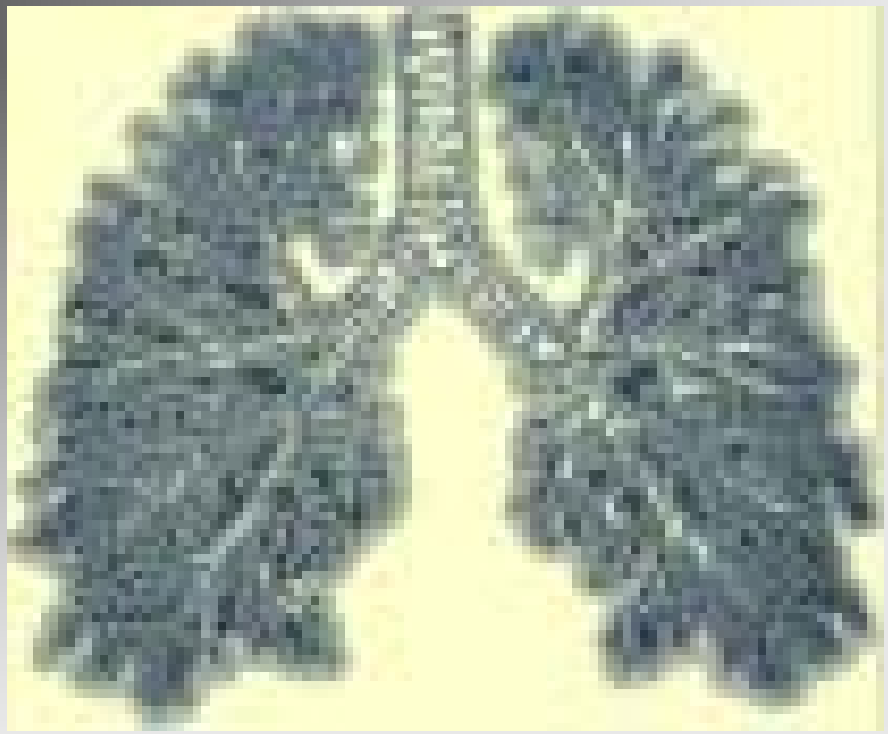
Maniobras de Reclutamiento



E. Zavala
UCI Quirúrgica

CLÍNIC
Corporació Sanitària

E. Zavala
UCI Quirúrgica

SARTD- CHGUV - Sesión de Formación Continuada
Valencia 3 de Abril 2007

"Open up the lung and keep the lung open"

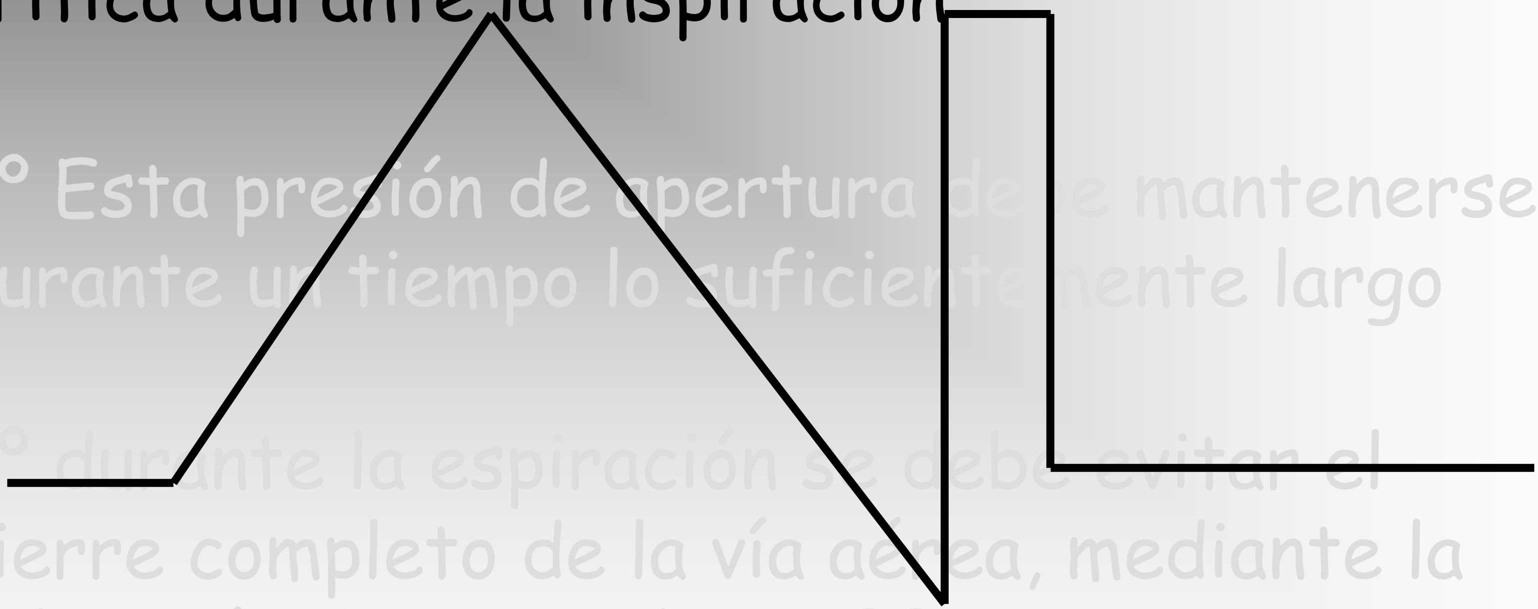
Porqué?

Cuando el pulmón está abierto, se caracteriza por un intercambio de gases optimo y con un % de shunt bajo (<10%), lo que corresponde a PaO2 >> 450 mmHg con FIO2 1. Las Paw necesarias son mínimas y la repercusión hemodinámica se minimiza.

ICM1992; 18:319-321

Pasos para abrir el pulmón:

1º Se debe alcanzar una presión de apertura crítica durante la inspiración



2º Esta presión de apertura debe mantenerse durante un tiempo lo suficientemente largo

3º durante la espiración se debe evitar el cierre completo de la vía aérea, mediante la aplicación de un nivel de PEEP

ICM1992; 18:319-321

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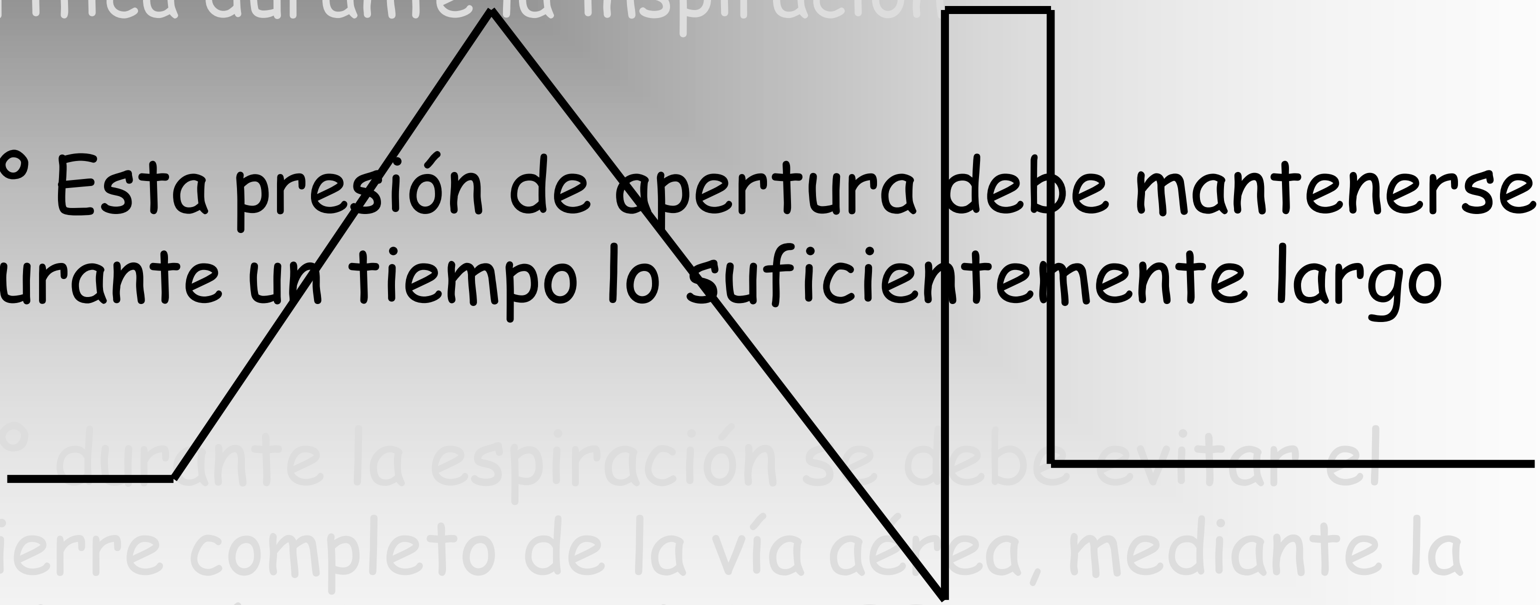

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ICM1992; 18:319-321

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1º Se debe alcanzar una presión de apertura crítica durante la inspiración

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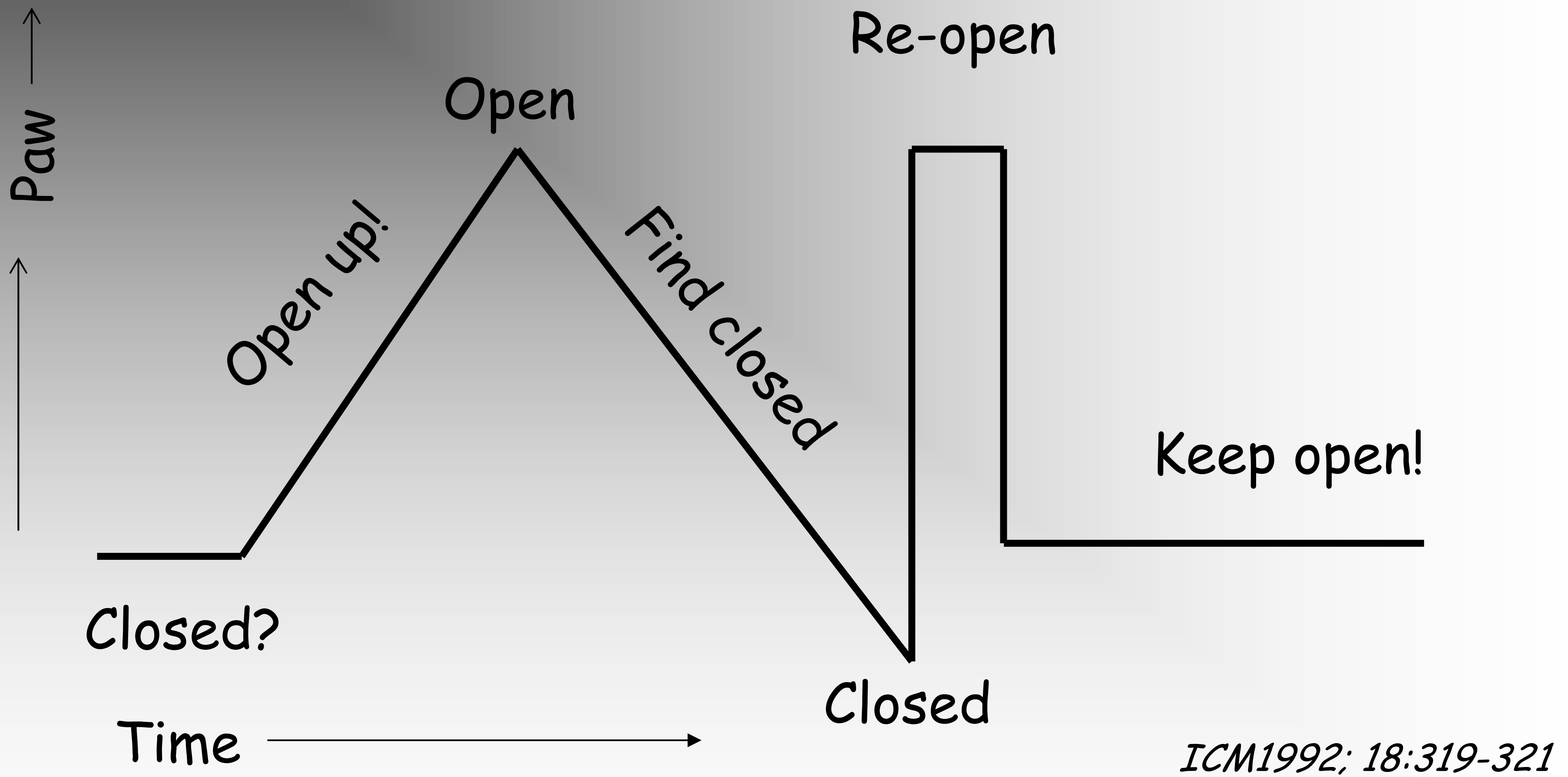
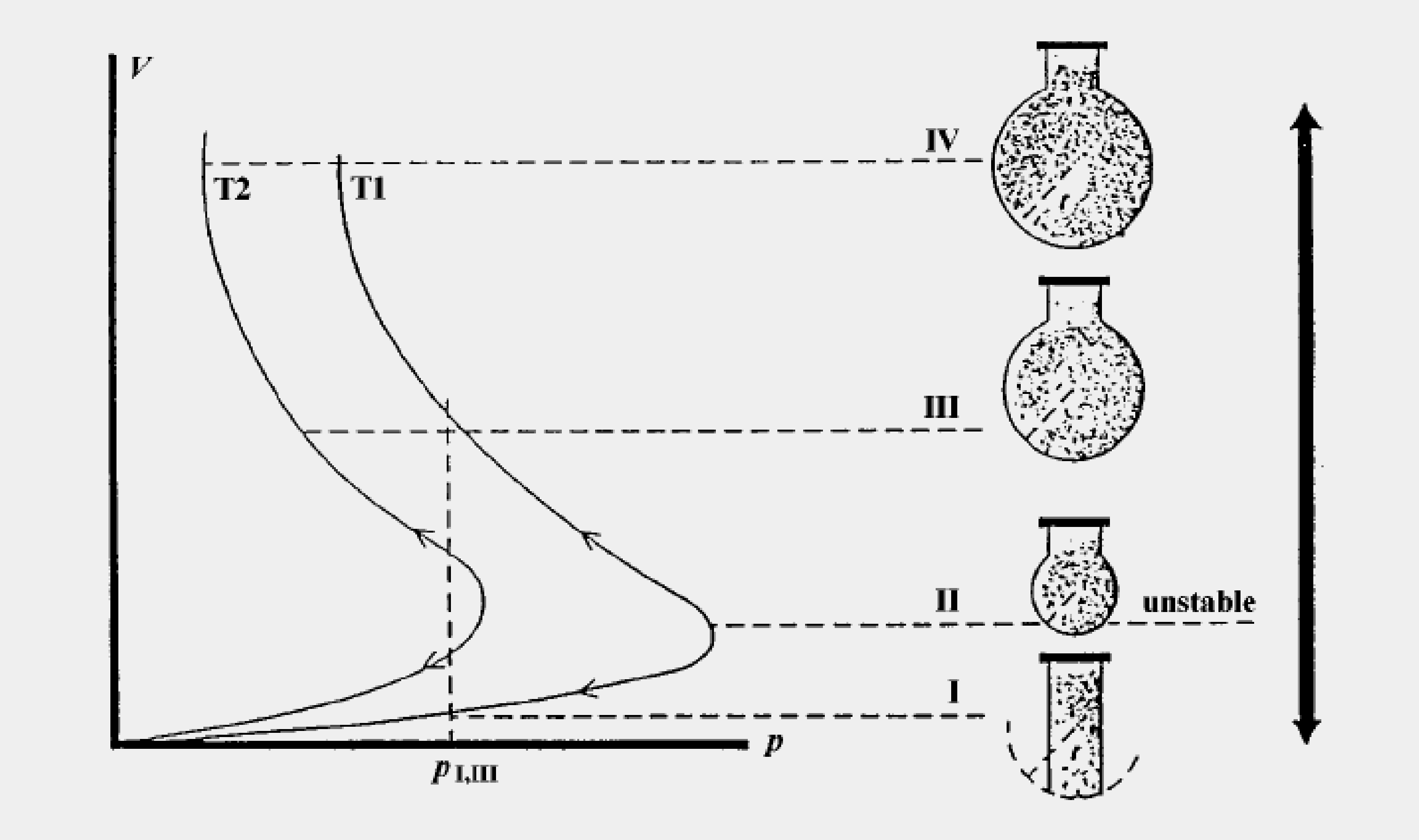
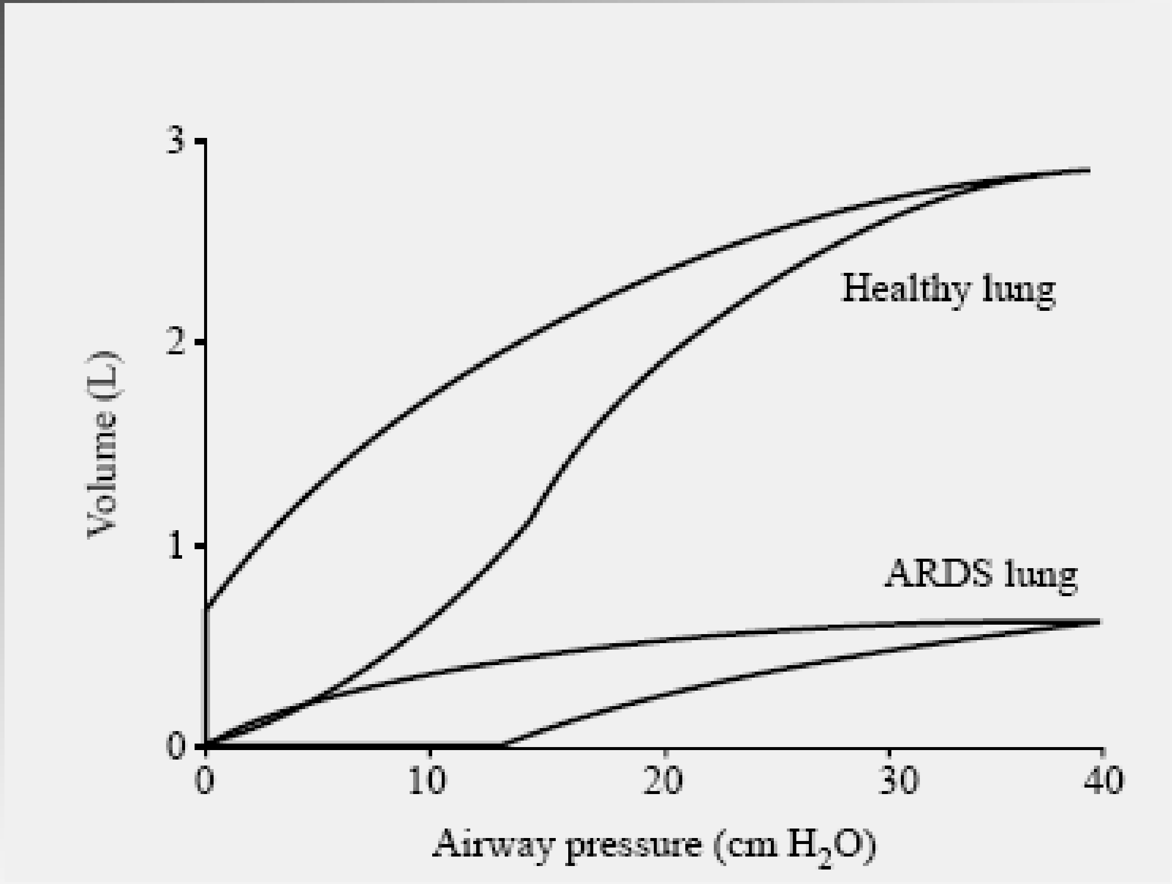
ICM1992; 18:319-321


Paw
Re-open
Open
Open up!
Find closed
Keep open!
Closed?
Closed
Time
ICM1992; 18:319-321

Comportamiento fisiológico alveolar



Curva Presión – Volúmen

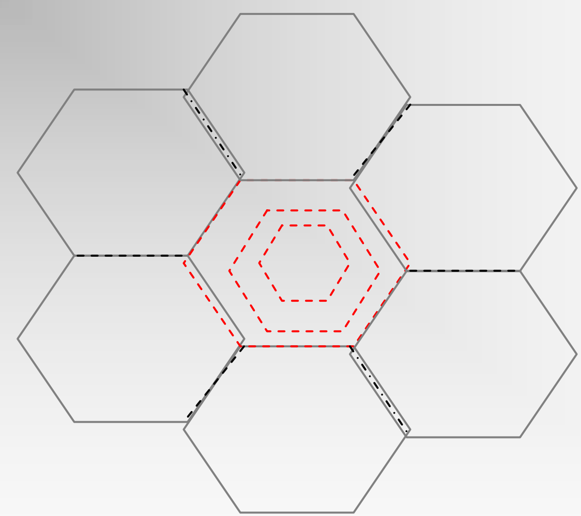


>> Pr
>> Ts

Minerva Anestesiol 2006; 72:117-8

Interdependencia alveolar

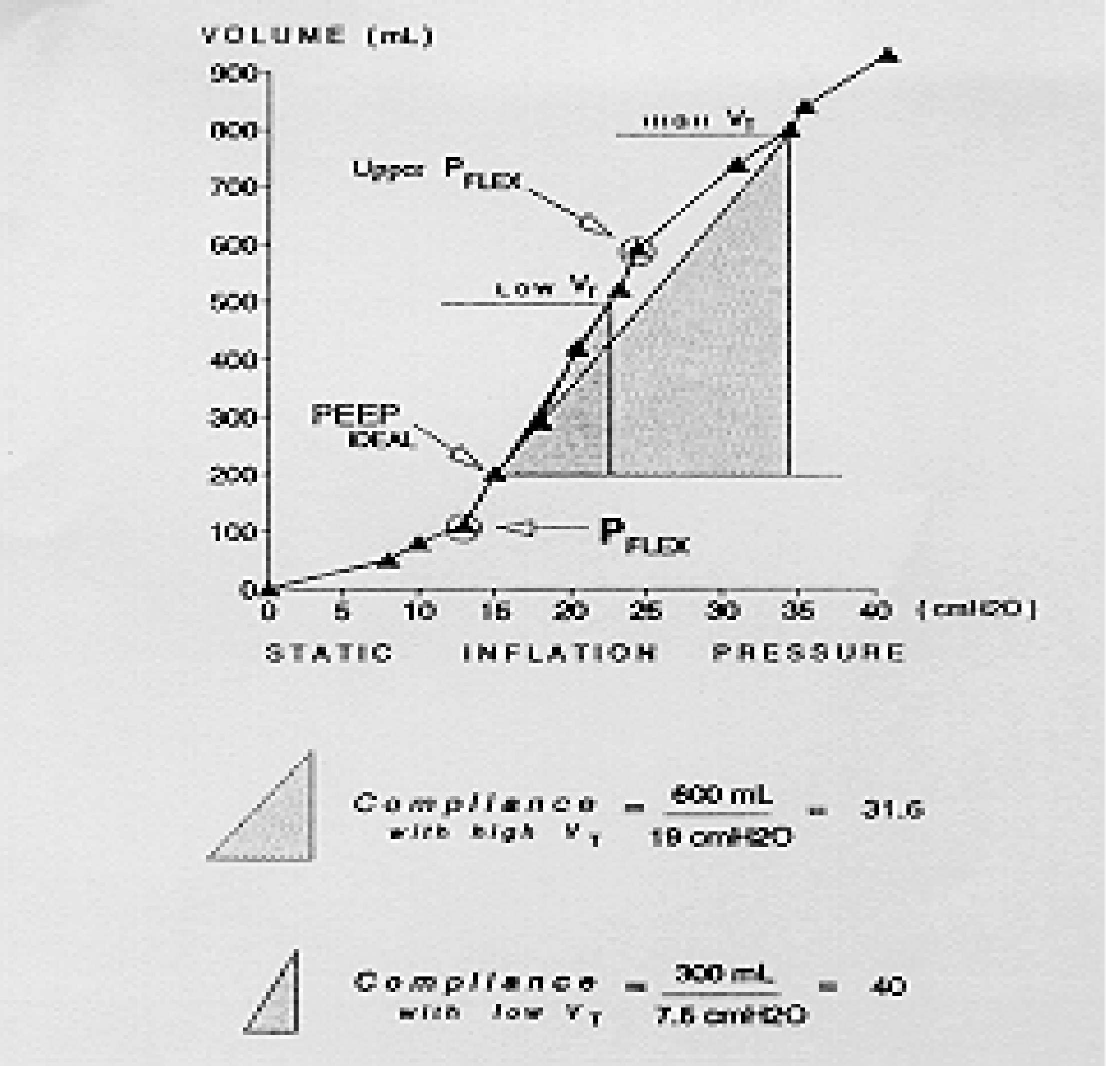
Alveolo normal ventilado



Alveolo tras inactivación del surfactante. Colapso final espiración

“Shear forces

Minerva Anestesiol 2006; 72:117-



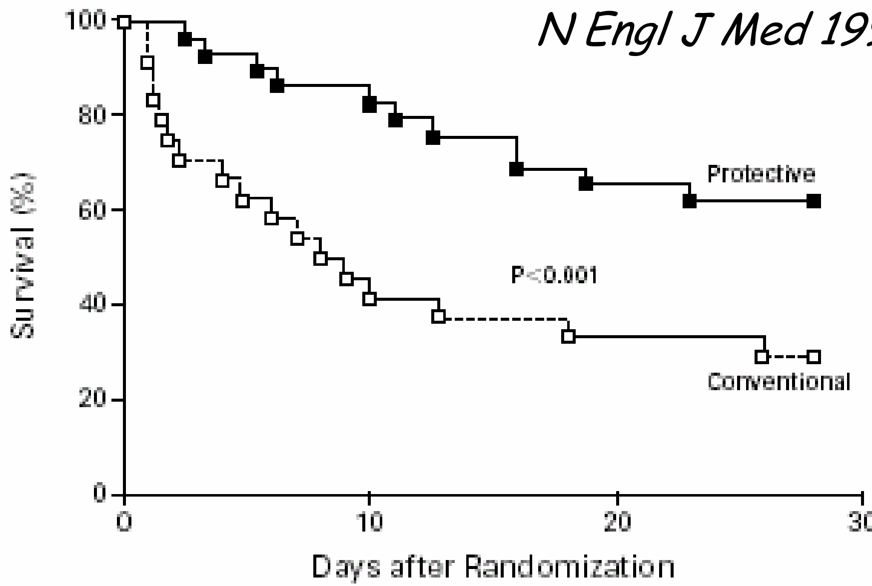
Vt alto, PEEP bajas vs MR combinado con Vt bajos y PEEP altas

Am J Respir Crit Care Med 1995

EFFECT OF A PROTECTIVE-VENTILATION STRATEGY ON MORTALITY IN THE ACUTE RESPIRATORY DISTRESS SYNDROME

MARCELO BRITTO PASSOS AMATO, M.D., CARMEN SILVIA VALENTE BARBAS, M.D., DENISE MACHADO MEDEIROS, M.D., RICARDO BORGES MAGALDI, M.D., GUILHERME DE PAULA PINTO SCHETTINO, M.D., GERALDO LORENZI-FILHO, M.D., RONALDO ADIB KAIRALLA, M.D., DANIEL DEHEINZELIN, M.D., CARLOS MUNOZ, M.D., ROSELAINE OLIVEIRA, M.D., TERESA YAE TAKAGAKI, M.D., AND CARLOS ROBERTO RIBEIRO CARVALHO, M.D.

N Engl J Med 1998; 338: 347-3554



No. at Risk				
Protective	29	25	20	18
Conventional	24	11	9	7

EVALUATION OF A VENTILATION STRATEGY TO PREVENT BAROTRAUMA IN PATIENTS AT HIGH RISK FOR ACUTE RESPIRATORY DISTRESS SYNDROME

THOMAS E. STEWART, M.D., MAUREEN O. MEADE, M.D., DEBORAH J. COOK, M.D., JOHN T. GRANTON, M.D., RICHARD V. HODDER, M.D., STEPHEN E. LAPINSKY, M.D., C. DAVID MAZER, M.D., RICHARD F. MCLEAN, M.D., TED S. ROGOVEIN, M.D., B. DIANA SCHOUTEN, R.N., THOMAS R.J. TODD, M.D., ARTHUR S. SLUTSKY, M.D., AND THE PRESSURE- AND VOLUME-LIMITED VENTILATION STRATEGY GROUP*

Limited ventilation group vs Conventional group

Limited ventilation group	Conventional group
Vt ≤ 8ml/kg	*Vt = 10 - 15 ml/kg*
Pplat ≤ 30 cm H2O	*Ppeak = 50 cm H2O*

New Engl J Med 1998; 338: 355-361

Table 3. Mean Ventilatory Variables on Days 1, 3, and 7.*

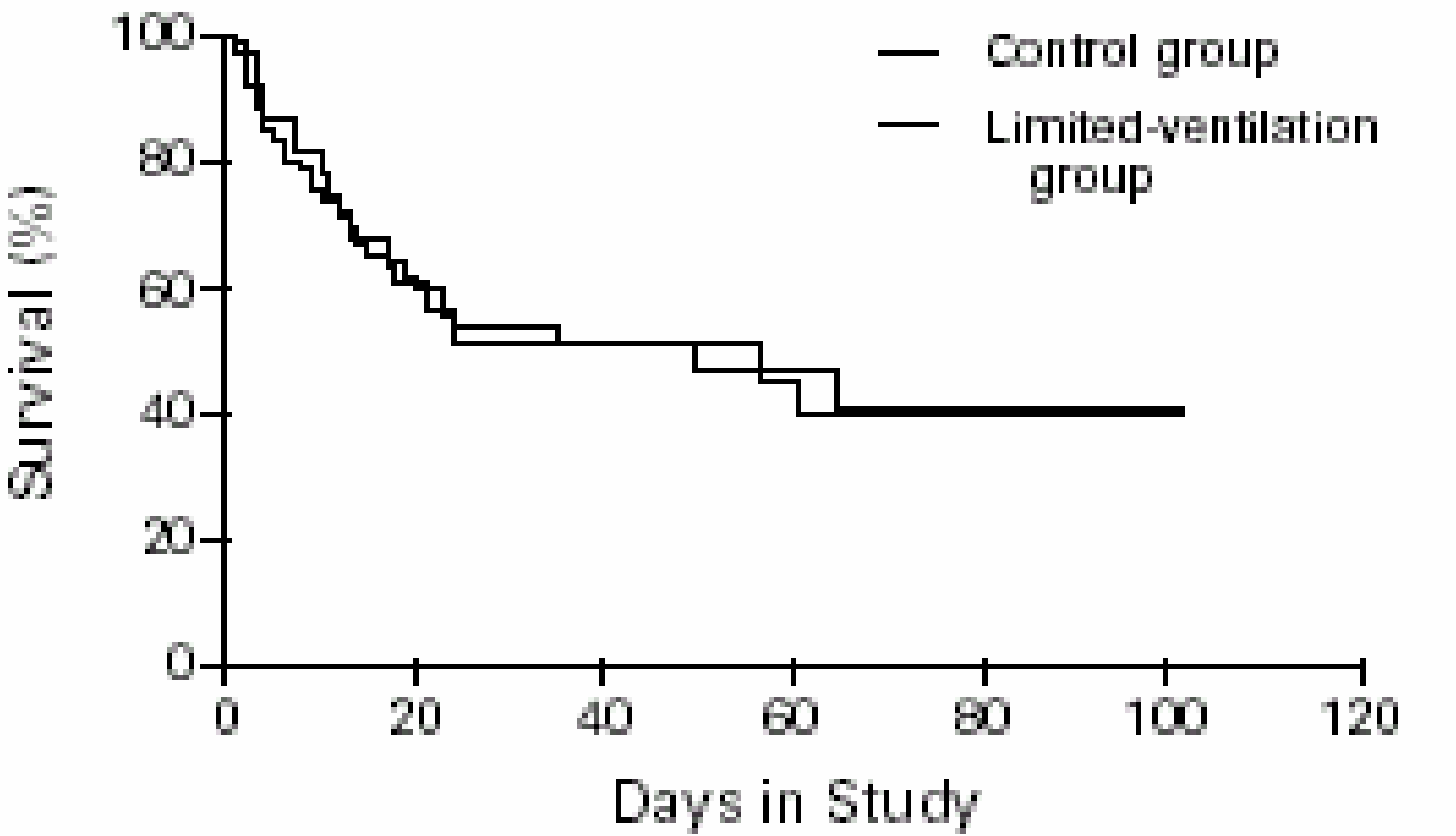
Variable	Day 1		Day 3		Day 7	
	Limited-ventilation group (N=60)	Control group (N=60)	Limited-ventilation group (N=51)	Control group (N=49)	Limited-ventilation group (N=30)	Control group (N=35)
Tidal volume (ml/kg)	7.0±0.7	10.7±1.4†	7.2±0.8	10.8±1.0†	6.8±0.6	10.1±1.4
Peak inspiratory pressure (cm of water)	24.2±5.2	32.1±9.5†	23.6±5.8	34.0±11.0†	24.3±4.4	33.5±11.
Plateau airway pressure (cm of water)	22.3±5.4	26.8±6.7‡	22.2±3.9	28.5±7.2‡	20.0±4.7	28.6±7.2
PEEP (cm of water)	8.6±3.0	7.2±3.3§	8.7±3.6	8.4±3.8	9.6±3.9	8.0±3.6
FiO_2	0.57±0.20	0.51±0.18	0.47±0.14	0.47±0.17	0.44±0.10	0.45±0.1
Respiratory rate (breaths/min)	22.1±6.2	15.6±5.0†	23.1±6.3	17.0±6.0†	24.9±6.5	19.2±4.7
Minute ventilation (liters/min)	11.1±3.0	11.7±3.8	11.3±3.2	11.8±4.2	11.6±2.8	12.3±4.0

*Variables are means ±SD for the second reading on the day specified. PEEP denotes positive end-expiratory pressure, and FiO_2 fracti of inspired oxygen. The numbers of patients shown for the various days are those who were still alive.

†P<0.001 for the comparison with the limited-ventilation group. ‡P<0.01 for the comparison with the limited-ventilation grou

§P<0.02 for the comparison with the limited-ventilation group.

New Engl J Med 1998; 338: 355-361



New Engl J Med 1998; 338: 355-361

Tidal Volume Reduction for Prevention of Ventilator-induced Lung Injury in Acute Respiratory Distress Syndrome

LAURENT BROCHARD, FRANÇOISE ROUDOT-THORAVAL, ERIC ROUPIE, CHRISTOPHE DELCLAUX, JEAN CHASTRE, ENRIQUE FERNANDEZ-MONDÉJAR, EVA CLÉMENTI, JORDI MANCEBO, PHILLIP FACTOR, DIMITRI MATAMIS, MARCO RANIERI, LLUIS BLANCH, GIUSEPPE RODI, HERVÉ MENTEC, DIDIER DREYFUSS, MIGUEL FERRER, CHRISTIAN BRUN-BUISSON, MARTIN TOBIN, FRANÇOIS LEMAIRE, and The Multicenter Trial Group on Tidal Volume Reduction in ARDS

Medical Intensive Care Unit, Henri Mondor Hospital, Assistance Publique–Hôpitaux de Paris, Université Paris XII and INSERM U 492, Créteil, France

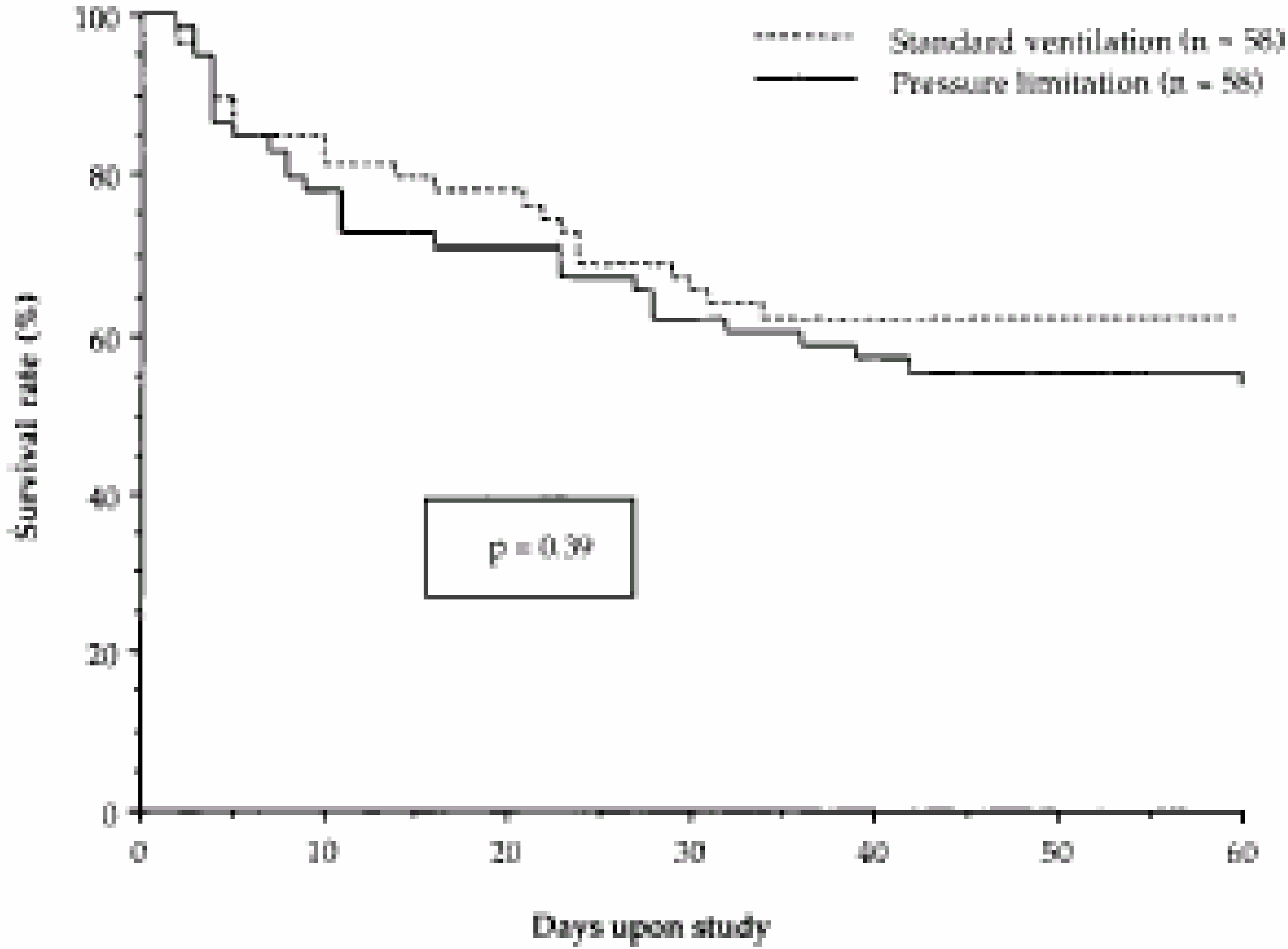
Vt < 10 ml/kg vs Vt ≥ 10 ml/kg (Conventional approach)

↓ *Pplat ≤ 25 cm H2O*

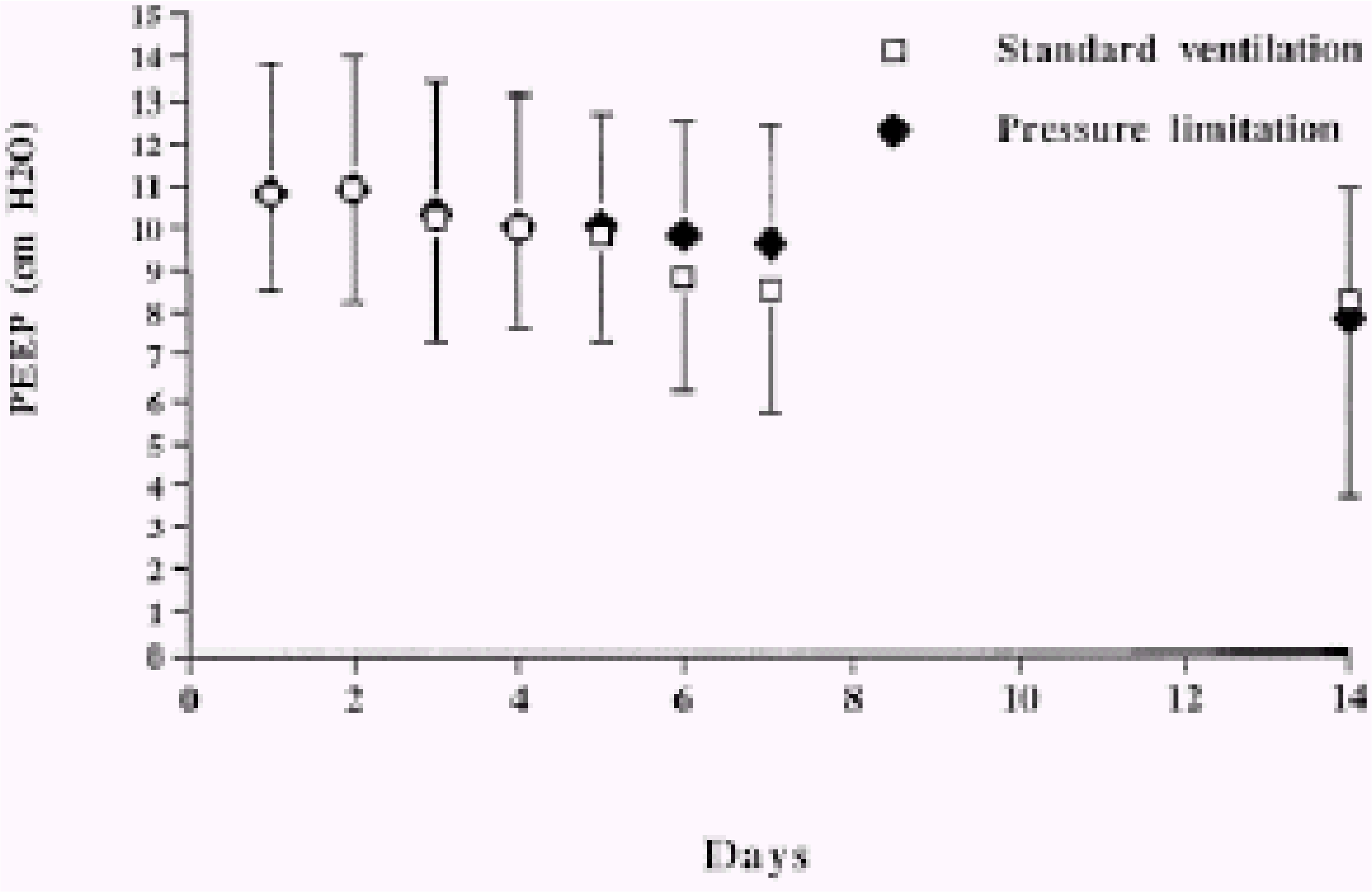
↓ *Normal PaCO2*

PEEP similar

Am J Respir crit Care Med 1998; 158: 1831-1838



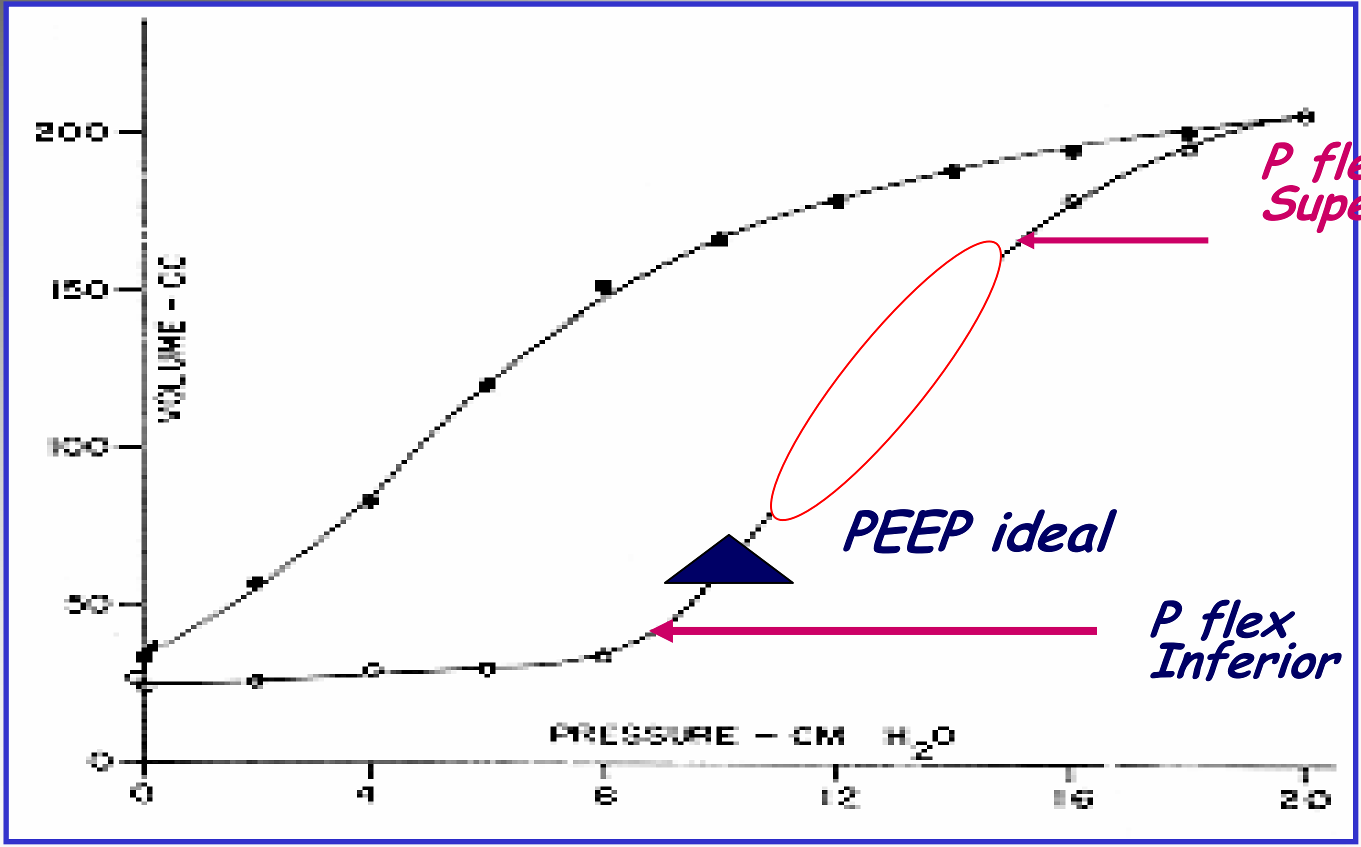
Am J Respir Crit Care Med 1998; 158: 1831-183



Am J Respir Crit Care Med 1998; 158: 1831-183

Curva Pr x Vol Sistema Respiratorio

Volúmen



Presión

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*

Traditional Ventilation

Vt 12ml/kg IBW
Pplat < 50 cm H2O

Lower Vt Ventilation

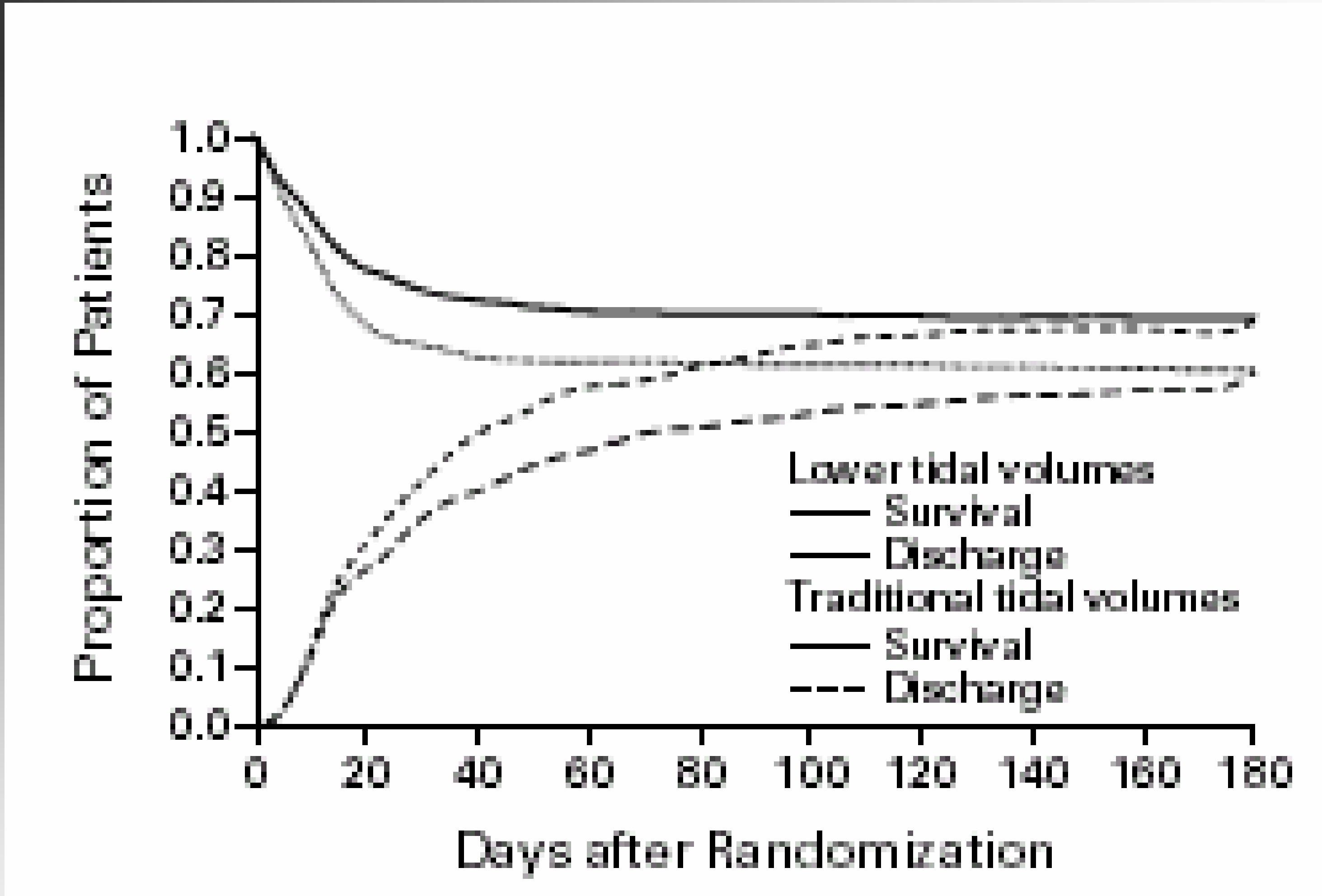
Vt 6 ml/kg IBW
Pplat < 30 cm H2O

New Engl J Med 2000; 342: 1301-130

Table 1. Summary of Ventilator Procedures.*

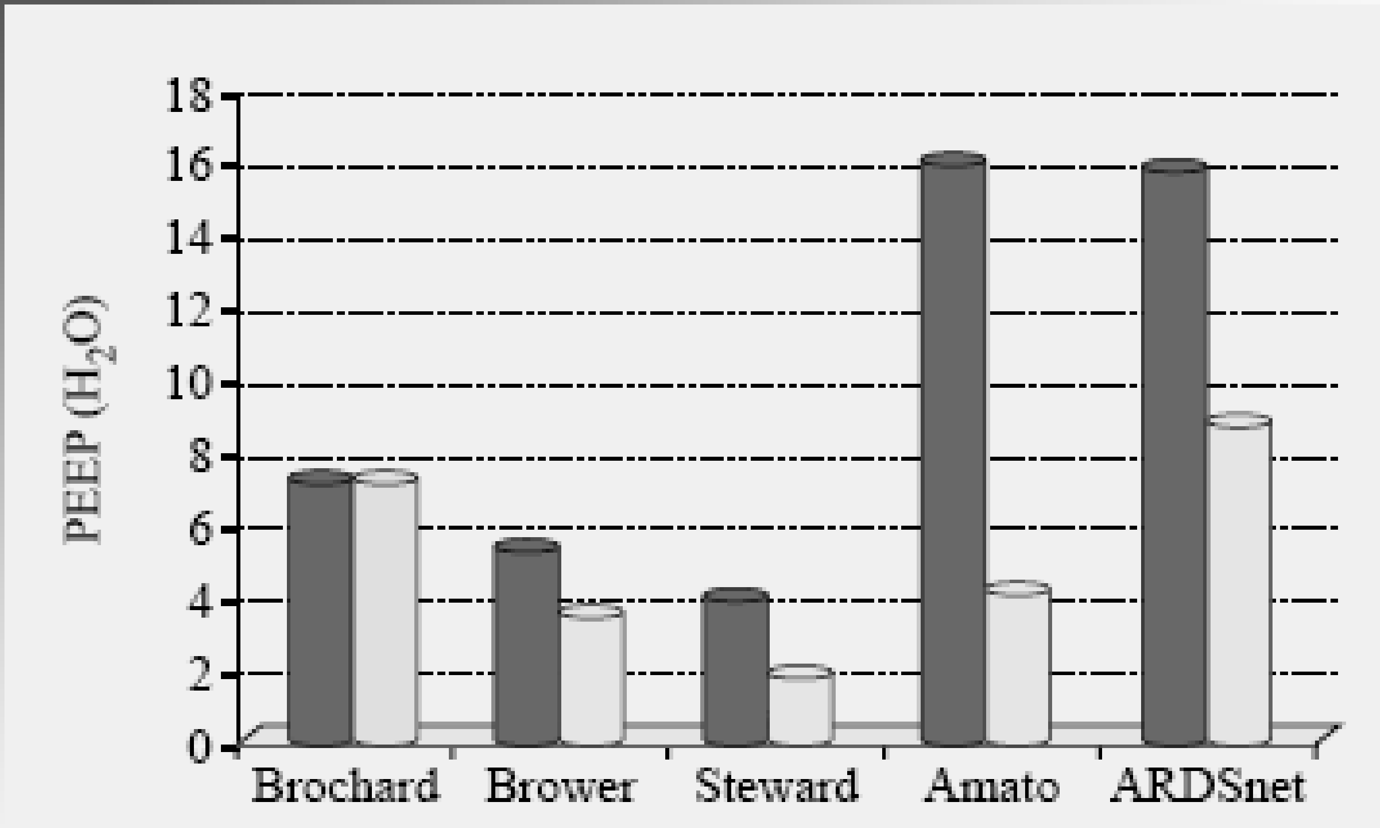
Variable	Group Receiving Traditional Tidal Volumes	Group Receiving Lower Tidal Volumes
Ventilator mode	Volume assist–control	Volume assist–control
Initial tidal volume (ml/kg of predicted body weight)†	12	6
Plateau pressure (cm of water)	≤50	≤30
Ventilator rate setting needed to achieve a pH goal of 7.3 to 7.45 (breaths/min)	6–35	6–35
Ratio of the duration of inspiration to the duration of expiration	1:1–1:3	1:1–1:3
Oxygenation goal	PaO_2, 55–80 mm Hg, or SpO_2, 88–95%	PaO_2, 55–80 mm Hg, or SpO_2, 88–95%
Allowable combinations of FiO_2 and PEEP (cm of water)‡	0.3 and 5 0.4 and 5 0.4 and 8 0.5 and 8 0.5 and 10 0.6 and 10 0.7 and 10 0.7 and 12 0.7 and 14 0.8 and 14 0.9 and 14 0.9 and 16 0.9 and 18 1.0 and 18 1.0 and 20 1.0 and 22 1.0 and 24	0.3 and 5 0.4 and 5 0.4 and 8 0.5 and 8 0.5 and 10 0.6 and 10 0.7 and 10 0.7 and 12 0.7 and 14 0.8 and 14 0.9 and 14 0.9 and 16 0.9 and 18 1.0 and 18 1.0 and 20 1.0 and 22 1.0 and 24
Weaning	By pressure support; required by protocol when FiO_2 ≤0.4	By pressure support; required by protocol when FiO_2 ≤0.4

New Engl J Med 2000; 342: 1301-1308



Total Pacientes 861
Mort 31% vs 39.8 % (p=0.007)

New Engl J Med 2000; 342: 1301-130



Minerva Anestesiol 2006; 72:117-8

The NEW ENGLAND JOURNAL of MEDICINE

ESTABLISHED IN 1812 JULY 22, 2004 VOL. 351 NO. 4

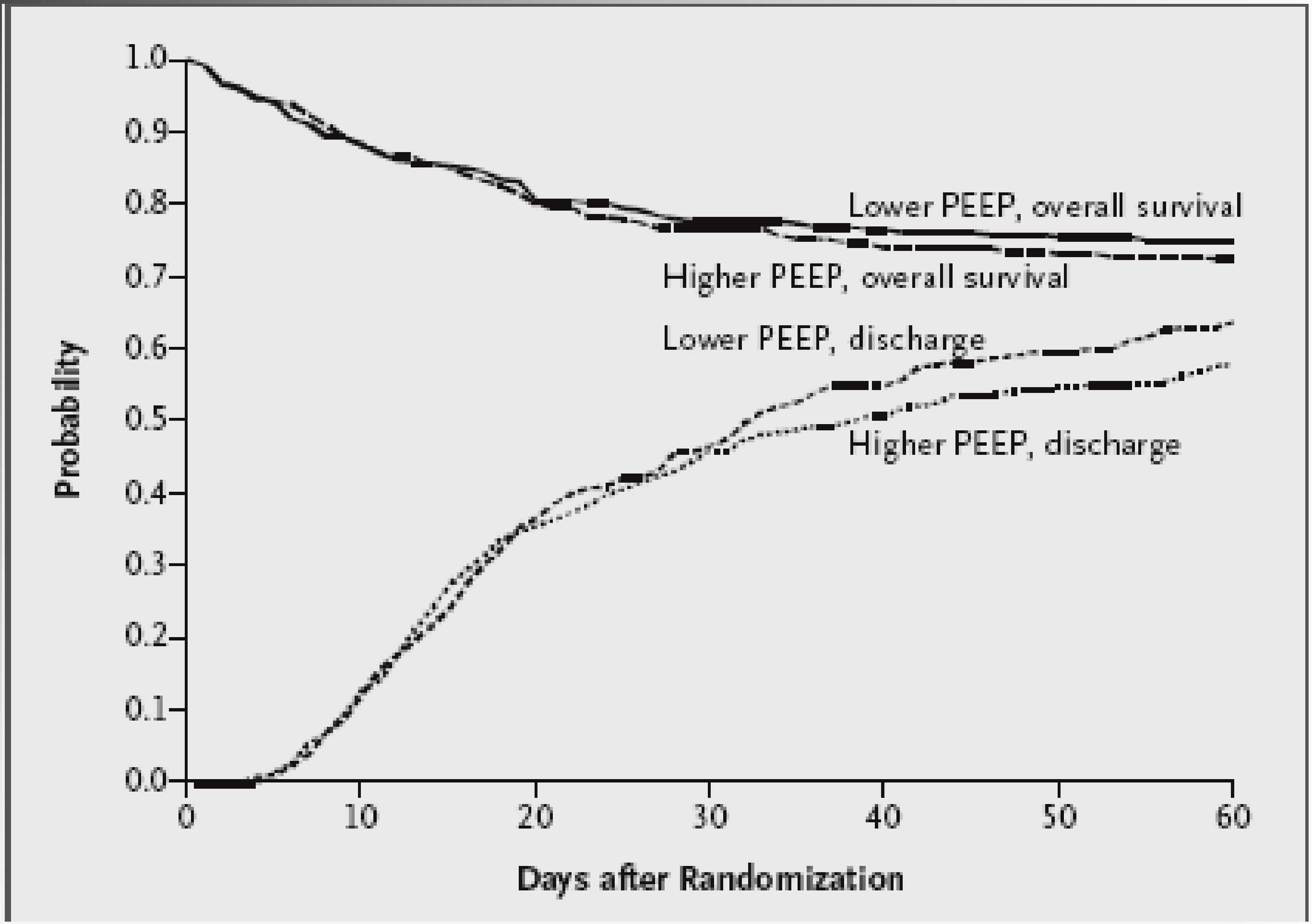
Higher versus Lower Positive End-Expiratory Pressures in Patients with the Acute Respiratory Distress Syndrome

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

Table 1. Summary of Ventilator Procedures in the Lower- and Higher-PEEP Groups.*

Procedure	Value													
Ventilator mode	Volume assist/control													
Tidal-volume goal	6 ml/kg of predicted body weight													
Plateau-pressure goal	≤30 cm of water													
Ventilator rate and pH goal	6–35, adjusted to achieve arterial pH ≥7.30 if possible													
Inspiration:expiration time	1:1–1:3													
Oxygenation goal														
PaO_2	55–80 mm Hg													
SpO_2	88–95%													
Weaning	Weaning attempted by means of pressure support when level of arterial oxygenation acceptable with PEEP ≤8 cm of water and FiO_2 ≤0.40													
Allowable combinations of PEEP and FiO_2†														
Lower-PEEP group														
FiO_2	0.3	0.4	0.4	0.5	0.5	0.6	0.7	0.7	0.7	0.8	0.9	0.9	0.9	1.0
PEEP	5	5	8	8	10	10	10	12	14	14	14	16	18	18–24
Higher-PEEP group (before protocol changed to use higher levels of PEEP)														
FiO_2	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.5	0.5	0.5–0.8	0.8	0.9	1.0	
PEEP	5	8	10	12	14	14	16	16	18	20	22	22	22–24	
Higher-PEEP group (after protocol changed to use higher levels of PEEP)														
FiO_2	0.3	0.3	0.4	0.4	0.5	0.5	0.5–0.8	0.8	0.9	1.0				
PEEP	12	14	14	16	16	18	20	22	22	22–24				

NEJM 2004; 351(4): 327-33

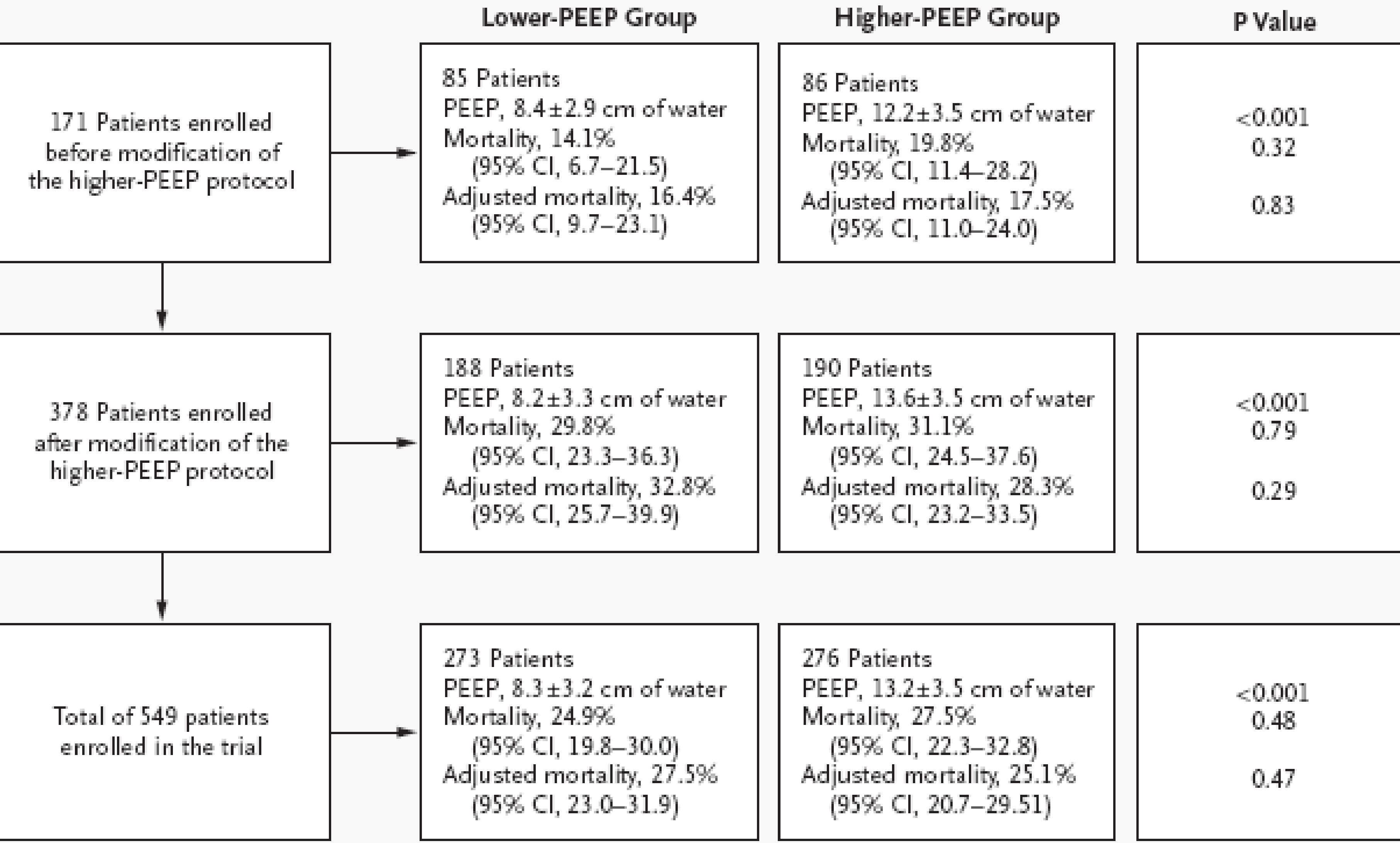


NEJM 2004; 351(4): 327-336

Table 4. Main Outcome Variables.*

Outcome	Lower-PEEP Group	Higher-PEEP Group	P Value
Death before discharge home (%)†			
Unadjusted	24.9	27.5	0.48
Adjusted for differences in baseline covariates	27.5	25.1	0.47
Breathing without assistance by day 28 (%)	72.8	72.3	0.89
No. of ventilator-free days from day 1 to day 28‡	14.5±10.4	13.8±10.6	0.50
No. of days not spent in intensive care unit from day 1 to day 28	12.2±10.4	12.3±10.3	0.83
Barotrauma (%)§	10	11	0.51
No. of days without failure of circulatory, coagulation, hepatic, and renal organs from day 1 to day 28	16±11	16±11	0.82

NEJM 2004; 351(4): 327-336

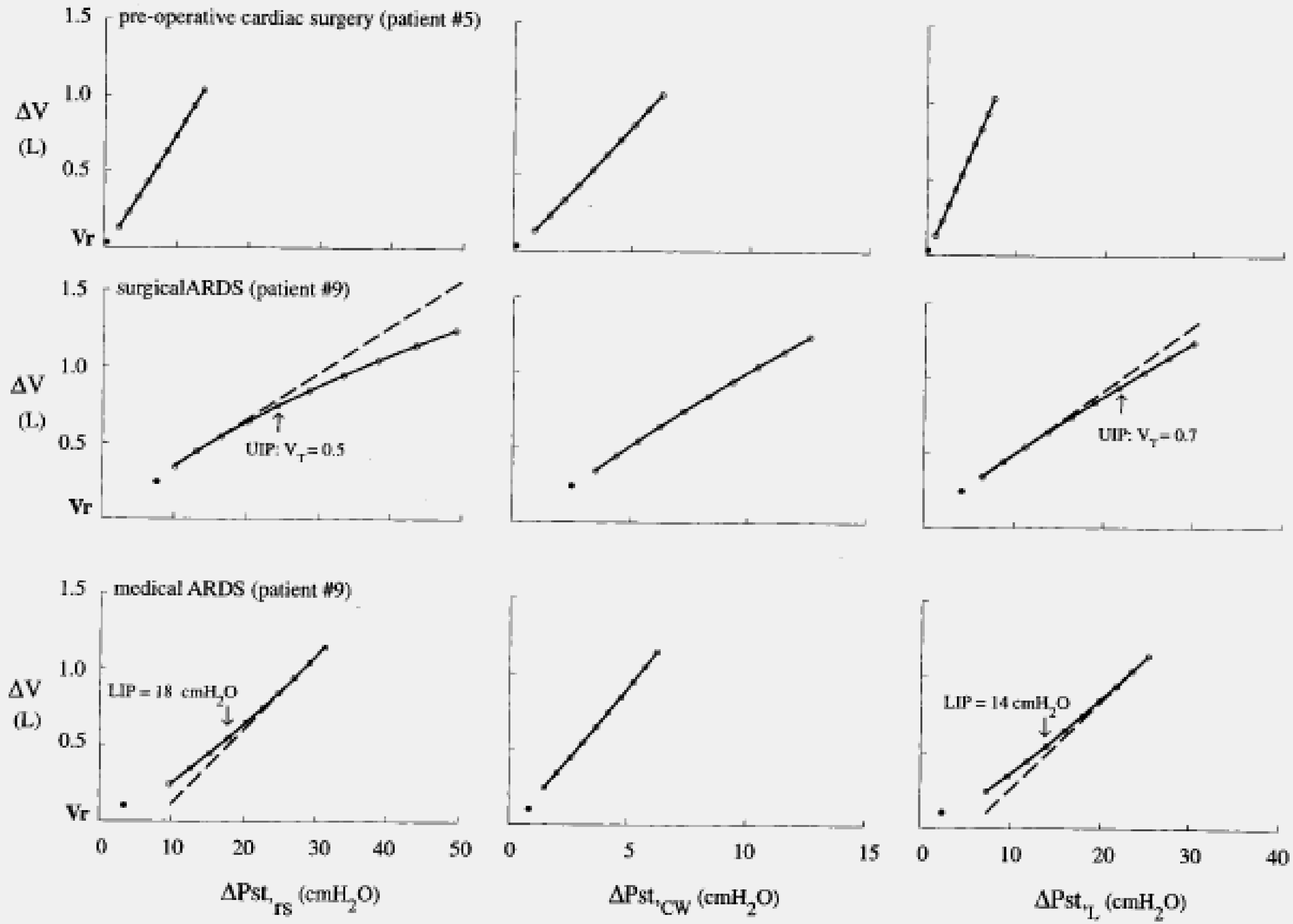


NEJM 2004; 351(4): 327-33

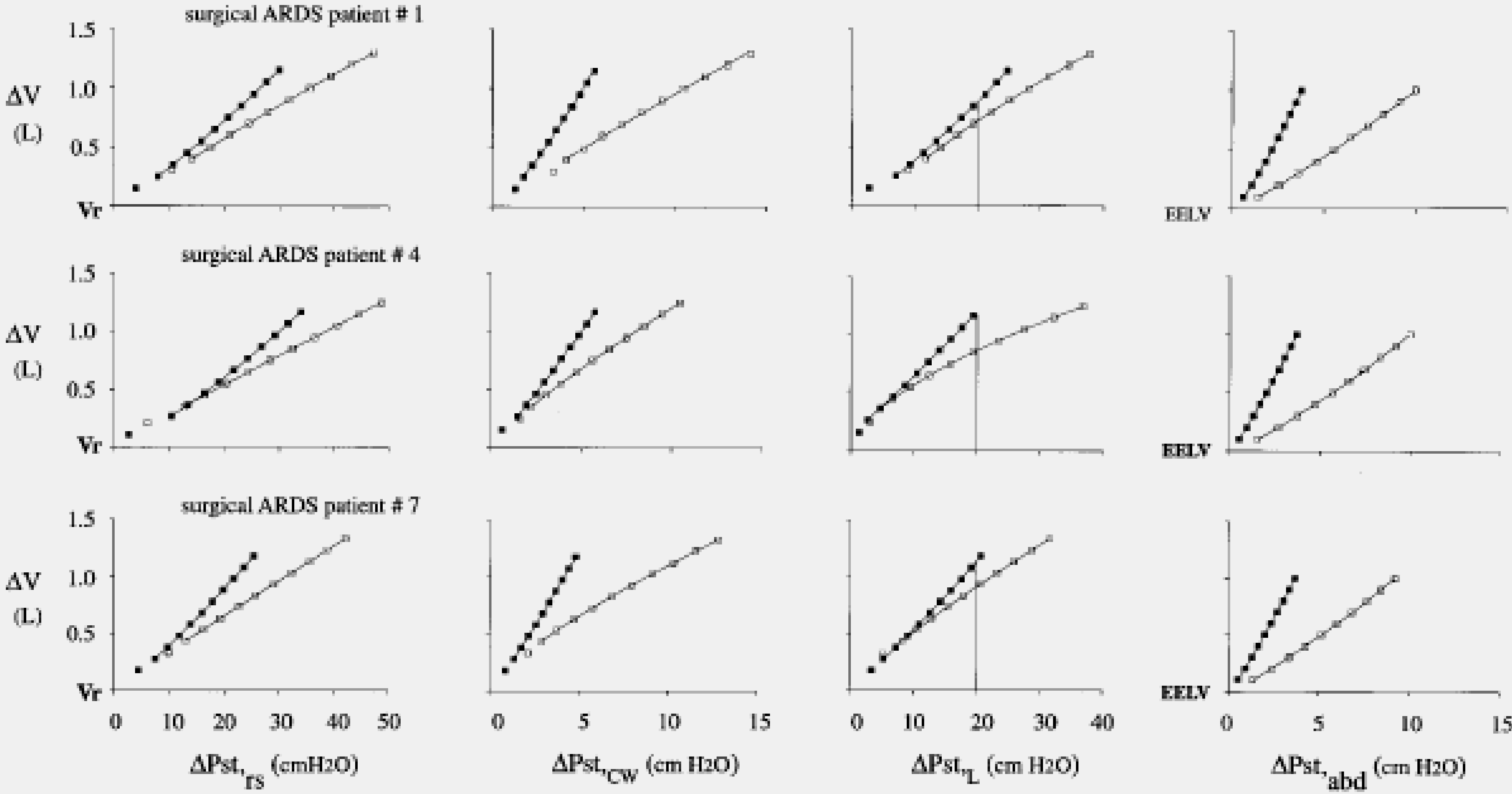
Impairment of Lung and Chest Wall Mechanics in Patients with Acute Respiratory Distress Syndrome

Role of Abdominal Distension

V. MARCO RANIERI, NICOLA BRIENZA, SERGIO SANTOSTASI, FILOMENA PUNTILLO, LUCIANA MASCIA, NICOLA VITALE, ROCCO GIULIANI, VINCENZO MEMEO, FRANCESCO BRUNO, TOMMASO FIORE, ANTONIO BRIENZA, and ARTHUR S. SLUTSKY



Curvas PxV tras cirugía descompresiva

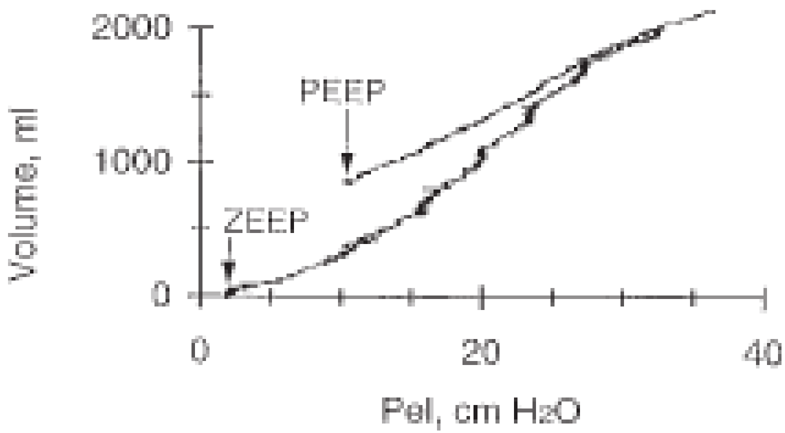


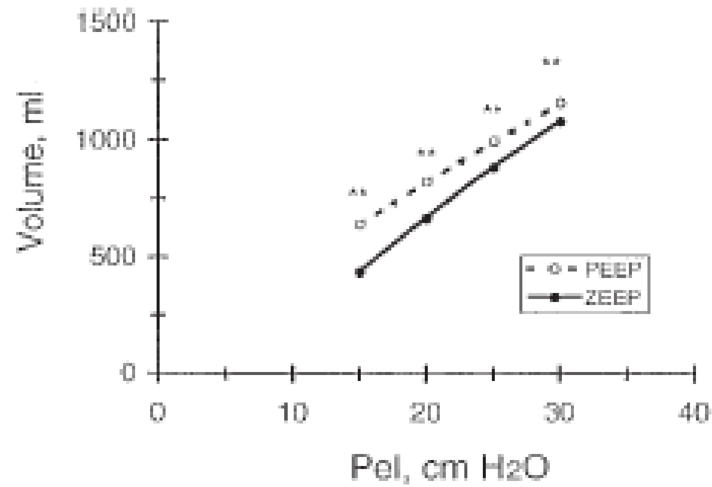
AJRCCM1997; 156:1082-91

Pressure–Volume Curves and Compliance in Acute Lung Injury

Evidence of Recruitment Above the Lower Inflection Point

BJÖRN JONSON, JEAN-CHRISTOPHE RICHARD, CHRISTIAN STRAUS, JORDI MANCEBO, FRANÇOIS LEMAIRE, and LAURENT BROCHARD





AJRCCM1999; 159:1172-78

State of the Art

What Has Computed Tomography Taught Us about the Acute Respiratory Distress Syndrome?

LUCIANO GATTINONI, PIETRO CAIRONI, PAOLO PELOSI, and LAWRENCE R. GOODMAN

Istituto di Anestesia e Rianimazione, Università degli Studi di Milano, Ospedale Maggiore Policlinico—IRCCS, Milano, Italy; and Department of Radiology, Medical College of Wisconsin, Milwaukee, Wisconsin

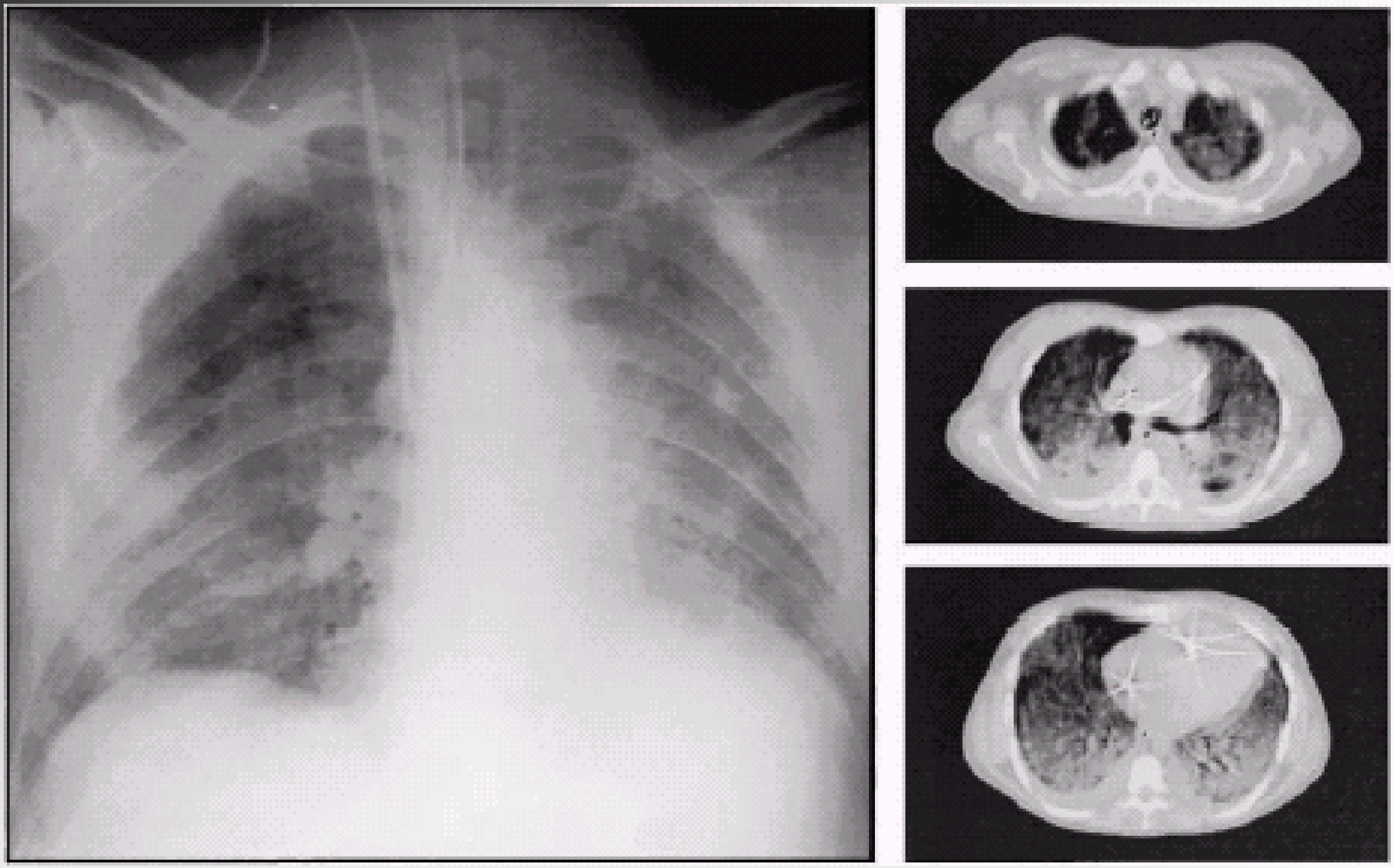
1985 CT scan & Anesthesia

1986 Gattinoni CT scan & ARDS

Morfología ARDS

Aspectos clínicos

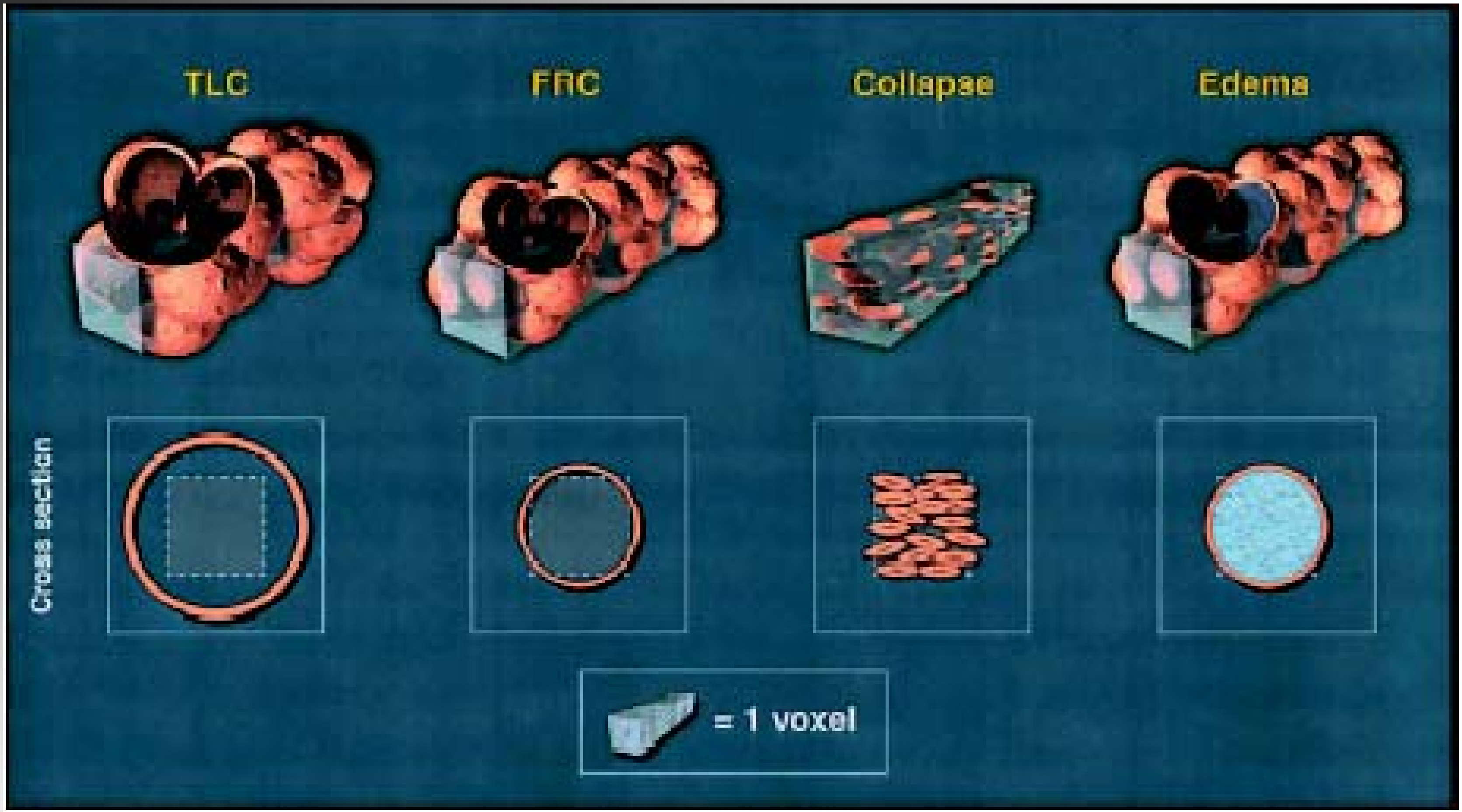
Am J Respir Crit Care Med 2001; 164: 1701-1711



PEEP 5 cm H2O *Am J Respir Crit Care Med 2001; 164: 1701-171*

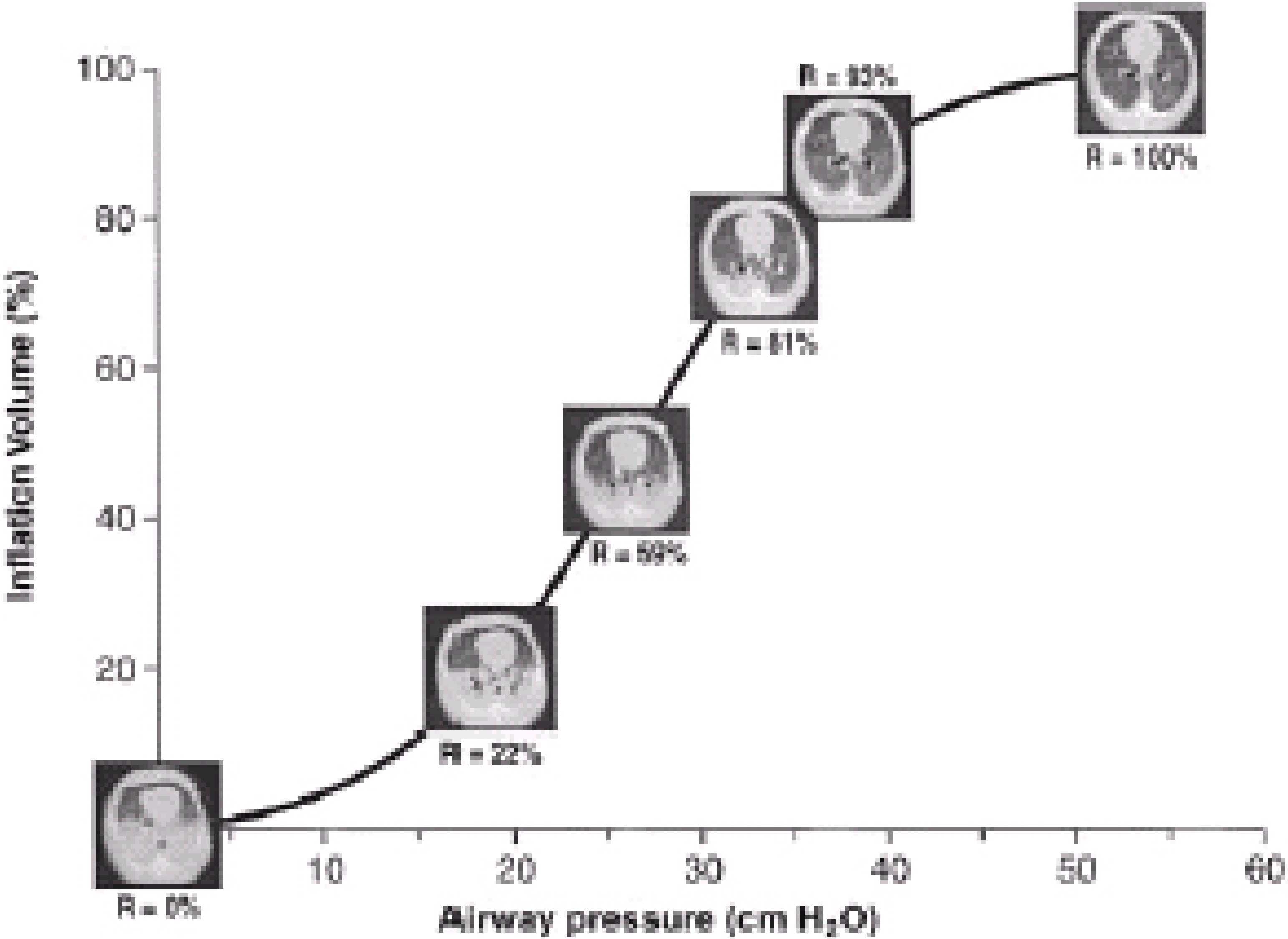
ARDS Sepsis

Lesión heterogenea

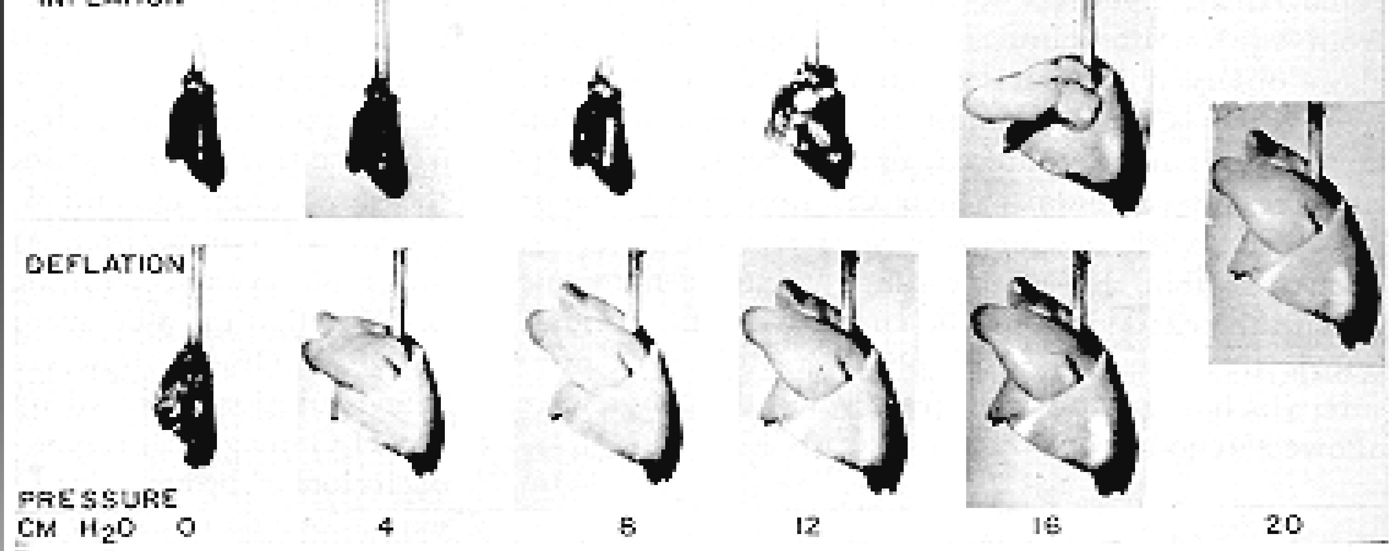


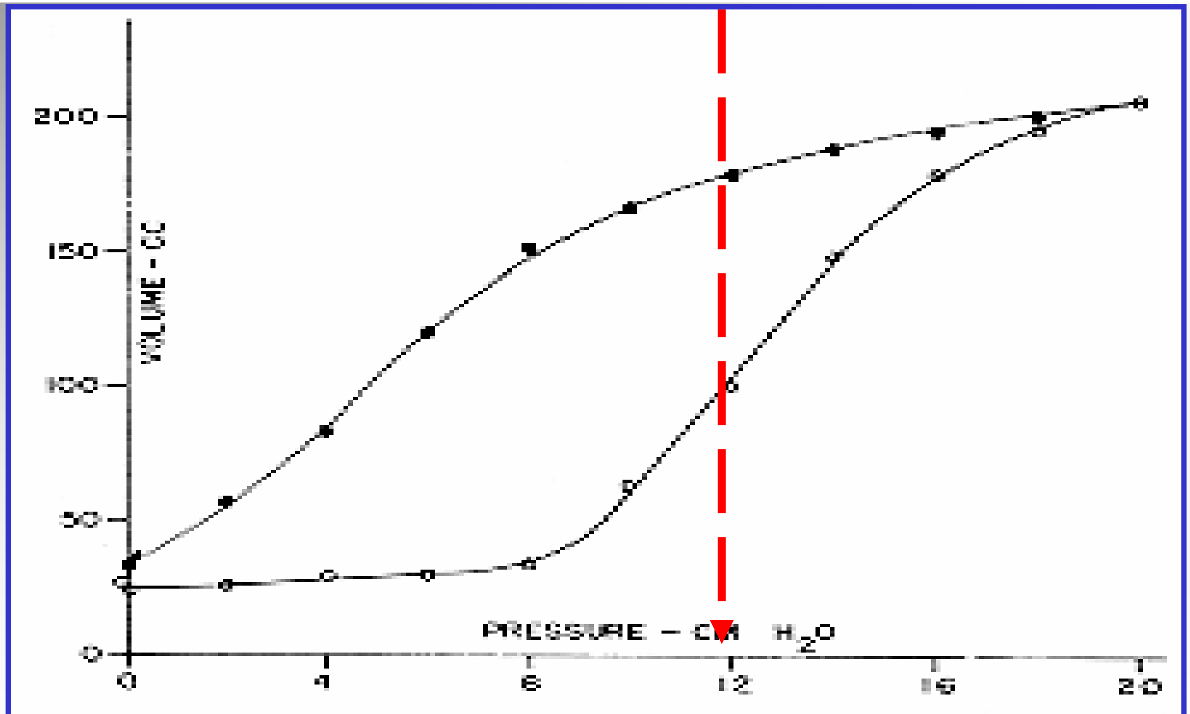
Análisis cuantitativo
Efecto de MR

Am J Respir Crit Care Med 2001; 164: 1701-171



Reclutamiento pulmonar *Am J Respir Crit Care Med 2001; 164: 1701-1711*


DEFLATION
PRESSURE
CM H_2O 0
4
8
12
16
20


200
150
100
50
0
VOLUME - CC
PRESSURE — CM H_2O
0
4
8
12
16
20

Protective ventilatory strategies

↓ P_AO_2

Changes in $\dot{V}A/\dot{Q}$ matching

Changes in Shunt

↑ $\dot{Q}_T$

PaO_2

Methodology

$\dot{V}_A/\dot{Q}$ relationships

Hemodynamics

Mechanics

P-V curve

V_T 8-10 ml/kg.

PEEP 8-10 cm H_2O

↓ V_T

↑ PEEP

Return to basal conditions

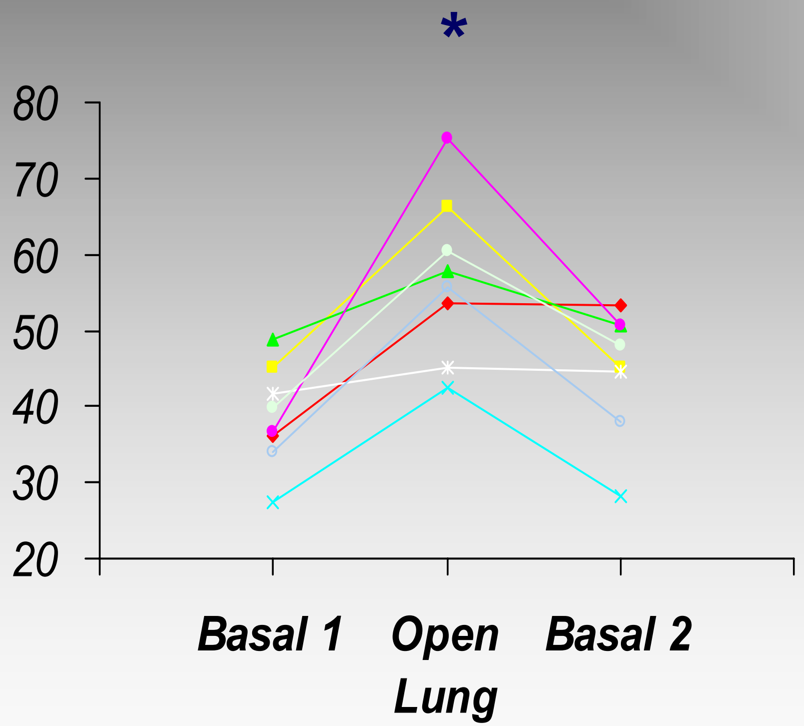
30 min	30 min	30 min
Basal 1	Open Lung	Basal 2

Ventilatory Pattern and Respiratory Mechanics

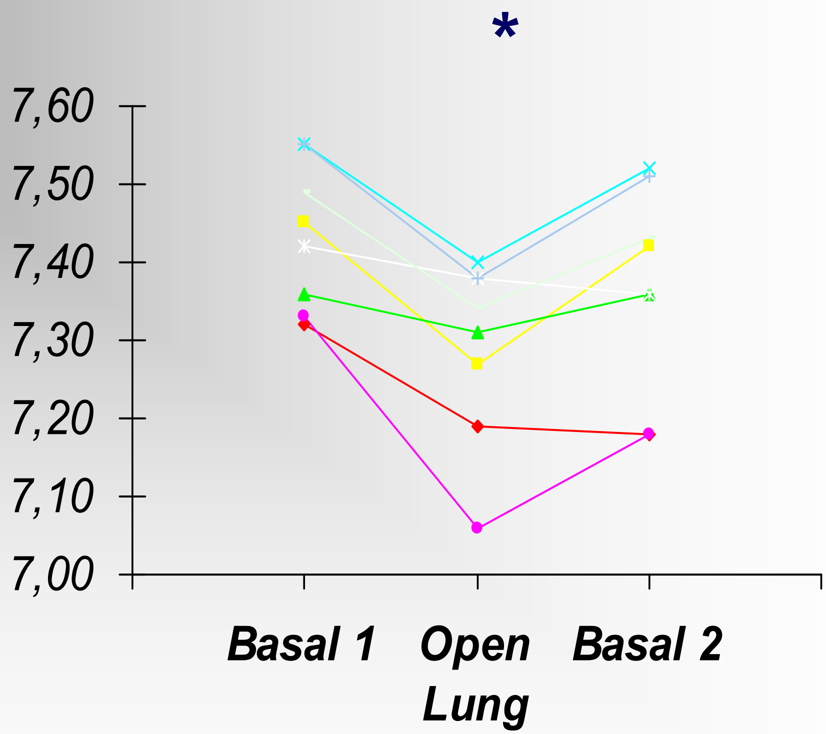
	Basal 1	Open Lung	Basal 2
f min^{-1}	15	15	15
Vt mL	666	416 *	663
PEEP cm H_2O	9	18 *	9
Pplat cm H_2O	28 (4.5)	29 (4.6)	28 (4.0)
Delta FRC	235 (190)	489 (149) *	179 (195)
Cs_{rs} $mL.cmH_2O^{-1}$	36 (14)	44 (16) *	38 (14)
Vr mL		187	

* $p<0.05$

$PaCO_2$

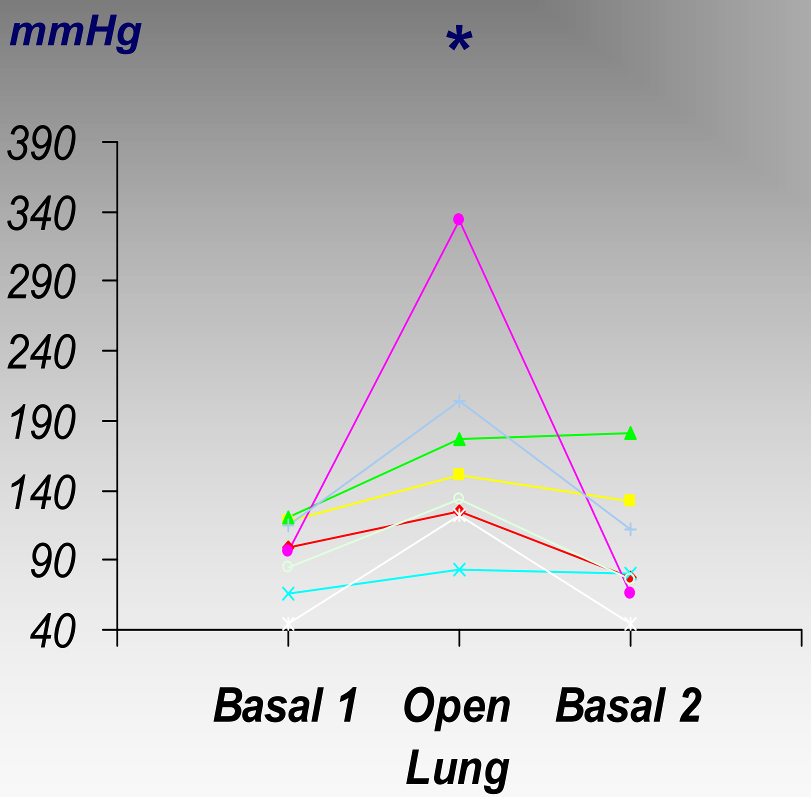


pHa

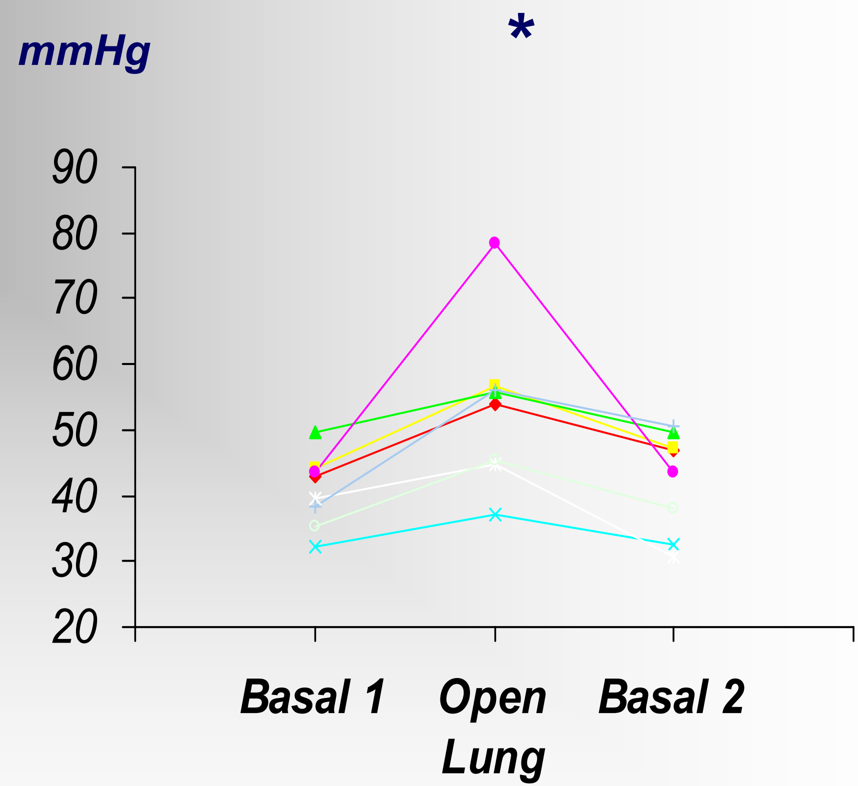


* $p<0.05$

PaO_2

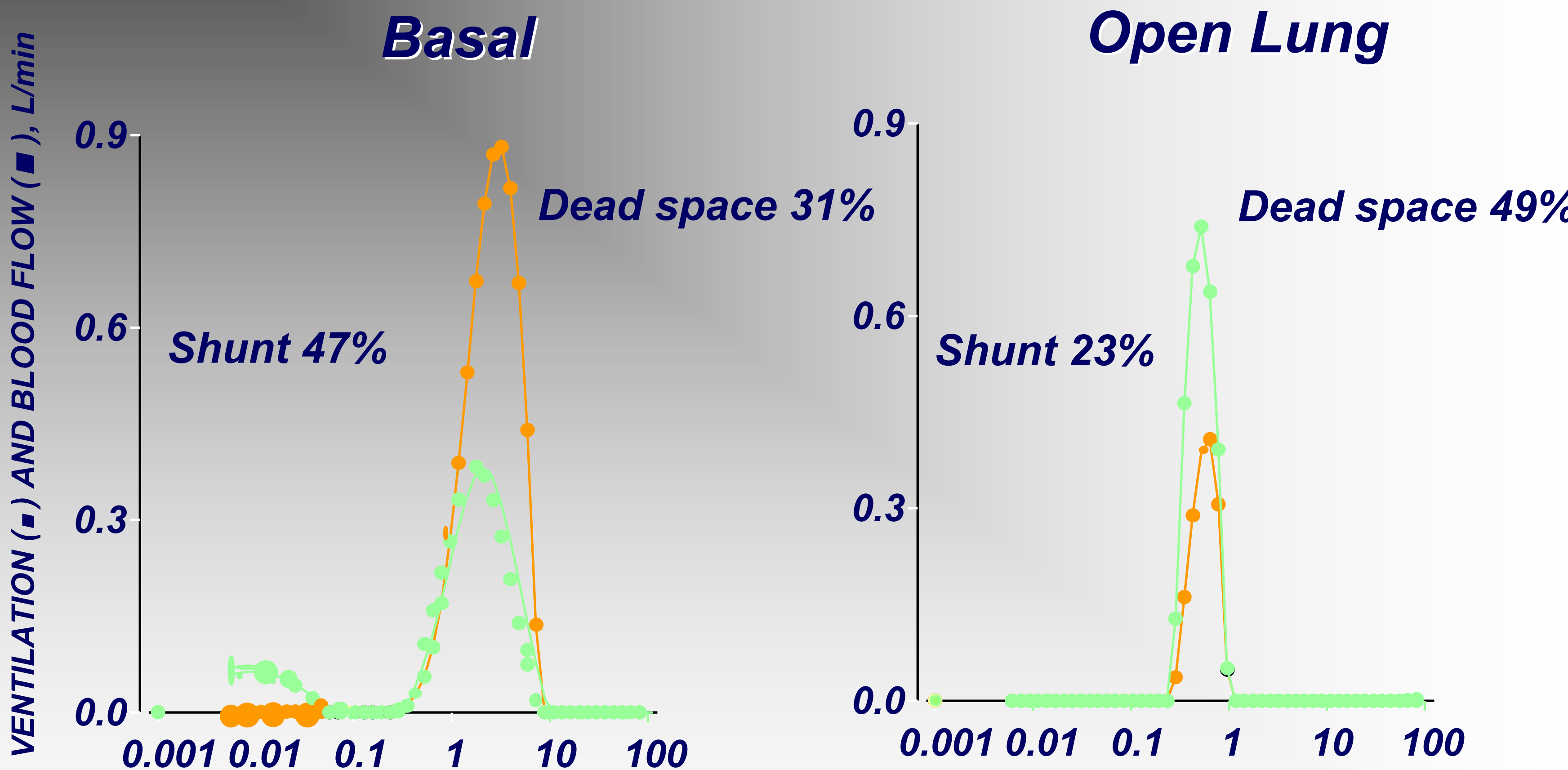


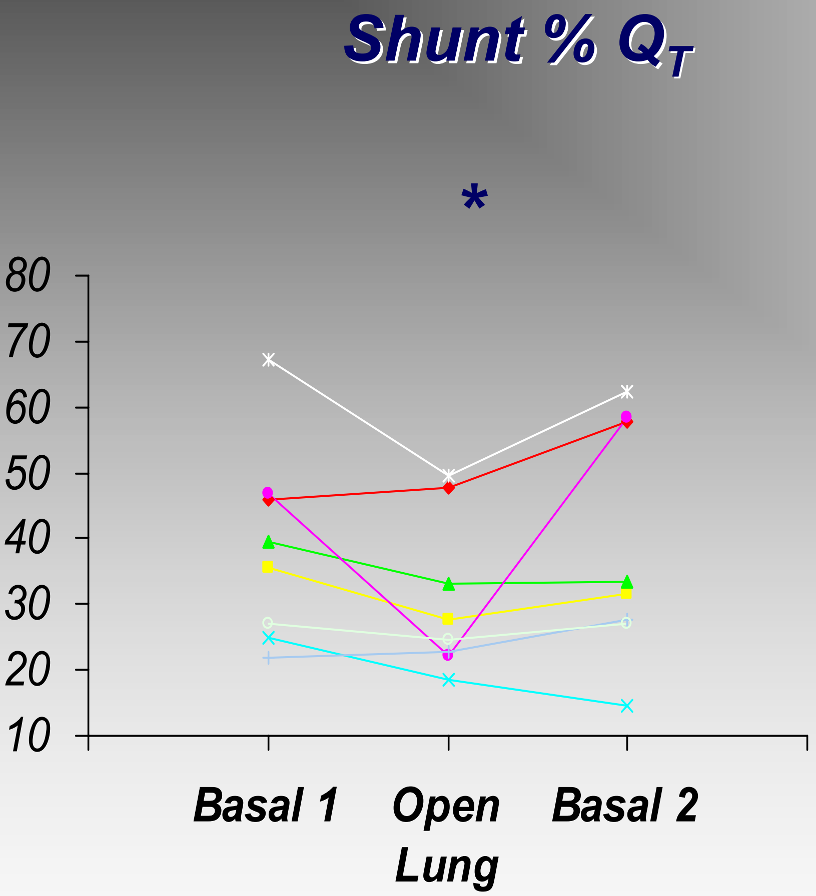
$P\bar{v}O_2$



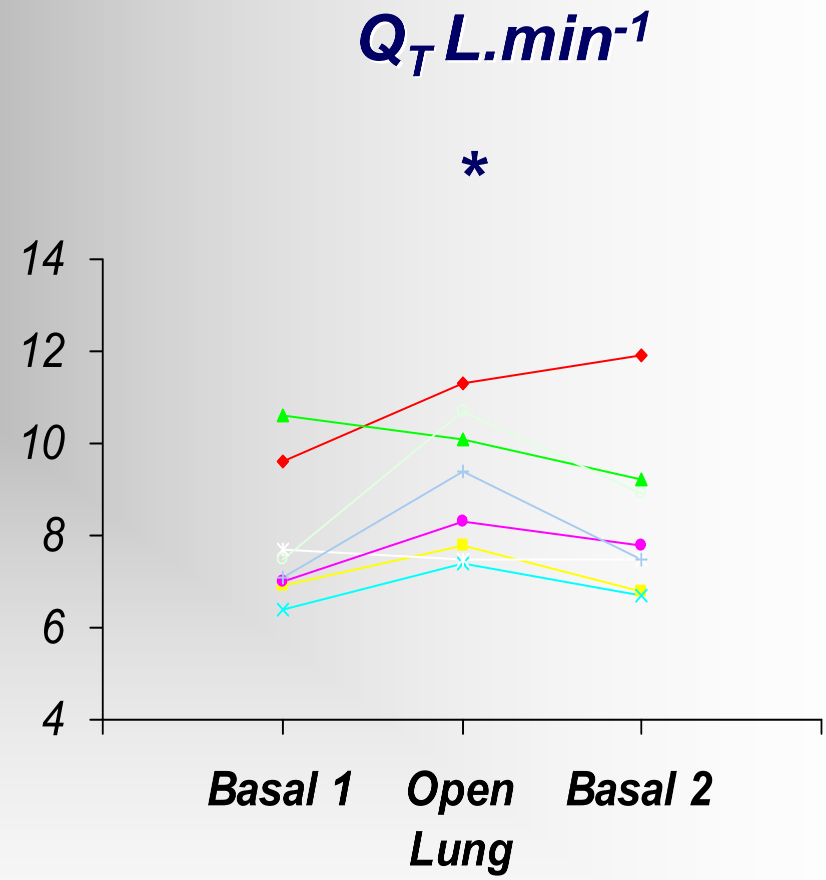
* $p<0.05$

VENTILATION-PERFUSION RATIO





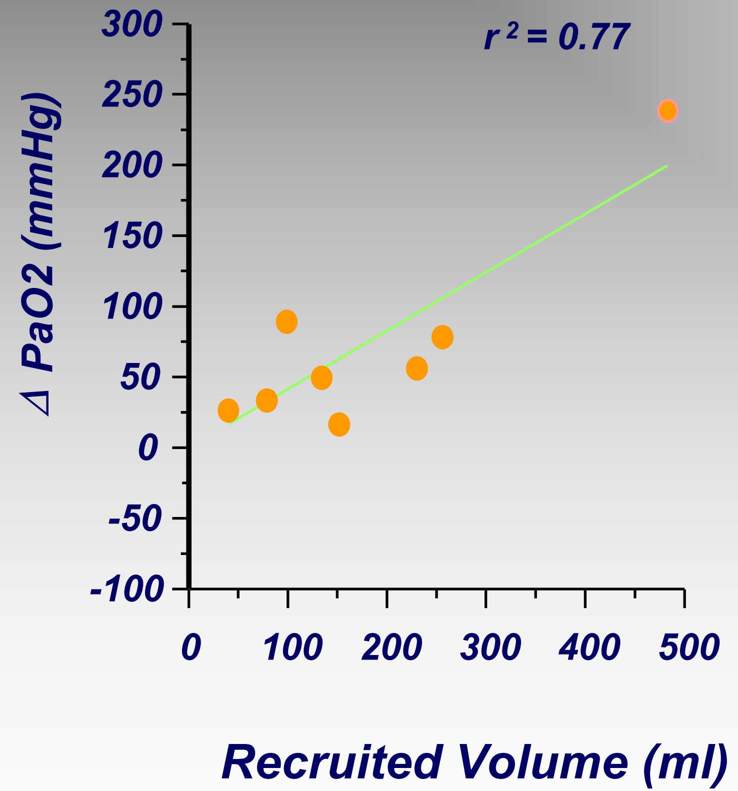
Shunt % Q_T
*
80
70
60
50
40
30
20
10
Basal 1
Open Lung
Basal 2

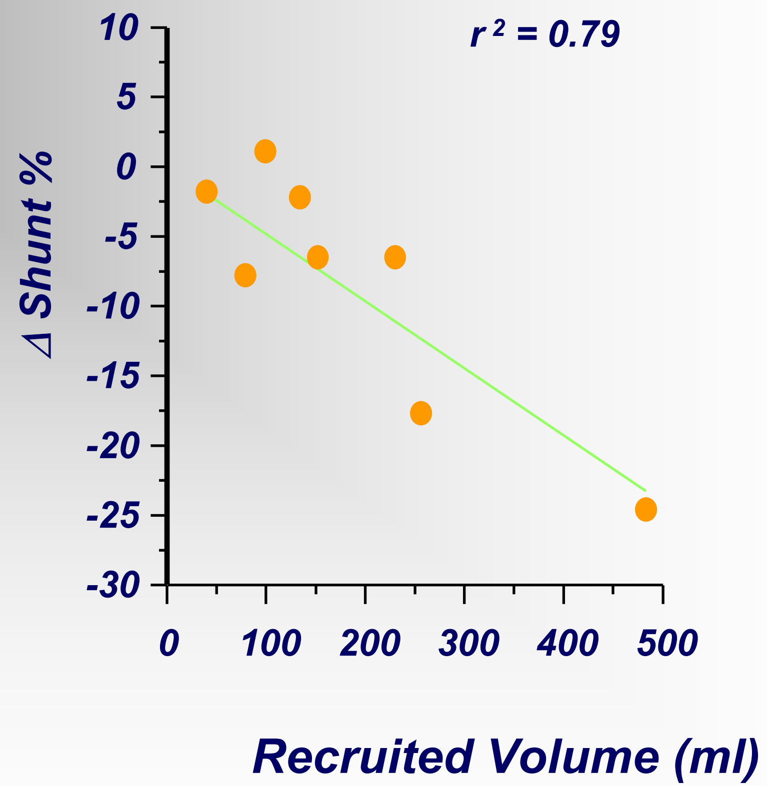


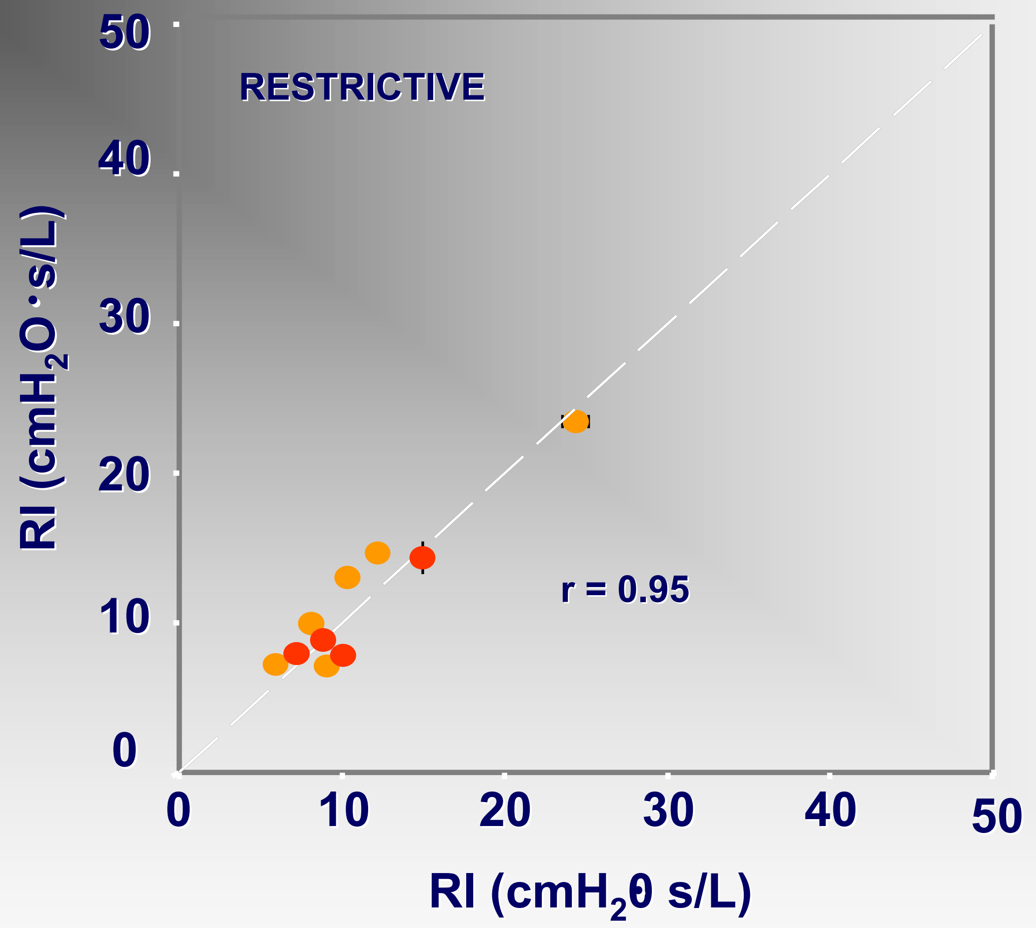
Q_T $L.min^{-1}$
*
14
12
10
8
6
4
Basal 1
Open Lung
Basal 2

* $p<0.05$

Open lung minus baseline differences







RESTRICTIVE
r = 0.95
50
40
30
20
10
0
0
10
20
30
40
50
RI (cmH2O·s/L)
RI (cmH2θ s/L)

Conclusions

The significant increase in arterial oxygenation was essentially explained by alveolar recruitment and the subsequent fall in intrapulmonary shunt produced by the protective ventilatory strategy

“Long lasting effects of recruitment maneuvers on pulmonary gas exchange in ALI/ARDS patients“

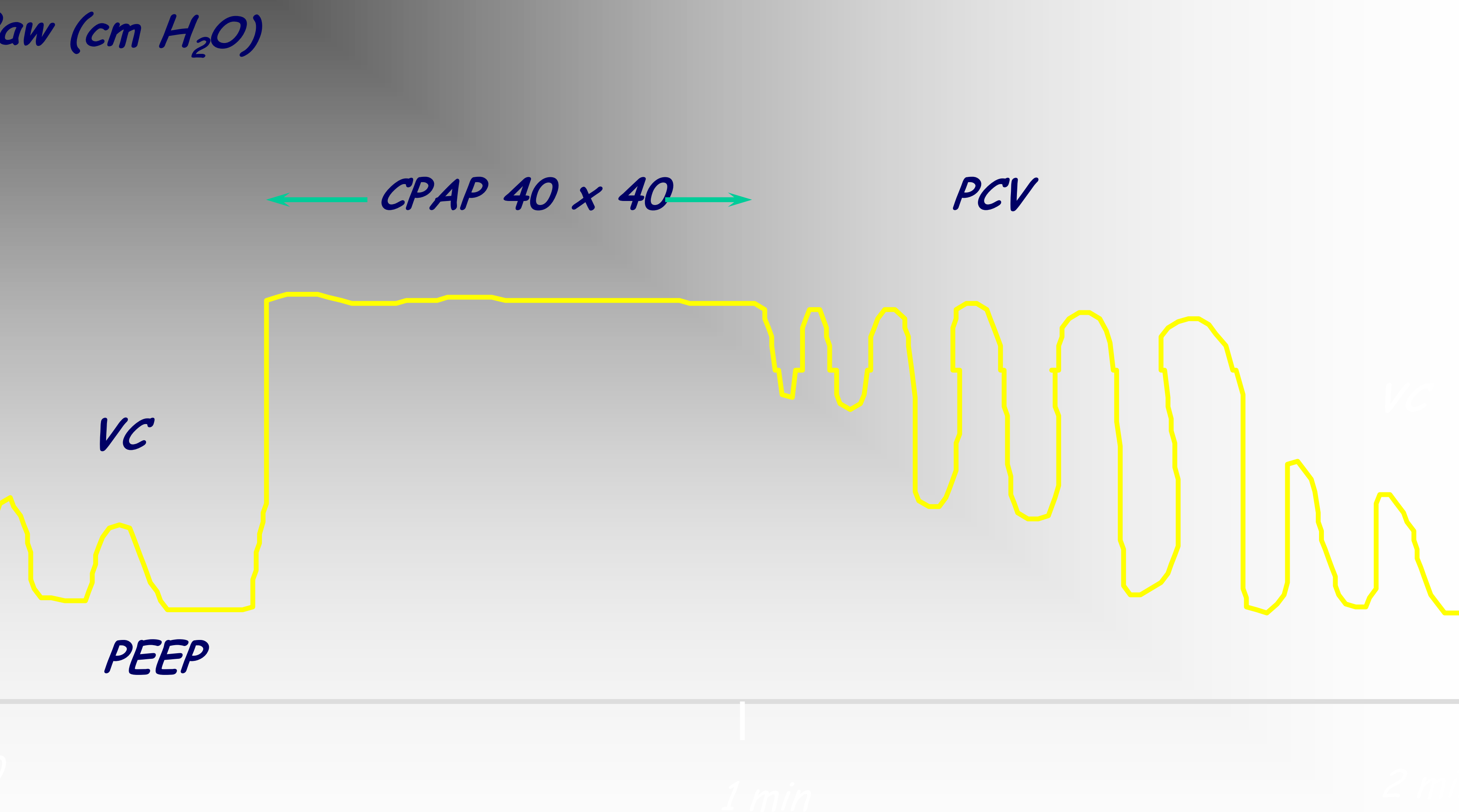
Zavala E, Roca J, Adalia R, Heering Ch, Valera JL, Alcón A, Rodriguez-Roisin R.

Hospital CLÍNIC

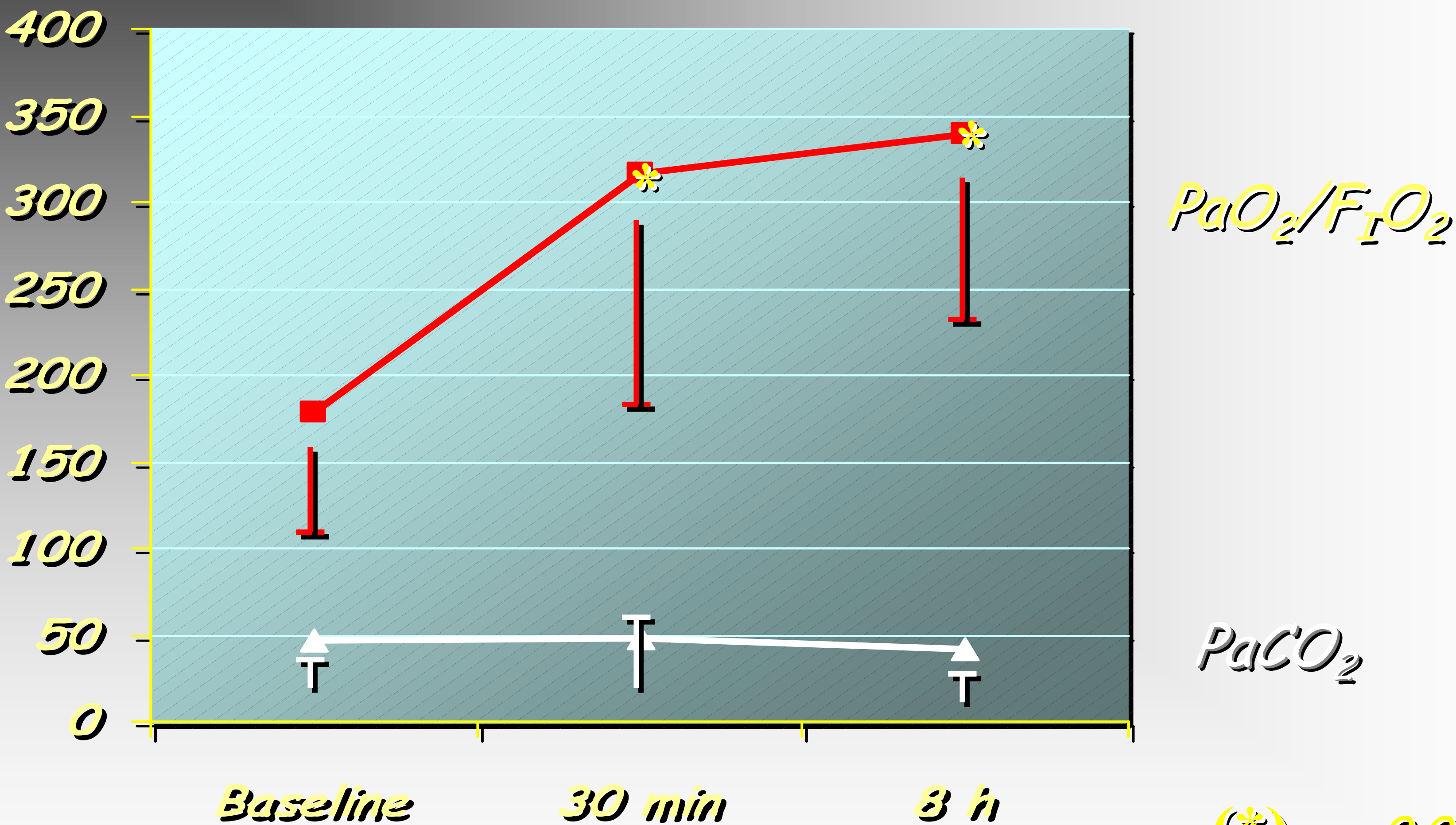
Universitat de Barcelona

ATS 2001

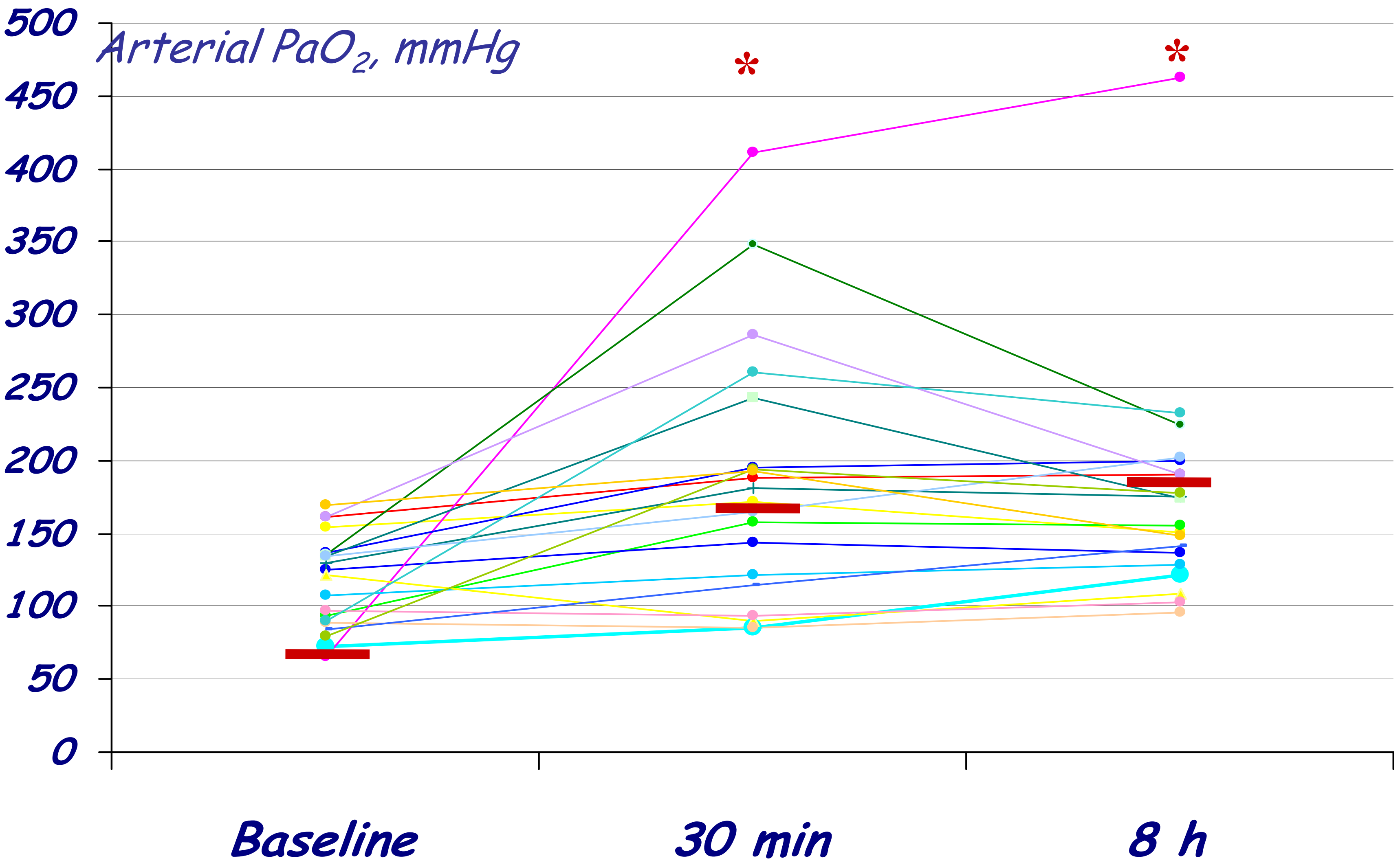
Recruitment maneuver (CPAP 40 x 40)



Arterial Blood Gases (mm Hg ±SEM)



(*) $p = 0.002$


500
450
400
350
300
250
200
150
100
50
0
Arterial PaO_2, mmHg
*
*
Baseline
30 min
8 h

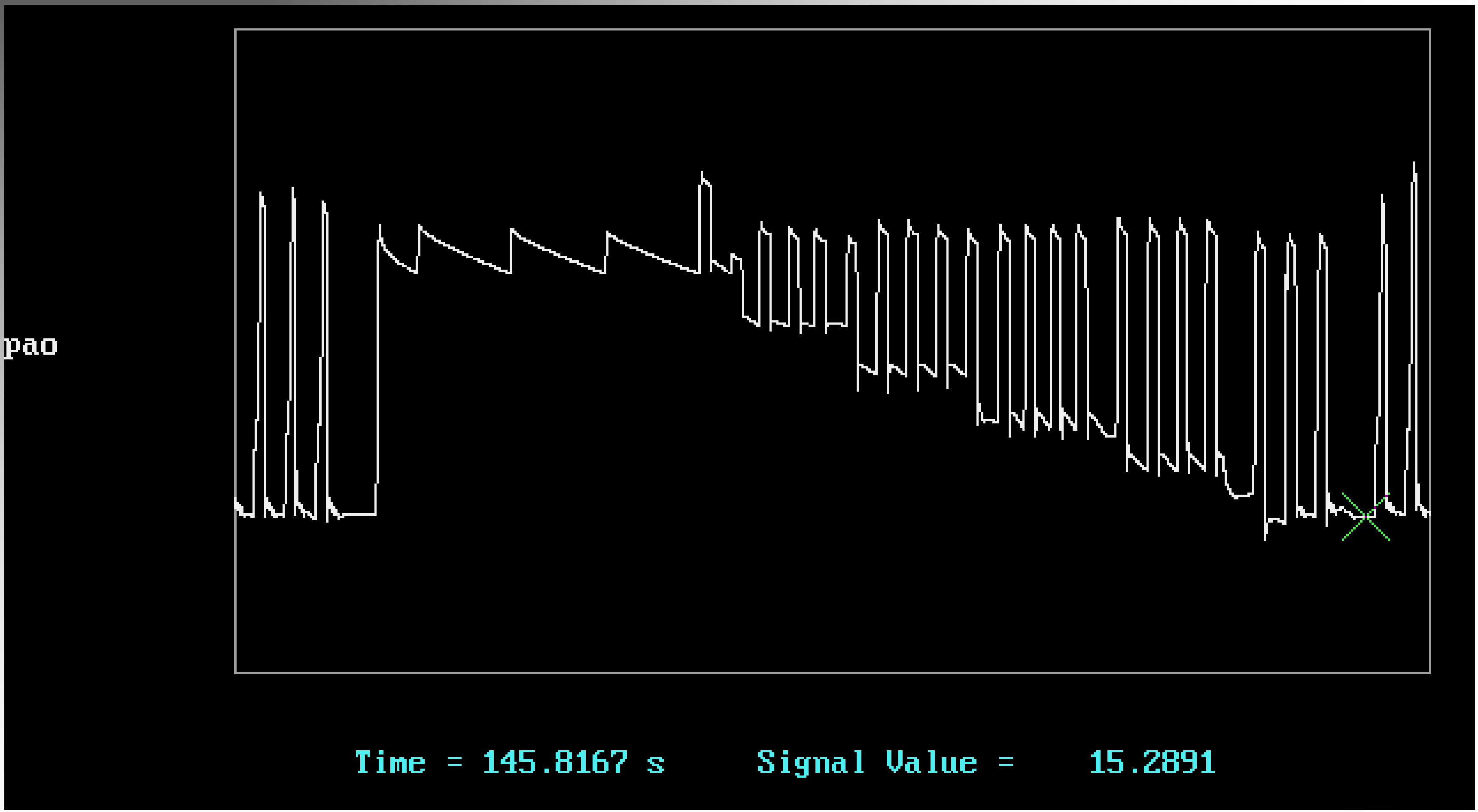
(*) p = 0.014

PaO_2/F_IO_2 in Responders (n=17)

Origin:	ALI	ARDS
- Extrapulmonary	3	8*
- Pulmonary	5	1

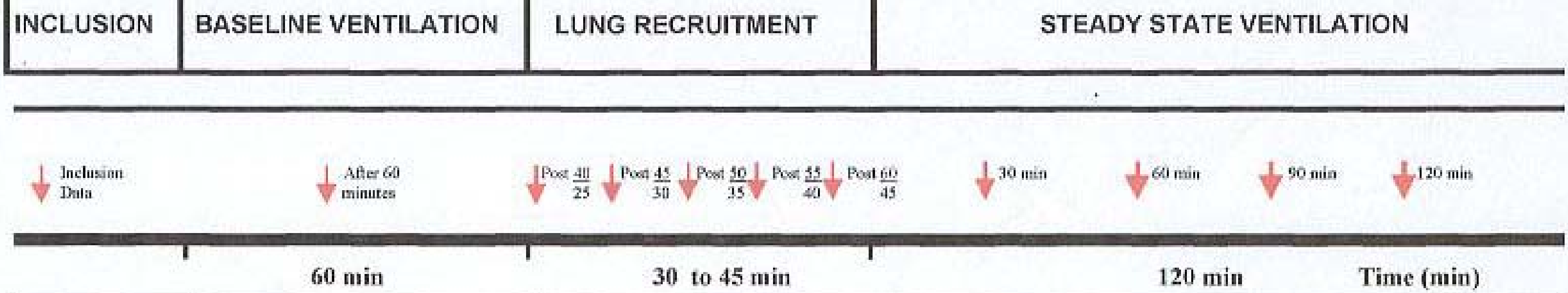
(*) $p = 0.027$

MR CPAP 40x40



" Effects of Recruitment Maneuvers on Lung Function in Patients with Acute Respiratory Distress Syndrome. Utility of continuous Assessment of Arterial Blood gases"

Dr L Blanch — H. Park Tauli (Sabadell)
Dr F Suarez — F. Jimenez Diaz (Madrid)
Dr E Fernandez — H. Virgen de las Nieves (Granada)
Dr J Mancebo — H. Sant Pau (Barcelona)
Dra E Zavala — H. Clínic (Barcelona)



INCLUSION

- Age >18
- > 3 Days MV
- ARDS criteria

EXCLUSION

- COPD
- Asthma
- Head injury
- Hemodyn. Instability
- Previous Barotrauma

NIH ventilation Protocol

VCV
Vt adjusted to 6 mL/kg
Pplat < 30 cmH2O
I:E 1:1 a 1:3
RR 6-35 bpm
(adjusted to achieve a pH goal of 7.3 to 7.45)

PEEP targeted to
PaO2, 55- 80 mm Hg, or SpO2, 88-95%

FiO2	PEEP (cmH2O)
0.3	5
0.4	5
0.4	8
0.5	8
0.5	10
0.6	10
0.7	10
0.7	12
0.7	14
0.8	14
0.9	14
0.9	16
0.9	18
1.0	18
1.0	20
1.0	22
1.0	24

LUNG RECRUITMENT

Aspiration of secretions before starting the recruitment

See Protocol sheet. (example Patient)

Stop recruitment phase when:
(one of the following)
1.- PaO2/FiO2 > 350 maintained during the back-up safety level.
2.- Maximum pressure is reached (60/40 cmH2O)
3.- Safety criteria are met:
± 20 % variations in HR
> 20% decrease in MAP
> 30% increase in $PaCO_2$
> 20% decrease in PaO_2
If Swan Ganz:
> 20% decrease in CI and/or SvO_2,
> 20% increase in MPAP

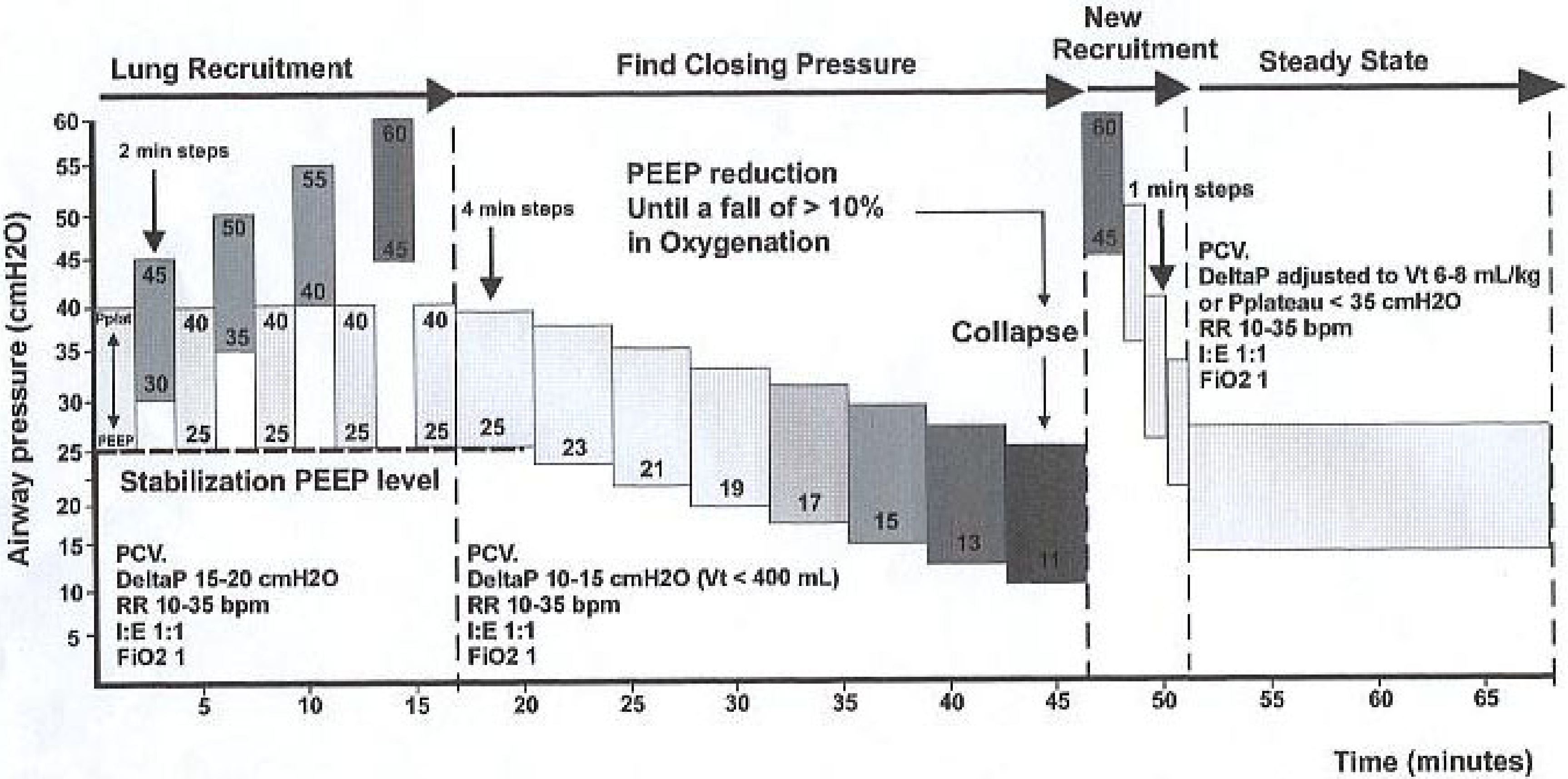
During closing pressure search the Inspiratory pressure gradient should be limited to obtain a Vt ≤ 400 mL

STEADY STATE VENTILATION

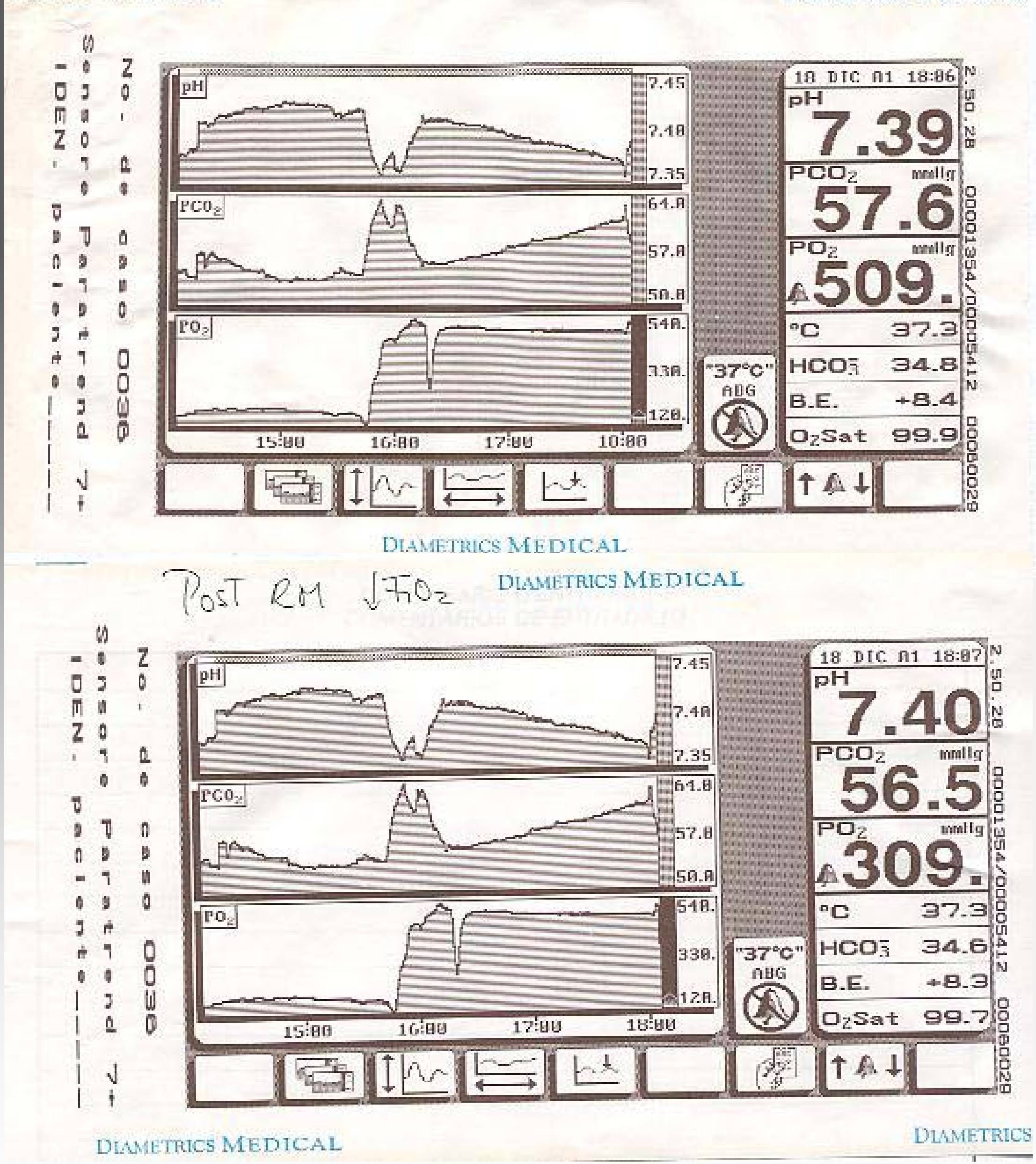
PCV
Delta P adjusted to Vt of 6-8 mL/kg
PEEP 2 cmH2O above closing pressure.
RR 10-35 bpm.
I:E 1:1

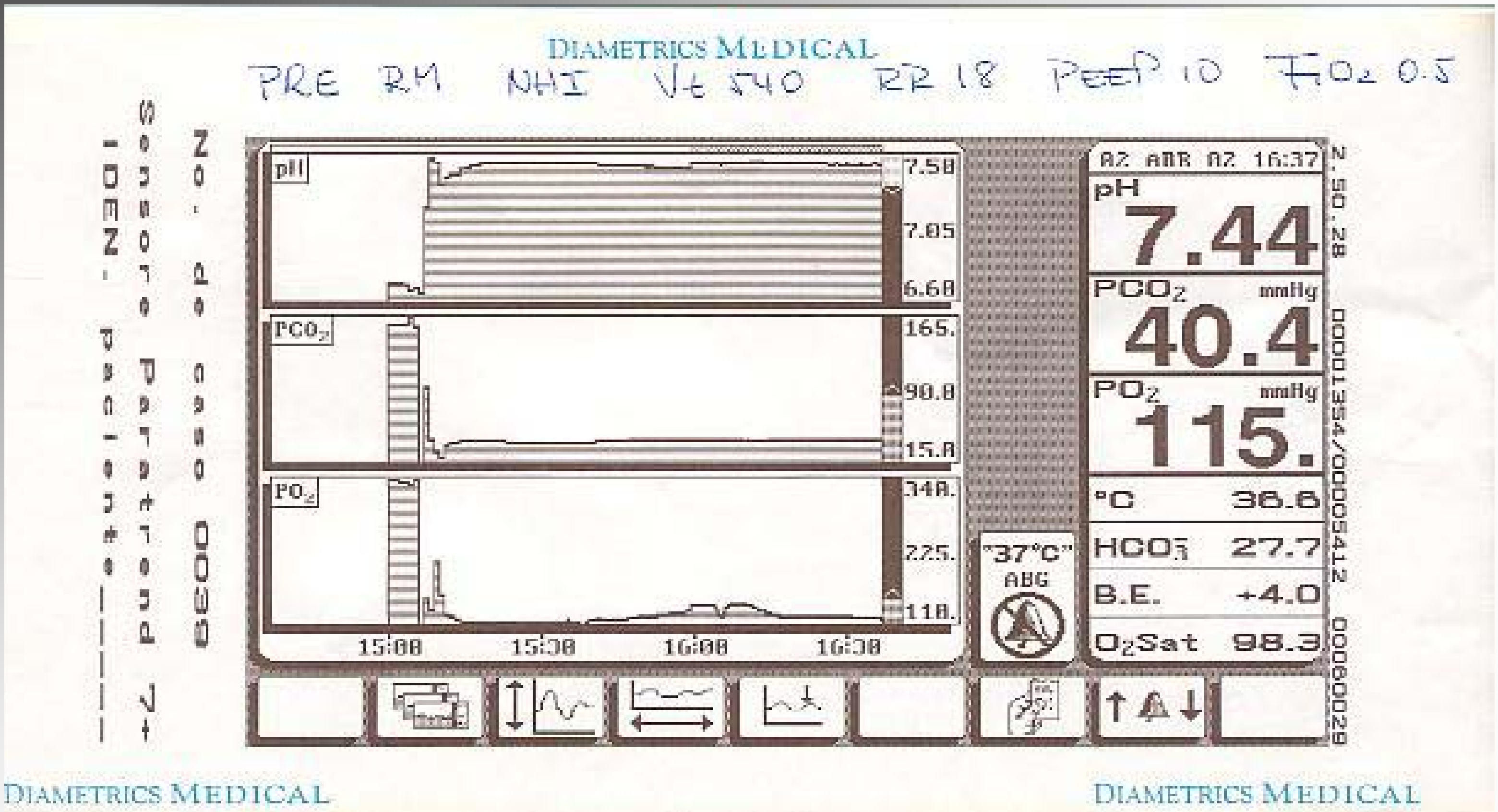
Avoid patient Disconnection during the study period..
If disconnection, a new recruitment, at identified opening pressures as shown in the protocol must be performed, returning to steady state ventilation.

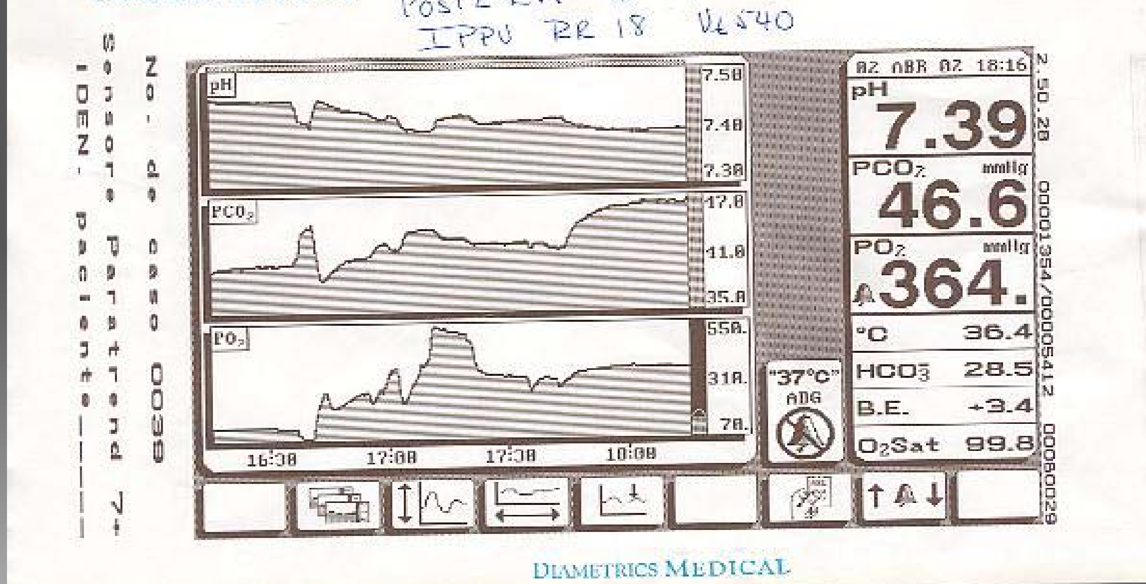
Lung Recruitment Maneuver

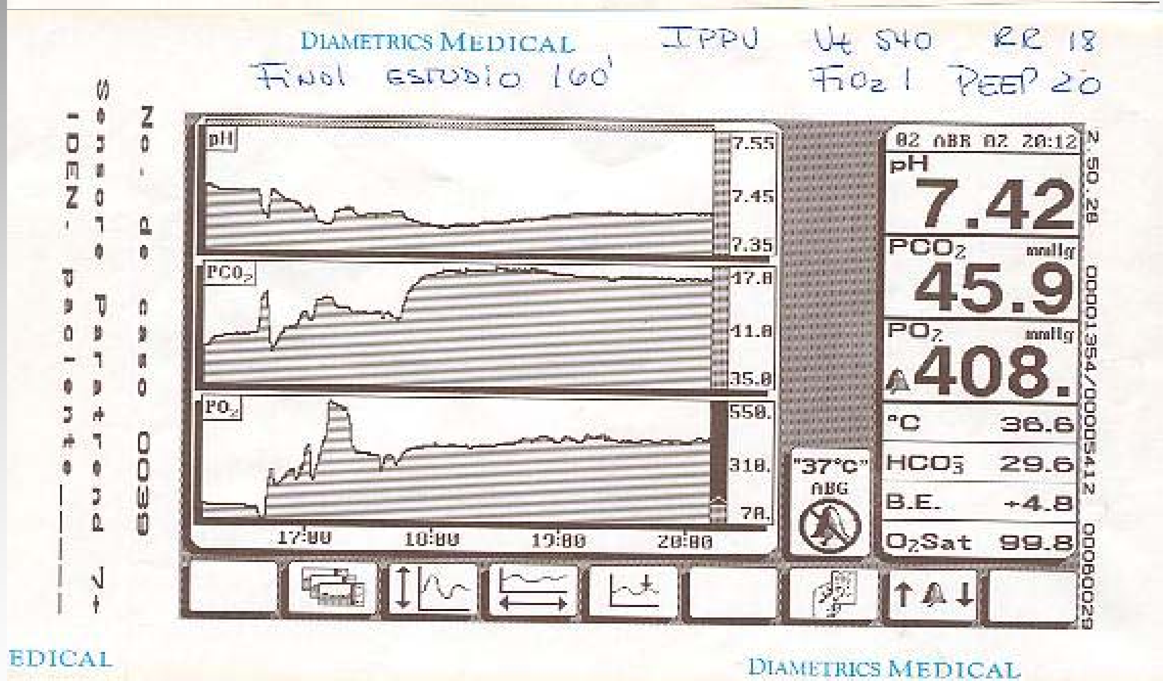


Recruitment maneuver in an example patient in which delta P was maintained at 15 cmH2O, opening pressures were found at 60/45 cmH2O and closing pressures were found at PEEP of 11 cmH2O. After the reopening PEEP is maintained 2 cmH2O above the closing pressure. (13 cmH2O in this patient).


18 DIC 01 18:06
pH 7.39
PCO2 mmHg 57.6
PO2 mmHg 509.
°C 37.3
HCO3 34.8
B.E. +8.4
O2Sat 99.9
"37°C" ABG
15:00
16:00
17:00
DIAMETRICS MEDICAL
Post RM ↓FiO2
DIAMETRICS MEDICAL
18 DIC 01 18:07
pH 7.40
PCO2 mmHg 56.5
PO2 mmHg 309.
°C 37.3
HCO3 34.6
B.E. +8.3
O2Sat 99.7
"37°C" ABG
15:00
16:00
17:00
18:00
DIAMETRICS MEDICAL
DIAMETRICS


DIAMETRICS MEDICAL
PRE RM NHI Vt 540 RR 18 PEEP 10 FiO2 0.5
pH
7.50
7.05
6.60
PCO2
165.
90.0
15.0
PO2
340.
225.
110.
15:00 15:30 16:00 16:30
"37°C"
ABG
02 ABR 02 16:37
pH
7.44
PCO2 mmHg
40.4
PO2 mmHg
115.
°C 36.6
HCO3 27.7
B.E. +4.0
O2Sat 98.3
DIAMETRICS MEDICAL
DIAMETRICS MEDICAL


IPPU RR 18 Vt 540
No. de caso 0039
Sensore Paratrend 7+
IDEN. Paciente ____
02 ABR 02 18:16
pH
7.39
PCO2 mmHg
46.6
PO2 mmHg
364.
°C 36.4
HCO3 28.5
B.E. +3.4
O2Sat 99.8
"37°C" ABG
16:30
17:00
17:30
18:00
DIAMETRICS MEDICAL


DIAMETRICS MEDICAL
IPPU Vt 540 RR 18
Final estudio 160'
FiO2 1 PEEP 20
No. de caso 0039
Sensore Paratrend 7+
IDEN. Paciente ____
02 ABR 02 20:12
pH
7.42
PCO2 mmHg
45.9
PO2 mmHg
408.
°C 36.6
HCO3 29.6
B.E. +4.8
O2Sat 99.8
"37°C" ABG
17:00
18:00
19:00
20:00
DIAMETRICS MEDICAL

Influence of Tidal Volume on Alveolar Recruitment

Respective Role of PEEP and a Recruitment Maneuver

JEAN-CHRISTOPHE RICHARD, SALVATORE M. MAGGIORE, BJORN JONSON, JORDI MANCEBO, FRANCOIS LEMAIRE, and LAURENT BROCHARD

Medical Intensive Care Unit and INSERM U 492, Henri Mondor Hospital, University Paris XII, Créteil, France

TABLE 2. VENTILATORY SETTINGS DURING VENTILATION WITH PEEP SET AT Pflip*

	LVT (n = 15)	CVT (n = 15)	p Value†
VT, ml	411 ± 55	664 ± 84	< 0.01
VT, ml · kg^{-1}	6 ± 1	10 ± 1	< 0.01
setPEEP, cm H_2O	10 + 4	10 + 4	NS
PEEPtot, cm H_2O	11 ± 4	11 ± 4	NS
Pplat, cm H_2O	23 ± 8	30 ± 10	< 0.01

Vt 6ml/kg vs 10 ml /kg
PEEP LIP

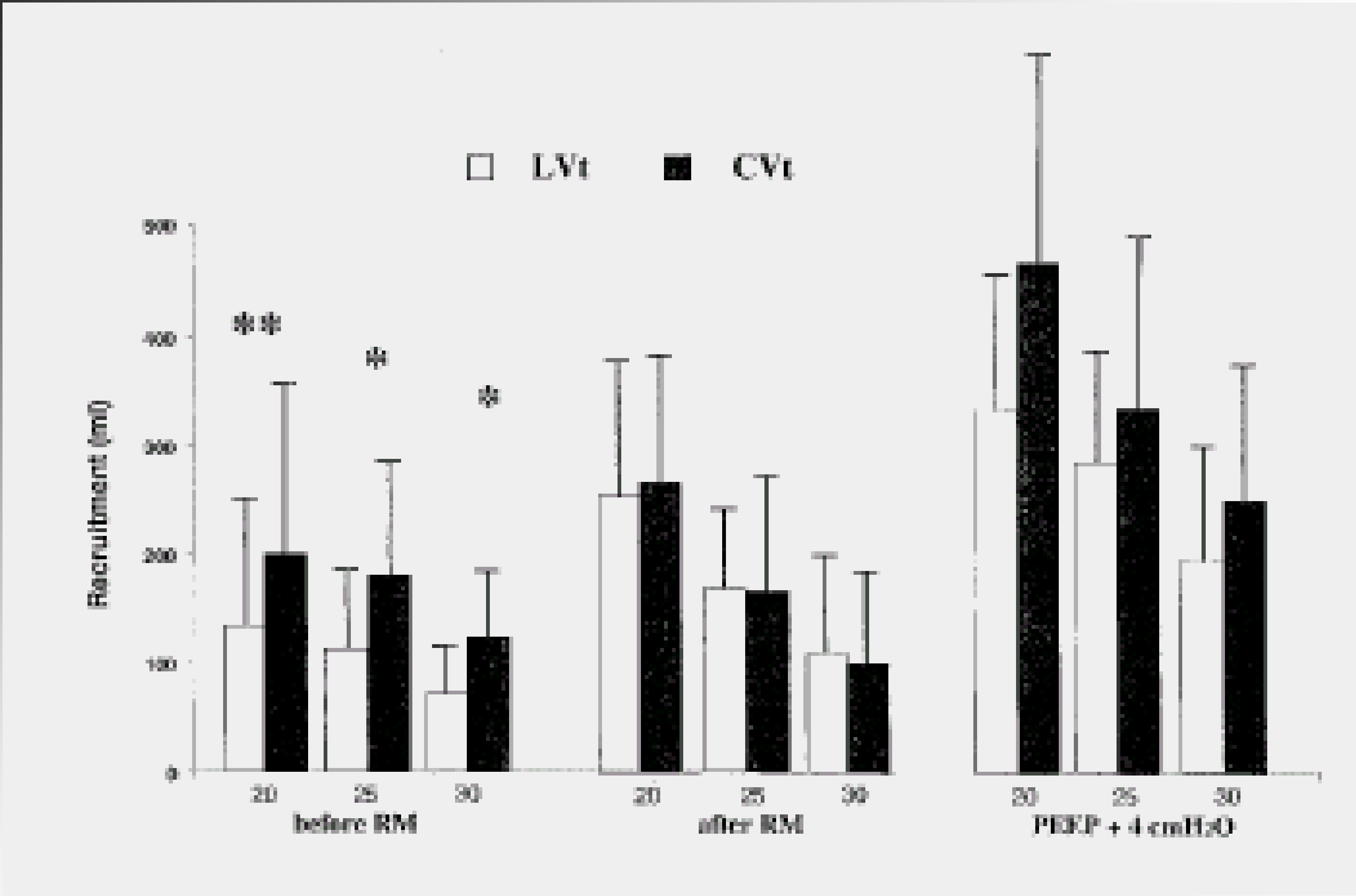
Am J Respir Crit Care Med 2001; 163: 1609-1613

TABLE 3. GAS EXCHANGE AND HEMODYNAMIC PARAMETERS DURING VENTILATION WITH PEEP SET AT Pflp*

	LVT (n = 15)	CVT (n = 15)	p Value†
Pa_{O_2}, mm Hg	136 ± 80	154 ± 82	NS
Pa_{O_2}/FI_{O_2}, mm Hg	165 ± 84	183 ± 80	NS
Sa_{O_2}, %	94.8 ± 5.0	97.6 ± 2.1	< 0.05
Pa_{CO_2}, mm Hg	60 ± 35	38 ± 21	< 0.001
pH	7.21 ± 0.1	7.36 ± 0.1	< 0.001
SBP, mm Hg	125 ± 25	121 ± 20	NS
DBP, mm Hg	60 ± 9	60 ± 10	NS
HR, min^{-1}	101 ± 15	93 ± 15	NS

Am J Respir Crit Care Med 2001; 163: 1609-1613

PEEP or RM reverses alveolar derecruitment induced by LVt



Am J Respir Crit Care Med 2001; 163: 1609-1613

Alveolar Derecruitment at Decremental Positive End-Expiratory Pressure Levels in Acute Lung Injury

Comparison with the Lower Inflection Point, Oxygenation, and Compliance

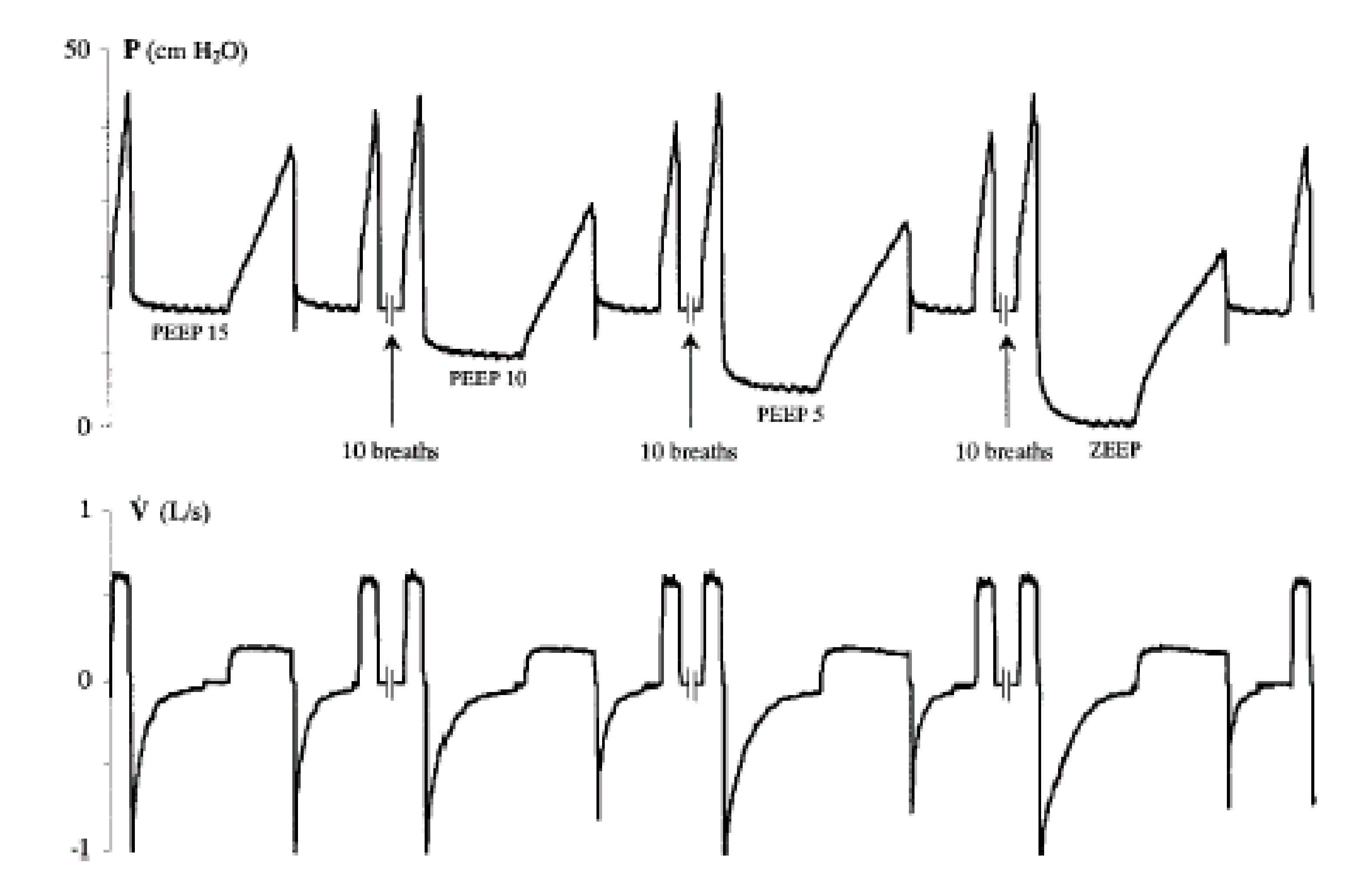
SALVATORE M. MAGGIORE, BJÖRN JONSON, JEAN-CHRISTOPHE RICHARD, SAMIR JABER, FRANÇOIS LEMAIRE, and LAURENT BROCHARD

Medical Intensive Care Unit, INSERM U492, Henri Mondor Teaching Hospital, AP-HP, Paris XII University, Créteil, France; and Department of Clinical Physiology, Lund University Hospital, Lund, Sweden

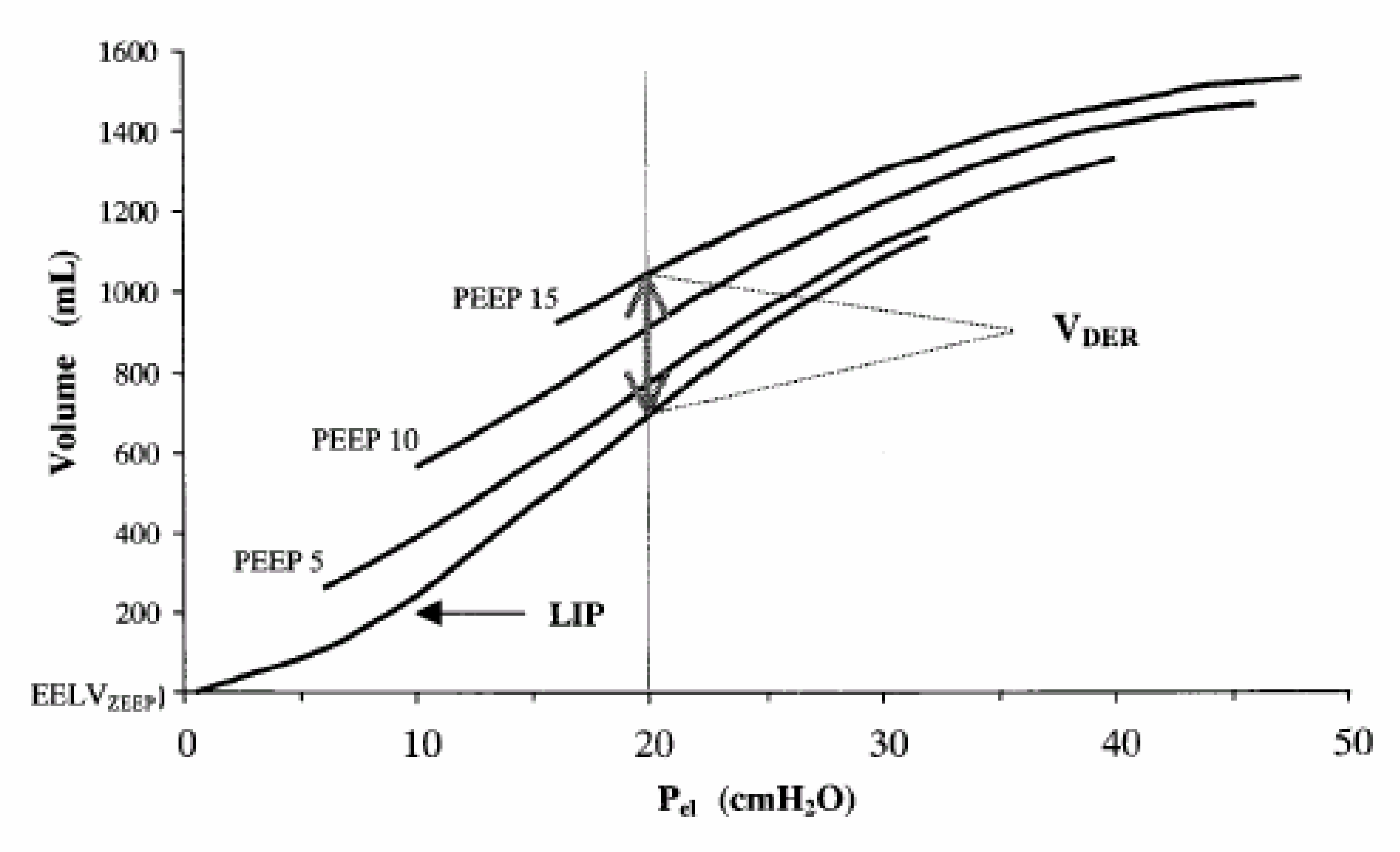
Curvas P x V a diferentes niveles de PEEP decrecientes

Determinar Pr cierre alveolar .... PEEP optima

Am J Respir Crit Care Med 2001; 164: 795-801



Am J Respir Crit Care Med 2001; 164: 795-801



Am J Respir Crit Care Med 2001; 164: 795-801

Recruitment Maneuvers during Lung Protective Ventilation in Acute Respiratory Distress Syndrome

ANA VILLAGRÁ, ANA OCHAGAVÍA, SARA VATUA, GASTÓN MURIAS, MARIA DEL MAR FERNÁNDEZ, JOSEFINA LOPEZ AGUILAR, RAFAEL FERNÁNDEZ, and LLUIS BLANCH

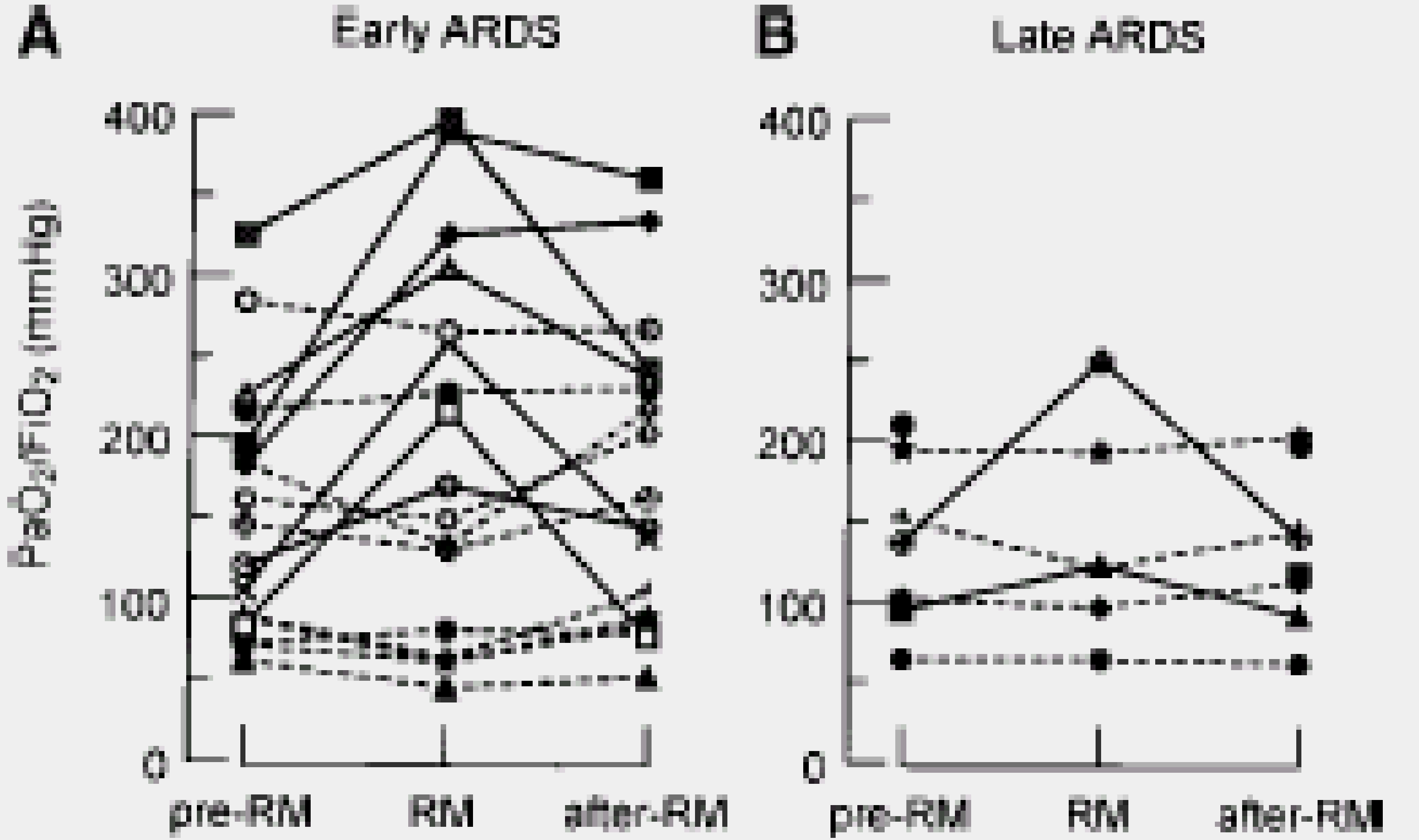
Critical Care Center, Hospital de Sabadell, Corporacio Parc Tauli, Sabadell, Spain

TABLE 2. VENTILATORY PATTERN AND HEMODYNAMIC VARIABLES BEFORE RM AT THE STUDY DAY*

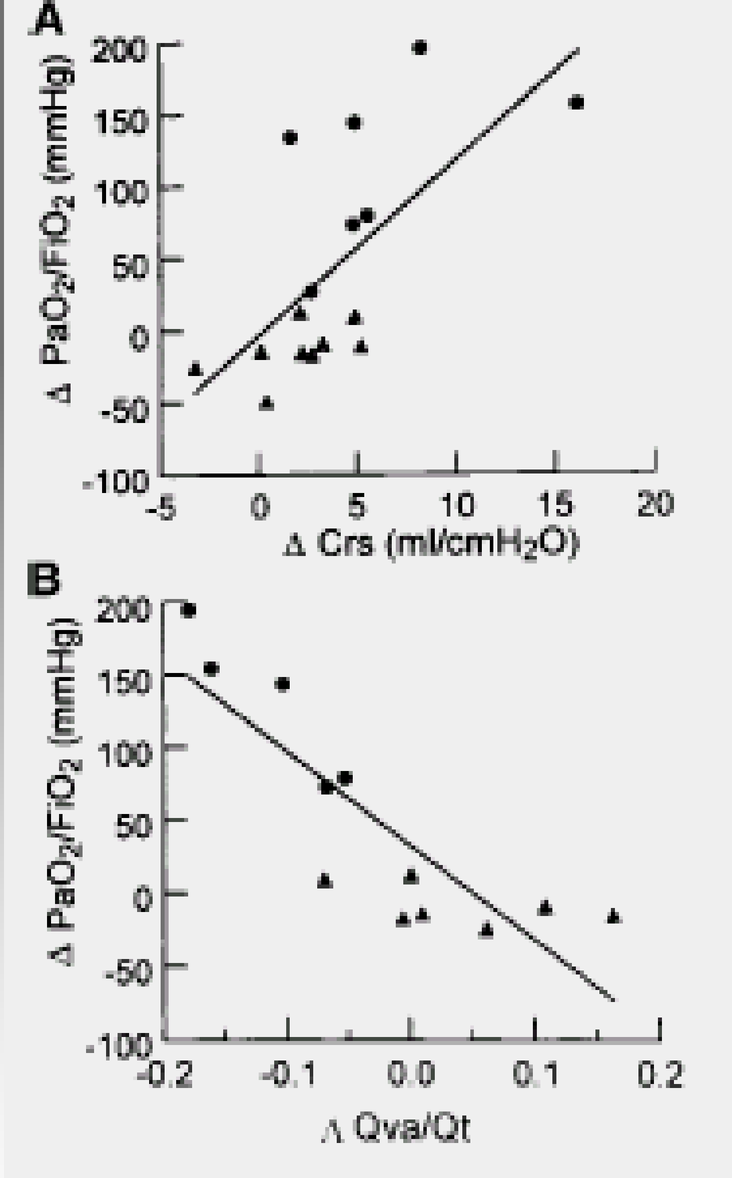
	Early ARDS	Late ARDS	p Value
V_T, L	0.494 ± 0.055	0.463 ± 0.076	NS
V, L/s	0.67 ± 0.11	0.66 ± 0.17	NS
$\dot{V}_E$, L/min	10.4 ± 1.6	10.7 ± 1.5	NS
RR, breaths/min	21 ± 3	24 ± 4	NS
PEEP, cm H_2O	14 ± 1	15 ± 2	NS
F_{IO_2}	0.84 ± 0.14	0.79 ± 0.14	NS

Ppeak 50 cm H2O
PEEP > LIP

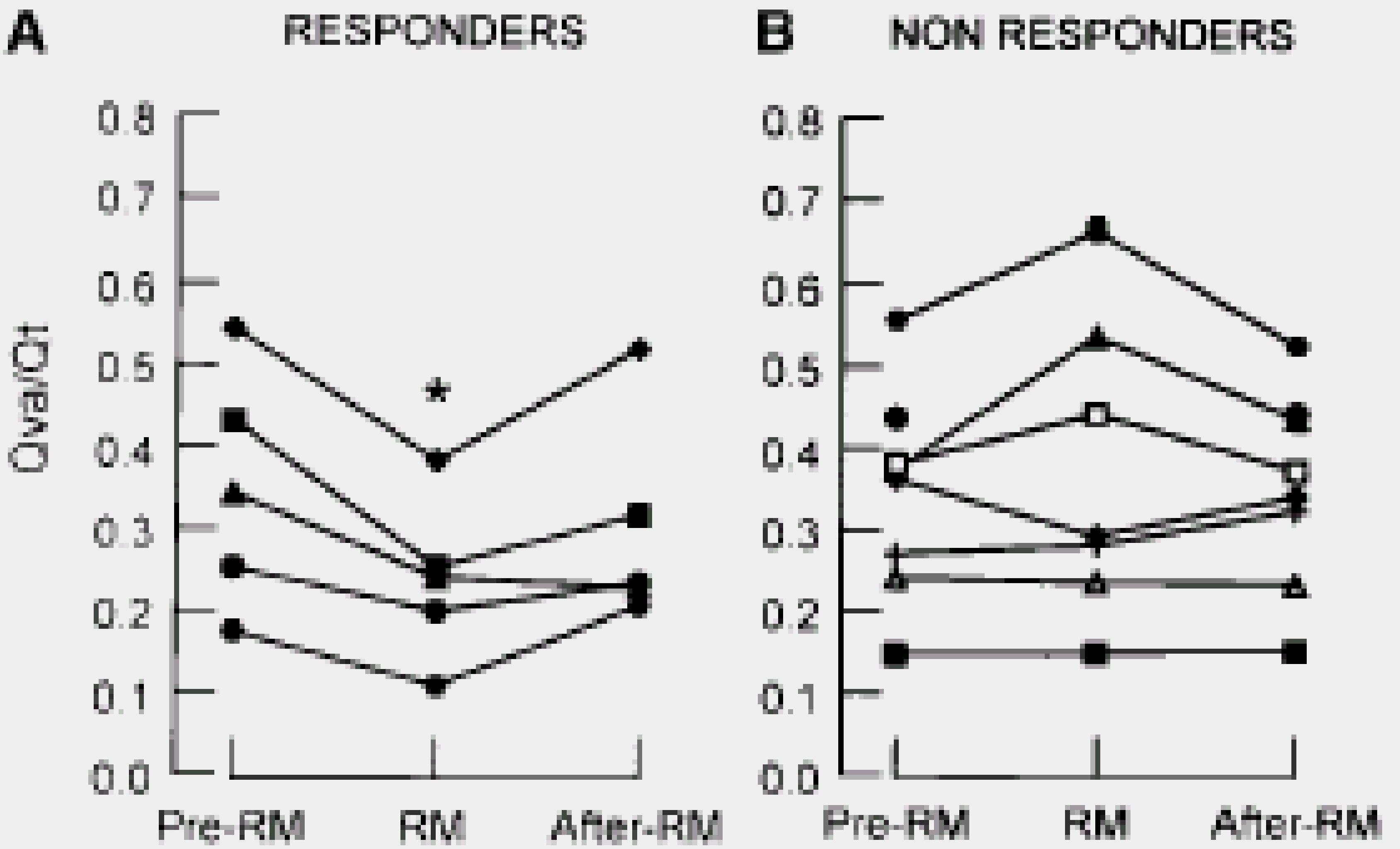
Am J Respir Crit Care Med 2002; 165: 165-170



Am J Respir Crit Care Med 2002; 165: 165-170



Am J Respir Crit Care Med 2002; 165: 165-170



Am J Respir Crit Care Med 2002; 165: 165-170

Anesthesiology 2002; 96:795–802

Effects of Recruiting Maneuvers in Patients with Acute Respiratory Distress Syndrome Ventilated with Protective Ventilatory Strategy

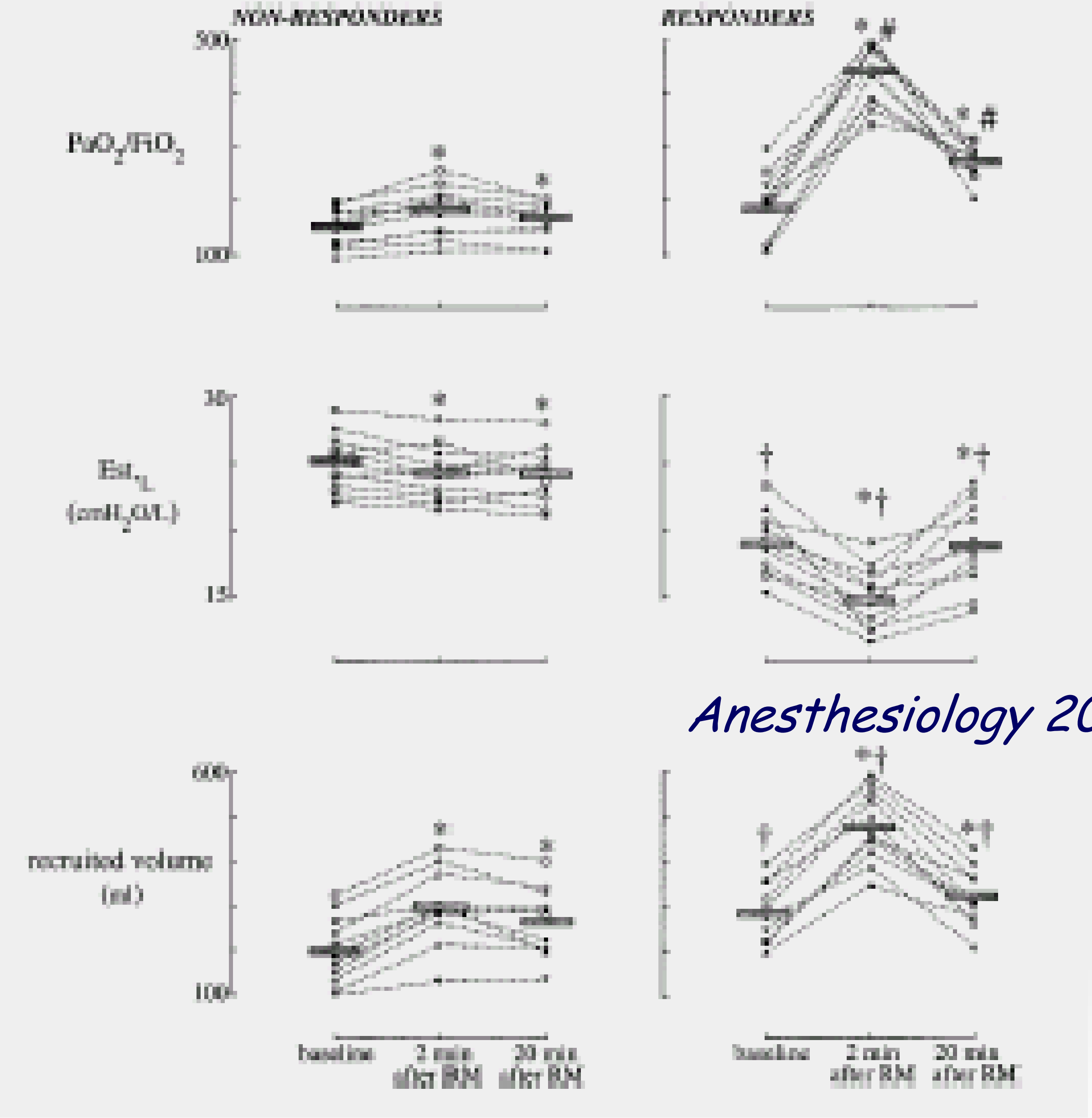
Salvatore Grasso, M.D.,* Luciana Mascia, M.D.,† Monica Del Turco, M.D.,‡ Paolo Malacarne, M.D.,‡
Francesco Giunta, M.D.,§ Laurent Brochard, M.D.,‖ Arthur S. Slutsky, M.D.,# V. Marco Ranieri, M.D.**

Vt bajo + MR (CPAP 40 x 40)
NIH (basal)

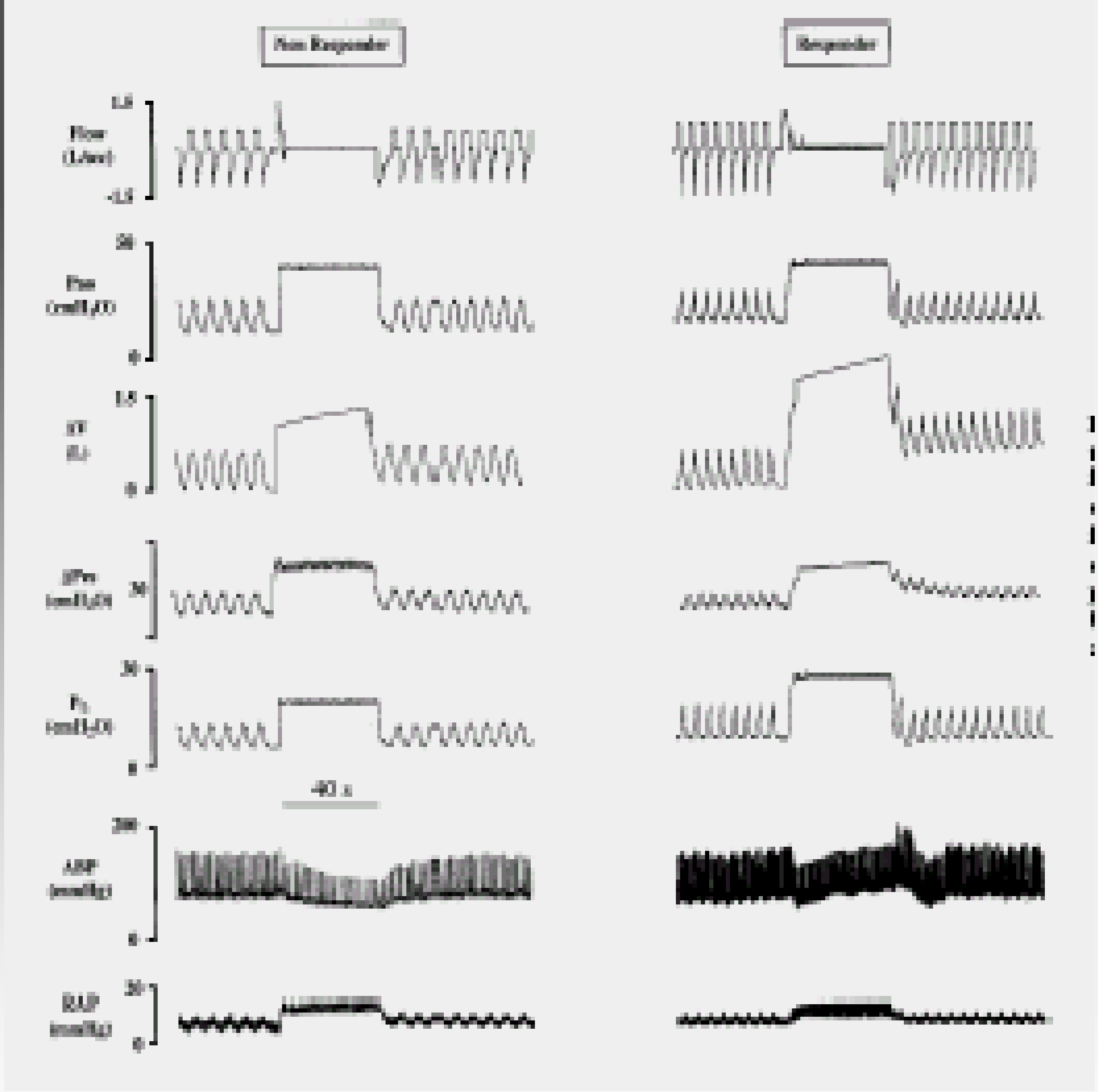
Fase temprana del ARDS Curvas P x V

Respondedores vs no respondedores

Anesthesiology 2002; 96: 795-80



Anesthesiology 2002; 96: 795-80



Anesthesiology 2002; 96: 795-80

The NEW ENGLAND JOURNAL of MEDICINE

ESTABLISHED IN 1812 APRIL 27, 2006 VOL. 354 NO. 17

Lung Recruitment in Patients with the Acute Respiratory Distress Syndrome

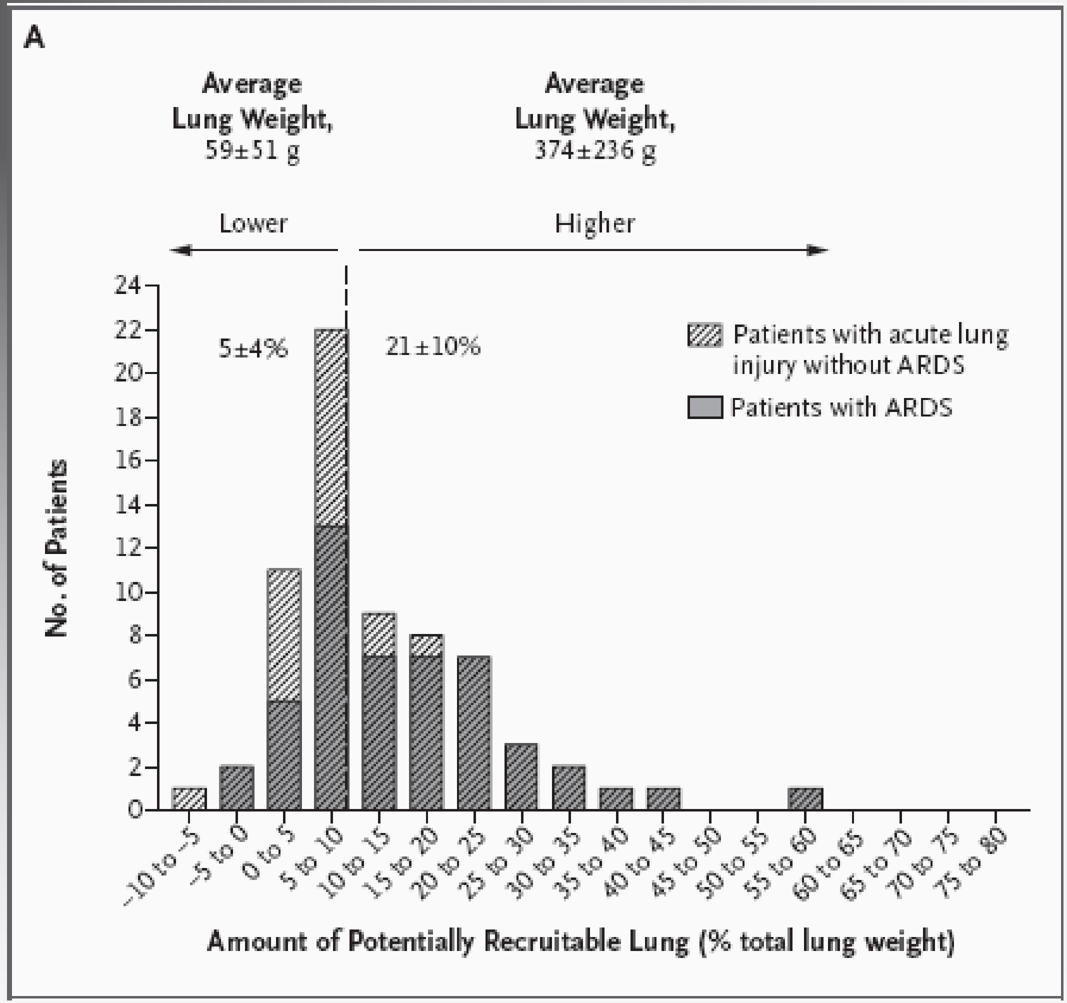
Luciano Gattinoni, M.D., F.R.C.P., Pietro Caironi, M.D., Massimo Cressoni, M.D., Davide Chiumello, M.D., V. Marco Ranieri, M.D., Michael Quintel, M.D., Ph.D., Sebastiano Russo, M.D., Nicolò Patroniti, M.D., Rodrigo Cornejo, M.D., and Guillermo Bugedo, M.D.

ARDS → Vent Mec → VILI

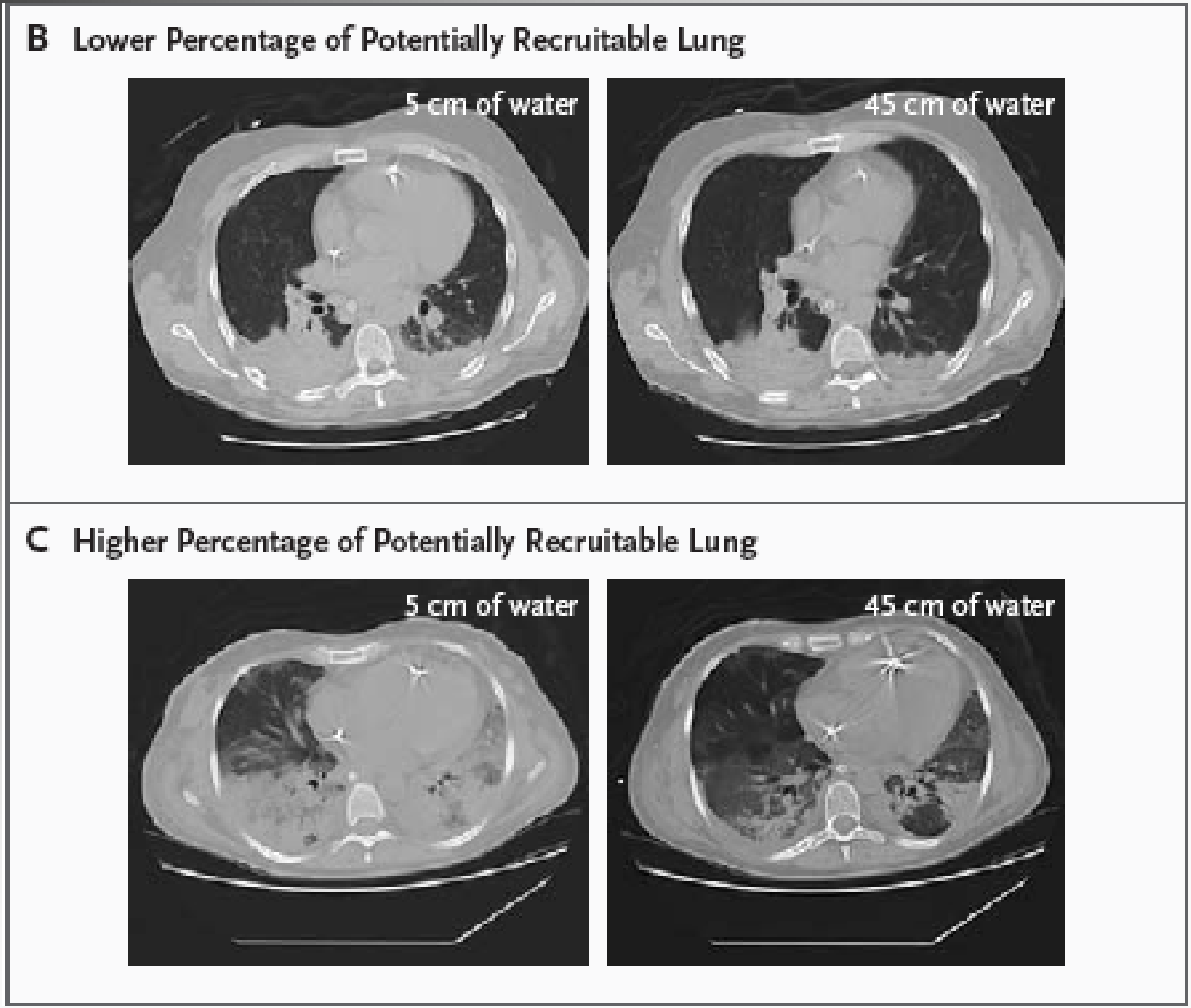
Vent Mec → Restaurar oxigenación adecuada

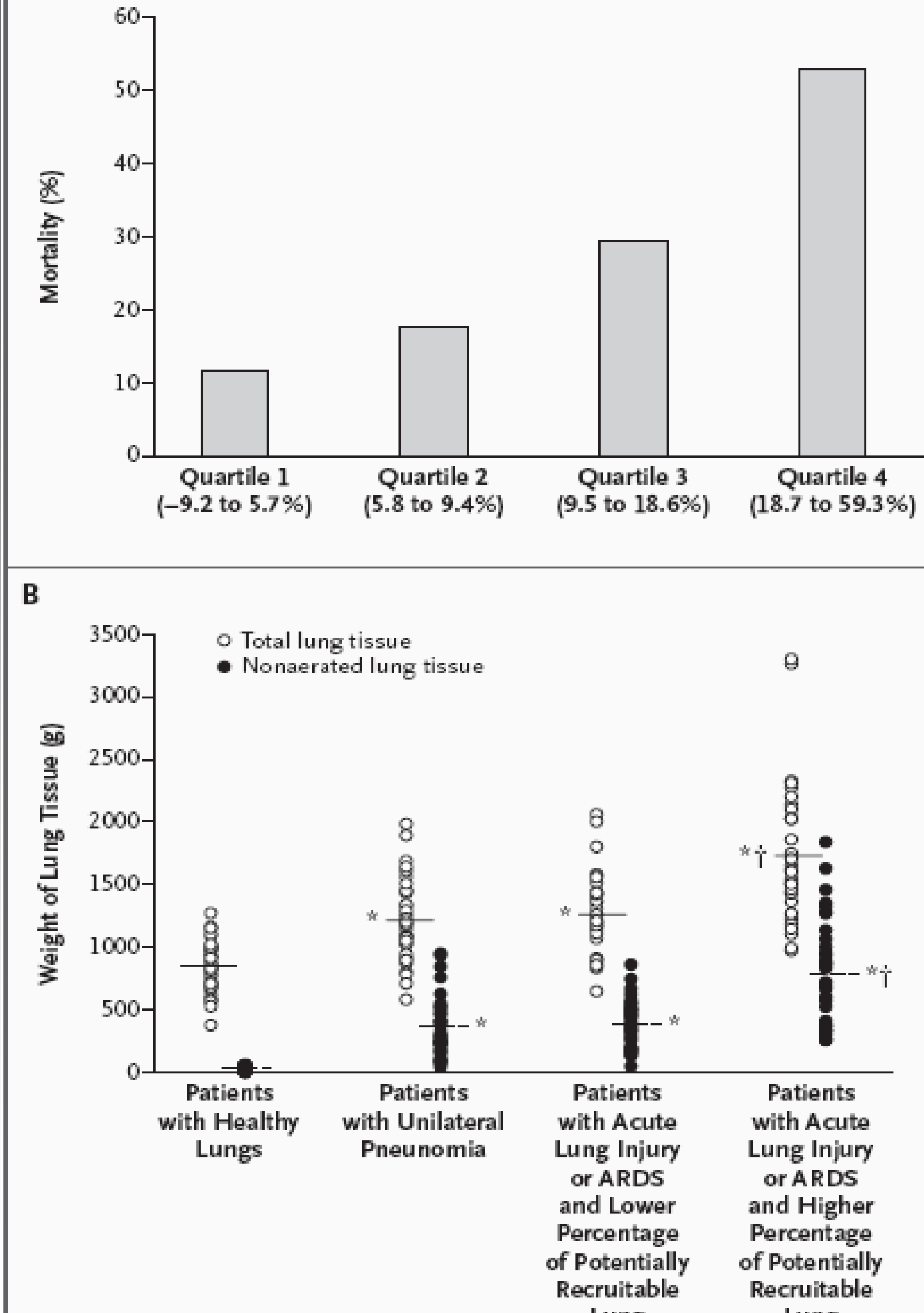
Ventilación Protectora de Pulmón OLA

Characteristic	Overall Population (N=68)	Patients with Lower Percentage of Potentially Recruitable Lung (N=34)†	Patients with Higher Percentage of Potentially Recruitable Lung (N=34)†	P Value‡
Age — yr	55±17	56±16	53±18	0.48
Female sex — no. (%)	33 (49)	15 (44)	18 (53)	0.47
Body-mass index	25±5	26±5	24±4	0.21
SAPS II score§	37±11	37±12	36±9	0.91
Tidal volume — ml/kg of predicted body weight	8.8±1.9	8.9±2.0	8.8±1.7	0.78
Minute ventilation — liters/min	9.8±3.0	9.5±2.7	10.1±3.3	0.45
Respiratory rate — breaths/min	18±7	17±6	19±7	0.57
PEEP — cm of water	11.1±3.0	10.8±2.9	11.5±3.1	0.34
Plateau pressure — cm of water	25±4	23±3	26±4	0.005
Respiratory-system compliance — ml/cm of water¶	44±17	49±16	40±18	0.02
PaO_2:FiO_2	200±77	225±70	176±77	0.008
FiO_2	0.50±15	0.46±10	0.54±18	0.07
$PaCO_2$ — mm Hg	42±14	38±8	46±17	0.04
Arterial pH	7.40±0.08	7.41±0.08	7.37±0.07	0.01
Cause of lung injury — no. (%)				
Pneumonia	25 (37)	7 (21)	18 (53)	0.01
Sepsis	24 (35)	17 (50)	7 (21)	0.02
Aspiration	4 (6)	3 (9)	1 (3)	0.61
Trauma	3 (4)	3 (9)	0	0.24
Other‖	12 (18)	4 (12)	8 (24)	0.34
Fluid balance before study — ml/day**	1413±2027	1427±2016	1398±2071	0.97
Days of ventilation before study††	5±6	5±6	6±6	0.50
Type of lung injury				0.02
Acute lung injury	19	14	5	
ARDS	49	20	29	



A
Average
Lung Weight,
59±51 g
Average
Lung Weight,
374±236 g
Lower
Higher
5±4%
21±10%
Patients with acute lung injury without ARDS
Patients with ARDS
No. of Patients
24
22
20
18
16
14
12
10
8
6
4
2
0
−10 to −5
−5 to 0
0 to 5
5 to 10
10 to 15
15 to 20
20 to 25
25 to 30
30 to 35
35 to 40
40 to 45
45 to 50
50 to 55
55 to 60
60 to 65
65 to 70
70 to 75
75 to 80
Amount of Potentially Recruitable Lung (% total lung weight)

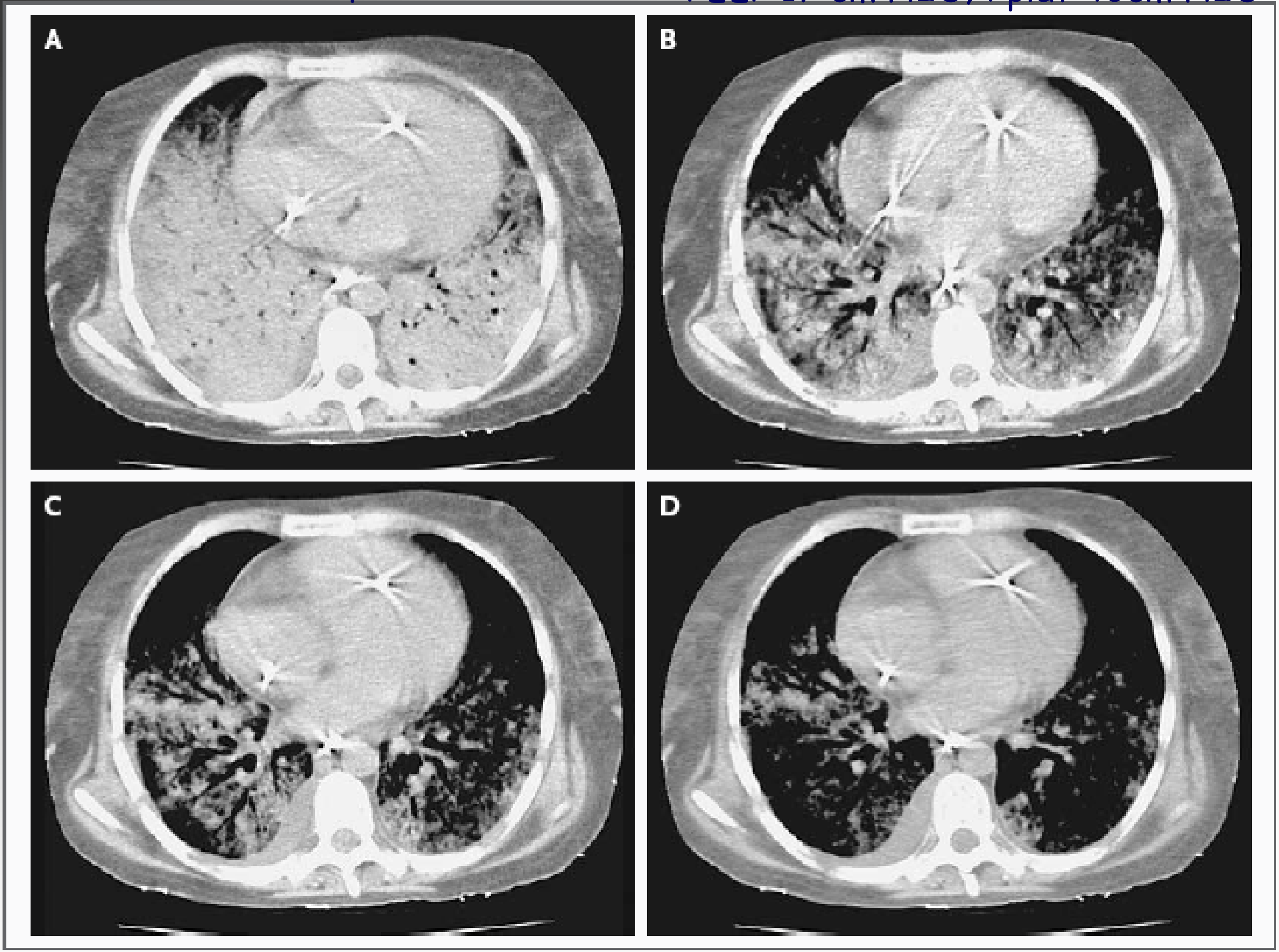

B Lower Percentage of Potentially Recruitable Lung
5 cm of water
45 cm of water
C Higher Percentage of Potentially Recruitable Lung
5 cm of water
45 cm of water



Mortality (%)
60
50
40
30
20
10
0
Quartile 1 (−9.2 to 5.7%)
Quartile 2 (5.8 to 9.4%)
Quartile 3 (9.5 to 18.6%)
Quartile 4 (18.7 to 59.3%)
B
Total lung tissue
Nonaerated lung tissue
Weight of Lung Tissue (g)
3500
3000
2500
2000
1500
1000
500
0
Patients with Healthy Lungs
Patients with Unilateral Pneunomia
Patients with Acute Lung Injury or ARDS and Lower Percentage of Potentially Recruitable
Patients with Acute Lung Injury or ARDS and Higher Percentage of Potentially Recruitable

PEEP 5 cm H2O; Pplat20 cm H2O

PEEP 17 cm H2O; Pplat 40cm H2O



35%

67%

87%

PEEP 25 cm H2O; Pplat 40cm H2O

PEEP 25 cm H2O; Pplat 60cm H2O

NEJM2006; 355:319-32

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

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

AT A GLANCE COMMENTARY

Scientific Knowledge on the Subject

Limiting tidal volume to 6 ml/kg and plateau pressure to 30 cm H_2O protects the lungs of patients with acute respiratory distress syndrome from ventilator-induced lung injury (VILI).

What This Study Adds to the Field

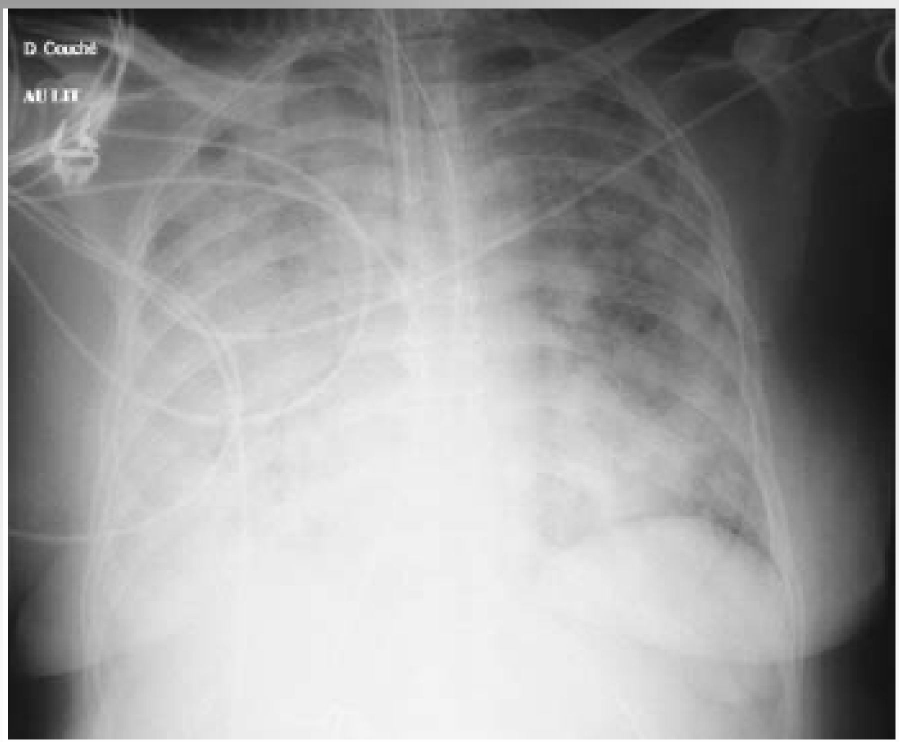
Patients characterized by a larger amount of collapsed lung may be exposed to VILI despite tidal volume and pressure limitation; plateau pressure should be limited to 28 cm H_2O to guarantee lung protection.

ensive Care Med (2006) 32:177–178
DI 10.1007/s00134-005-2853-4

CORRESPONDENCE

ntoine Vieillard-Baron
Cyril Charron
rançois Jardin

ung "recruitment" or lung verinflation maneuvers?



ICM2006; 32:177-178

Pplat 26-28 cm H2O !!

ICM2006; 32:177-178

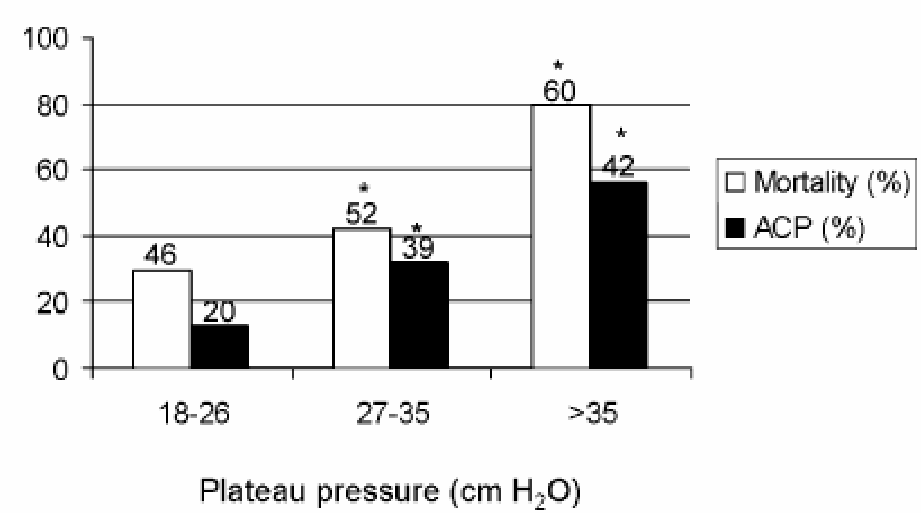
tensive Care Med (2007) 33:444–447
OI 10.1007/s00134-007-0552-z

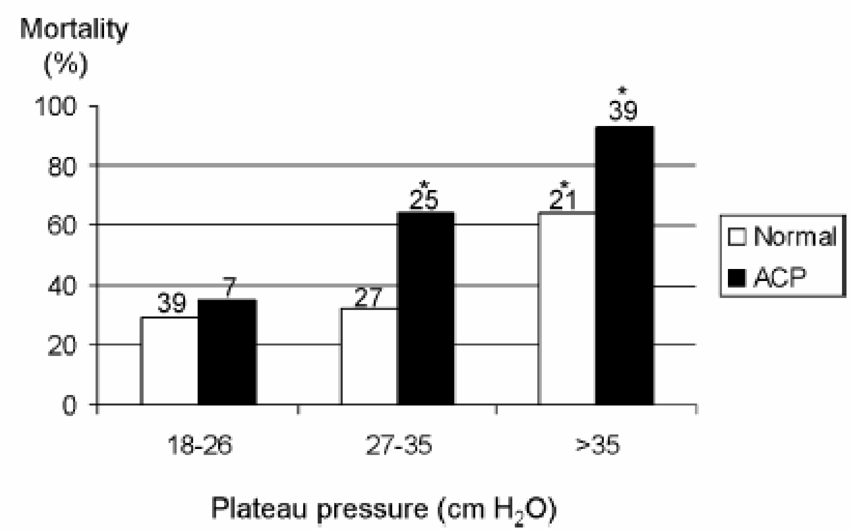
ORIGINAL

rançois Jardin
ntoine Vieillard-Baron

Is there a safe plateau pressure in ARDS? The right heart only knows

Valoración por ECOCardio de la (f) VD: 325 pacientes





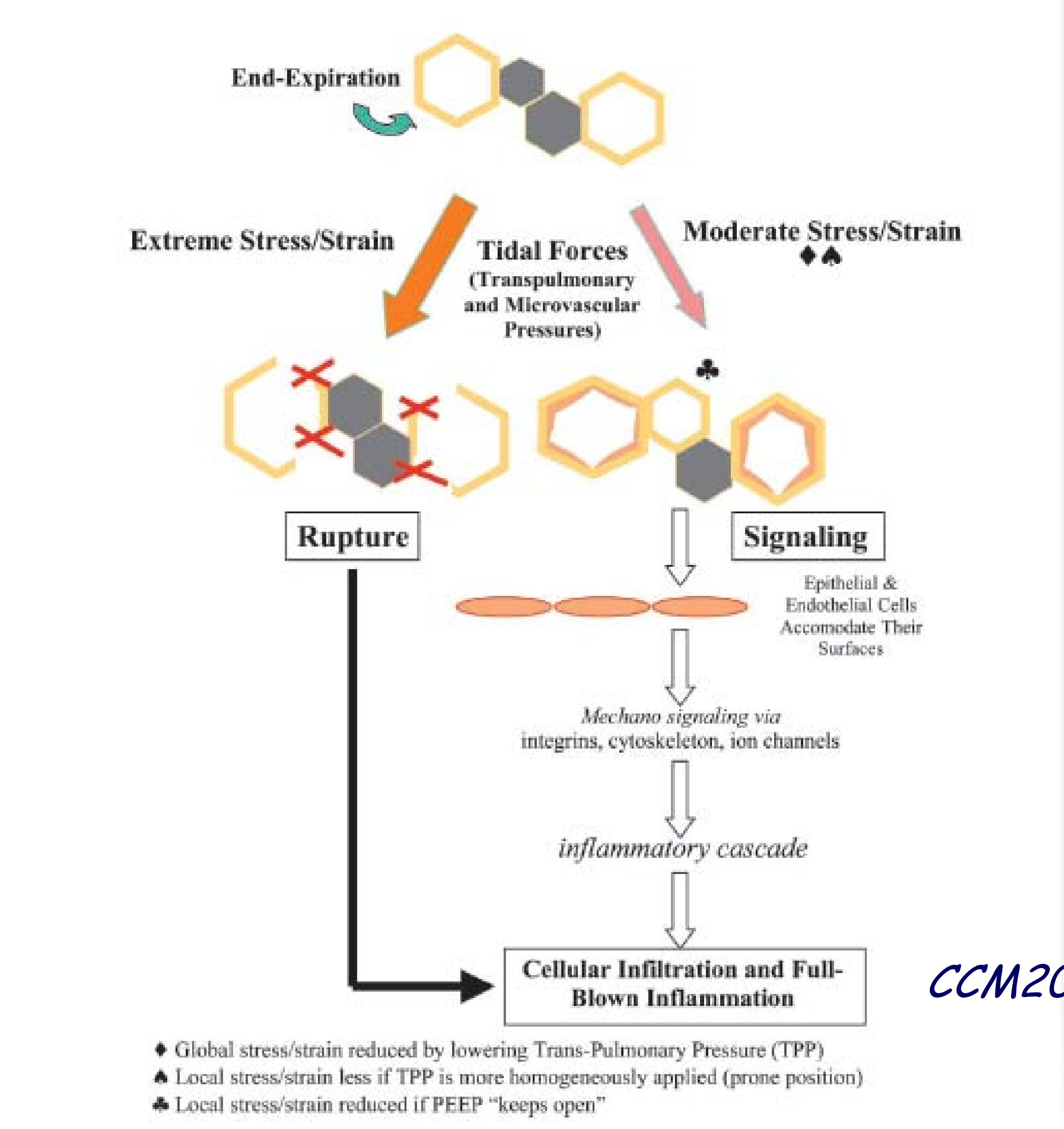
ICM2007; 33:444-447

Ventilatory management of acute respiratory distress syndrome: A consensus of two

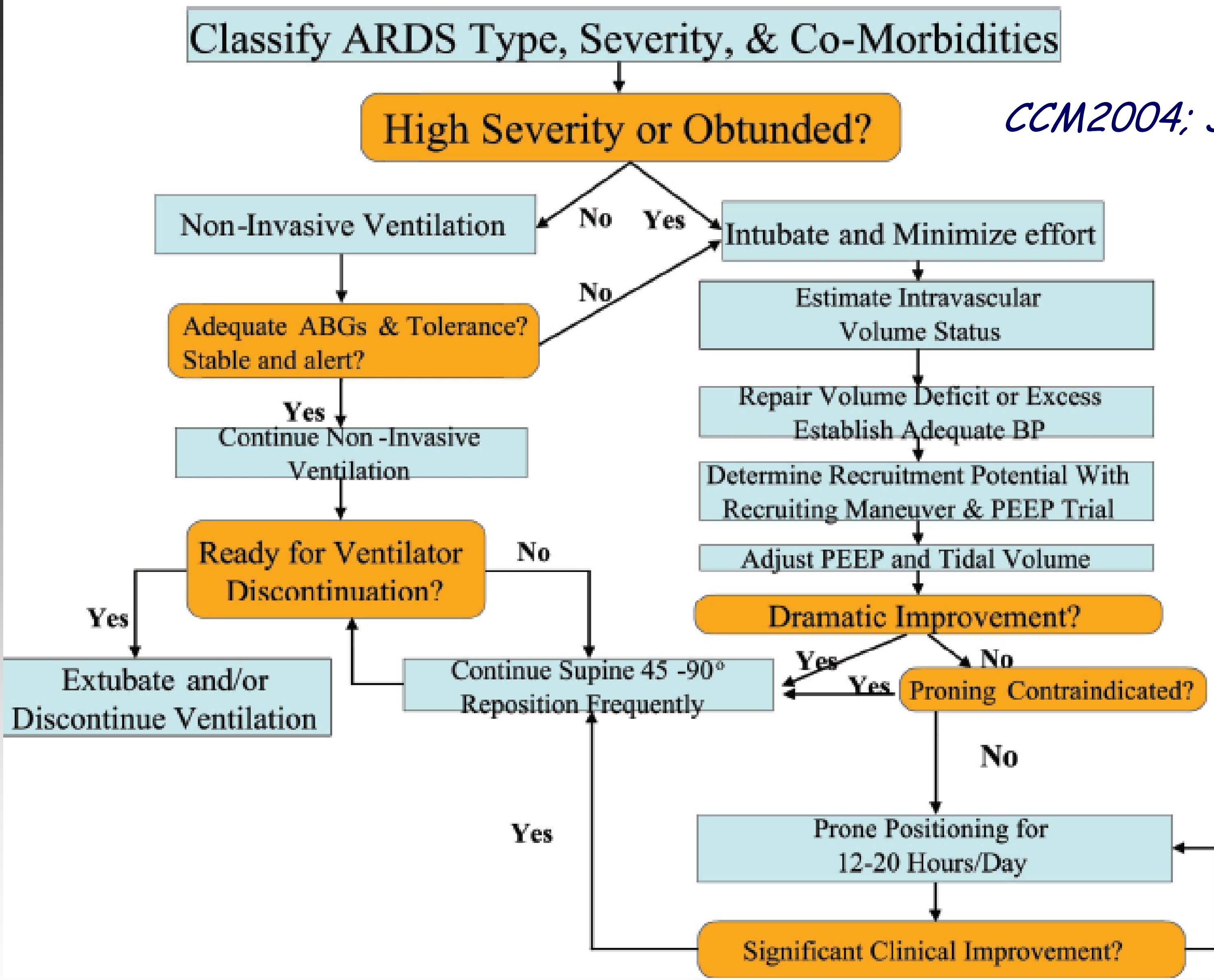
John J. Marini; Luciano Gattinoni

Execution of an effective lung-protective ventilation strategy remains an empirical process best guided by integrated physiology and a readiness to revise the management approach depending on the individual's response.

CCM2004; 32:250-5

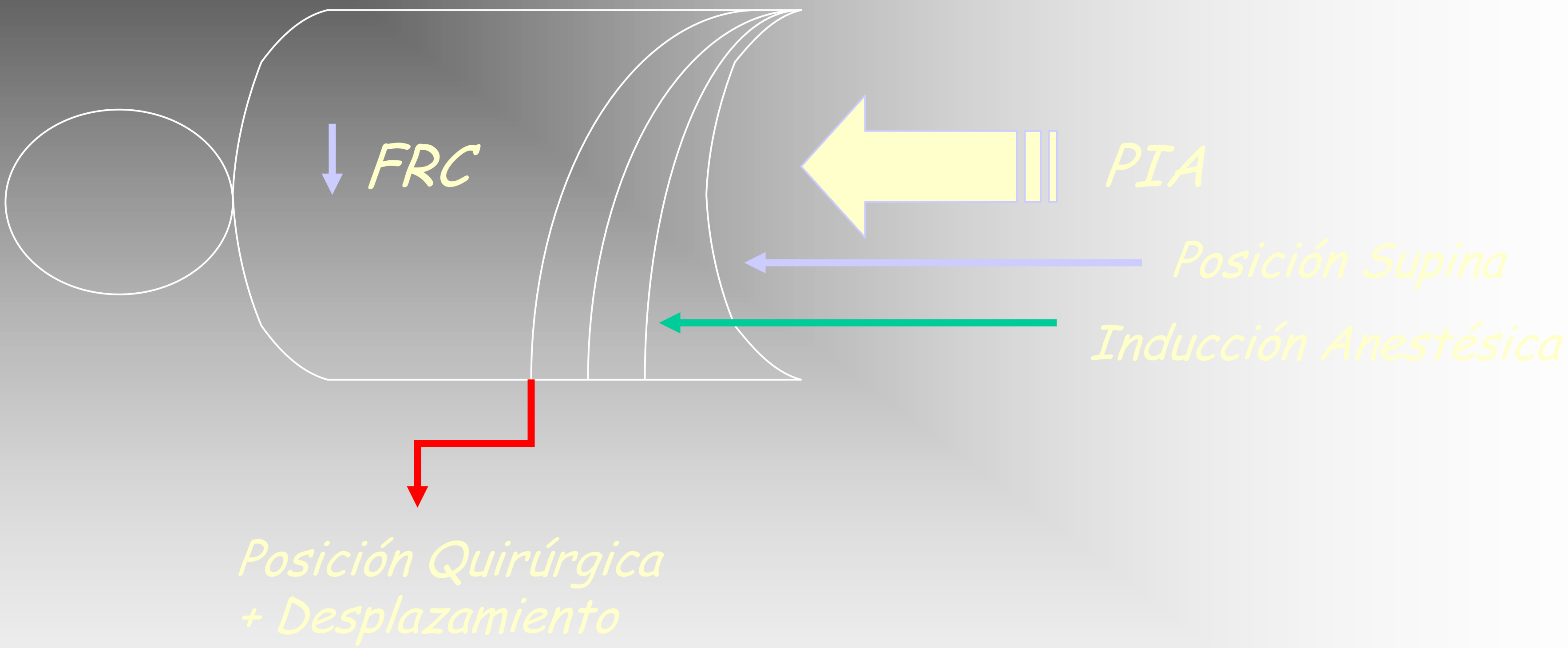


CCM2004; 32:250-5



CCM2004; 32:250-5

Causas de la reducción de la CRF - Anestesia



Desplazamiento cefálico del diafragma

Open Lung Management in Anesthesia

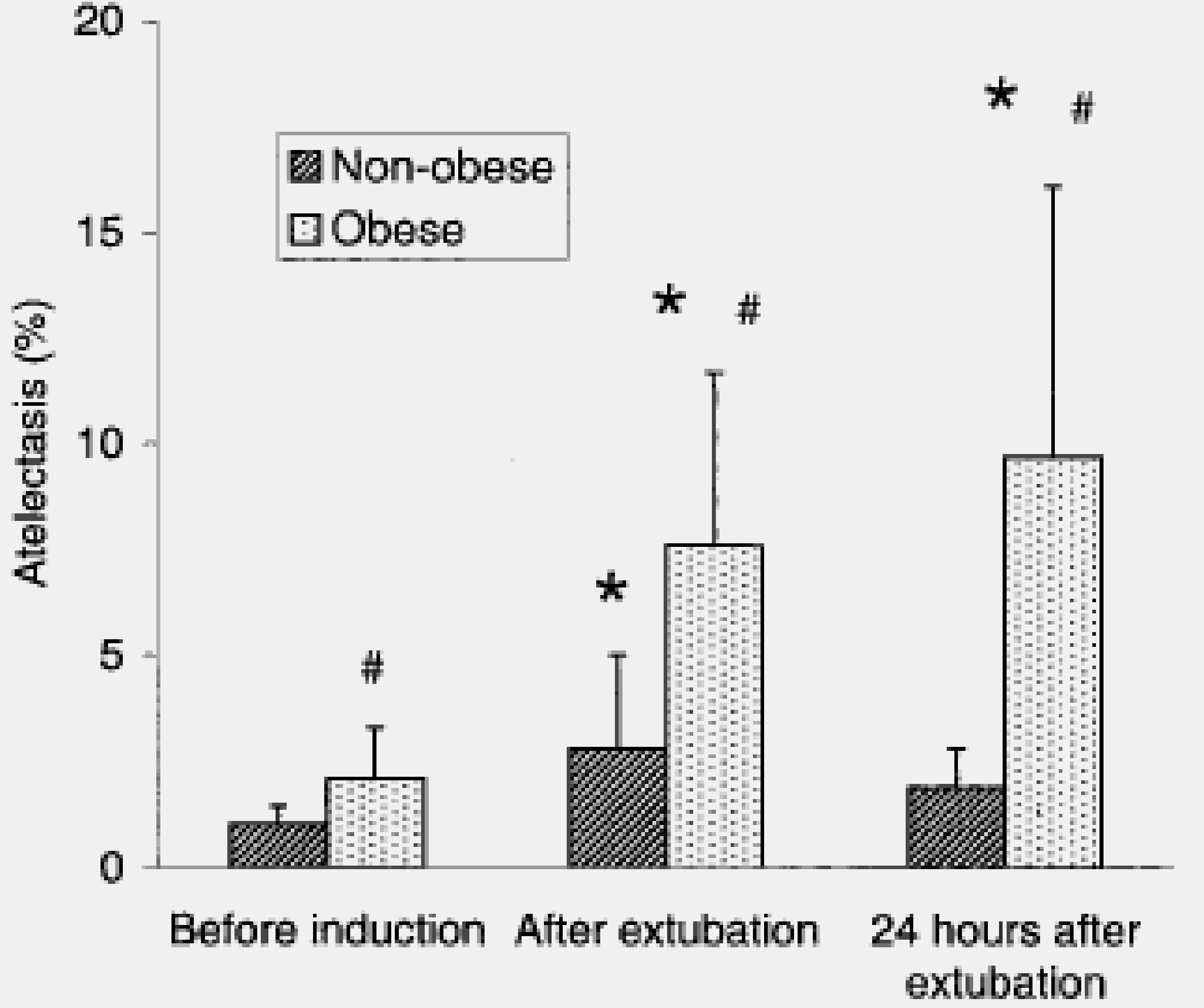
Morbid Obesity and Postoperative Pulmonary Atelectasis: An Underestimated Problem

A.-S. Eichenberger, MD*, S. Proietti, MD†, S. Wicky, MD†, P. Frascarolo, PhD*, M. Suter, MD‡, D. R. Spahn, MD*, and L. Magnusson, MD, PhD*

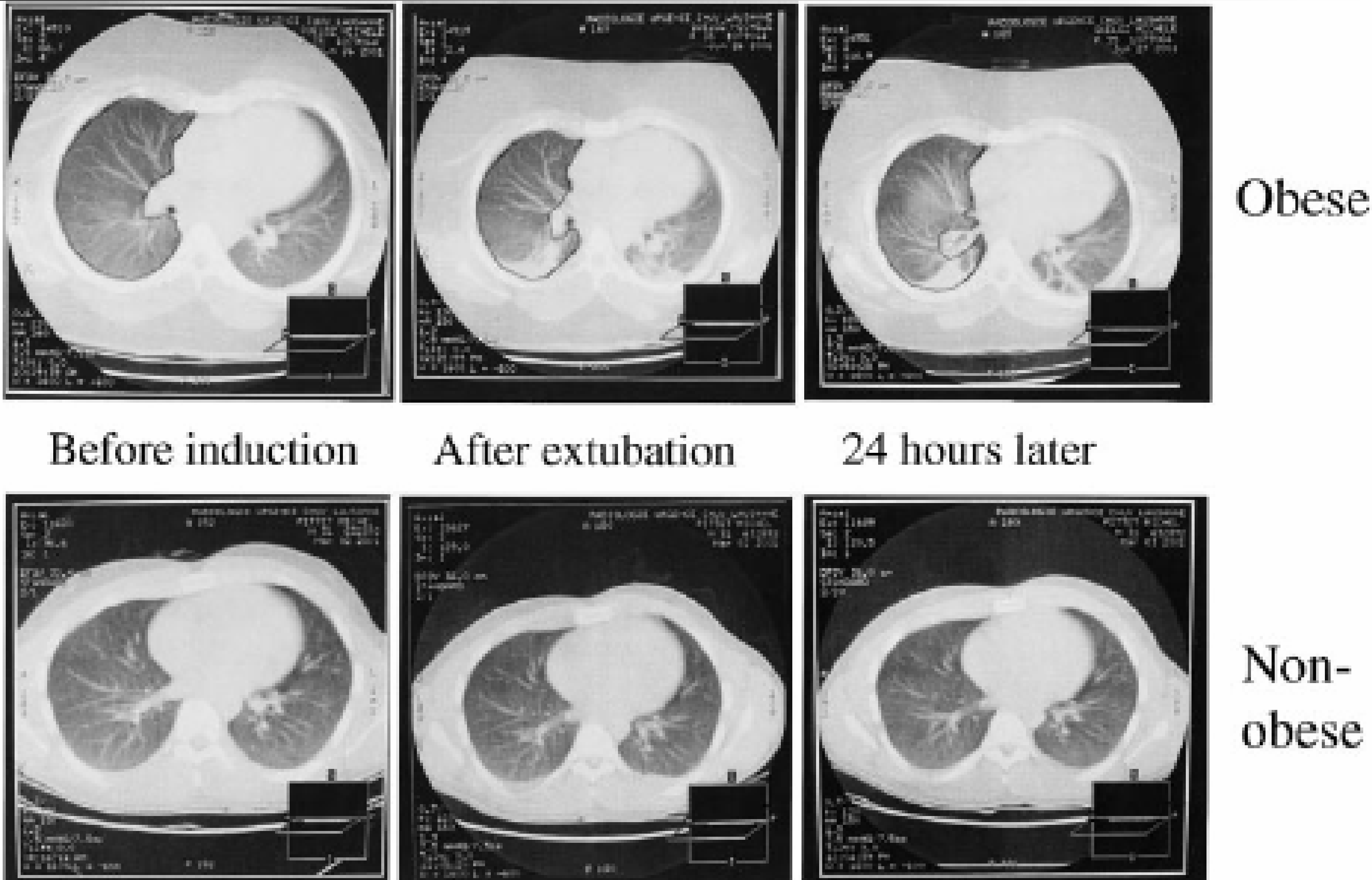
General anesthesia impair pulmonary gas exchange because atelectasis formation in nonobese patients.
In obese patients, atelectasis formation are more significant.

Variable	Morbid obese patients (n = 20)	Nonobese patients (n = 10)	P value
Male/female	4/16	3/7	NS
Body mass index (kg/m^2)	46.5 ± 7.0	24.0 ± 2.3	<0.05
Age (yr)	39.5 ± 10.0	47.5 ± 13.7	NS
ASA status (I/II/III)	(0/15/5)	(4/6/0)	<0.05
Anesthesia duration (min)	140.5 ± 54.3	72.6 ± 20.7	<0.001

AnesthAnlgesia2002; 95:1788-92



AnesthAnlgesia2002; 95:1788-92



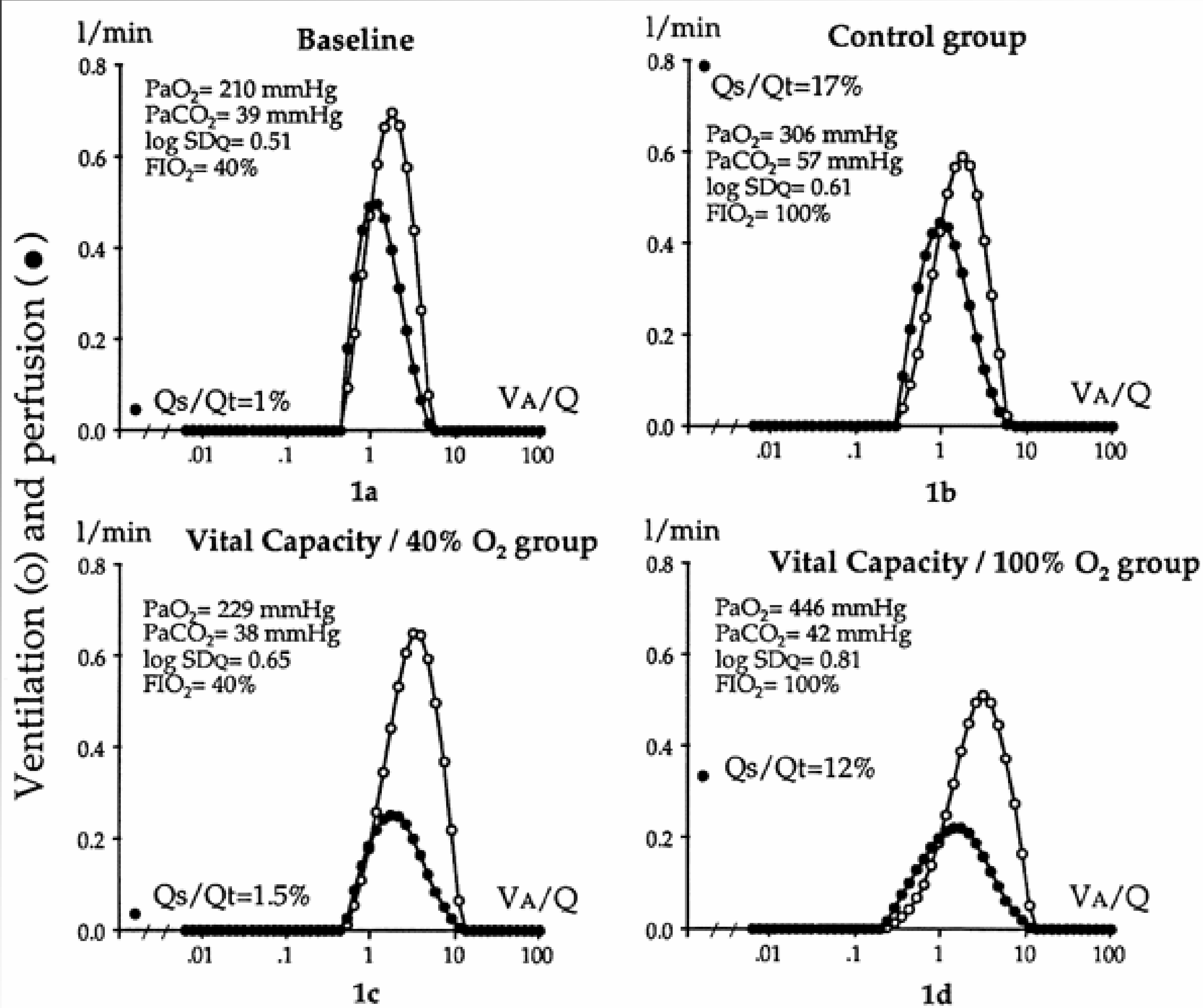
AnesthAnlgesia2002; 95:1788-9

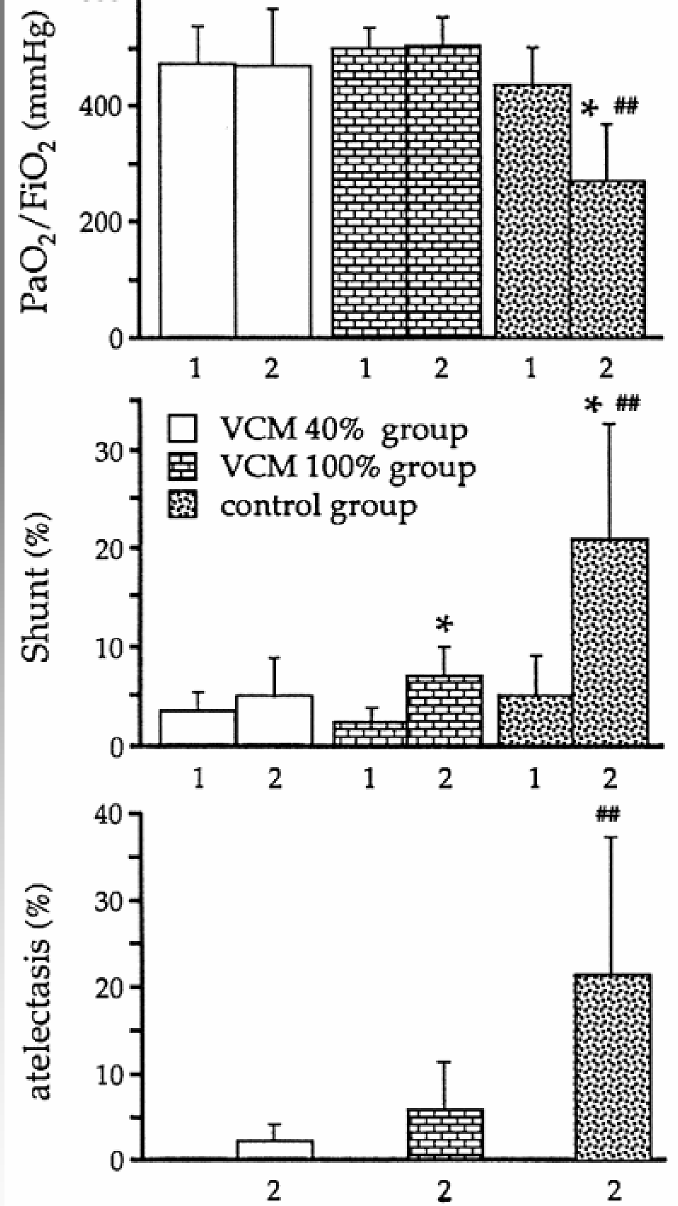
Use of a Vital Capacity Maneuver to Prevent Atelectasis after Cardiopulmonary Bypass. An Experimental Study

Lennart Magnusson, MD; Vitas Zemgulis, MD; Arne Tenling, MD; Johan Wernlund, MD; Hans Tyden, MD, PhD; Stefan Thelin, MD, PhD; Goran Hedenstierna, MD, PhD

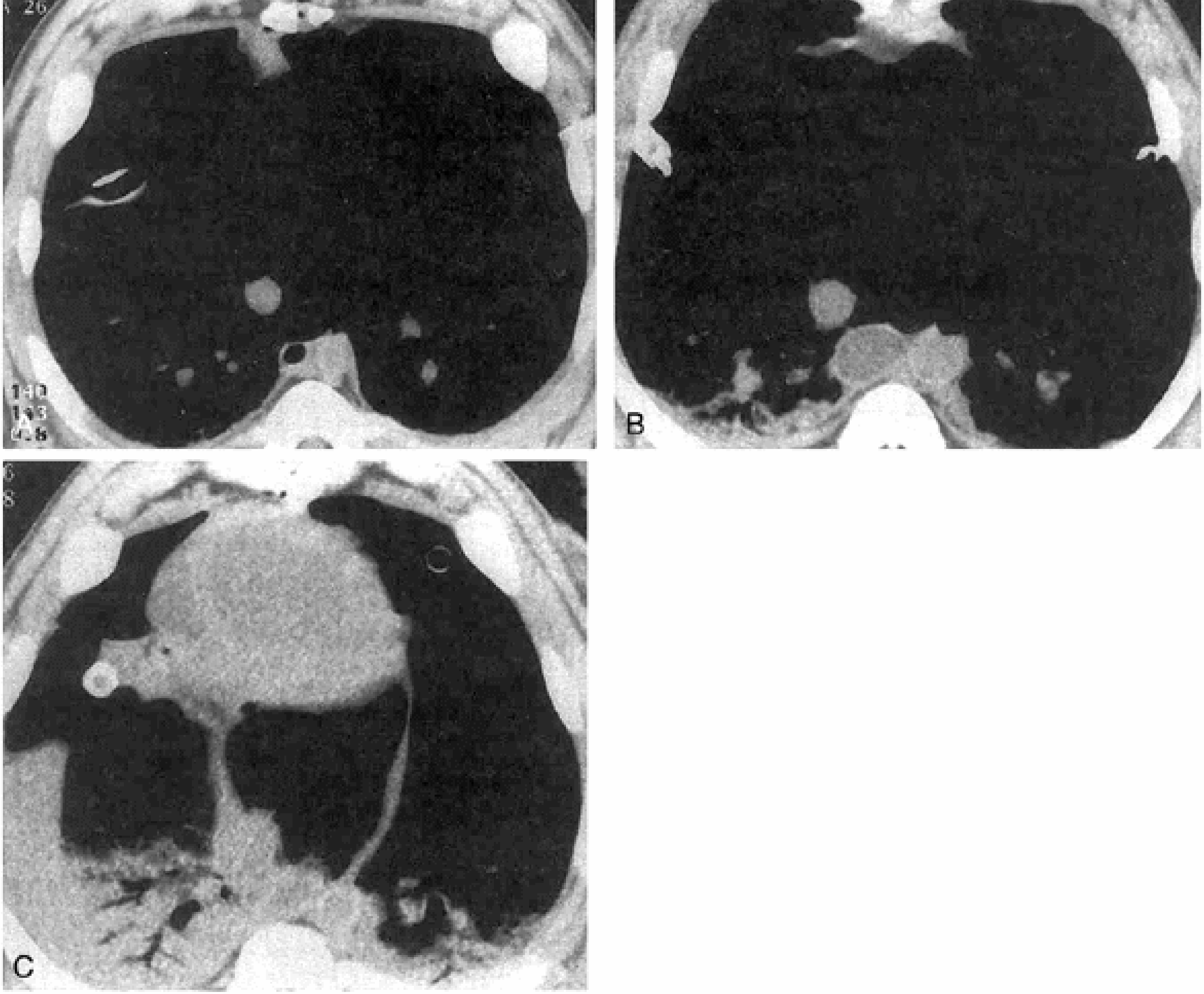
Incremento shunt correlacionado con cantidad de atelectasias
RM previene aparición de atelectasias.............

Anesthesiology 1998; 88: 134-14


Ventilation (o) and perfusion (●)
l/min
Baseline
PaO2= 210 mmHg
PaCO2= 39 mmHg
log SDQ= 0.51
FIO2= 40%
Qs/Qt=1%
VA/Q
1a
l/min
Control group
Qs/Qt=17%
PaO2= 306 mmHg
PaCO2= 57 mmHg
log SDQ= 0.61
FIO2= 100%
VA/Q
1b
l/min
Vital Capacity / 40% O2 group
PaO2= 229 mmHg
PaCO2= 38 mmHg
log SDQ= 0.65
FIO2= 40%
Qs/Qt=1.5%
VA/Q
1c
l/min
Vital Capacity / 100% O2 group
PaO2= 446 mmHg
PaCO2= 42 mmHg
log SDQ= 0.81
FIO2= 100%
Qs/Qt=12%
VA/Q
1d



PaO2/FiO2 (mmHg)
400
200
0
1
2
1
2
1
2
* ##
Shunt (%)
30
20
10
0
VCM 40% group
VCM 100% group
control group
*
* ##
1
2
1
2
1
2
atelectasis (%)
40
30
20
10
0
##
2
2
2


A
B
C

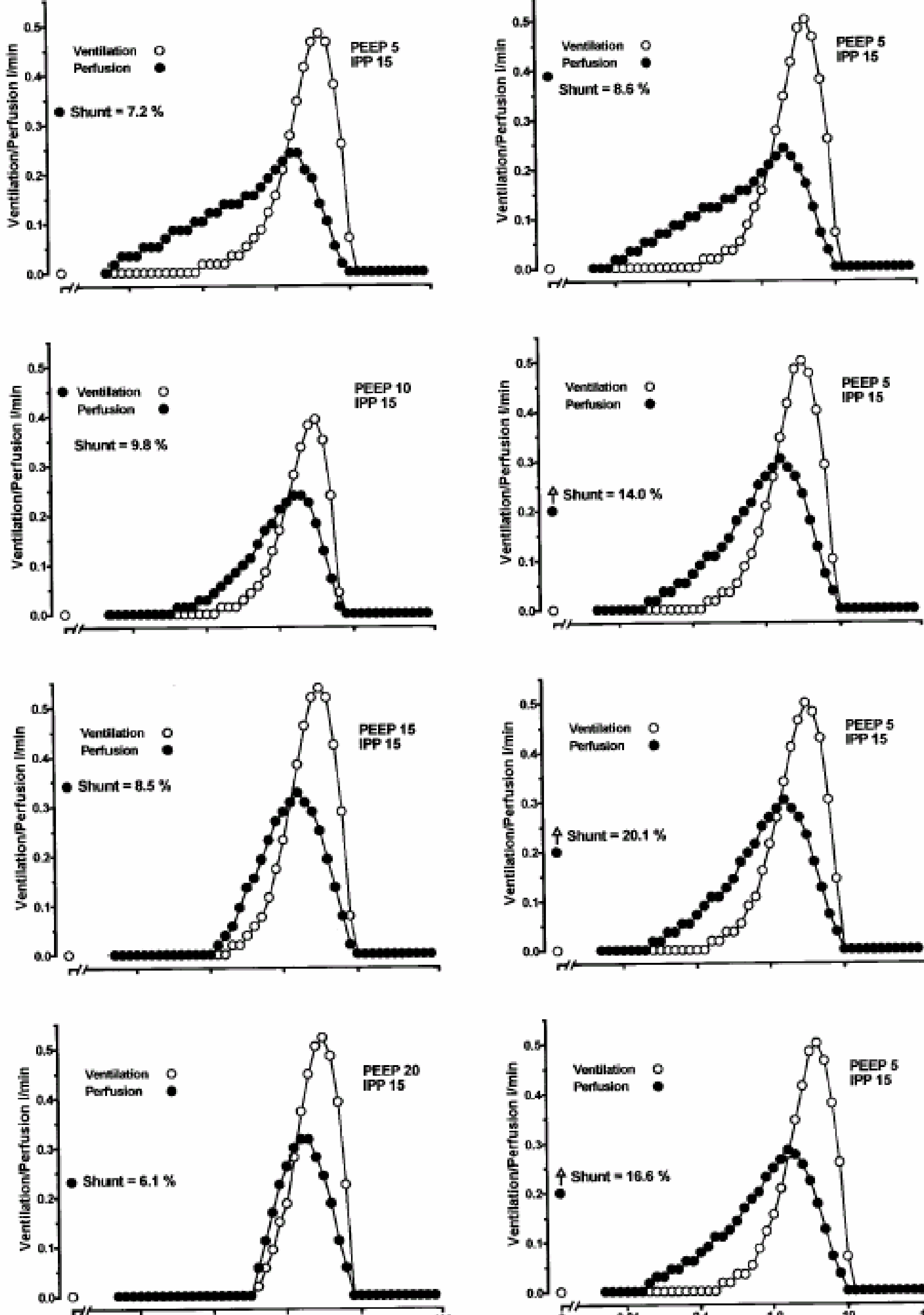
Inert Gas Exchange During Pneumoperitoneum at Incremental Values of Positive End-Expiratory Pressure

Alexander Loeckinger, MD, Axel Kleinsasser, MD, Christoph Hoermann, MD
Anette Krismer, MD, Michael Gassner, MD, Christian Keller, MD
Friedrich Puehringer, MD, and Karl H. Lindner, MD

Department of Anesthesiology and Critical Care Medicine, The Leopold-Franzens-University of Innsbruck, Innsbruck, Austria

V/Q Efecto de diferentes niveles de PEEP insuflación CO2 15 cm H2O

Anesth Analg 2000; 90: 466-471



Ventilation
Perfusion
Shunt = 7.2 %
PEEP 5
IPP 15
Ventilation
Perfusion
Shunt = 8.6 %
PEEP 5
IPP 15
Ventilation
Perfusion
Shunt = 9.8 %
PEEP 10
IPP 15
Ventilation
Perfusion
Shunt = 14.0 %
PEEP 5
IPP 15
Ventilation
Perfusion
Shunt = 8.5 %
PEEP 15
IPP 15
Ventilation
Perfusion
Shunt = 20.1 %
PEEP 5
IPP 15
Ventilation
Perfusion
Shunt = 6.1 %
PEEP 20
IPP 15
Ventilation
Perfusion
Shunt = 16.6 %
PEEP 5
IPP 15
Ventilation/Perfusion l/min

EEP 15 cm H2O

Posición Prono

Inicios Prono

Bryan 1974: *pacientes anestesiados en Prono mostraban una mejor expansión de las regiones dorsales del pulmón con una mejoría en la oxigenación*

Piehl & Brown 1976: *Estudio retrospectivo Prono mejoraba la oxigenación en 5 pacientes con SDRA*

Douglas et al 1977: *Estudio prospectivo Prono mejoría en la oxigenación en pacientes con SDRA.*

.. En la actualidad se consideral Prono un método simple y seguro de mejorar la oxigenación....aunque las causas fisiológicas no están completamente explicadas

Eur Respir J 2002; 20: 1017-1028

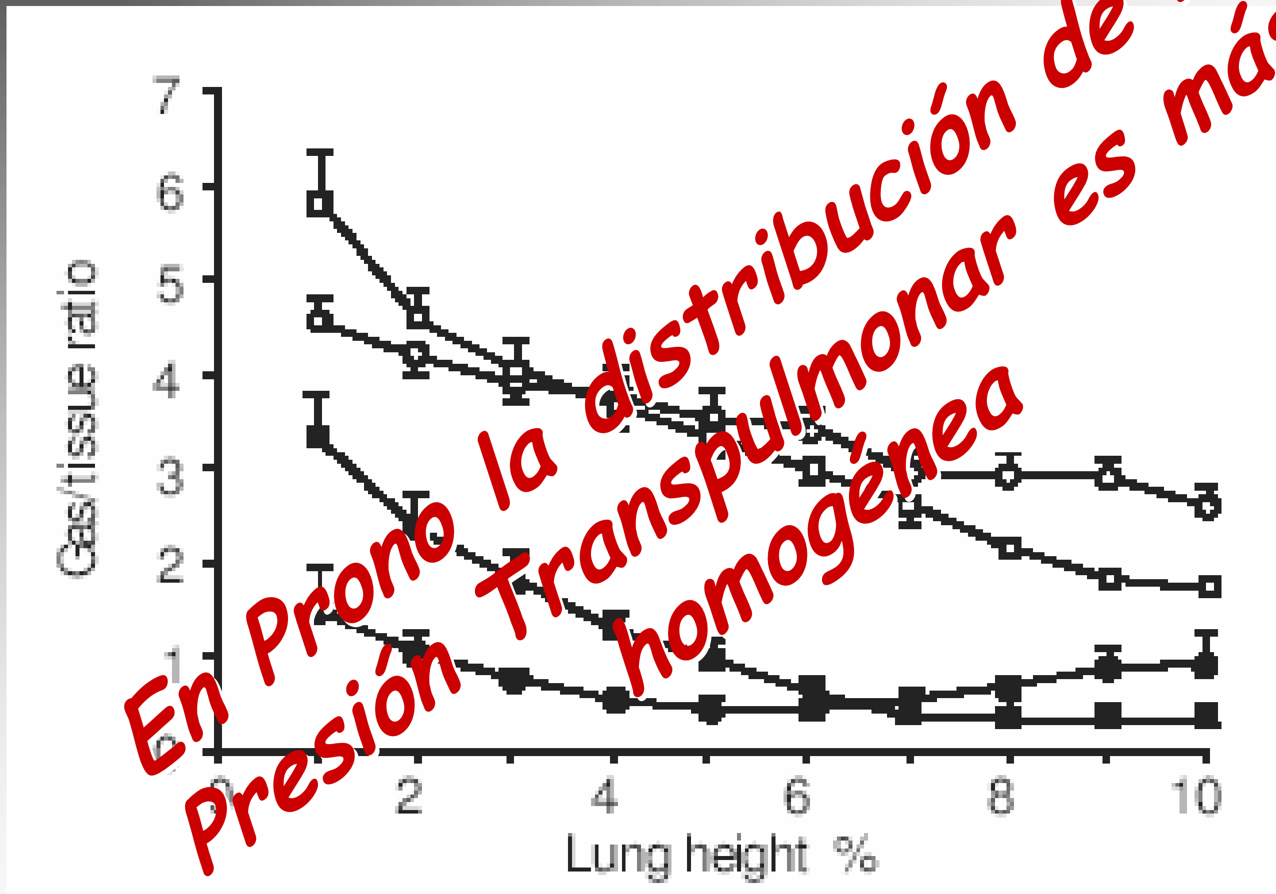
Objetivos fisiológicos del Prono

Introducción

1. Mejorar la oxigenación
2. Mejorar la mecánica respiratoria
3. Homogeneizar el gradiente de Ppl, inflación alveolar y la distribución de la ventilación
4. Aumentar el volumen pulmonar y disminuir la cantidad de zonas atelectasiadas
5. Facilitar el drenaje de secreciones
6. Reducir el VALI

Eur Respir J 2002; 20: 1017-1028

Distribución de insuflación alveolar, ventilación y perfusión en ARDS



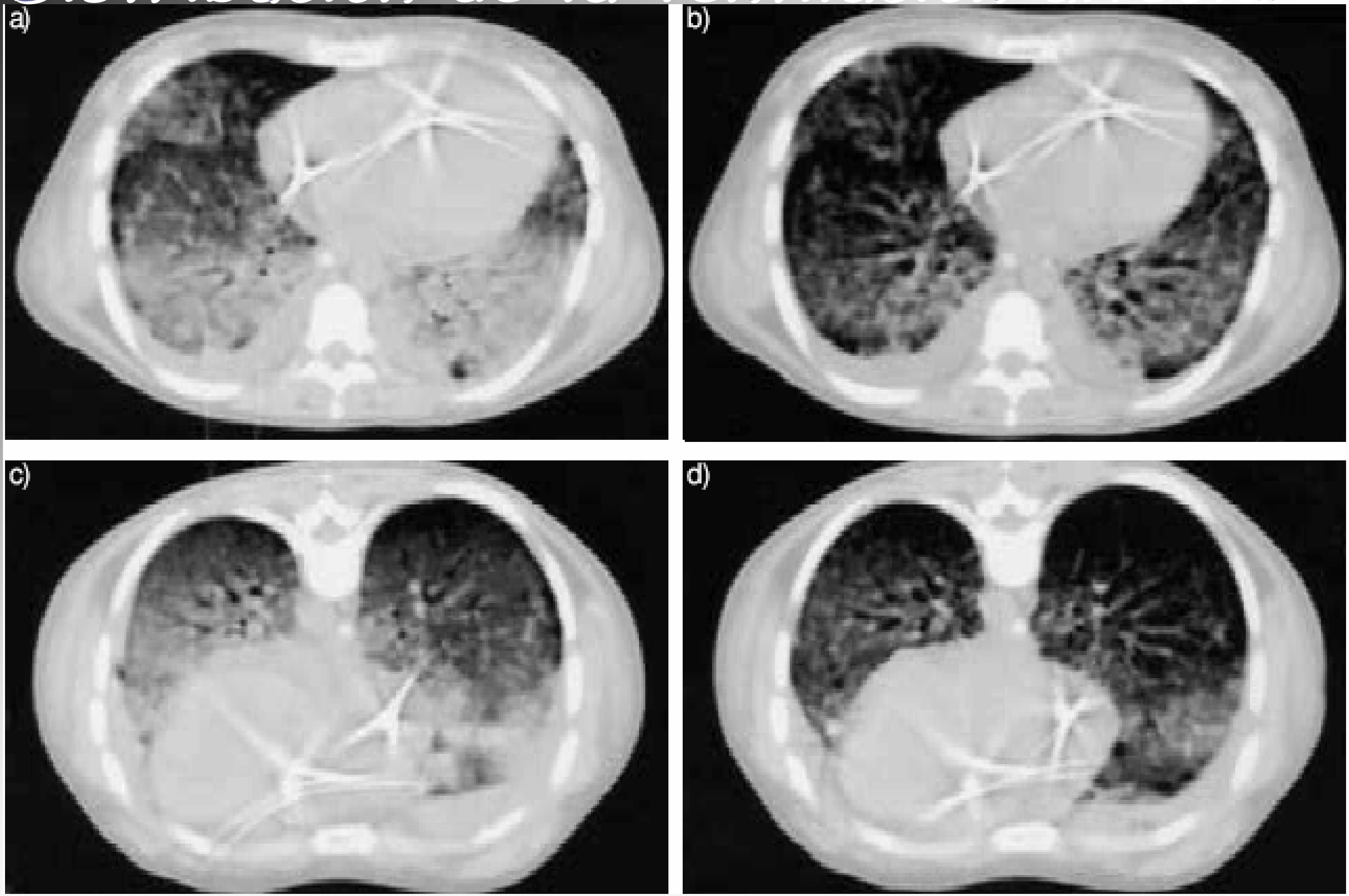
En Prono la distribución de la Presión Transpulmonar es más homogénea

Gattinoni L. In Tobin 1994. Principles and Practice of Mechanical Ventilation

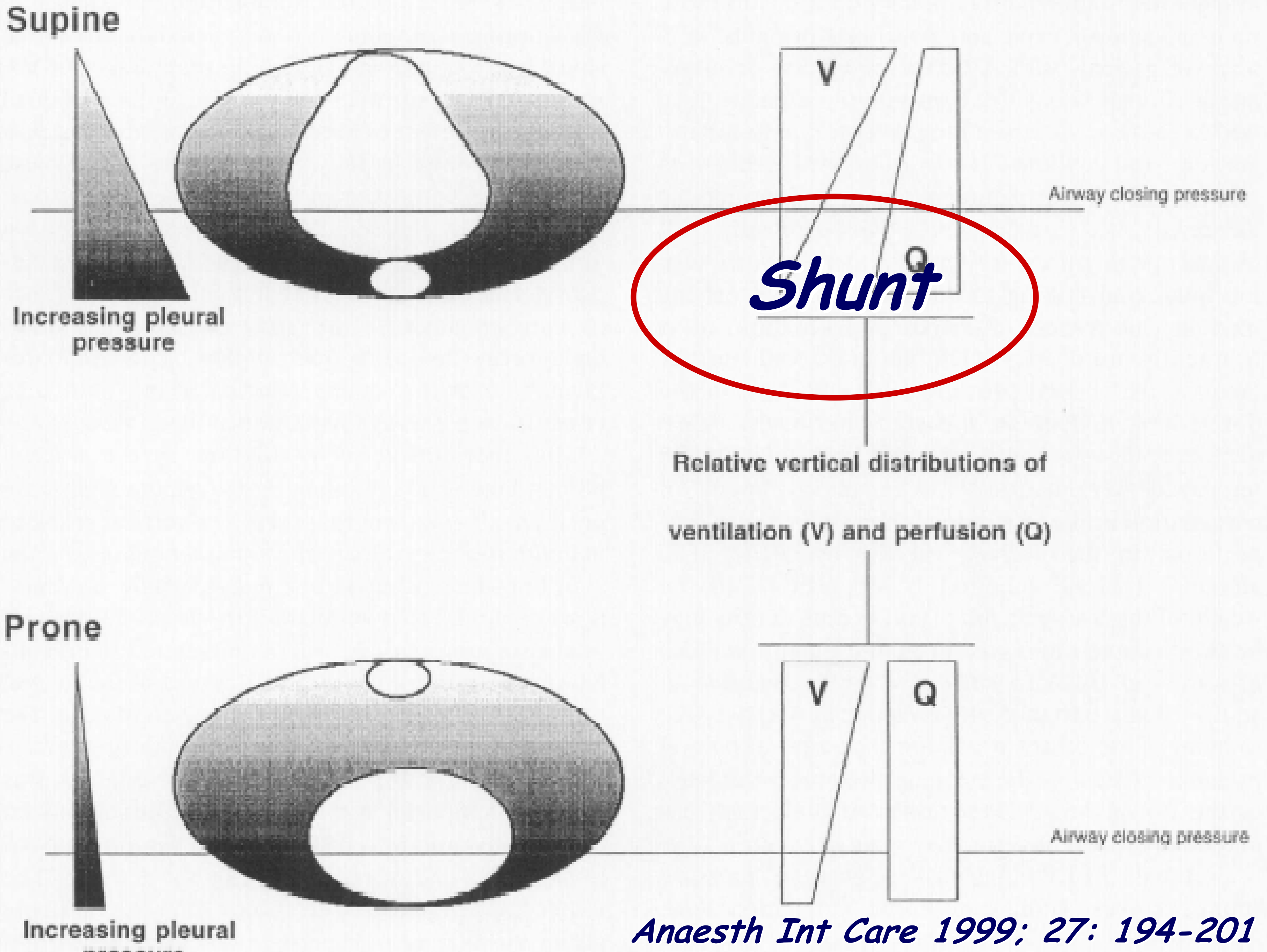
Distribución de la ventilación alveolar

SP

PP

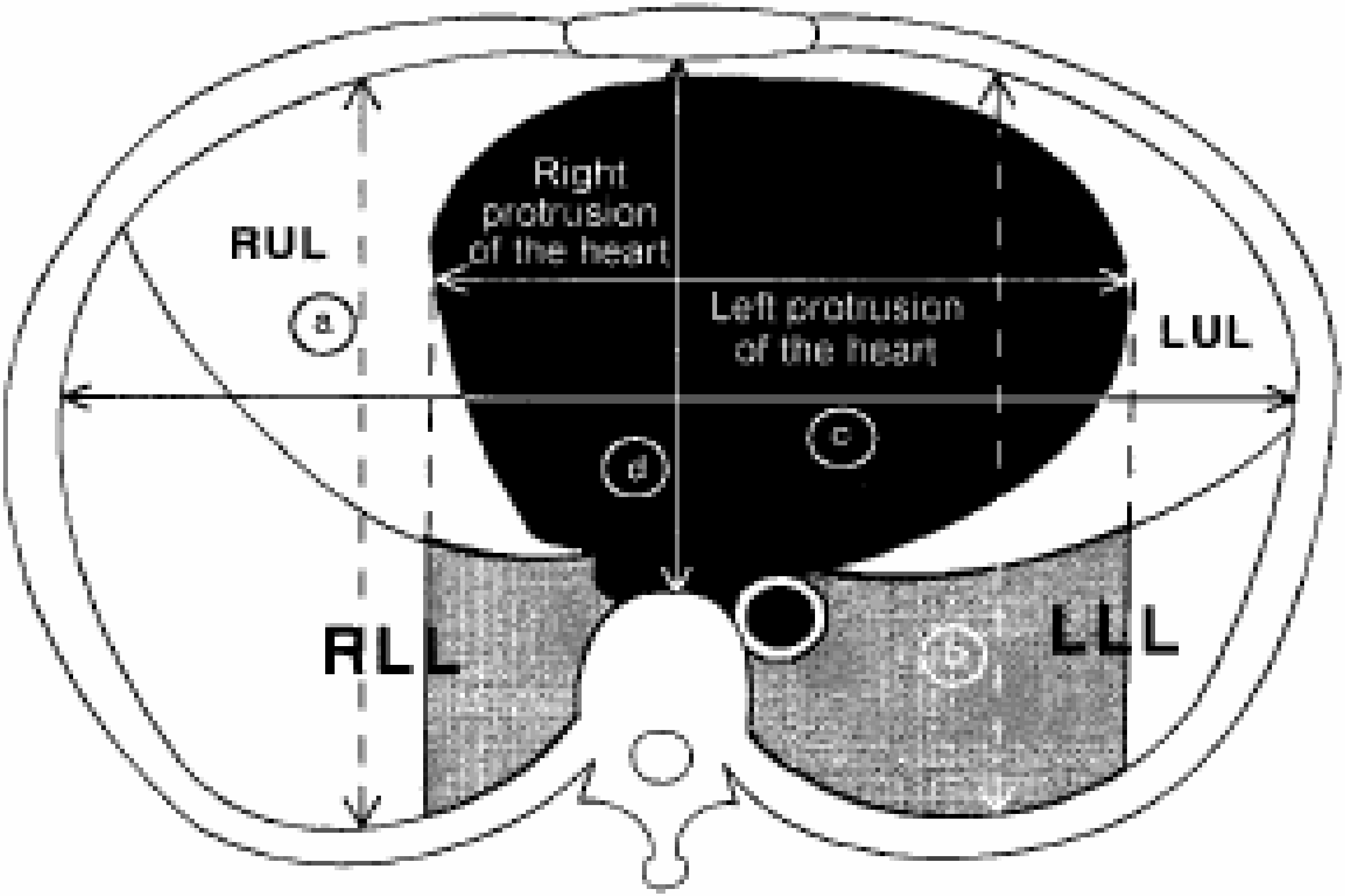


Eur Respir J 2002; 20: 1017-1028



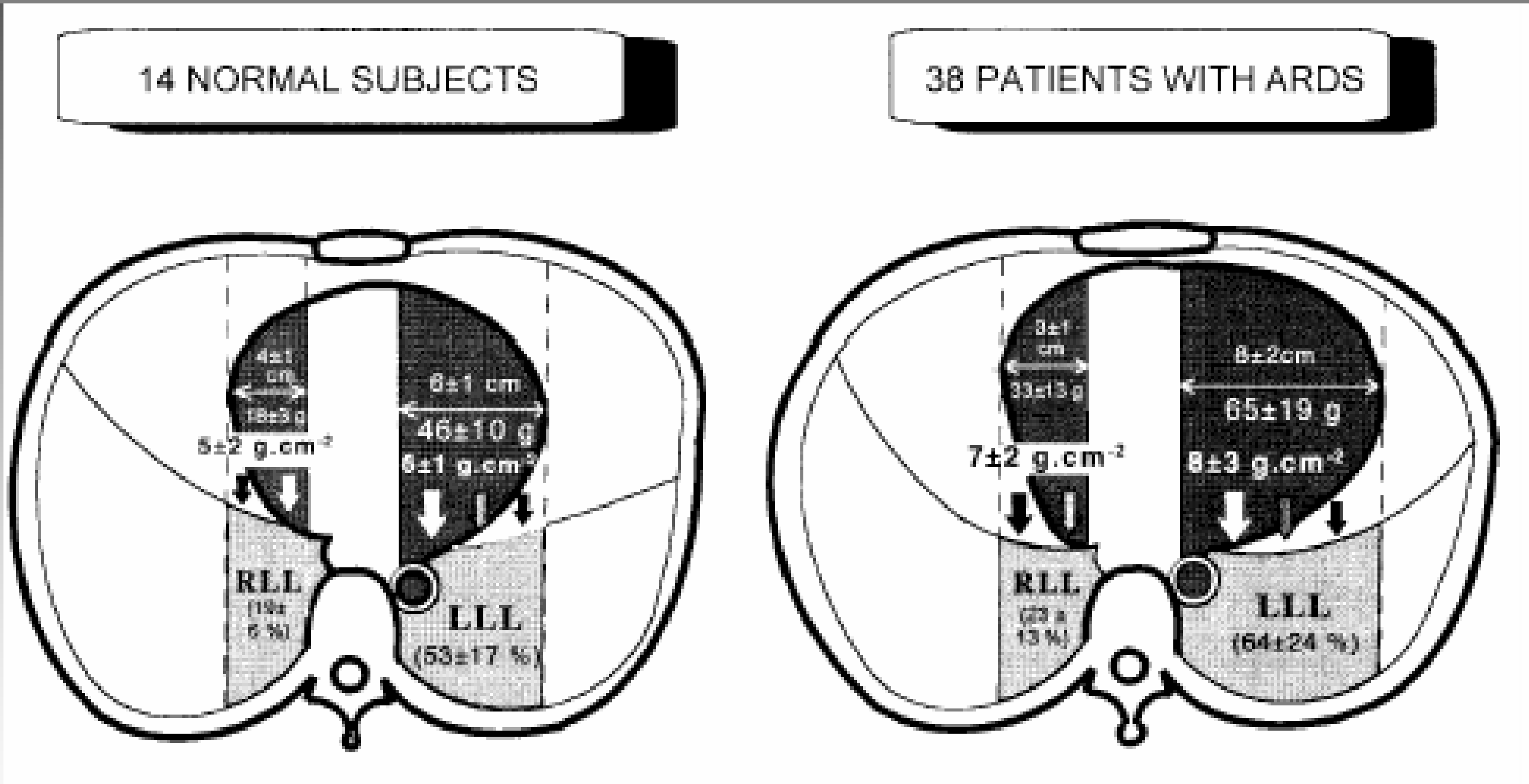
Anaesth Int Care 1999; 27: 194-201

Influencia del corazón en la pérdida de volumen en SDRA



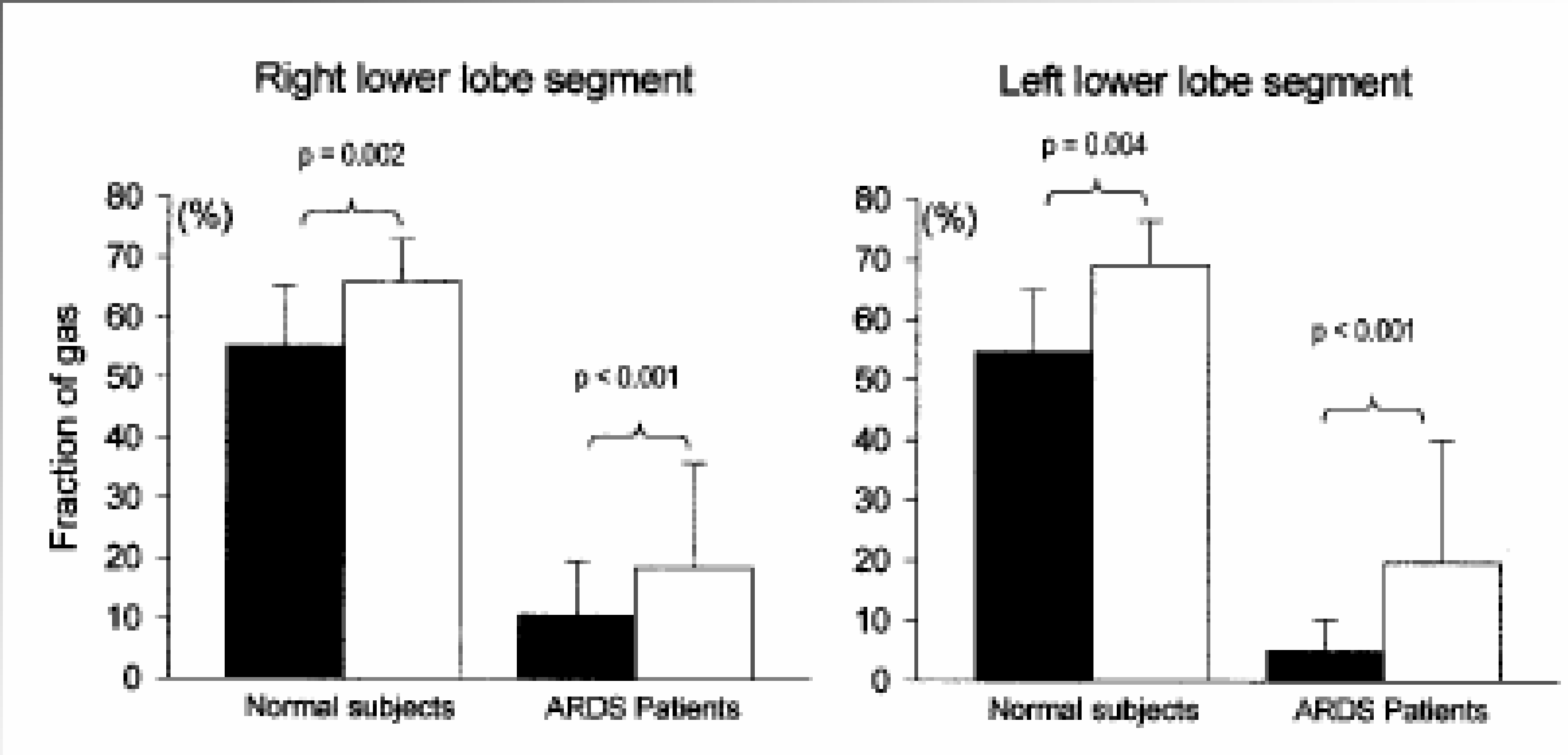
Am J Respir Crit Care Med 2000; 161: 2005-2012

Influencia del corazón en la pérdida de volumen en SDRA



Am J Respir Crit Care Med 2000; 161: 2005-201

Influencia del corazón en la pérdida de volumen en SDRA



Am J Respir Crit Care Med 2000; 161: 2005-201

The Prone Position Eliminates Compression of the Lungs by the Heart

ICHARD K. ALBERT and ROLF D. HUBMAYR

edical Service, Denver Health Medical Center, and Department of Medicine, University of Colorado Health Sciences Center, enver, Colorado; and Mayo Clinic and Foundation, Rochester, Minnesota

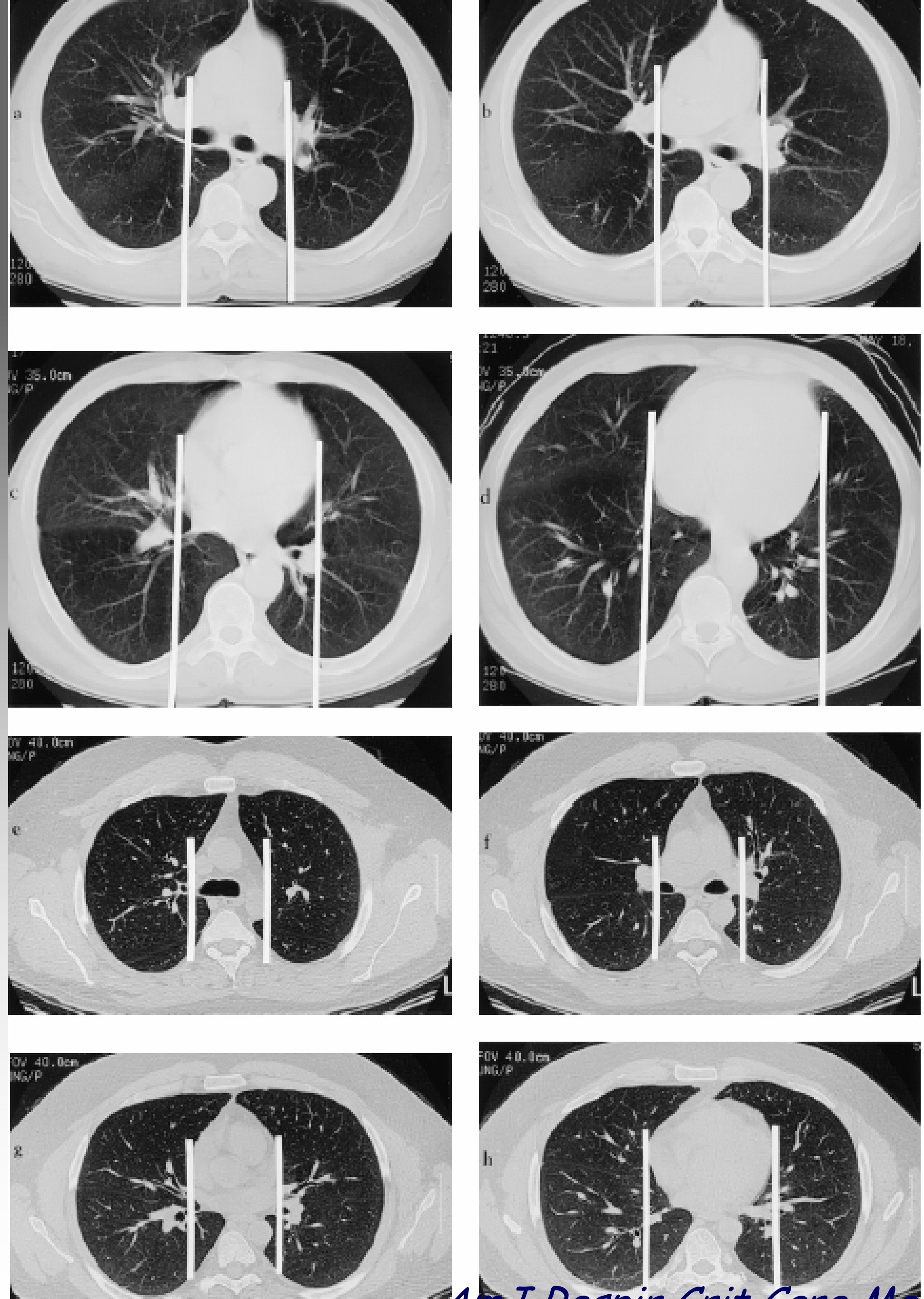
Hipótesis: Posición prono mejora la oxigenación porque estaura la ventilación en las regiones dorsales del pulmón, sin comprometer las zonas ventrales.

Objetivo: Estudiar el mecanismo de este cambio de entilación, medición del volumen pulmonar debajo del orazón.

Pacientes: 7 pacientes en Ds vs DP, mediante TAC orácico

AmJ Respir Crit Care Med 2000; 161: 1660-166

Masa Cardíaca



I	D
7±4%	11±4
↓	↓
42±8%	16±4

Am J Respir Crit Care Med 2000; 161: 1660-16

Masa Cardíaca

I	D
≤ 1	$\leq 4\%$

Compresión directa sobre el esternón

AmJRespir Crit Care Med 2000; 161: 1660-166

Implicaciones Clínicas

1. Prono elimina la fuerza compresiva del corazón sobre las regiones dorsales del pulmón.
2. Estos cambios disminuyen la Presión inspiratoria necesaria para obtener el máximo reclutamiento
3. Disminuye la PEEP necesaria para mantener el reclutamiento
4. Disminuye la apertura y cierre cíclico de vías aéreas

AmJRespir Crit Care Med 2000; 161: 1660-166

Effects of the Prone Position on Respiratory Mechanics and Gas Exchange during Acute Lung Injury

PAOLO PELOSI, DANIELA TUBIOLO, DANIELE MASCHERONI, PIERLUIGI VICARDI, STEFANIA CROTTI, FRANCO VALENZA, and LUCIANO GATTINONI

Istituto di Anestesia e Rianimazione, Università degli Studi de Milano and Servizio di Anestesia e Rianimazione, Ospedale Maggiore, Istituto di Ricovero e Cura a Carattere Scientifico (IRCCS), Milan, Italy

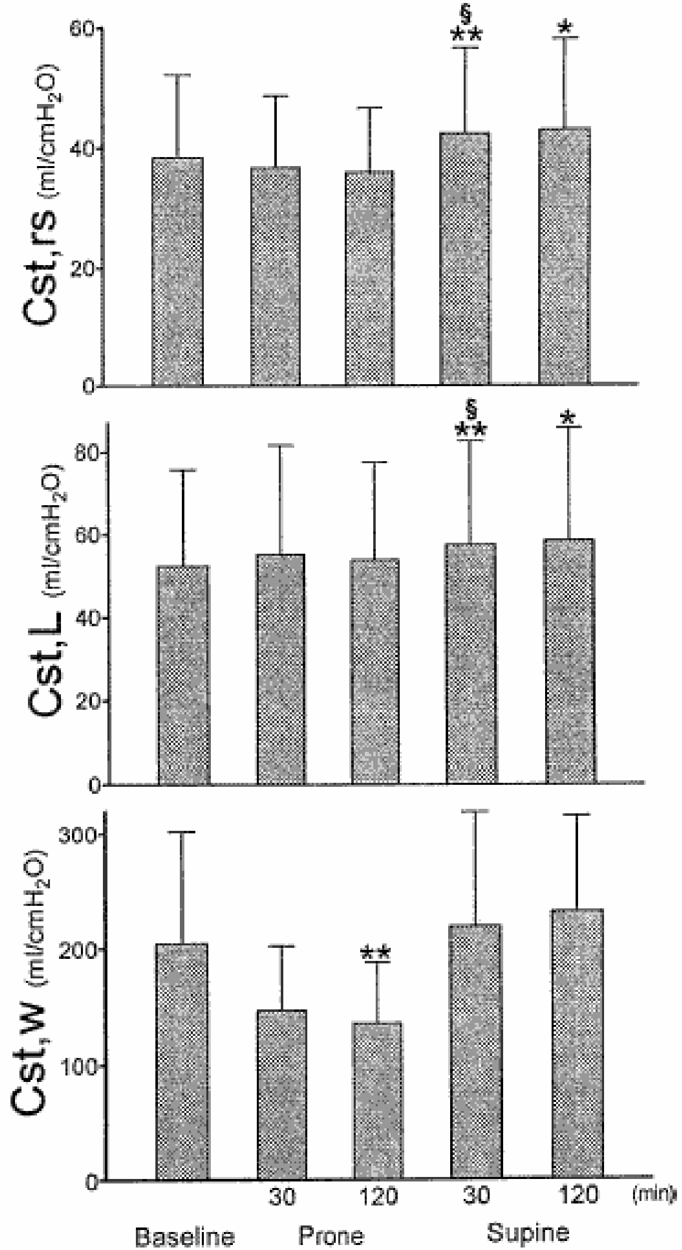
Estudio en 16 pacientes ALI/SDRA, en VC: Relación entre el intercambio gaseoso y mecánica pulmonar durante 2 horas de Prono

ARTERIAL BLOOD GAS VALUES AND PHYSIOLOGIC DEAD SPACE DURING THE STUDY*

	Baseline 0 min	Prone 30 min	Prone 120 min	Supine 30 min	Supine 120 min
a$_{O_2}$, mm Hg	103.19 ± 23.79	119.06 ± 31.81	129.25 ± 32.86[†]	123.13 ± 50.02	117.92 ± 54.9
a$_{CO_2}$, mm Hg	48.04 ± 11.13	50.23 ± 11.76	49.61 ± 11.74	49.96 ± 12.57	48.21 ± 12.6
Ha	7.346 ± 0.086	7.337 ± 0.067	7.334 ± 0.068	7.336 ± 0.07	7.348 ± 0.0
Qs/QT	0.28 ± 0.12	0.27 ± 0.11	0.25 ± 0.11	0.27 ± 0.10	0.28 ± 0.1
D/VT	0.55 ± 0.08	0.58 ± 0.07	0.55 ± 0.08	0.55 ± 0.09	0.55 ± 0.0

AmJ Respir Crit Care Med 1998; 157: 387-393

Cambios en la Compliance



38.4 ± 13.7 vs 35.9 ± 10.7 ml/cm H_2O

52.4 ± 23.3 vs 53.9 ± 23.6 ml/cm H_2O

204.8 ± 97.4 vs 135.9 ± 52.5 ml/cm H_2O

Prone Positioning atteneuates and redistributes VILI in dogs

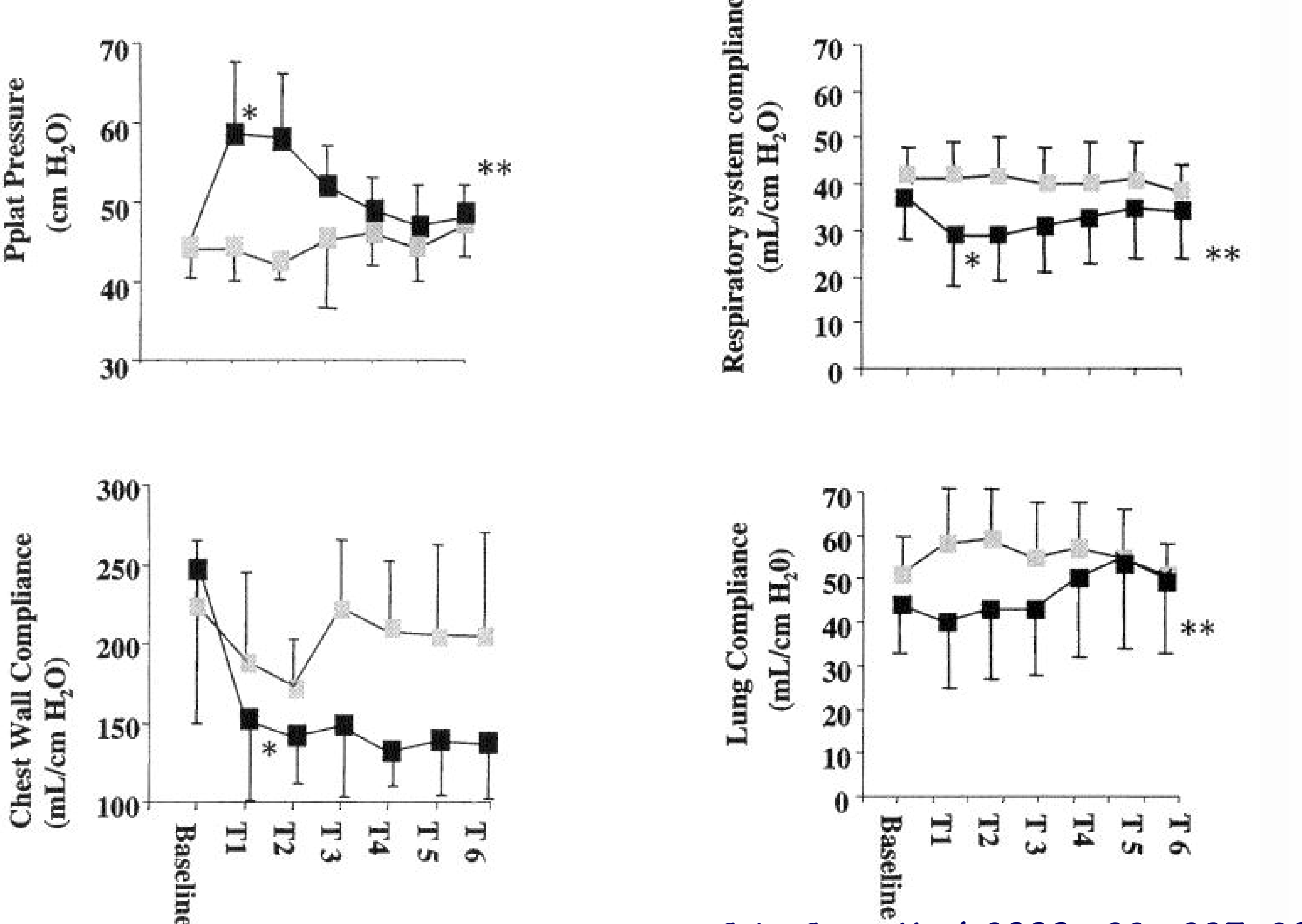
Objetivo: Comparar la extensión y distribución de las lesiones histológicas y edema resultante de la VM con PEEP alta vs PEEP baja en DS y DP.

Estudio en 10 perros (5 ne DS y 5 DP) en intérvalos de 6 hrs

El peso y el Score histológico DS > DP

En DP el peso era > en regiones dependientes, pero sin cambios histológicos

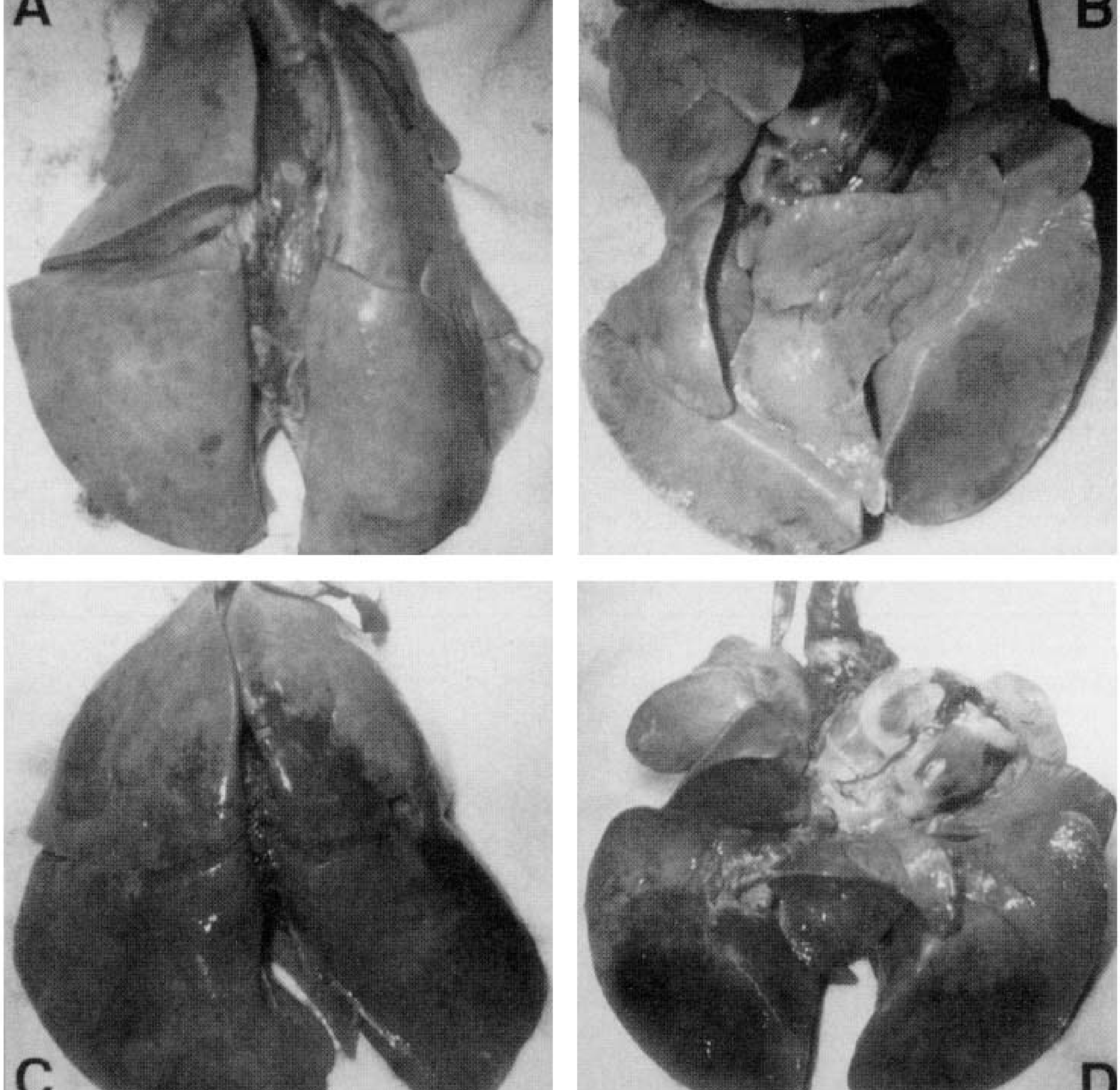
Crit Care Med 2000; 28: 295-303



Crit Care Med 2000; 28: 295-303

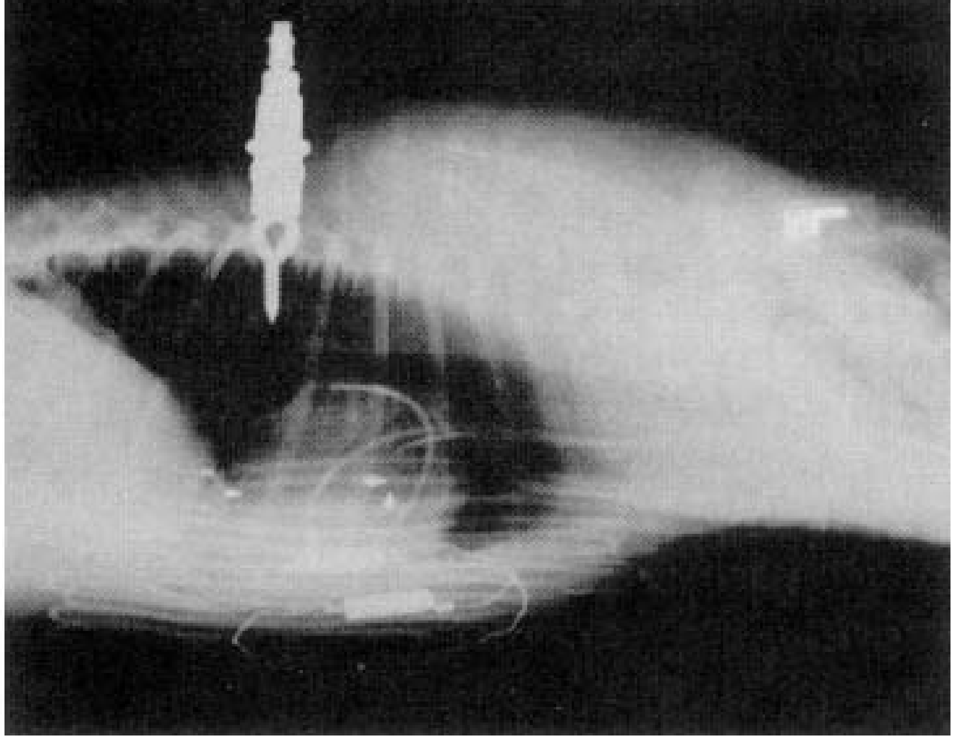
Prono

Supino

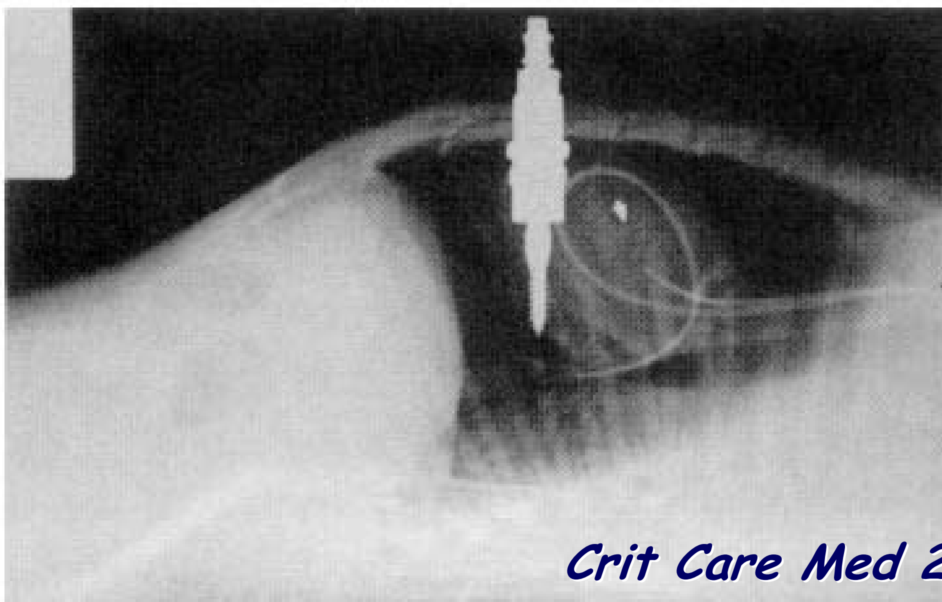


Crit Care Med 2000; 28: 295-303

Prono



Supino



Crit Care Med 2000; 28: 295-303

Conclusiones:

Las lesiones y el edema en Ds en este estudio, era similar al provocado en estudios experimentales previos, mediante ALI provocado por Ac. Oleico, en animales ventilados con el mismo nivel de PEEP y presión transpulmonar. Estas alteraciones quedaban atenuadas por el prono.

Crit Care Med 2000; 28: 295-303

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*

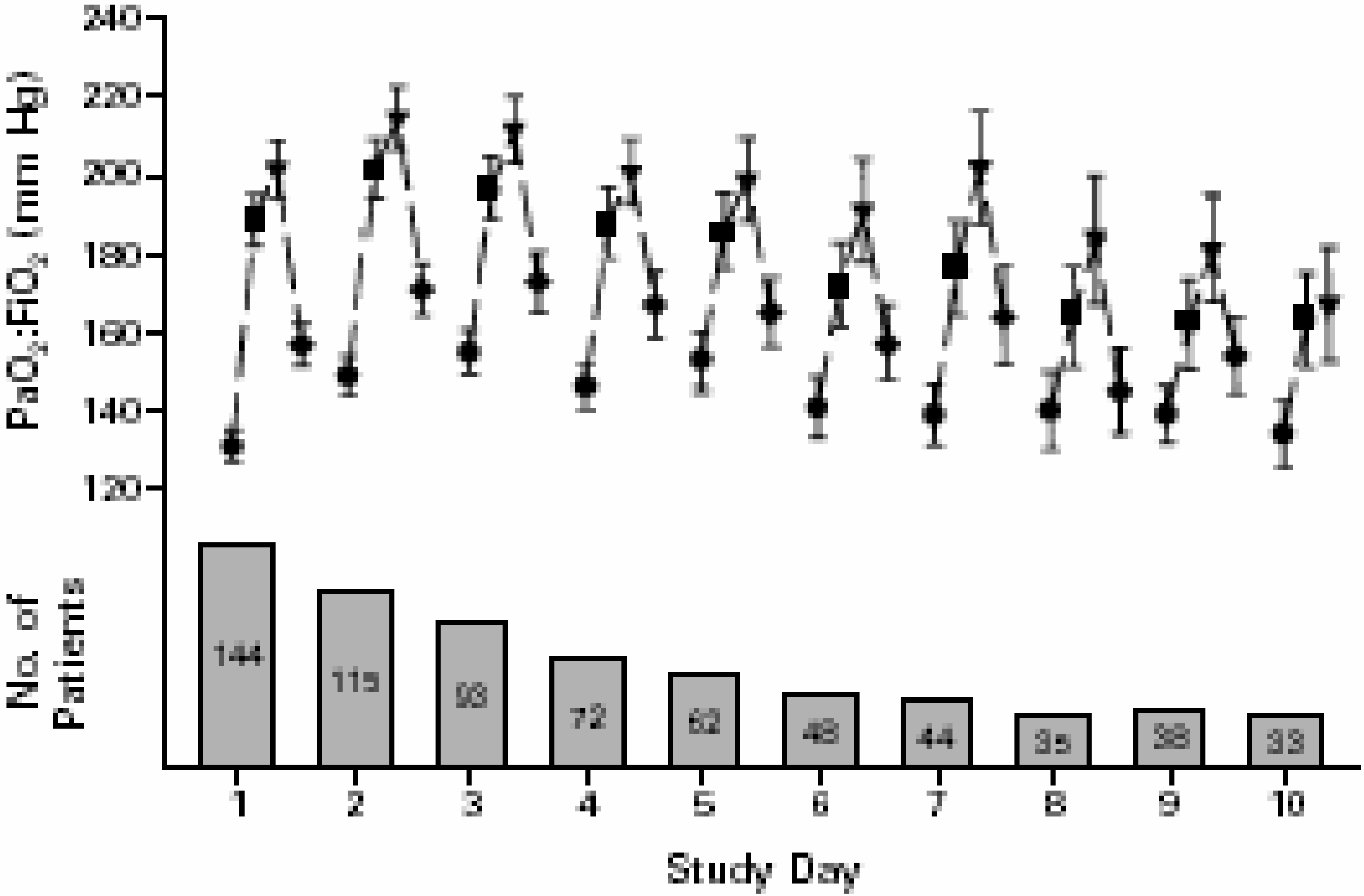
Estudio multicéntricoy randomizado para la comparación de DS vs DP en 304 (152) y supervivencia en ambos grupos.

DP: ≥ 6hrs durante 10 días.

PaO_2/FIO_2 < 200; PEEP > 5 cm H_2O

PaO_2/FIO_2 < 300; PEEP > 10 cm H_2O

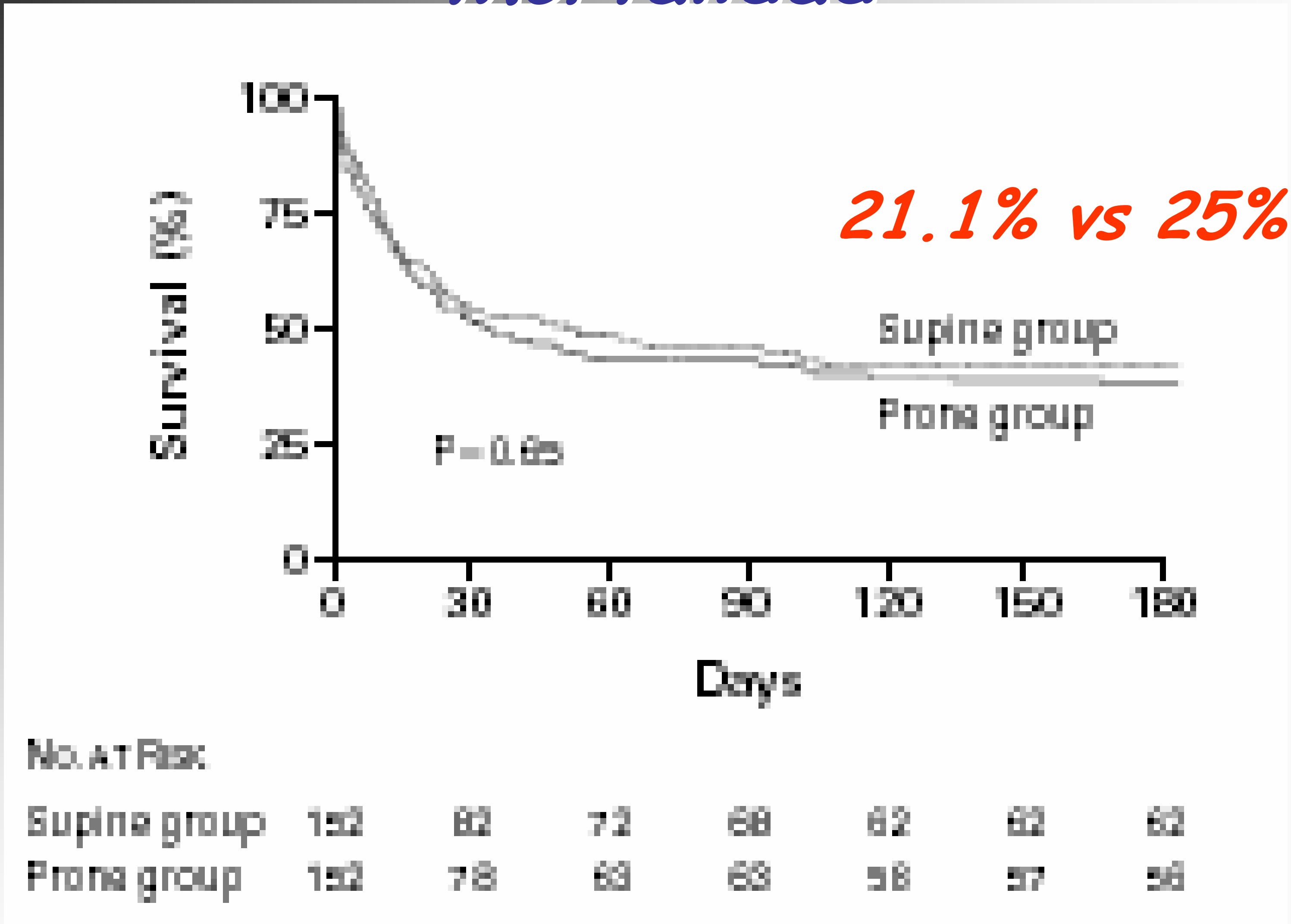
NEJM 2001; 345: 568-57



PaO_2/FIO_2 antes, a la hora y al final del Prono

NEJM 2001; 345: 568-57

Mortalidad



21.1% vs 25%

NEJM 2001; 345: 568-57

TABLE 2. CHANGES IN RESPIRATORY VARIABLES DURING THE 10-DAY TREATMENT PERIOD.*

VARIABLE	BASE-LINE VALUE			AVERAGE CHANGE†		
	SUPINE GROUP	PRONE GROUP	P VALUE	SUPINE GROUP	PRONE GROUP	P VALUE
PaO_2 (mm Hg)	88.3±[illegible]	85.[illegible]	0.31	1.5±26.8	15.0±26.4	0.04
FiO_2 (%)	72.7±[illegible]	7[illegible]	0.72	−7.6±17.6	−12.7±18.7	0.02
$PaO_2:FiO_2$	129.5±[illegible]	[illegible]±48.[illegible]	0.46	44.6±68.2	63.0±66.8	0.02
PEEP (cm of water)	9.6±[illegible]	[illegible]	0.79	0.0±2.9	−0.1±2.5	0.81
Peak inspiratory pressure (cm of water)	32.6±7.4	32.4±7.5	0.86	−0.6±5.3	−0.1±6.6	0.85
Tidal volume						
Milliliters	658±192	652±177	0.80	−11±138	25±128	0.02
Milliliters per kilogram of predicted body weight‡	10.3±2.9	10.3±2.7	0.92	−0.1±2.2	0.4±2.1	0.03
Respiratory rate (breaths/min)	17.2±5.1	17.1±5.3	0.91	1.3±4.5	0.7±4.2	0.20
Minute ventilation (liters/min)	10.4±3.3	10.4±3.2	0.96	0.5±2.6	0.5±2.3	0.96
$PaCO_2$ (mm Hg)	44.2±11.8	45.1±11.0	0.50	2.5±9.9	0.6±11.2	0.81

NS

NEJM 2001; 345: 568-57

PRO

1. Favorece drenaje de secreciones
2. El pulmón "cabe" mejor en el tórax
3. V/Q más uniforme en Prono
4. Debido a la mejoría de la distribución de la Ventilación,la Cst,w disminuye sin deterioro de la oxigenación
5. En prono los pacientes responden mejor a MR
6. Protección ante VALI

Crit Care 2002; 6: 15-17

CON

1. El Prono no está exento de riesgos
2. No hay estudios que demuestren que mejore el pronóstico
3. Sobre/infra valoración del Prono
4. La mejoría en la oxigenación demostrada en estudios animales, justifica el Prono en pacientes??

Crit Care 2002; 6: 15-17

The Effects of Prone Position on IAP and Cardiovascular and Renal function in Patients with ALI

Estudio en 16 pacientes ALI, durante DP y DS:

- Aumento en la oxigenación
- Aumento de la PIA 12 ± 4 vs 14 ± 5 mmHg
- Aumento del IC & Aumento del DO_2
- Disminución de fracción renal del IC
- Aumento de las resistencias vasculares renales
- Sin cambios en GU, FG, excreción renal Na, osm

Crit Care and Trauma 2001; 92: 1226-1231

Complications of Prone Ventilation in Patients with Multisystem Trauma with Fulminant Acute Respiratory Distress Syndrome

Estudio en 9 pacientes ARDS postraumático (12 meses)
Hipoxemia refractaria a otras estrategias ventilatorias

- Edad 29±4.5 años
- ISS 26 ± 5
- Prono: LIS 3.5;
- PaO_2/FIO_2 75 ± 7 a 147 ± 27

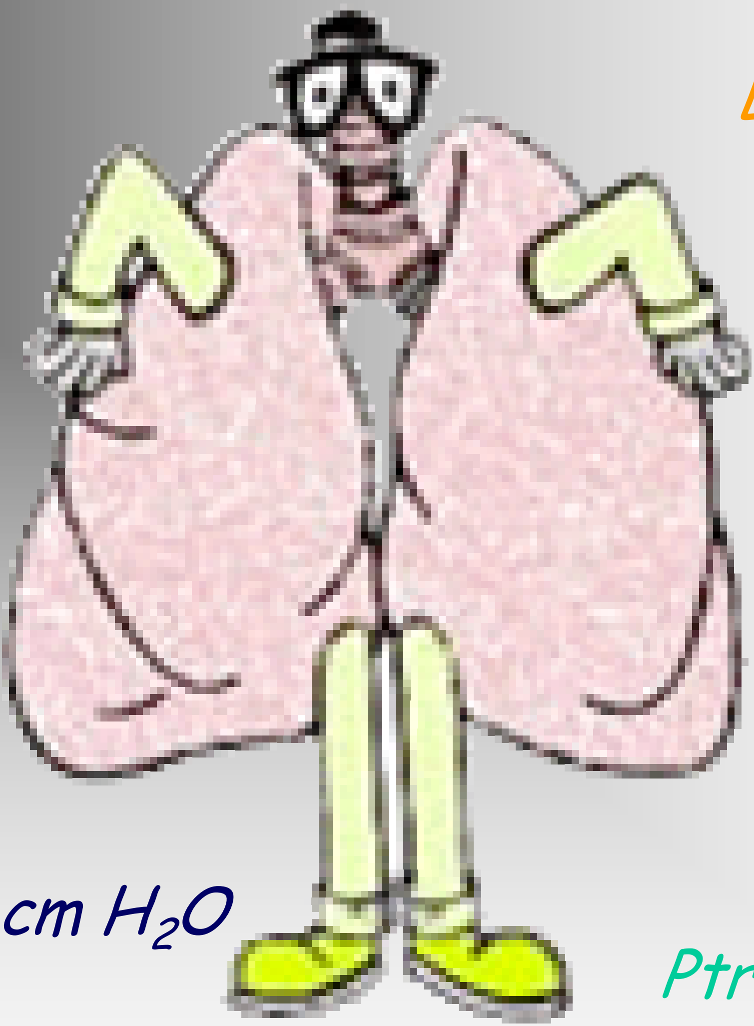
Complicaciones (44%):

- Dehiscencia de sutura abdominal
- Necrosis por presión facial severa y torácica
- Paro cardíaco inmediatamente al Prono

Journal of Trauma 2000; 48: 224-228

Sights

Low Vt



High PEEP

CPAP 40 x 40

Pplat « 30 cm H_2O

Ptransp < 15 cm H_2O

"Open up the lung and keep it open"