

Ventilación Mecánica en el SDRA

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Definición

- Síndrome de Distres Respiratorio (SDRA) es definido como un edema pulmonar no cardiogénico y falla respiratoria aguda en pacientes críticos.
- Desarrollo de infiltrados bilaterales e hipoxemia severa sin falla cardíaca congestiva.
- Mayor causa de morbilidad y mortalidad en UCI.

Ann Intern Med. 2004;141:460-470.

Acute Respiratory Distress Syndrome The Berlin Definition

The ARDS Definition Task Force*

Tabla 3. La Definición de Berlín de SDRA

Síndrome Distrés Respiratorio Agudo	
Timing	Dentro de una semana de una lesión clínica conocida, aparición o empeoramiento de síntomas respiratorios.
Radiografía Torax	Opacidades bilaterales - no explicadas completamente por derrames, atelectasia o nódulos.
Origen del edema	Falla respiratoria no completamente explicada por falla cardíaca o sobrecarga de volumen. Requiere evaluación objetiva (por ej. Ecocardiografía) para excluir edema hidrostático si no presenta factores de riesgo.
Oxigenación*	
Leve	200 mmHg < PaFi < 300 mmHg, con PEEP o CPAP > 5 cmH ₂ O
Moderada	100 mmHg < PaFi < 200 mmHg, con PEEP > 5 cmH ₂ O
Severa	PaFi < 100 mmHg, con PEEP > 5 cmH ₂ O

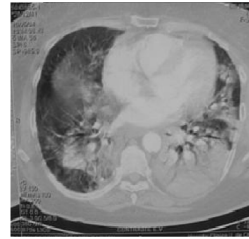
Abbreviations: CPAP, Positive pressure ventilation on the ventilator; PEEP, Positive end-expiratory pressure; PaO₂, partial pressure of oxygen; PaFi, partial pressure of oxygen at functional residual capacity.

* Si la alveolar es > 100 mmHg, debe ser calculado un factor de corrección (PaFi x [presión barométrica - P_{H₂O}]).

* Puede ser otorgado de manera no invasiva en el grupo de SDRA leve.

JAMA 2012; 307(23): E1-E7

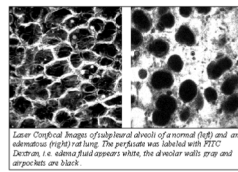
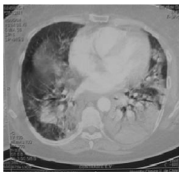
S.D.R.A.



- Conjunto de síntomas asociados a injuria pulmonar severa de diversa etiología.
- Caracterizado por:
 - Hipoxemia
 - Disminución Distensibilidad
 - Infiltrados bilaterales.
 - PaFi < 200
 - Sin evidencia falla cardíaca.

Hess D., Kacmarek R. "Essentials of Mechanical Ventilation" 2ª Edición Ed. Mac Grahill (2002)

SDRA



Ocupación alveolar (Consolidación)
Colapso Alveolar (zonas reclutables)
Alvéolos normales

Chest 2001; 120:1347-1367

3 conceptos fisiopatológicos básicos...

- El pulmón en el SDRA es pequeño
- El pulmón en el SDRA es inestable
- La ventilación mecánica produce daño

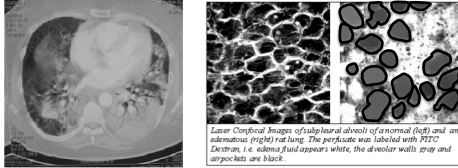


Trauma por sobredistensión /
Atelectrauma / Biotrauma

3 conceptos fisiopatológicos básicos...

- El pulmón en el SDRA es pequeño

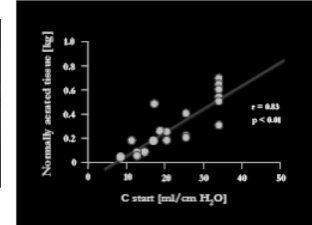
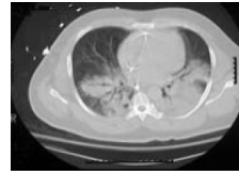
Concepto de "Baby Lung"



Chest 2001; 120:1347-1367

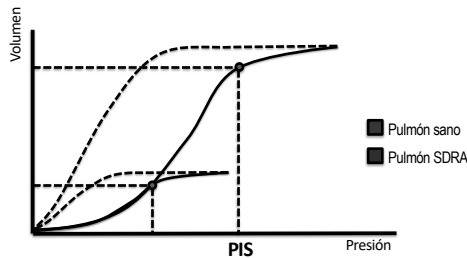
Pressure-Volume Curve of Total Respiratory System in Acute Respiratory Failure: Computed Tomographic Scan Study

Luciano Gattinoni, Antonio Pesenti, Leonello Avalli, Francesca Rossi, and Michela Bombino



Am. J. Respir. Crit. Care Med. 1987; 136: 730-736

- El pulmón en el SDRA es pequeño ("Baby Lung")
... un problema de "continente"



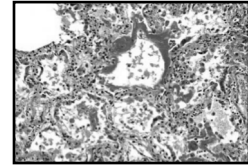
Chest 2001; 120:1347-1367

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 LORENZO-FILHO, M.D., RONALDO ADIB KARALLA, M.D., DANIEL DEHENEZLIN, M.D., CARLOS MUNOZ, M.D., ROSELAINE OLIVEIRA, M.D., TERESA YAE TAKAGAKI, M.D., AND CARLOS ROBERTO RIBEIRO CARVALHO, M.D.

Ventilación Protectora

- Amato et al.
- VC 12ml/Kg vs 6 ml/Kg.
- > sobrevivió a 28 días (38% vs 71%)



N Engl J Med 338:347-54 (1998)

Tidal volume is a major determinant of cyclic recruitment-derecruitment in acute respiratory distress syndrome

A. BRUHN¹, D. BUGEDO¹, F. RIQUELME¹, J. VARAS¹, J. RETAMAL¹, C. BESA², C. CABRERA², G. BUGEDO¹

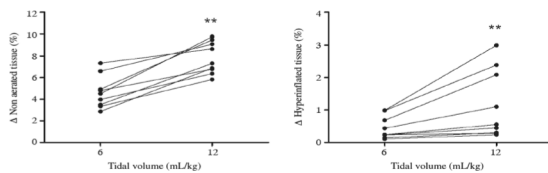
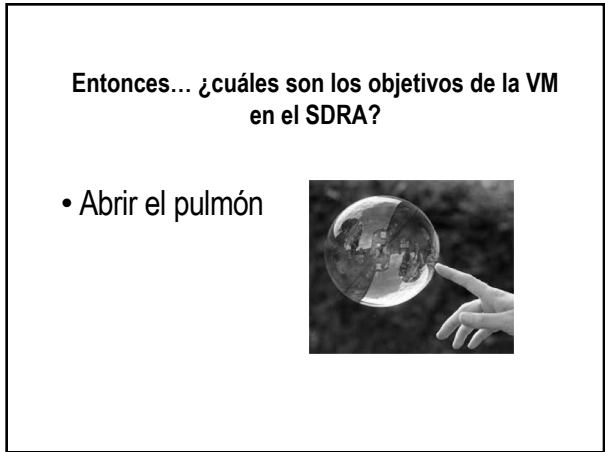
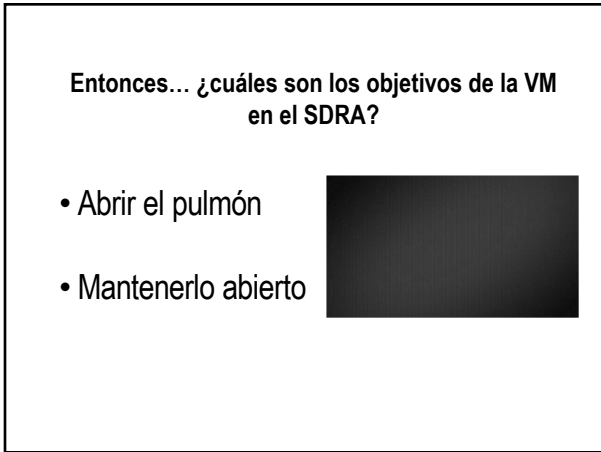
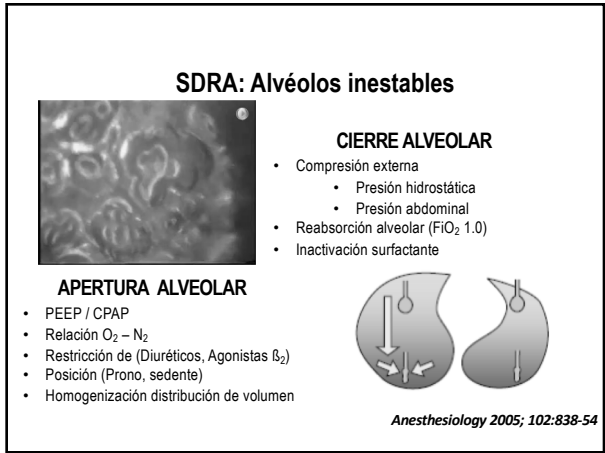
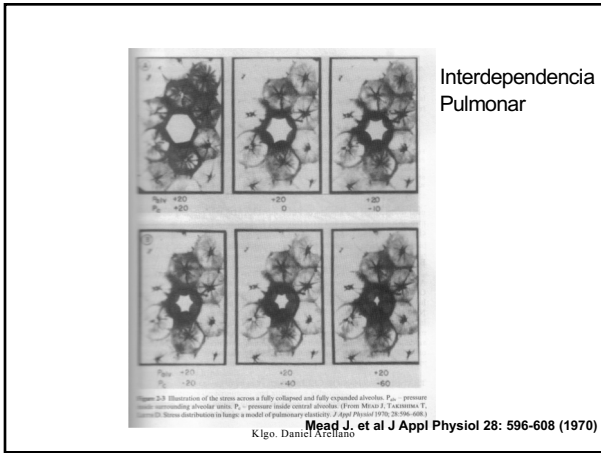
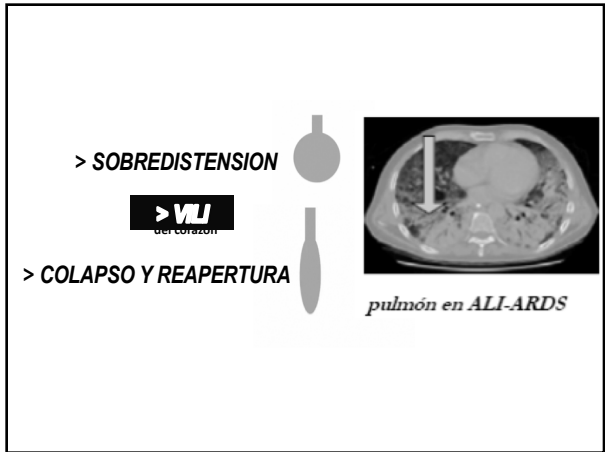
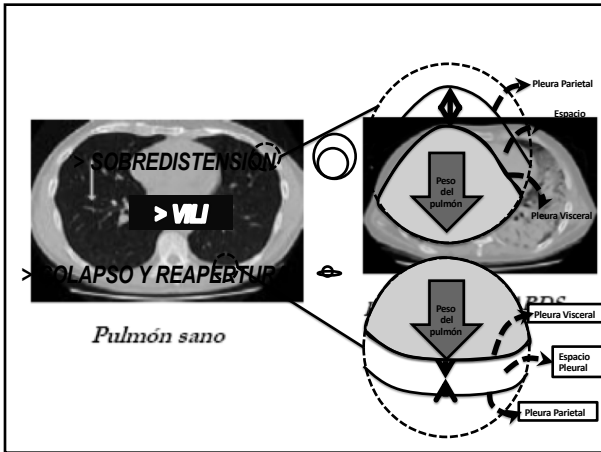


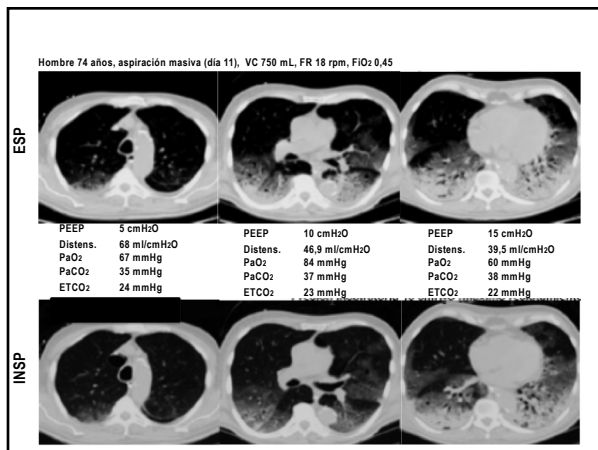
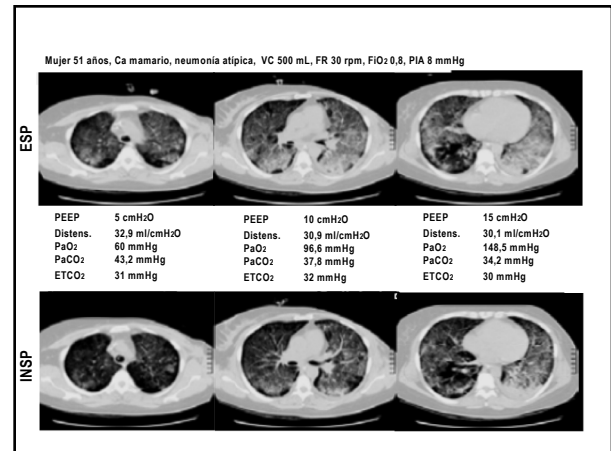
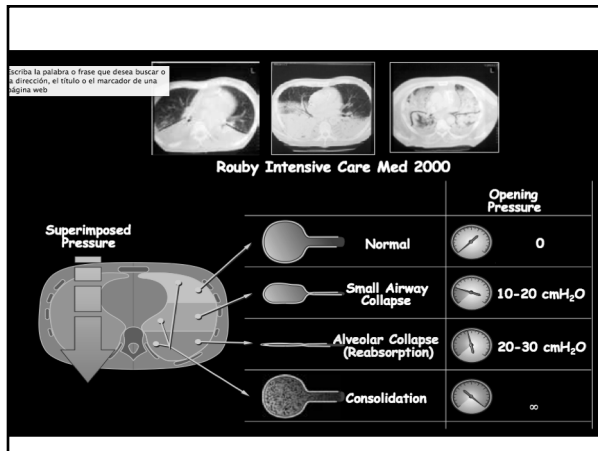
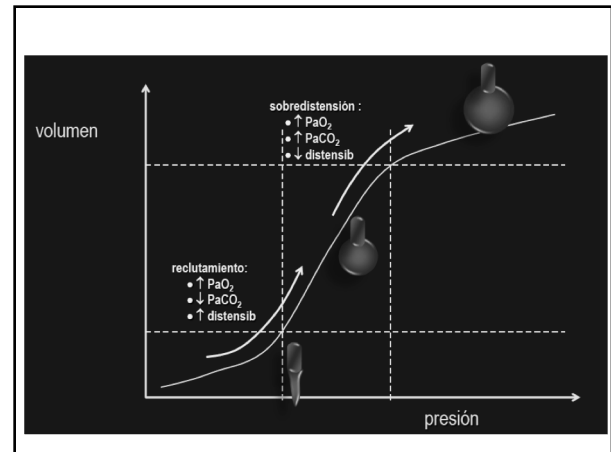
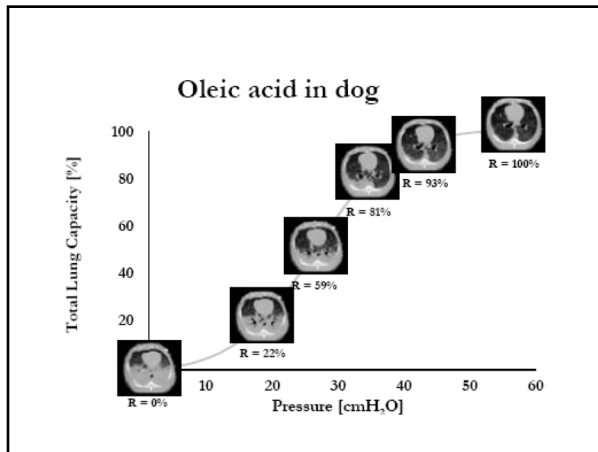
Figure 3.—Cyclic recruitment-derecruitment and tidal hyperinflation. The graphs present cyclic recruitment — derecruitment, this is cyclic variation of non aerated tissue-non aerated tissue max — non aerated tissue min (expressed as % of lung tissue weight, on the left), and tidal hyperinflation, this is cyclic variation of hyperinflated tissue-hyperinflated tissue max — hyperinflated tissue min (expressed as % of lung tissue weight, on the right) for each of the 9 patients with VT 6 and VT 12 mL/kg. **P<0.01 compared with VT 6 mL/kg.

Minerva Anestesiol 2011;77:418-26

3 conceptos fisiopatológicos básicos...

- El pulmón en el SDRA es pequeño
→ Concepto de "Baby Lung"
- El pulmón en el SDRA es inestable
→ Apertura y cierre cíclico (Atelectrauma)

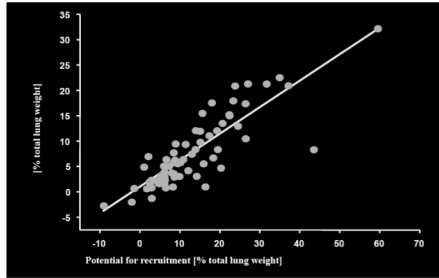




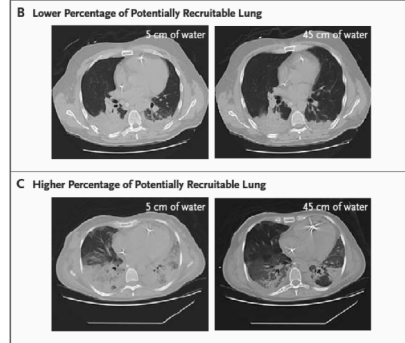
ALI/ARDS lung composition			
	Lower potential for recruitment (34 pts)	Higher potential for recruitment (34 pts)	P
Lung weight	1266 ± 327	1735 ± 547	0.0001
% aerated lung tissue	70 ± 12	56 ± 17	<0.0001
% openable at 45cmH ₂ O	5 ± 4	21 ± 10	<0.0001
% always closed	25 ± 12	24 ± 14	0.69

Gattinoni L, Caironi F, Cressoni M, Chiumello D, Ranieri VM, Quintel M, Russo S, Coiro R, Bugedo G, *NEJM* 2006; 354(17):1775-86

Potencial de Reclutamiento en función del peso pulmonar



Gattinoni et al NEJM 2006, 354(17):1775-86

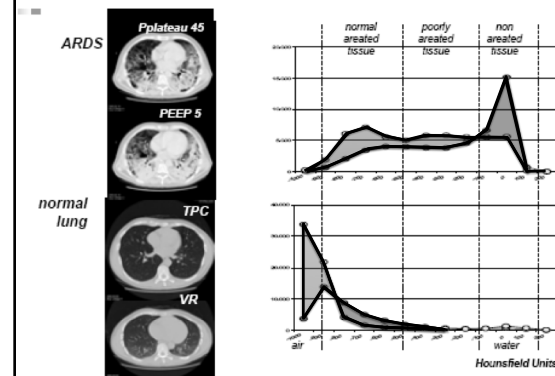


The NEW ENGLAND JOURNAL of MEDICINE

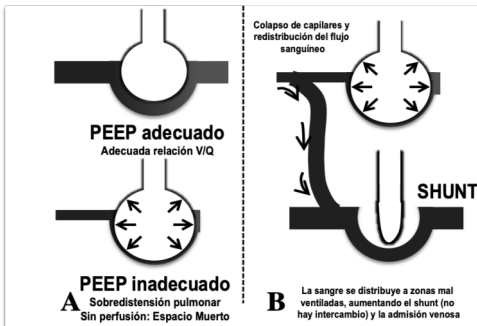
ESTABLISHED IN 1812 APRIL 27, 2006 VOL. 354 NO. 17

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 Bugeño, M.D.

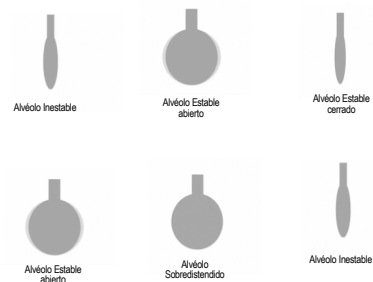


Selección de PEEP óptimo

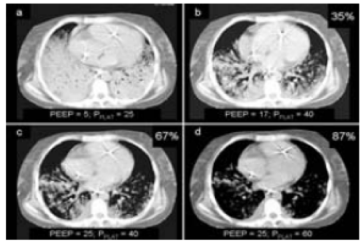


Crit Care Clinics 2002;18:15-33

“Maniobras de reclutamiento pulmonar util en pacientes con potencial de reclutamiento”



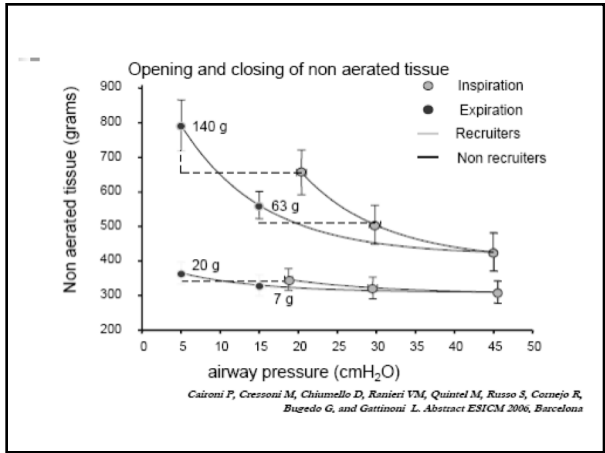
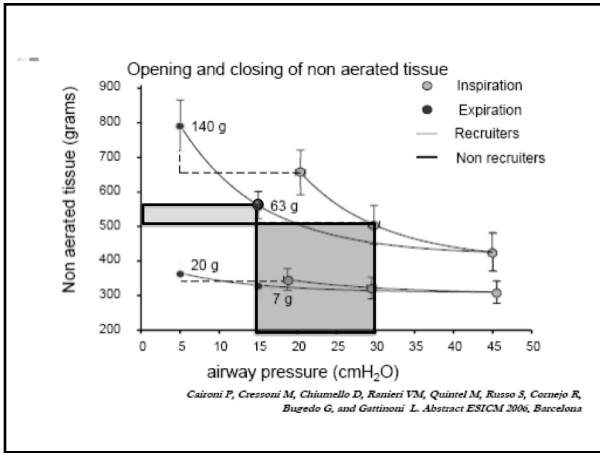
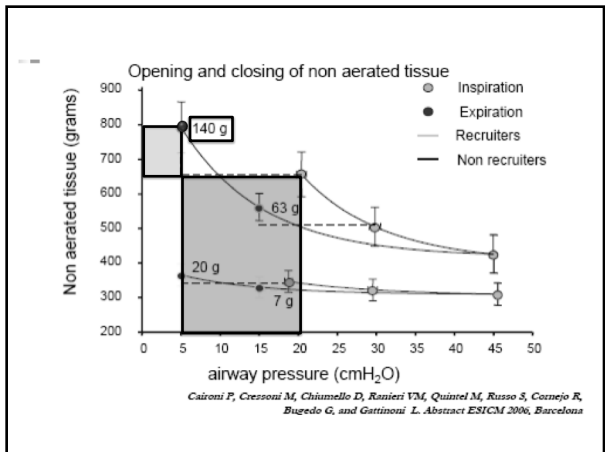
Full open lung



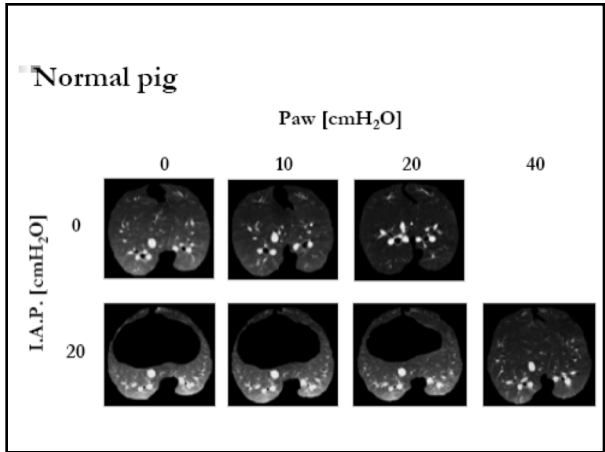
Tiene un precio:

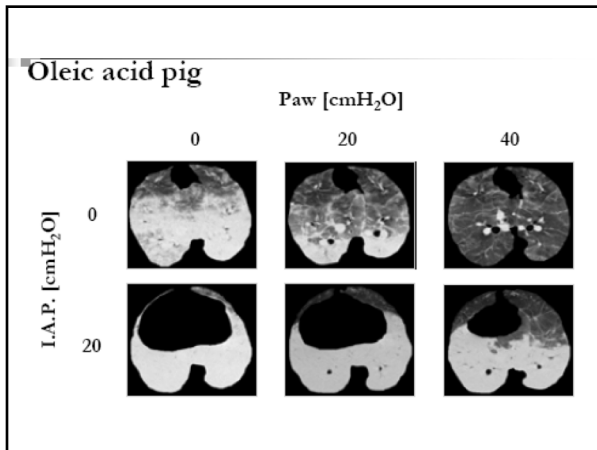
- Retención de CO₂ (95+34mmHg)
- Acidosis severa (pH 6.94±0.11)
- Infusión de gran volumen para mantener la función hemodinámica

Borges J, et al. *Am J Respir Crit Care Med*; 174(3): 268-275, 2006
Bugeo G, Bruhn A. *Am J Respir Crit Care Med*; 174(10):1159, 2006



EFFECTO DE LA PRESIÓN INTRAABDOMINAL

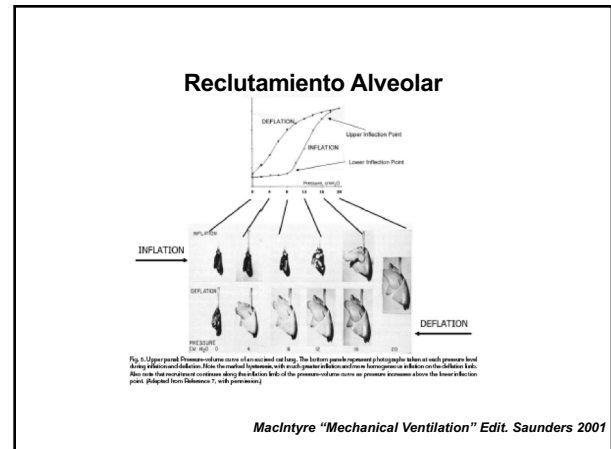
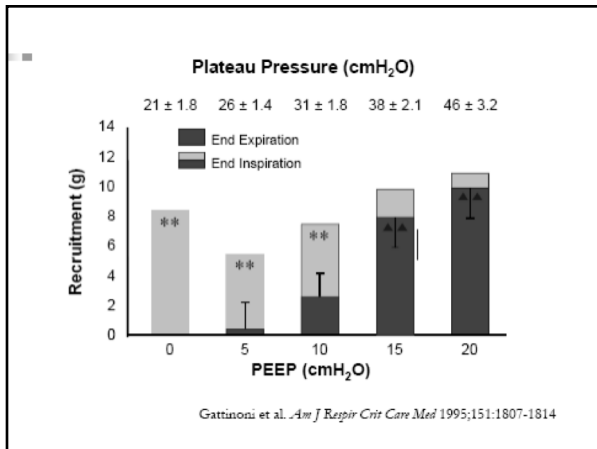





Entonces... ¿cuáles son los objetivos de la VM en el SDRA?

- Abrir el pulmón • Evitar atelectasias cíclicas
- Mantener pulmón abierto

Intensive Care Med 1992; 18: 319-321

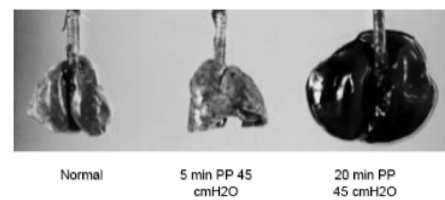


3 conceptos fisiopatológicos básicos...

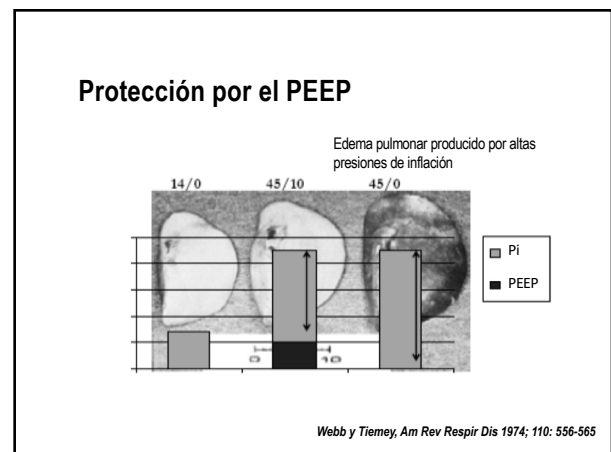
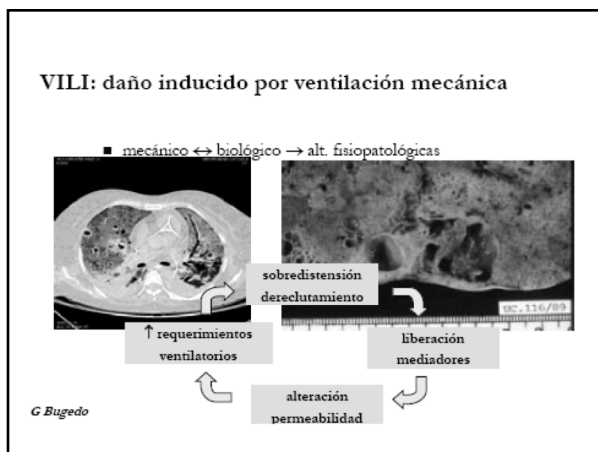
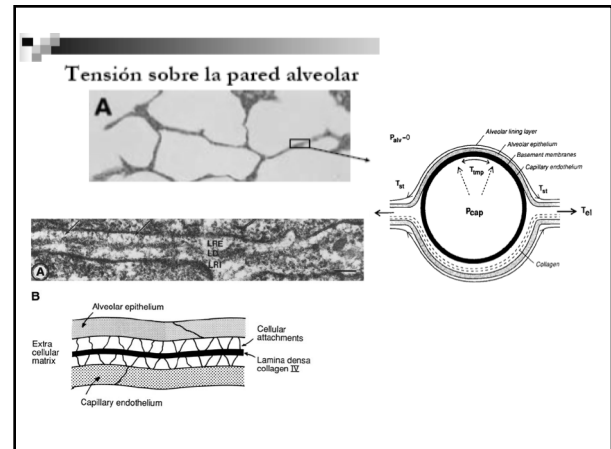
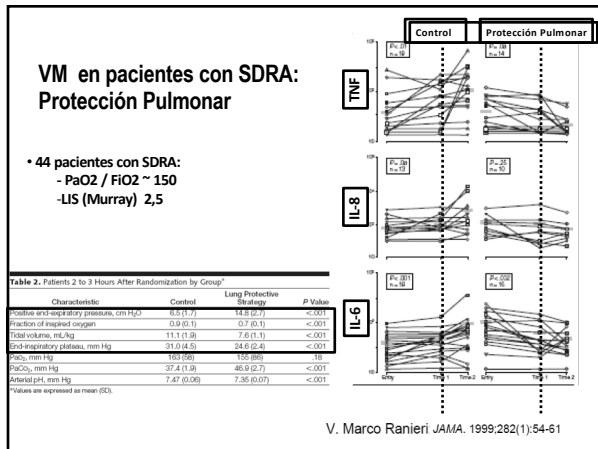
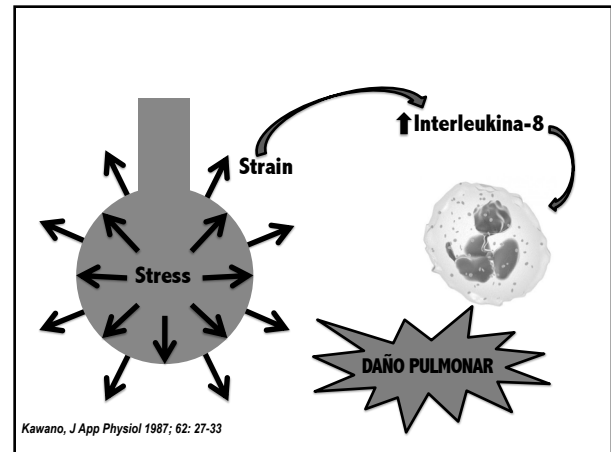
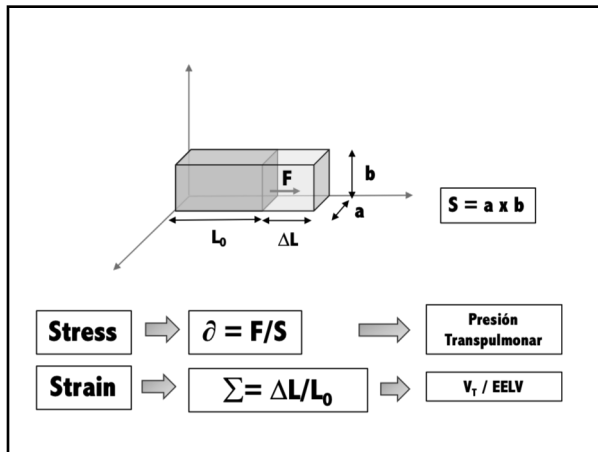
- El pulmón en el SDRA es pequeño
- El pulmón en el SDRA es pequeño
- La ventilación mecánica produce daño

Volu / Baro / Bio-trauma

Daño Inducido por la VM



Dreyfuss R, Am Rev Resp Dis 1985; 132: 880



Protección por el PEEP

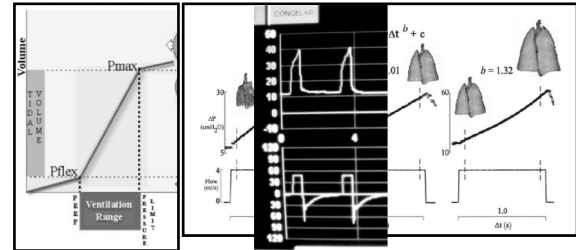


Alvéolo Estable

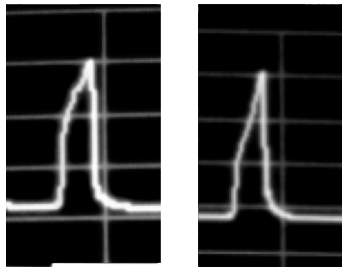


Alvéolo Inestable

Índice de Stress



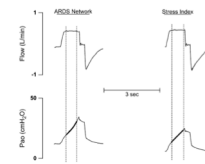
Índice de Stress



ARDSnet Ventilatory Protocol and Alveolar Hyperinflation

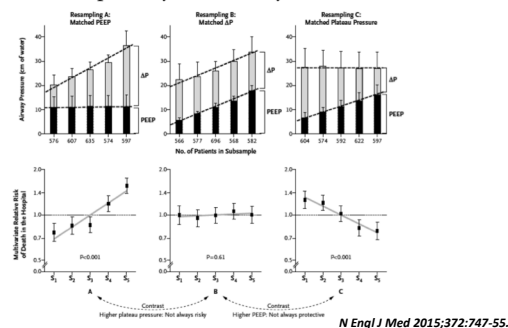
Role of Positive End-Expiratory Pressure

	ARDSnet	Stress Index	P Value
PEEP _{max} cm H ₂ O	13.2 ± 2.4	6.8 ± 2.2	<0.01
PEEP _{min} cm H ₂ O	0.9 ± 1.1	1.1 ± 1.6	NS
V _T ml	420 ± 80	440 ± 40	NS
RR breaths/min	23 ± 5	22 ± 4	NS
Minute ventilation, L/min	8.6 ± 2.8	9 ± 3.1	NS
EtO ₂ cm H ₂ O/L	34.7 ± 6.6	31.2 ± 7.4	<0.01
EtO ₂ cm H ₂ O/L	28.6 ± 6.7	26.3 ± 7.1	<0.01
EtO ₂ cm H ₂ O/L	5.9 ± 2.4	6.2 ± 2.4	NS
P _{ao}	0.75 ± 0.14	0.76 ± 0.13	NS
pH	7.397 ± 0.1	7.408 ± 0.1	NS
P _{aO₂/P_{aO₂}}	122 ± 44	110 ± 32	NS
P _{aO₂/F_{iO₂}}	40.6 ± 6.1	41.8 ± 6.3	<0.01

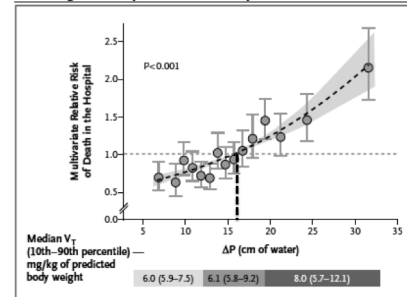


Am J Respir Crit Care Med Vol 176, pp 761-767, 2007

Driving Pressure and Survival in the Acute Respiratory Distress Syndrome



Driving Pressure and Survival in the Acute Respiratory Distress Syndrome



Conclusiones



- ➔ En un pulmón pequeño (ARDS lung), Presiones/Volúmenes elevados son deletéreos
- ➔ En un pulmón inestable las atelectasias cíclicas son deletéreas
- ➔ Mantener el pulmón abierto: Siempre? Todo?

Conclusiones

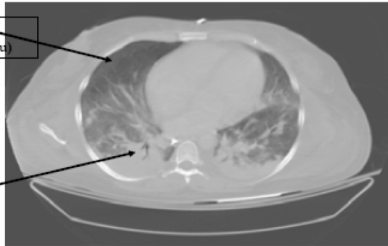


- El "VILI" se produce por excesivo stress/strain, global/regional, y se afectan zonas que están menos comprometidas
- Stress/strain a nivel celular, via IL-8, induce acumulación de neutrófilos que producen mayor injuria pulmonar

SDRA

Evitar la sobredistensión
(limitar VI y presión plateau)

Evitar dereclutamiento
(adecuar PEEP)



Programación inicial del VM en SDRA

