	1.46 (1.07–2.00), $p = 0.02$	I/NR
Driving pressure ≥15 cmH_2O	1.90 (1.40–2.58), $p < 0.01$	2.26 (1.58–3.23), $p < 0.01$
PaO_2/FiO_2 ratio <100 mmHg on TEE day	1.45 (1.09–1.95), $p = 0.01$	1.45 (1.02–2.08), $p = 0.04$
Severe cor pulmonale	1.89 (1.08–3.30), $p = 0.03$	2.00 (1.03–3.88), $p = 0.04$
Shock on TEE day	3.25 (2.32–4.56), $p < 0.01$	2.57 (1.73–3.80), $p < 0.01$
Prone position during ARDS	0.72 (0.52–0.99), $p = 0.045$	0.56 (0.37–0.84), $p < 0.01$


Intensive Care Med
DOI 10.1007/s00134-015-4141-2

SEVEN-DAY PROFILE PUBLICATION

Armand Mekontso Dessap
Florence Boissier
Cyril Charron
Emmanuelle Bégot
Xavier Repessé
Annick Legras
Christian Brun-Buisson
Philippe Vignon
Antoine Vieillard-Baron

Acute cor pulmonale during protective ventilation for acute respiratory distress syndrome: prevalence, predictors, and clinical impact

752 ARDS patients
11 ICUs in France
502 in derivation and
250 in validation cohorts

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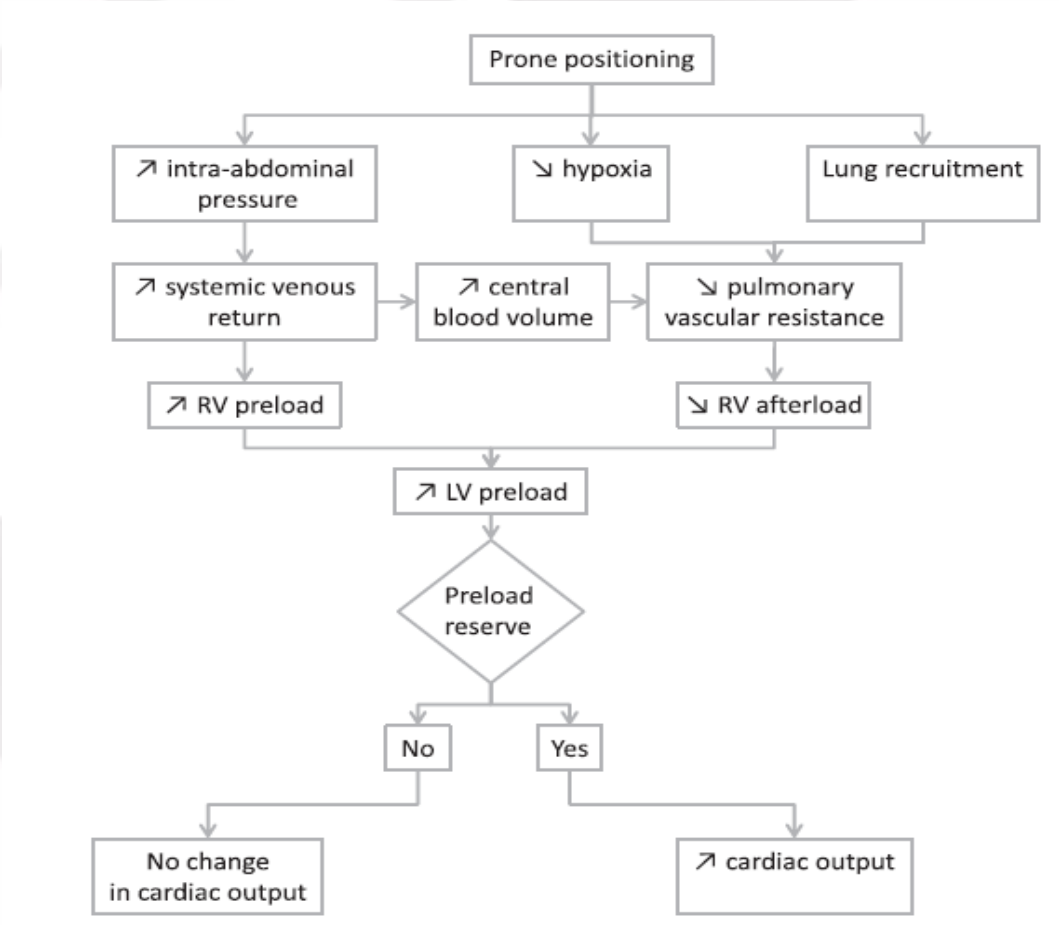
Preload dependence and cardiac index in prone position Hypothesis tested



Joswiak AJRCCM 2014

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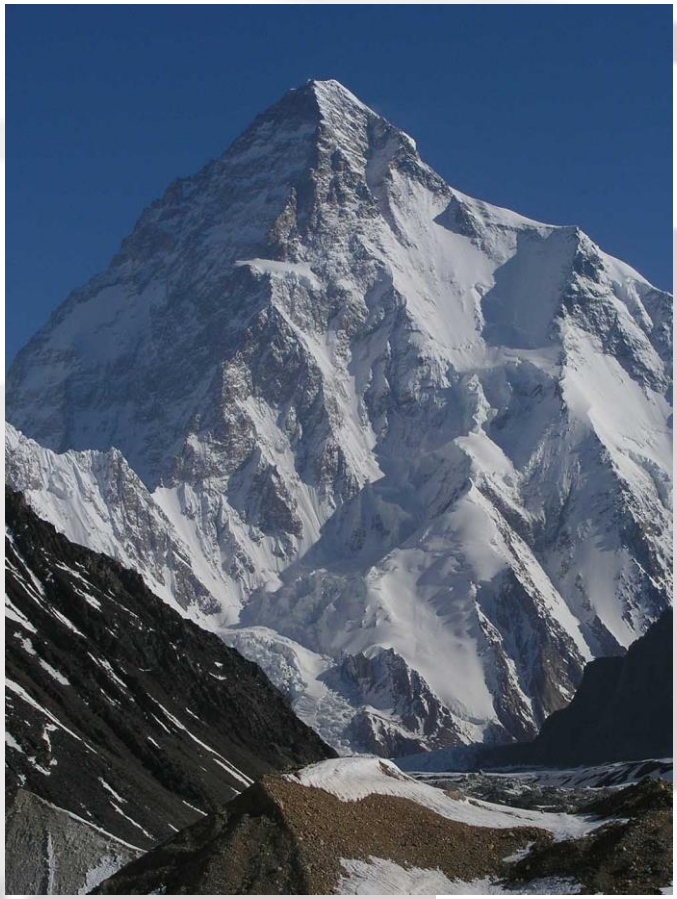


The New England Journal of Medicine

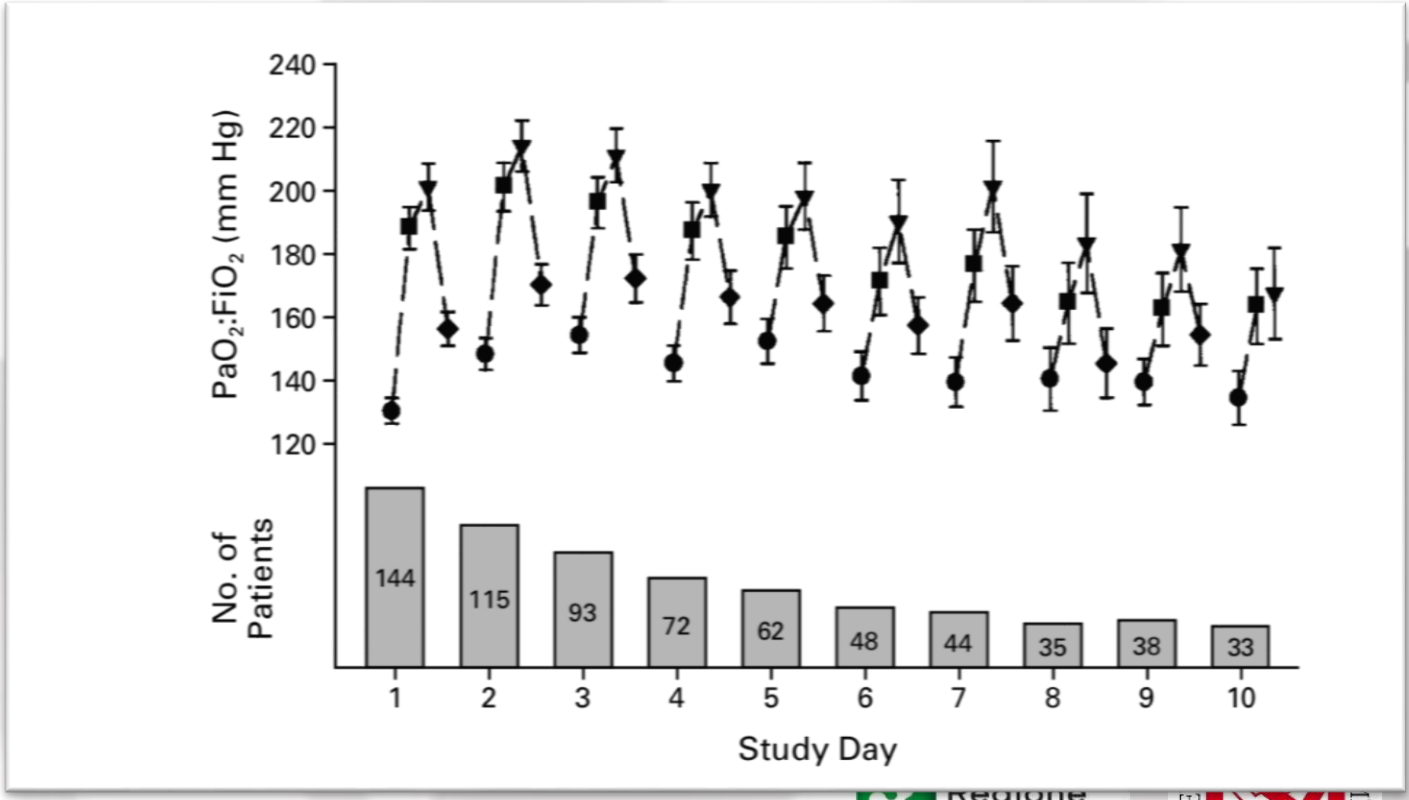
EFFECT OF PRONE POSITIONING ON THE SURVIVAL OF PATIENTS WITH ACUTE RESPIRATORY FAILURE

LUCIANO GATTINONI, M.D., GIANNI TOGNONI, M.D., ANTONIO PESENTI, M.D., PAOLO TACCONE, M.D., DANIELE MASCHERONI, M.D., VIOLETA LABARTA, M.S., ROBERTO MALACRIDA, M.D., PAOLA DI GIULIO, R.N., M.S.C., ROBERTO FUMAGALLI, M.D., PAOLO PELOSI, M.D., LUCA BRAZZI, M.D., AND ROBERTO LATINI, M.D., FOR THE PRONE–SUPINE STUDY GROUP*

Prono- supino I (2001)

Limiti

- Durata pronazione >> 7.0±1.8 h
- P/F fino a 300
- Ventilazione non standard (enroll. 1996-1999 preARDSnet trial)



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The New England Journal of Medicine

EFFECT OF PRONE POSITIONING ON THE SURVIVAL OF PATIENTS WITH ACUTE RESPIRATORY FAILURE

Luciano Gattinoni, M.D., Gianni Tognoni, M.D., Antonio Pesenti, M.D., Paolo Taccone, M.D., Daniele Mascheroni, M.D., Violeta Labarta, M.S., Roberto Malacrida, M.D., Paola Di Giulio, R.N., M.S.C., Roberto Fumagalli, M.D., Paolo Pelosi, M.D., Luca Brazzi, M.D., and Roberto Latini, M.D., for the Prone–Supine Study Group*

N Engl J Med, Vol. 345, No. 8 · August 23, 2001

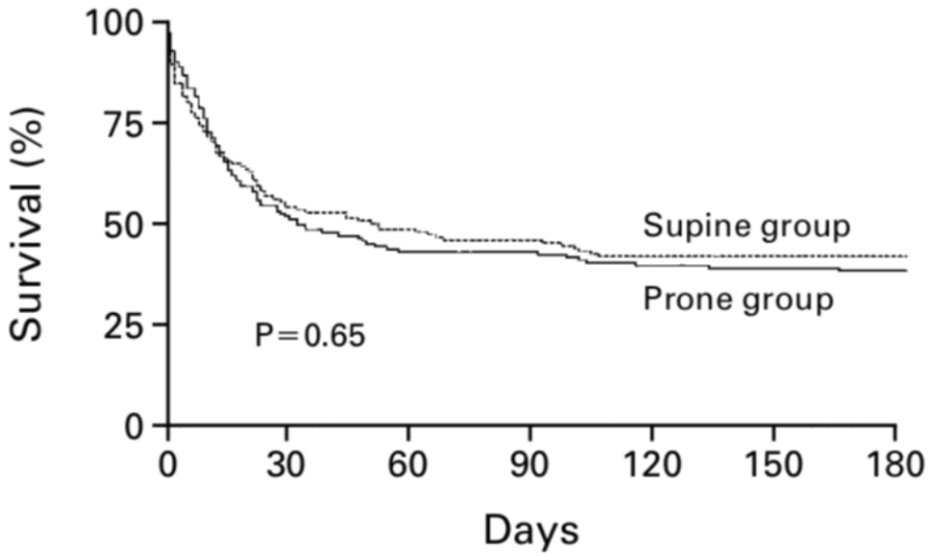
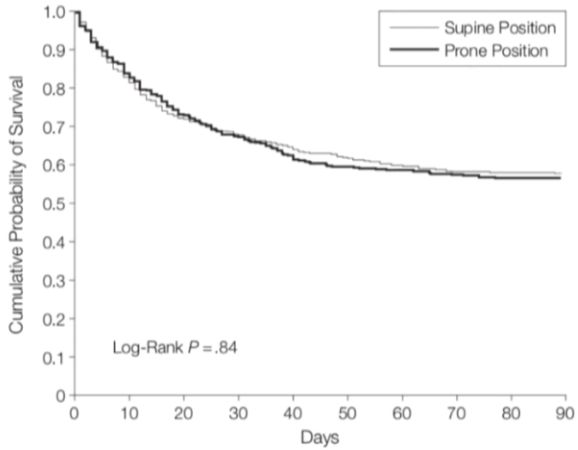


Figure 2. Cumulative Probability of Patient Survival After Randomization



Effects of Systematic Prone Positioning in Hypoxemic Acute Respiratory Failure: A Randomized Controlled Trial

Claude Guerin; Sandrine Gaillard; Stephane Lemasson; et al.

JAMA. 2004;292(19):2379-2387 (doi:10.1001/jama.292.19.2379)

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JAMA®

Online article and related content current as of November 13, 2009.

Effects of Systematic Prone Positioning in Hypoxemic Acute Respiratory Failure: A Randomized Controlled Trial

Claude Guerin; Sandrine Gaillard; Stephane Lemasson; et al.

JAMA. 2004;292(19):2379-2387 (doi:10.1001/jama.292.19.2379)

Patients

Patients were considered eligible if they met all the following criteria: mechanical ventilation through either oral or nasal tracheal intubation or tracheostomy; a PaO_2/FIO_2 of 300 or less; at least 18 years;

Guerin (2004)

Prone Position

Patients were in the prone position for a median of 4.0 (interquartile range, 2.0-6.0) days. During the first week after randomization, the median amount of time patients were in the prone position was 8.0 (interquartile range, 7.7-9.8) hours per day and 0.0 hours per day for the 81 patients who had crossed over to the prone group ($P<.001$).

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A Multicenter Trial of Prolonged Prone Ventilation in Severe Acute Respiratory Distress Syndrome

Jordi Mancebo, Rafael Fernández, Lluis Blanch, Gemma Rialp, Federico Gordo, Miquel Ferrer, Fernando Rodríguez, Pau Garro, Pilar Ricart, Immaculada Vallverdú, Ignasi Gich, José Castaño, Pilar Saura, Guillermo Domínguez, Alfons Bonet, and Richard K. Albert

Am J Respir Crit Care Med Vol 173. pp 1233–1239, 2006

Mancebo (2006)

Methods: We enrolled 136 patients within 48 h of tracheal intubation for severe ARDS, 60 randomized to supine and 76 to prone ventilation. Guidelines were established for ventilator settings and weaning. The prone group was targeted to receive continuous prone ventilation treatment for 20 h/d.

mortality. A total of 718 turning procedures were done, and prone position was applied for a mean of 17 h/d for a mean of 10 d.

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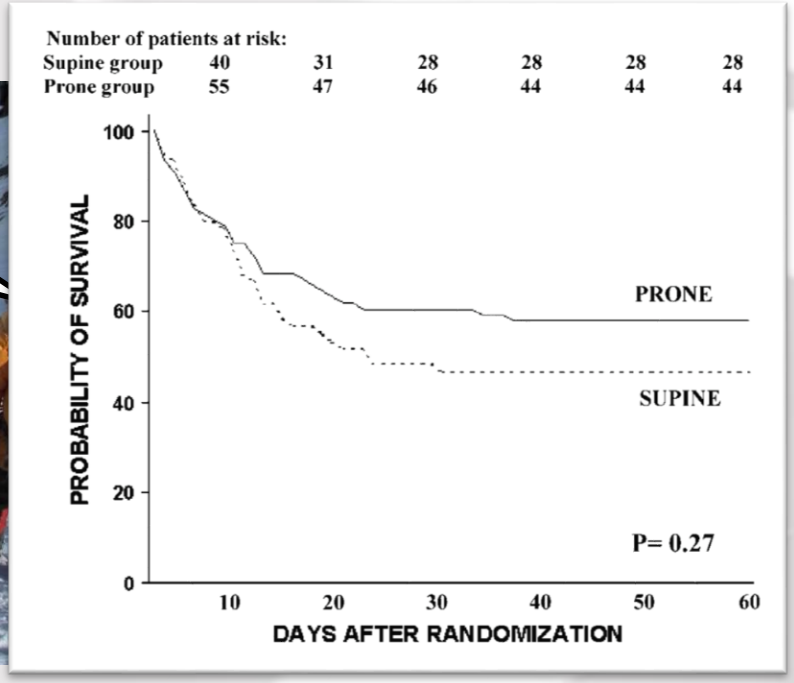
A Multicenter Trial of Prolonged Prone Ventilation in Severe Acute Respiratory Distress Syndrome

Jordi Mancebo, Rafael Fernández, Lluis Blanch, Gemma Rialp, Federico Gordo, Miquel Ferrer, Fernando Rodríguez, Pau Garro, Pilar Ricart, Immaculada Vallverdú, Ignasi Gich, José Castaño, Pilar Saura, Guillermo Domínguez, Alfons Bonet, and Richard K. Albert

Mancebo (2006)



RESULTS

Because of a marked decrease in the number of patients enrolled in the last year, the study was aborted after 142 participants had been randomized (62 supine and 80 prone). Of these, 136 (60

JAMA®

Online article and related content current as of November 13, 2009.

Prone Positioning in Patients With Moderate and Severe Acute Respiratory Distress Syndrome: A Randomized Controlled Trial

Paolo Taccone; Antonio Pesenti; Roberto Latini; et al.

JAMA. 2009;302(18):1977-1984 (doi:10.1001/jama.2009.1614)

Patients were 342 adults with ARDS receiving mechanical ventilation, enrolled from February 2004 through June 2008 and prospectively stratified into subgroups with moderate (n=192) and severe (n=150) hypoxemia.

Prone Positioning

Patients enrolled in the prone group were ventilated in the prone position for 1397 of 2760 patient-days (51.0%). Each patient underwent a mean of 8.4 (SD, 6.3) pronation sessions, which lasted for 18 (SD, 4) hours per day. The

Prono-supino II (2009)

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Online article and related content current as of November 13, 2009.

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Paolo Taccone; Antonio Pesenti; Roberto Latini; et al.

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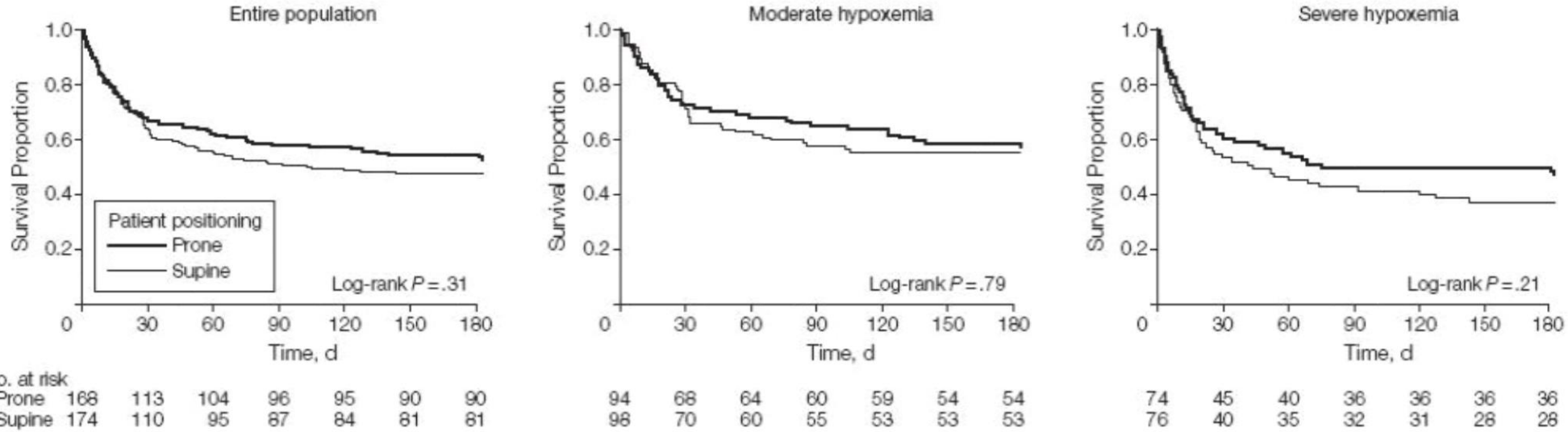
Prono-supino II (2009)

Figure 2. Kaplan-Meier Survival Curves of the Prone-Supine II Study Population: Entire Population and Patients With Moderate and Severe Hypoxemia



Time indicates days since randomization.

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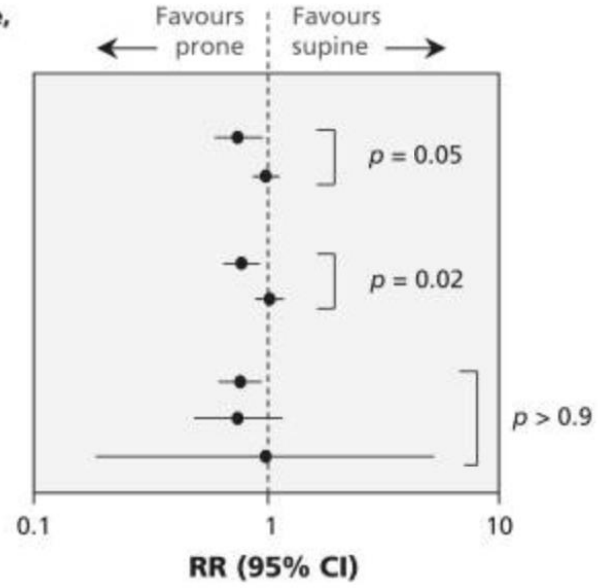
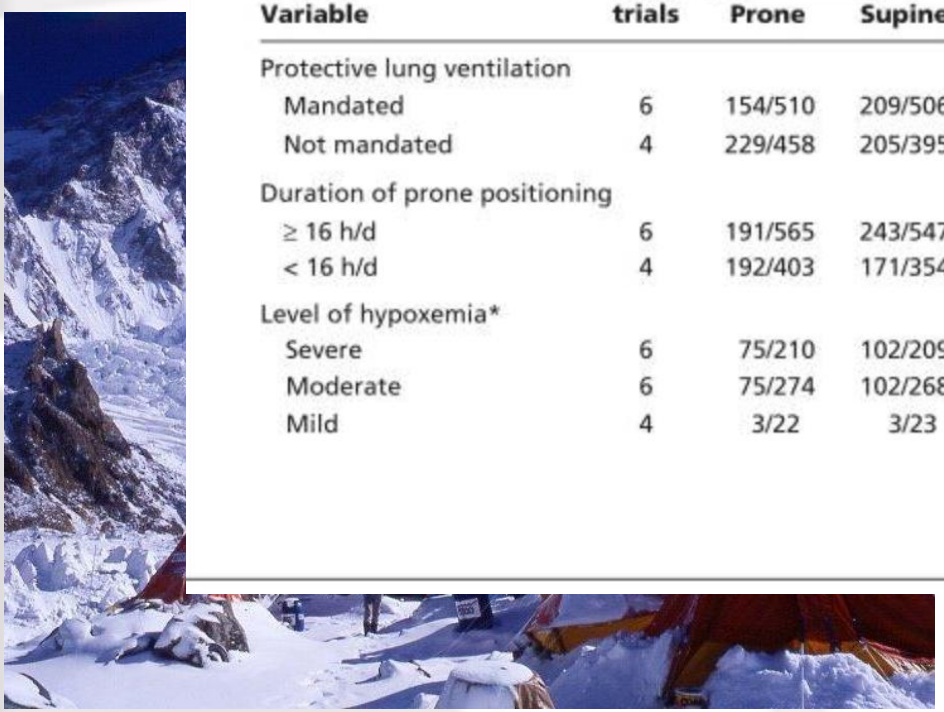
CMAJ RESEARCH

Effect of prone positioning during mechanical ventilation on mortality among patients with acute respiratory distress syndrome: a systematic review and meta-analysis

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

Variable	No. of trials	Deaths, *n/N* Prone	Deaths, *n/N* Supine	RR (95% CI)	I^2 value, %
Protective lung ventilation					
Mandated	6	154/510	209/506	0.74 (CI 0.59–0.95)	29
Not mandated	4	229/458	205/395	0.98 (CI 0.86–1.12)	0
Duration of prone positioning					
≥ 16 h/d	6	191/565	243/547	0.77(CI 0.64–0.92)	21
< 16 h/d	4	192/403	171/354	1.02 (CI 0.88–1.17)	0
Level of hypoxemia*					
Severe	6	75/210	102/209	0.76 (CI 0.61–0.94)	0
Moderate	6	75/274	102/268	0.74 (CI 0.48–1.16)	42
Mild	4	3/22	3/23	0.98 (CI 0.18–5.24)	0





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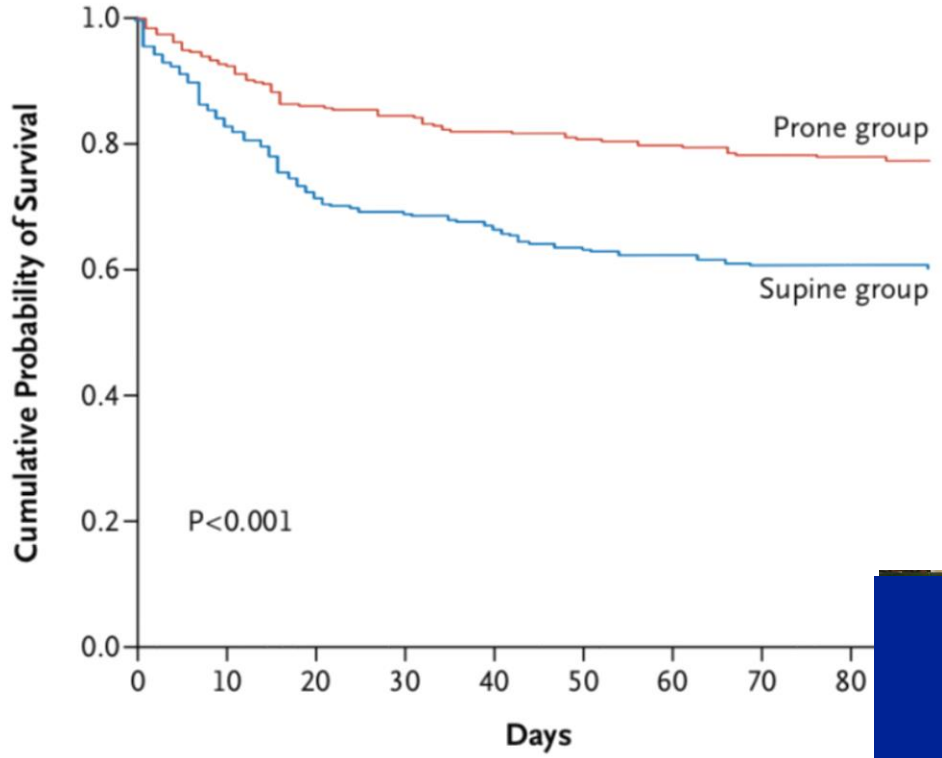


No. at Risk

Prone group	237	202	191	186	182
Supine group	229	163	150	139	136

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

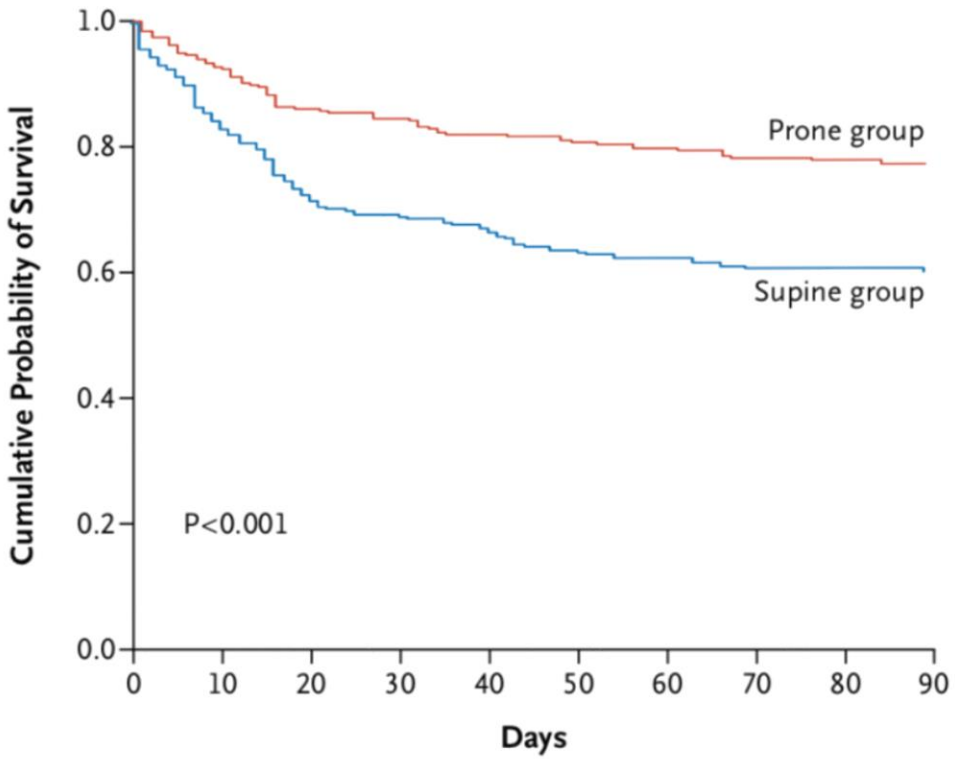
N Engl J Med 2013;368:2159-68.
DOI: 10.1056/NEJMoa1214103

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.,



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- Average baseline PaO_2/FiO_2 100mmHg
- Cicli pronazione 17±3 h
- 6ml/kg, Pplat <30cmH2O

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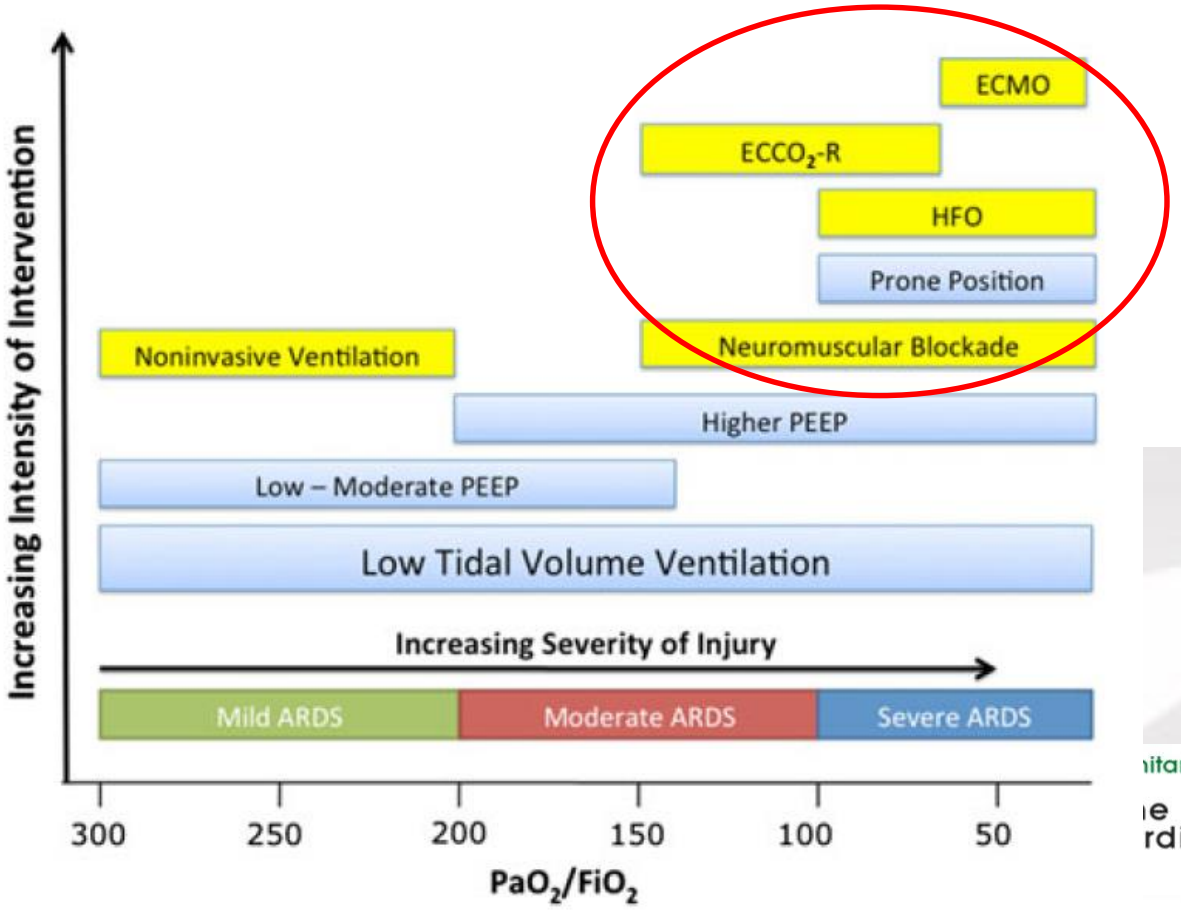
Intensive Care Med (2012) 38:1573–1582
DOI 10.1007/s00134-012-2682-1

SPECIAL ARTICLE

Niall D. Ferguson
Eddy Fan
Luigi Camporota
Massimo Antonelli
Antonio Anzueto
Richard Beale
Laurent Brochard
Roy Brower
Andrés Esteban
Luciano Gattinoni
Andrew Rhodes
Arthur S. Slutsky
Jean-Louis Vincent
Gordon D. Rubenfeld
B. Taylor Thompson
V. Marco Ranieri

The Berlin definition of ARDS: an expanded rationale, justification, and supplementary material



Clinical Review & Education

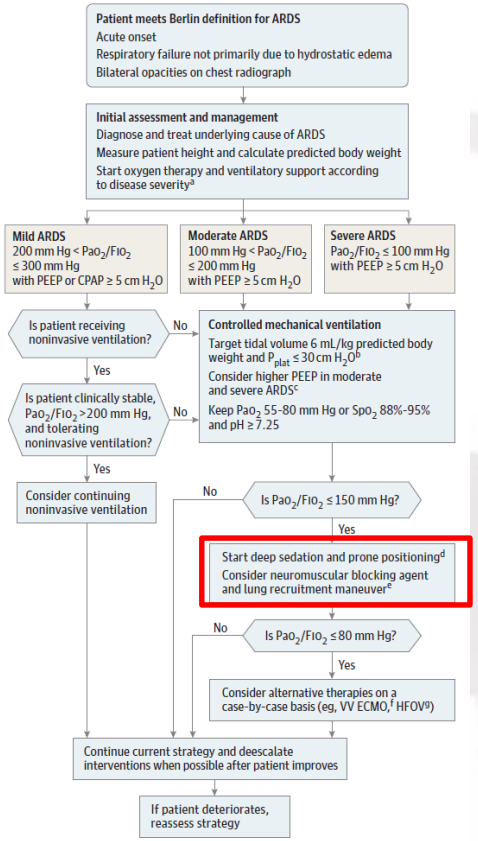
JAMA | Review

Acute Respiratory Distress Syndrome
Advances in Diagnosis and Treatment

Eddy Fan, MD, PhD; Daniel Brodie, MD; Arthur S. Slutsky, MD

JAMA. 2018;319(7):698-710.

Figure 2. A Sample Treatment Algorithm for Patients With ARDS



Start deep sedation and prone positioning[d]
Consider neuromuscular blocking agent
and lung recruitment maneuver[e]

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Outline

- Theoretical aspects
  - Mechanisms of oxygenation improvement
  - VILI prevention
  - Haemodynamic effects
  - Effect on Survival
  - **Real life**
- Pratical aspects

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COMPLICATIONS

A total of 31 cardiac arrests occurred in the supine group, and 16 in the prone group (P=0.02). There were no significant differences between the groups with respect to other adverse effects (Table S6 in the Supplementary Appendix).

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Prone Positioning in Patients With Moderate and Severe Acute Respiratory Distress Syndrome

A Randomized Controlled Trial

Paolo Taccone, MD
Antonio Pesenti, MD
Roberto Latini, MD

Context Post hoc analysis of a previous trial has suggested that prone positioning may improve survival in patients with severe hypoxemia and with acute respiratory distress syndrome (ARDS).

Table 3. Incidence of Complications During the 28-Day Prone-Supine II Study Period

Complication	Patients, %[a] All	Prone	Supine	*P* Value[c]	
	Entire Population				
Need for increased sedation/muscle relaxants	68.1	80.4	56.3	<.001	1
Airway obstruction	42.1	50.6	33.9	.002	
Transient desaturation	57.0	63.7	50.6	.01	1
Vomiting	20.8	29.1	12.6	<.001	
Hypotension, arrhythmias, increased vasopressors	63.2	72.0	54.6	<.001	1
Loss of venous access	9.9	16.1	4.0	<.001	
Displacement of endotracheal tube	7.6	10.7	4.6	.03	
Displacement of thoracotomy tube	2.9	4.2	1.7	.21	

Would you prone a patient with…?

1. Mild ARDS
2. Moderate ARDS
3. Severe ARDS

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Original Investigation | CARING FOR THE CRITICALLY ILL PATIENT

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

	Mild	Moderate	Severe	P value
Continuous NMBA	7.4 %	16.4 %	33.2 %	<0.001
Recruitment maneuvers	9.0 %	16.8 %	29.4 %	<0.001
Prone positioning	0.6 %	3.9 %	13.2 %	<0.001

ORIGINAL

A prospective international observational prevalence study on prone positioning of ARDS patients: the APRONET (ARDS Prone Position Network) study

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	Mild	Moderate	Severe	P value
Prone positioning	5.9 %	10.3 %	32.9 %	<0.001

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ORIGINAL

A prospective international observational prevalence study on prone positioning of ARDS patients: the APRONET (ARDS Prone Position Network) study

C. Guérin[1,2,3,30*], P. Beuret[4], J. M. Constantin[5,6], G. Bellani[7], P. Garcia-Olivares[8], O. Roca[9,10], J. H. Meertens[11], P. Azevedo Maia[12], T. Becher[13], J. Peterson[14,15], A. Larsson[16,17], M. Gurjar[17], Z. Hajjej[18], F. Kovari[19], A. H. Assiri[20], E. Mainas[21], M. S. Hasan[22], D. R. Morocho-Tutillo[23], L. Baboi[1], J. M. Chrétien[24], G. François[25], L. Ayzac[26], L. Chen[27], L. Brochard[27] and A. Mercat[28,29] for the investigators of the APRONET Study Group, the REVA Network, the Réseau recherche de la Société Française d'Anesthésie-Réanimation (SFAR-recherche) and the ESICM Trials Group

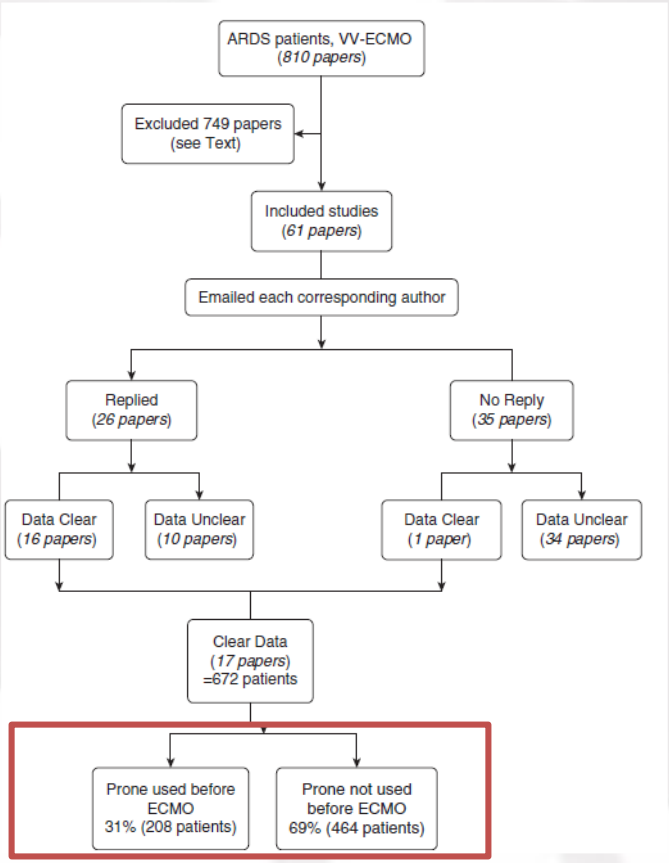
Table 3 Results of the multivariate logistic regression analysis on the risk factors for not proning ARDS patients

	Odds ratio (95% confidence intervals)	*P* value
Diabetes (reference absent)	0.68 (0.40–1.17)	0.16
Immunodeficiency (reference absent)	1.28 (0.71–2.28)	0.41
SAPS II (per point score)	1.04 (1.03–1.05)	0.0001
Pneumonia (reference absent)	0.74 (0.46–1.19)	0.21
$PaO_2/F_IO_2 < 150$ vs. ≥ 150 mmHg	0.34 (0.19–0.61)	0.0001
$F_IO_2 < 60$ vs. $\geq 60\%$	0.64 (0.37–1.13)	0.13
$V_T < 6$ vs. ≥ 6 ml/kg pbw	0.56 (0.35–0.89)	0.015
PEEP > 10 vs. ≤ 10 cmH_2O	0.38 (0.23–0.64)	0.0001
Plateau pressure (per each cmH_2O increase)	1.07 (1.04–1.11)	0.0001

Unproven and Expensive before Proven and Cheap: Extracorporeal Membrane Oxygenation versus Prone Position in Acute Respiratory Distress Syndrome

Xuehan Li[1,2,3], Damon C. Scales[3,4], and Brian P. Kavanagh[1,3]

Am J Resp Crit Care Med, 2018



Dr. Brian P Kavanagh (1962-2019)

Caso Clinico

A.G.M.J.

- 38 aa, donna
- Grave obesità (160cm, 140kg, BMI 55)
- Non altre comorbidità

Conduce una vita normale, lavora, madre di due figli

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In PS Castellanza il 6/2/2018 per tosse e dispnea

7/2 IOT dopo trial di NIV fallito, L'8/2 chiamato ECMO team per ipossia ed ipercapnia

Al ns arrivo:

Ventilazione: 500x18, PEEP 18, Plat 41

>> Cpl,rs 23, Driving P 23

Con fio2 100% pO2 50, pCO2 81, pH 7.27

> Connessa ad ECMO-vv, trasporto c/o HSG

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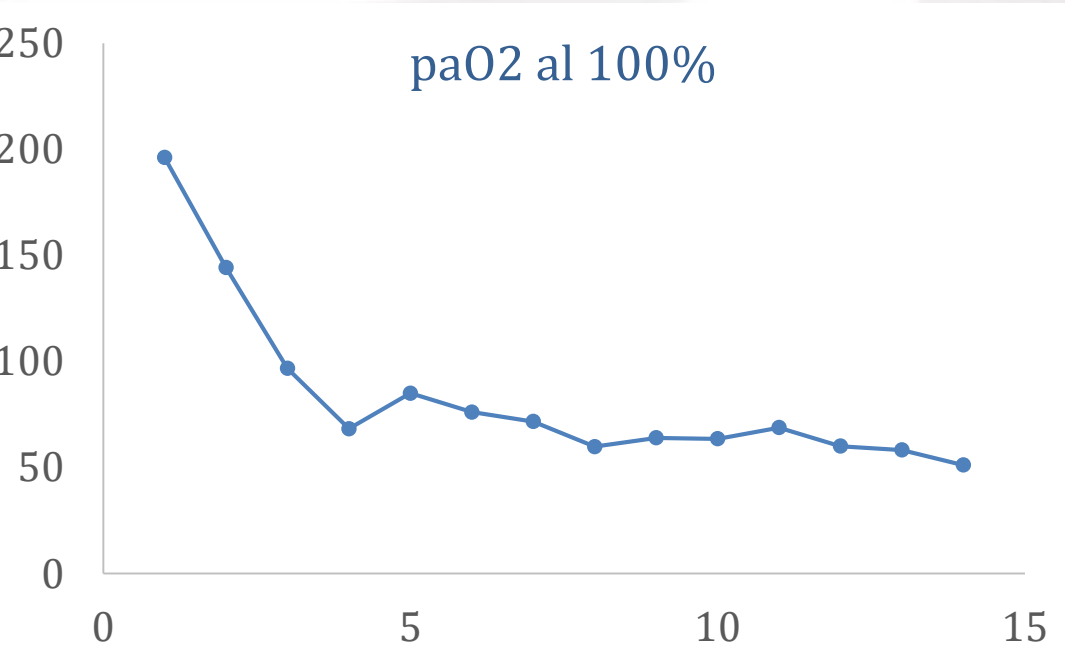
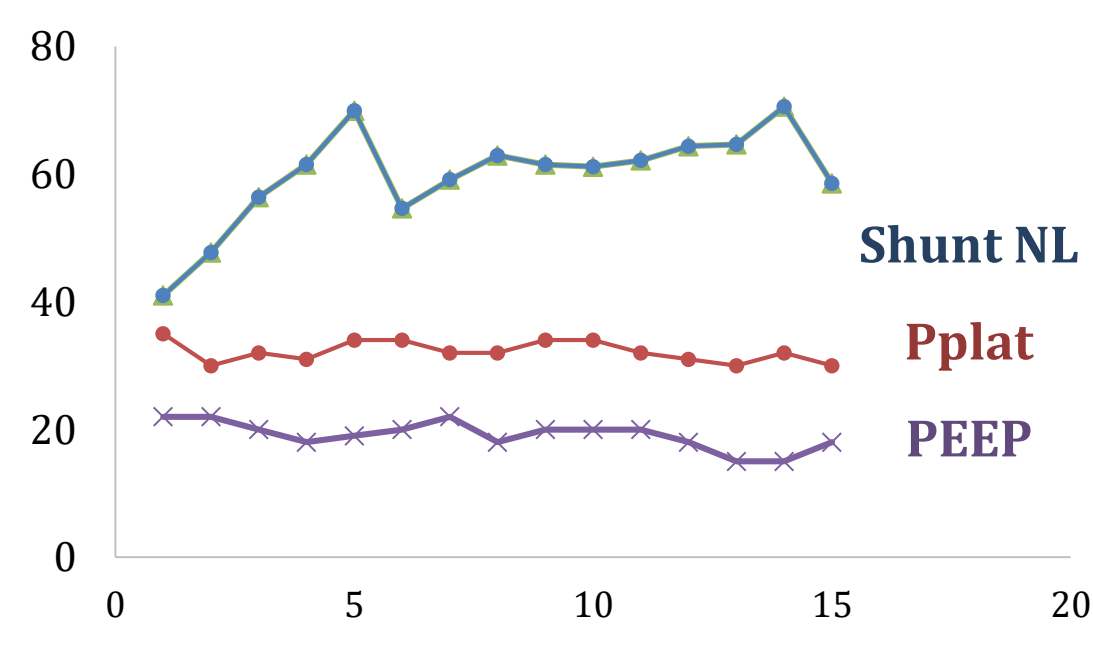
Prime 2 settimane di ricovero





Pes 17 cmH2O, El,l/El,rs 0.8

Non risposta a reclutamento / peep

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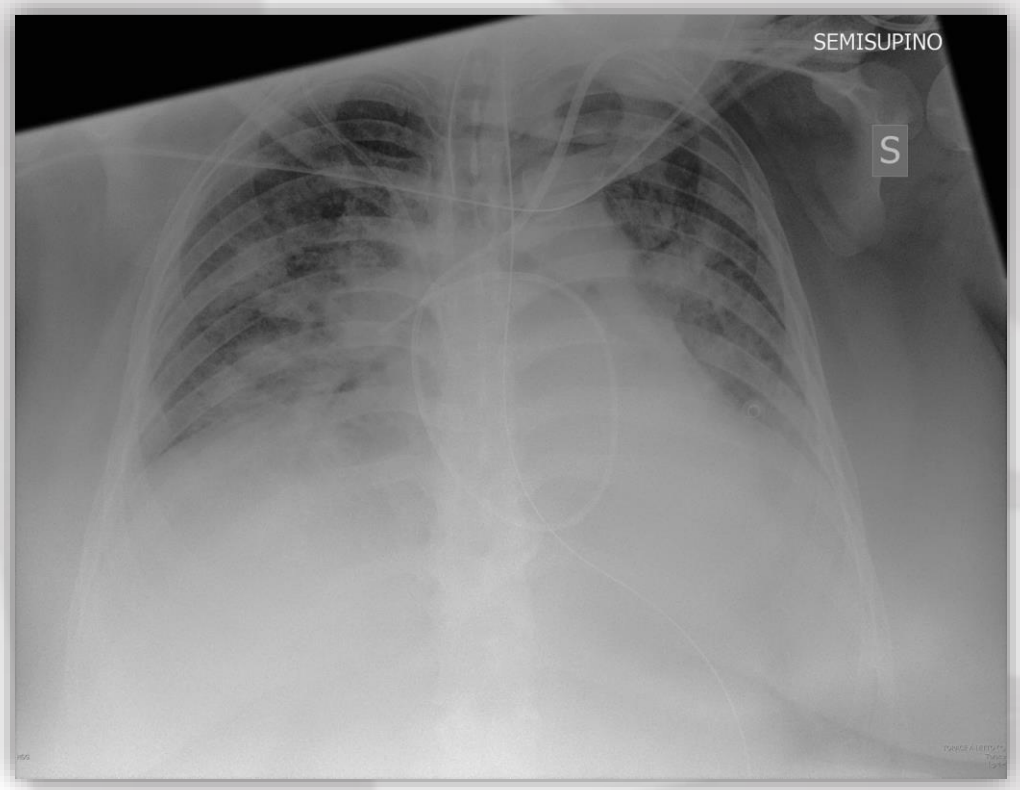
24/2

17° giornata di ECMO



BF 4.7L/min Fio2 100%, Pin -90

190ml x10/min, PEEP 18, Pplat 30, **Cpl,rs 16**

pO2 51, Shunt NL 70%, CO 12L/min, **VO2 tot 430**

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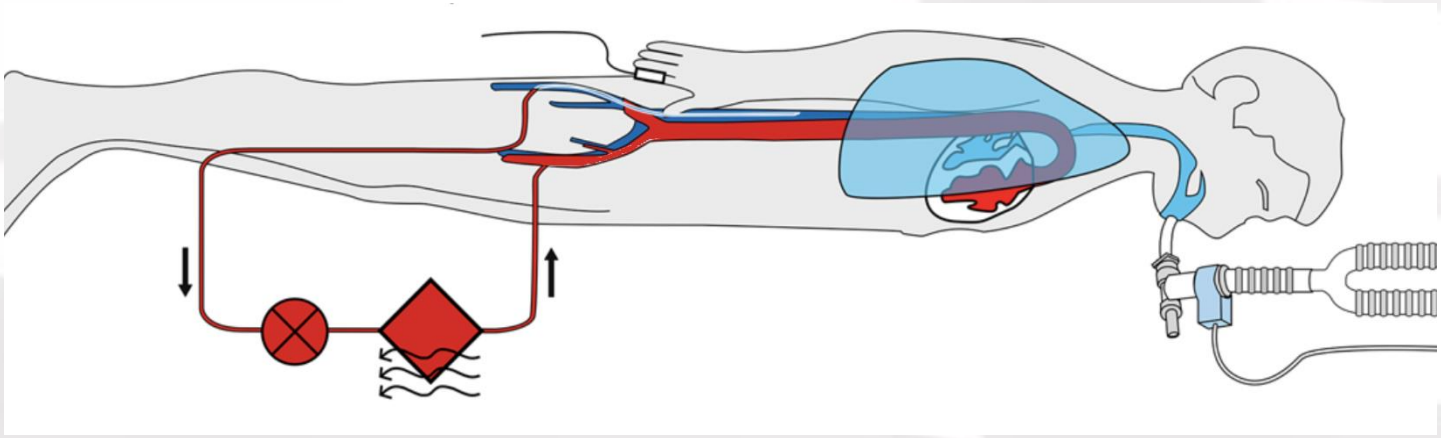

?

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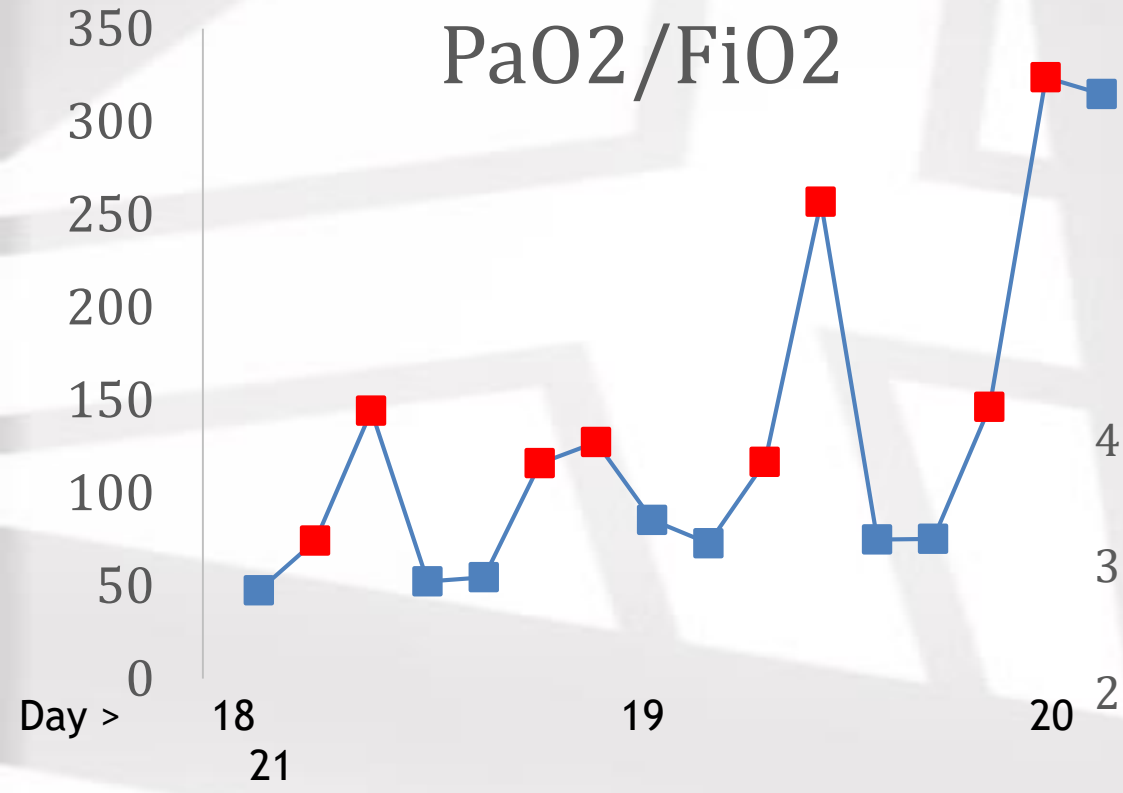
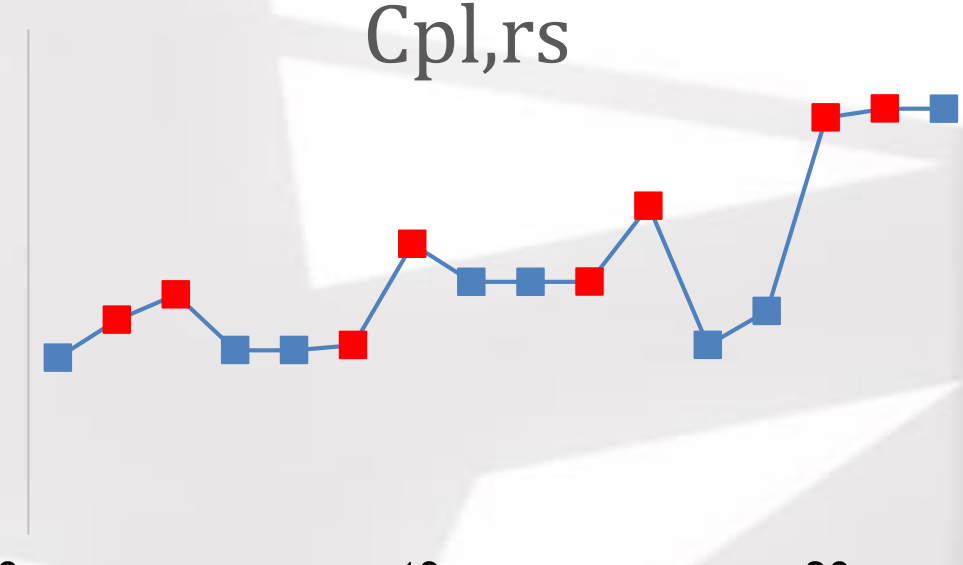
18° giornata di ECMO

Inizio pronazioni





- Posiz. **SUPINA**
- Posiz. **PRONA**

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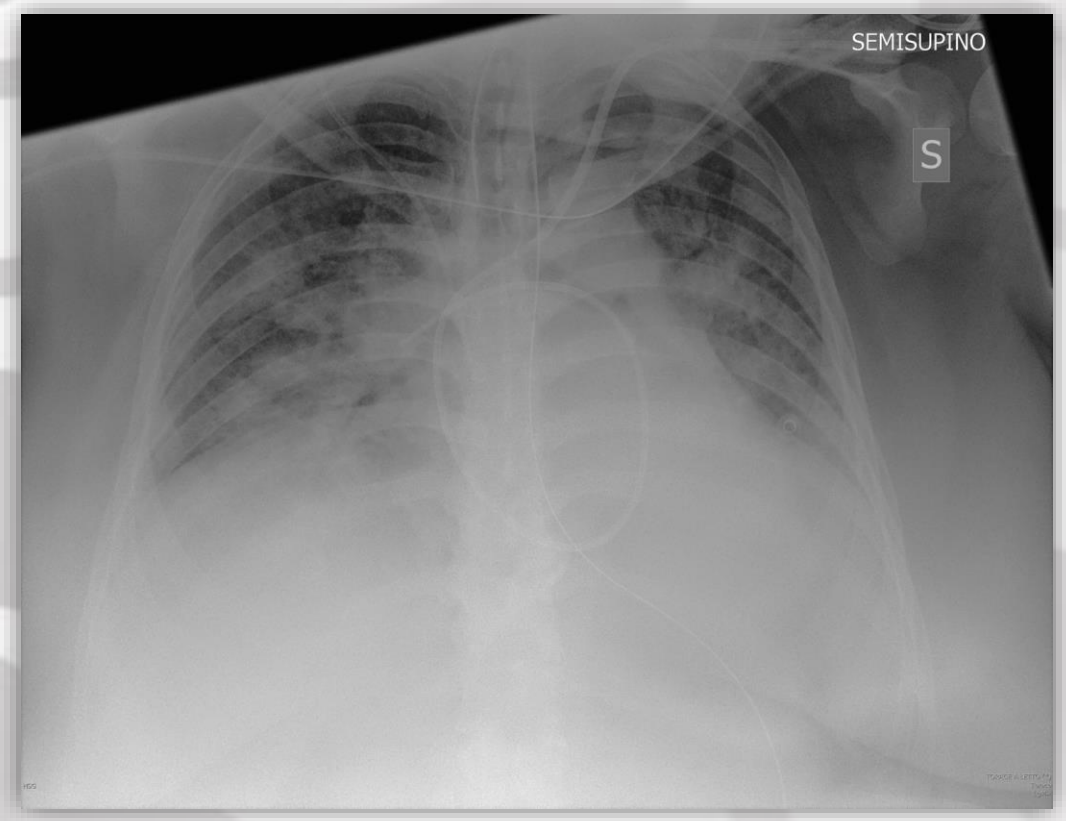
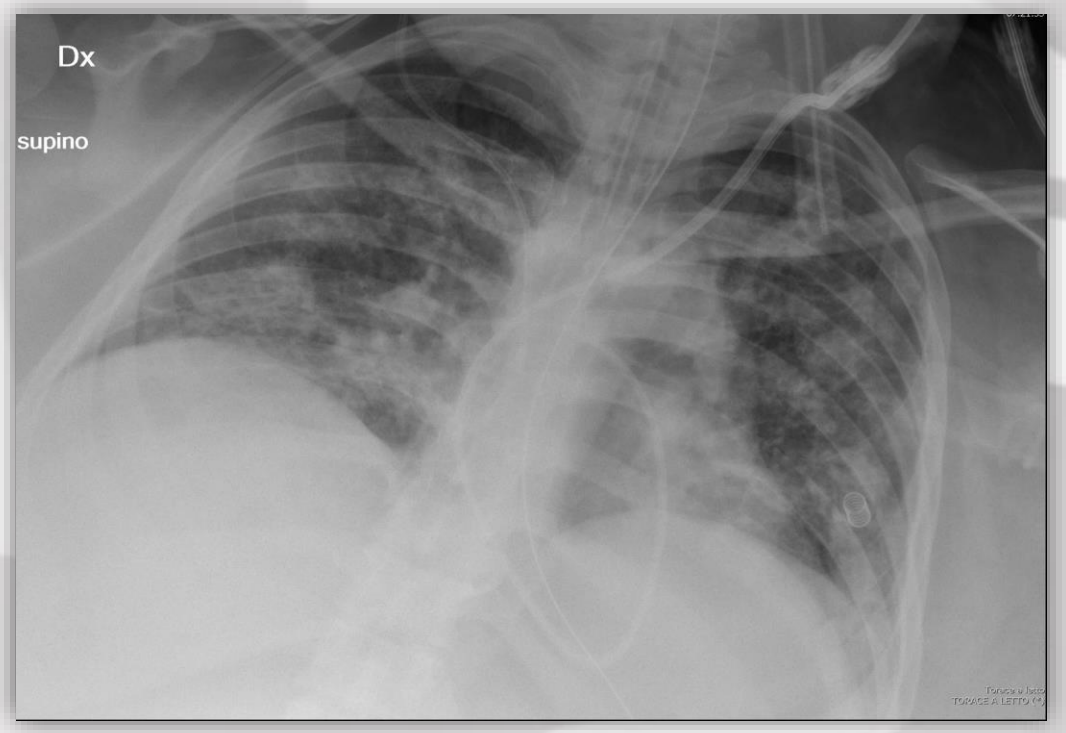
24/2



29/2



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Journal of Critical Care 30 (2015) 1390–1394

Contents lists available at ScienceDirect

Journal of Critical Care

journal homepage: www.jccjournal.org

Prone positioning improves oxygenation in spontaneously breathing nonintubated patients with hypoxemic acute respiratory failure: A retrospective study☆,☆☆,★

Vittorio Scaravilli [a,*], Giacomo Grasselli [b], Luigi Castagna [a], Alberto Zanella [a], Stefano Isgrò [b], Alberto Lucchini [b], Nicolò Patroniti [a,b], Giacomo Bellani [a,b], Antonio Pesenti [a,b]

[a] Dipartimento di Scienze della Salute, Università degli Studi di Milano Bicocca, Via Cadore 48, 20900, Monza, MB, Italy
[b] Dipartimento di Emergenza e Urgenza, Ospedale San Gerardo, Via Pergolesi 33, 20900, Monza, MB, Italy

	All procedures (n = 43)		
	PRE	PRONE	POST
Oxygen mask	24	16	23
High flow nasal cannula	1	2	1
Helmet CPAP	11	12	10
Mask NIV	7	13	9
F_{IO_2} (%)	74 ± 18	70 ± 22	69 ± 20
PEEP (cmH_2O)	0 (0-9)	9 (0-9)	4 (0-10)

Variable	PRE	PRONE	POST	*P*
Procedures without changes in respiratory device, PEEP, and F_{IO_2} (n = 18)				
pH	7.42 ± 0.04	7.42 ± 0.03	7.42 ± 0.03	.50
$Paco_2$(mmHg)	47.8 ± 10.9	46.8 ± 9.8	47.1 ± 9.6	.42
HCO_3^- (mmol/L)	30.0 ± 5.7	30.0 ± 6.1	29.2 ± 4.2	.84
Pao_2 (mmHg)	88 ± 26	131 ± 60*†	91 ± 23	<.001
HbO_2 (%)	95.1 ± 1.9	96.7 ± 1.5*	95.5 ± 253	.01
Base excess (mmol/L)	4.8 ± 4.9	4.9 ± 5.2	4.1 ± 3.7	.68
Procedures during non-invasive positive pressure ventilation (n = 10)				
pH	7.43 ± 0.04	7.43 ± 0.03	7.43 ± 0.03	.85
$Paco_2$(mmHg)	44.8 ± 5.8	43.8 ± 4.8	44.0 ± 4.3	.54
HCO_3^- (mmol/L)	29.0 ± 4.2	28.5 ± 3.7	29.1 ± 3.5	.48
Pao_2 (mmHg)	97 ± 30	128 ± 48†	92 ± 20	.02
HbO_2 (%)	95.9 ± 1.1	97.0 ± 1.7	96.0 ± 1.8	.04
Base excess (mmol/L)	4.1 ± 4.2	3.7 ± 3.6	4.3 ± 3.3	.48
All procedures (n = 43)				

Conclusions

- Prone position improves oxygenation but…..
- …. Oxygenation improvement is not the major target! (nor a KPI)
- Prone position MUST be performed in moderate to severe ARDS
- ECMO before prone position ≈ malpractice!

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Thank you for your attention!

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