MEDIZINISCHE UNIVERSITÄT
INNSBRUCK

Mecánica pulmonar y falla respiratoria

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Respiratory Failure

Work Load

1. Parenchym
2. Nosocomial

Efficiency

1.Chest Deformation
2. Diaphragma
3. Uncoordinated Breaths

Energy

1. Regulation
2. Power

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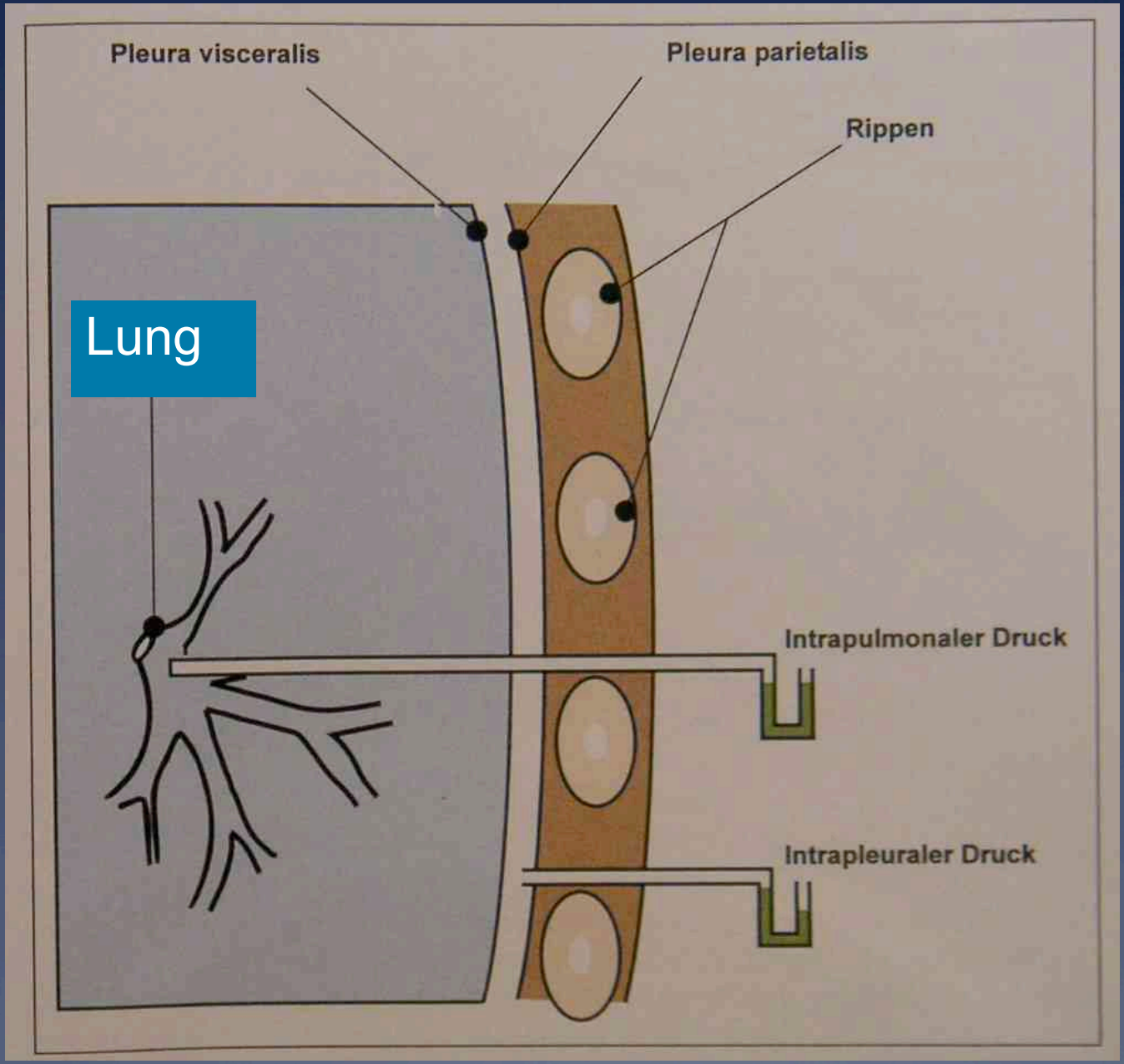
¿Cómo crear una diferencia de presión?

- 1. Comprimir el gas en un lado
- 2. Aumentar el volumen en el otro lado



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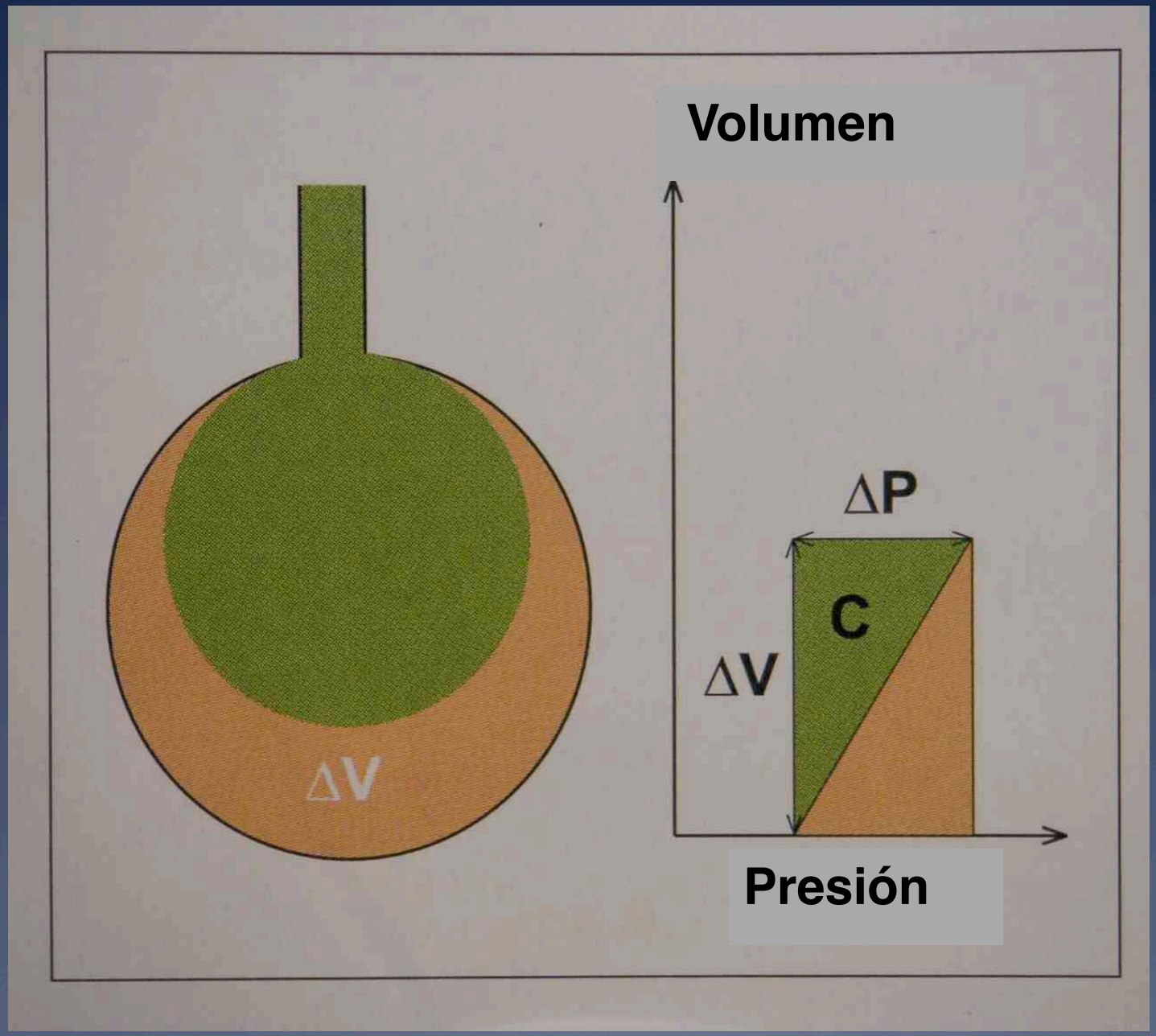

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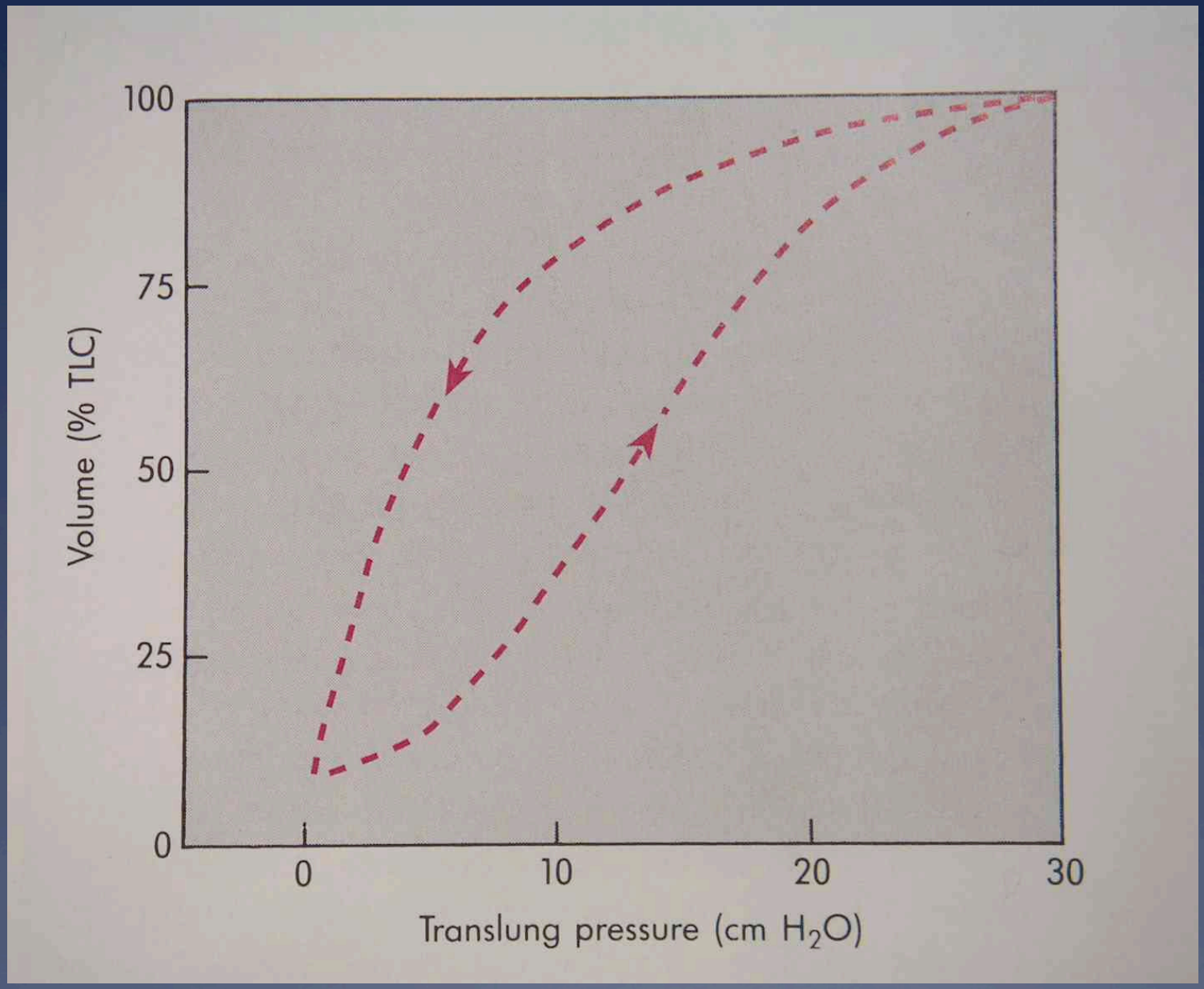

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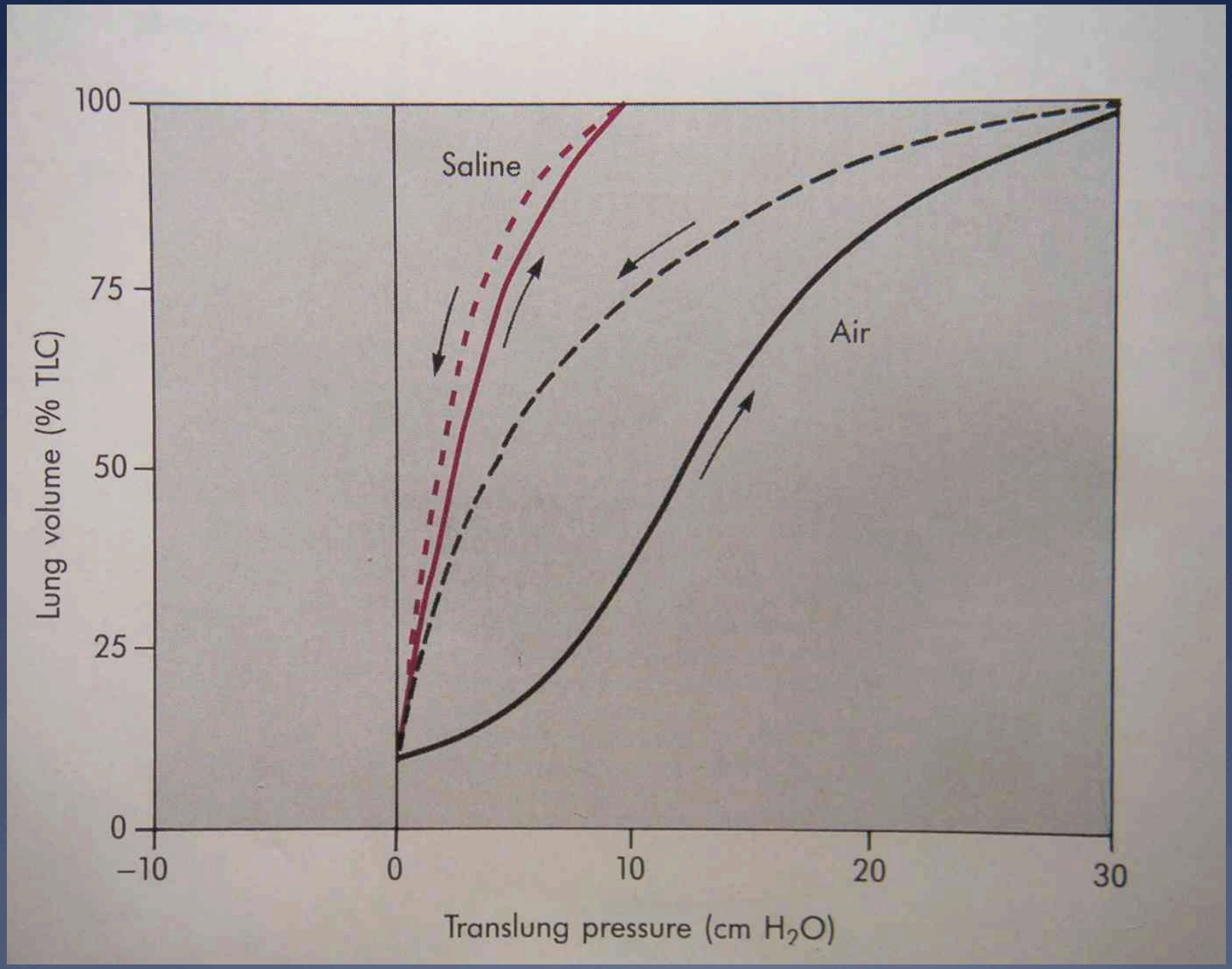
La distensibilidad respiratoria:

- Distensibilidad pulmonar
- Distensibilidad torácica

La distensibilidad pulmonar está determinada por:

- Tensión superficial de los alveolos
- Propiedades viscoelásticas del tejido pulmonar
  - ¡Contenido de agua en el pulmón!



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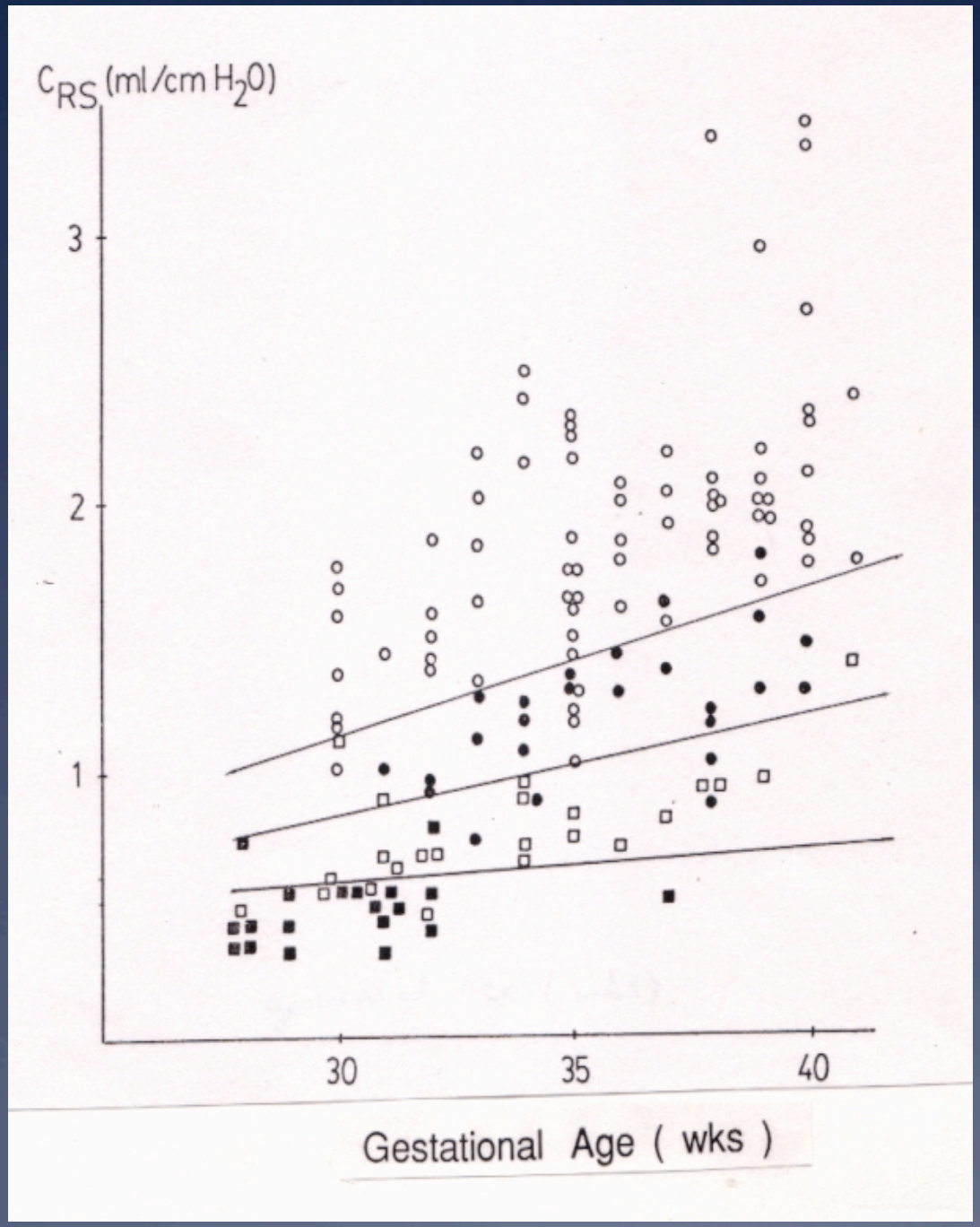
Developmental Differences between Newborns and Adults

Organ System RESPIRATION	Newborn per kg	Adult per kg
Frecuencia respiratoria	30-35	15
Volumen corriente	4-6	4-6
FRC (ml)	30	50
Valv (ml/min)	100 - 150	60
Valv/FRC	4 - 5*	1 - 2*
VD (ml)	1.5 - 3	1 - 2



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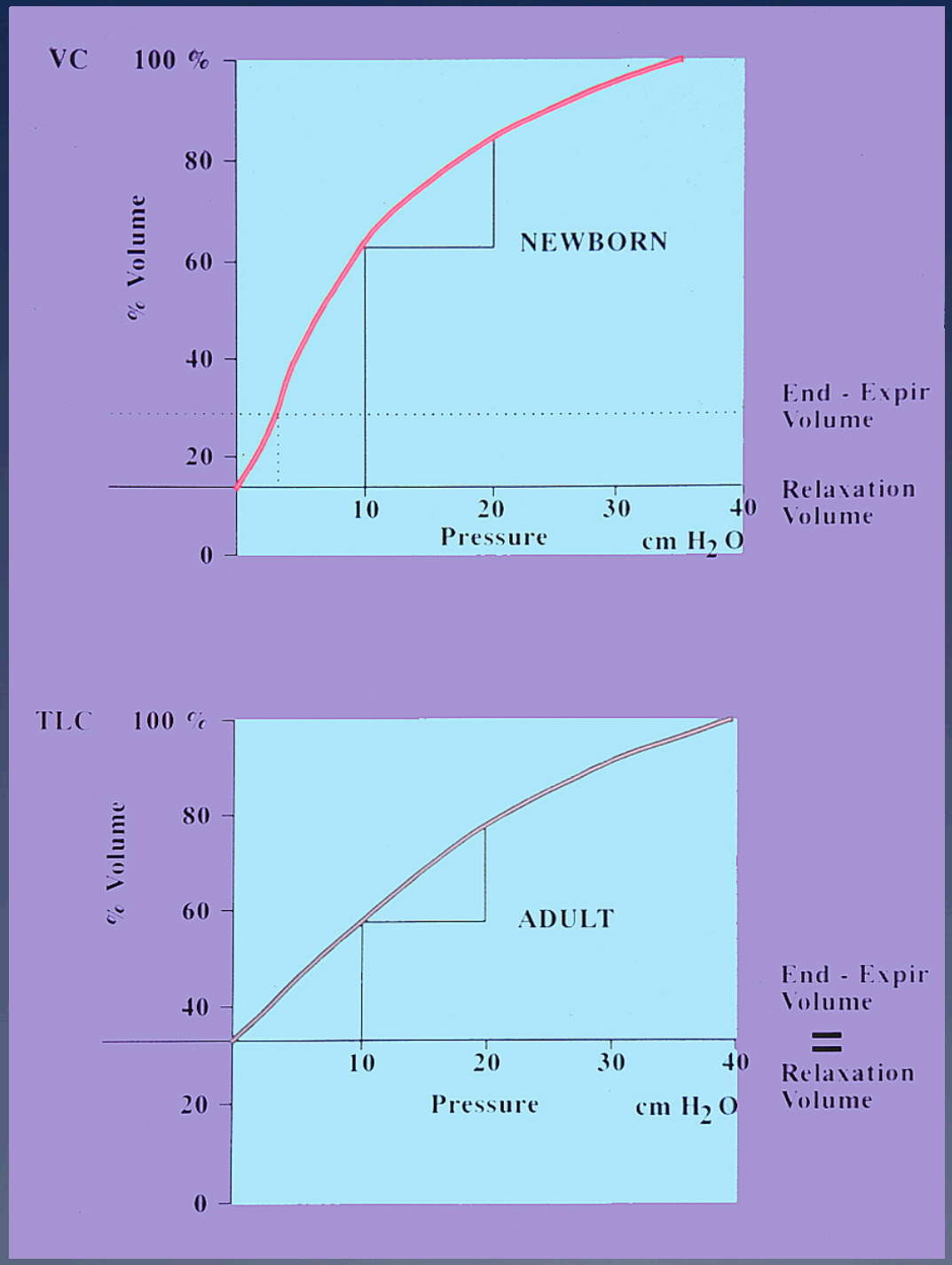
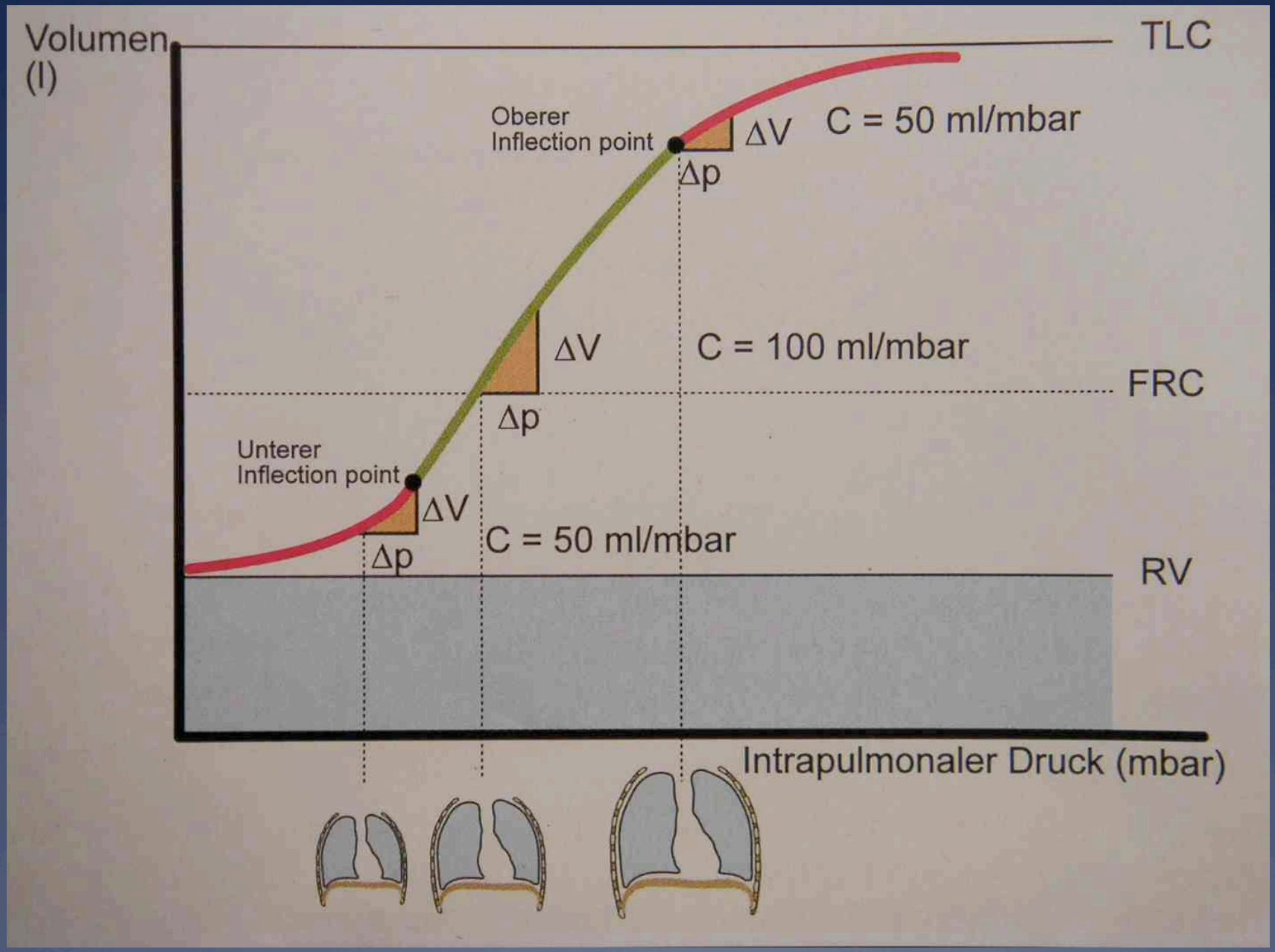

VC
100 %
80
60
40
20
0
% Volume
NEWBORN
10
20
30
40
Pressure
cm H_2O
End - Expir Volume
Relaxation Volume
TLC
100 %
80
60
40
20
0
% Volume
ADULT
10
20
30
40
Pressure
cm H_2O
End - Expir Volume
=
Relaxation Volume



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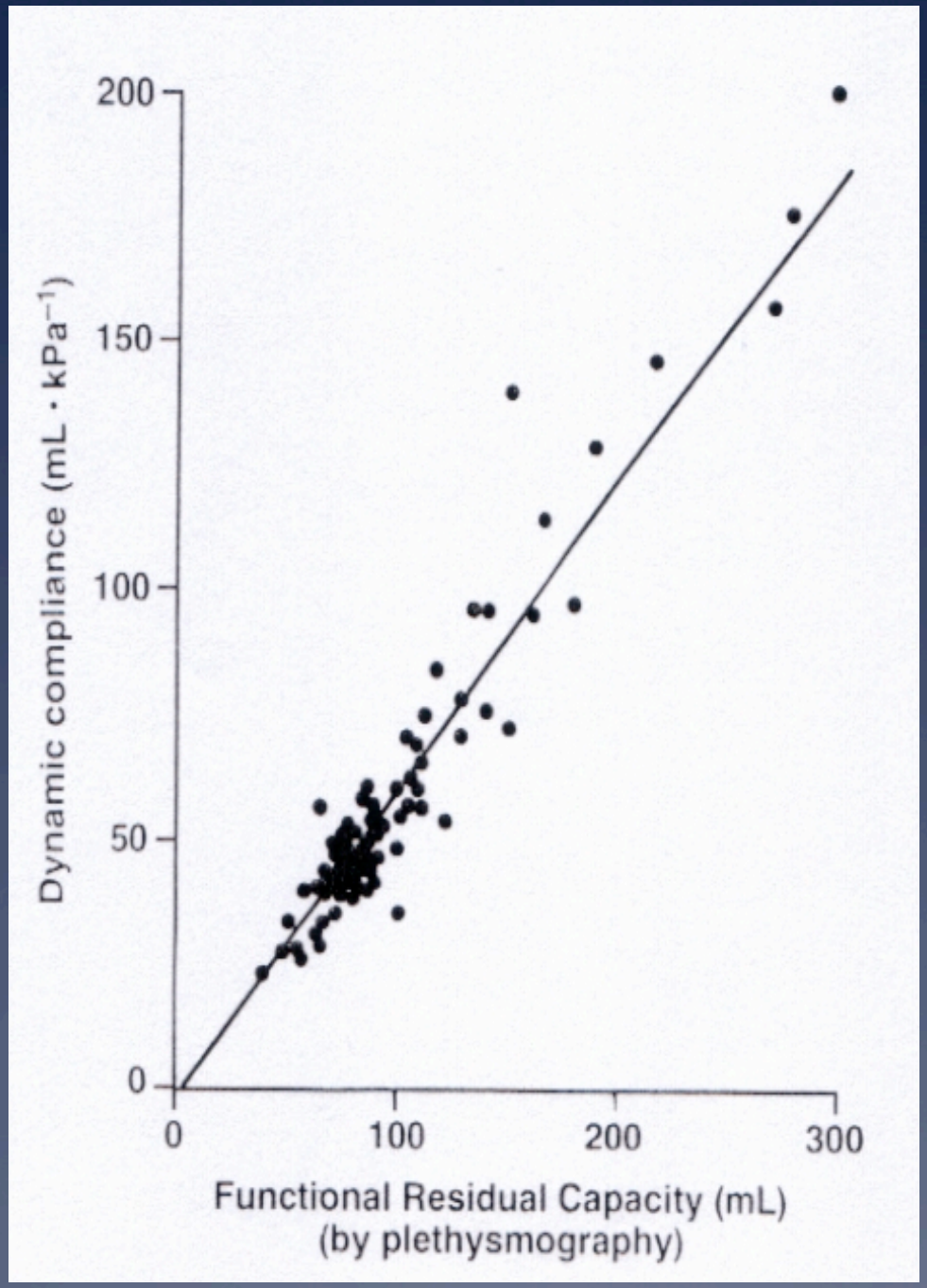

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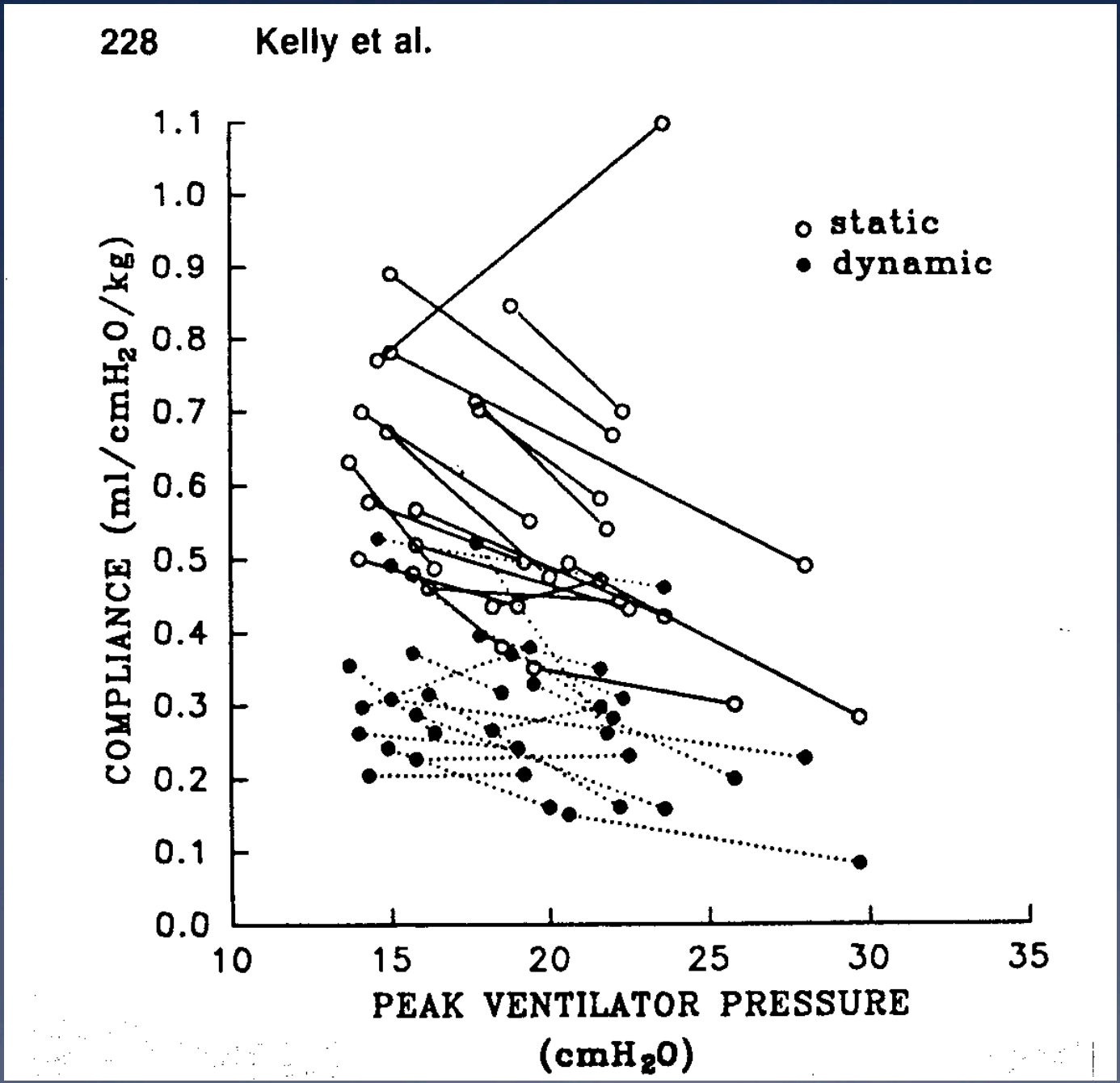
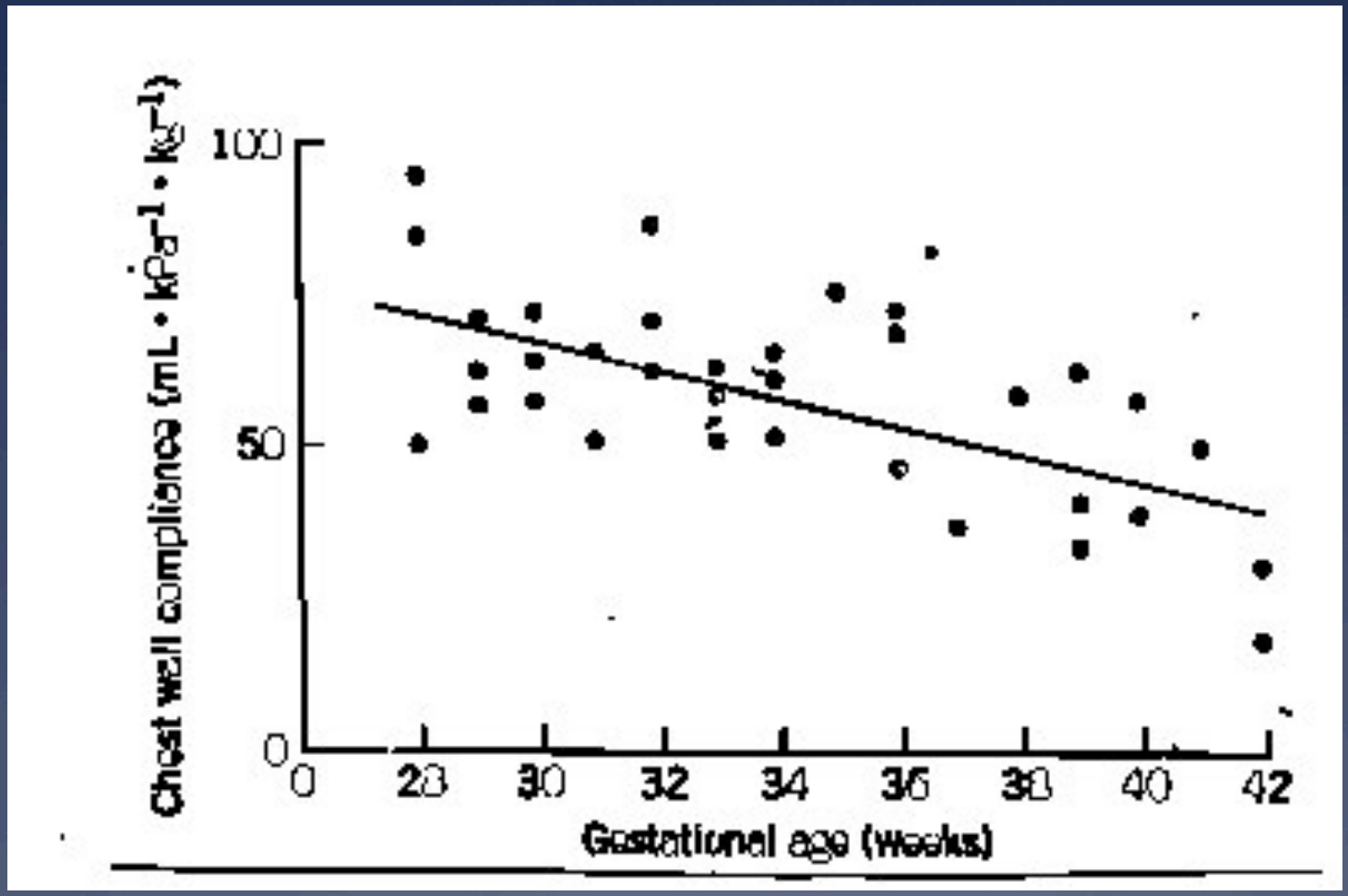

228 Kelly et al.
COMPLIANCE (ml/cmH2O/kg)
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
10
15
20
25
30
35
PEAK VENTILATOR PRESSURE
(cmH2O)
static
dynamic



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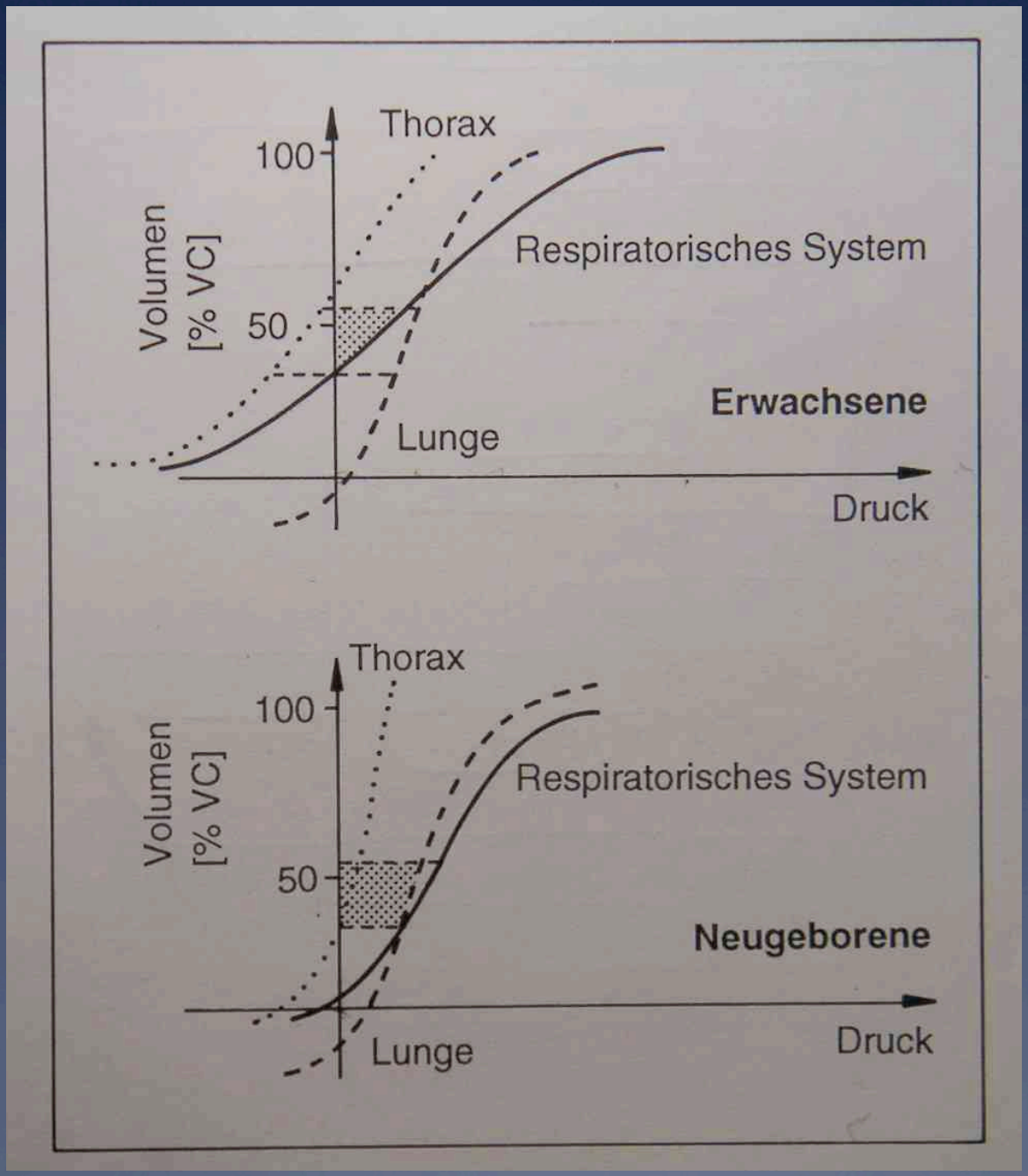

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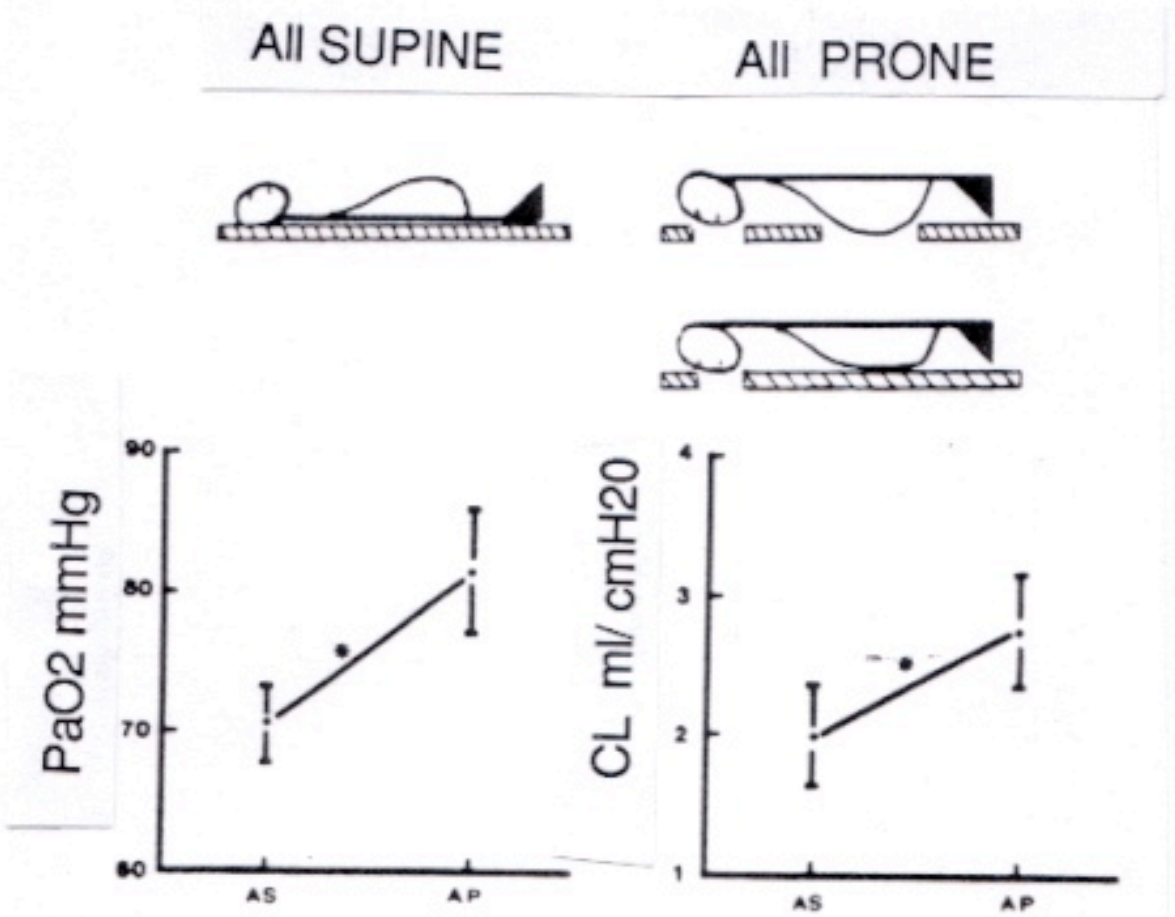

Wagaman MJ et al., J Pediatr 1979

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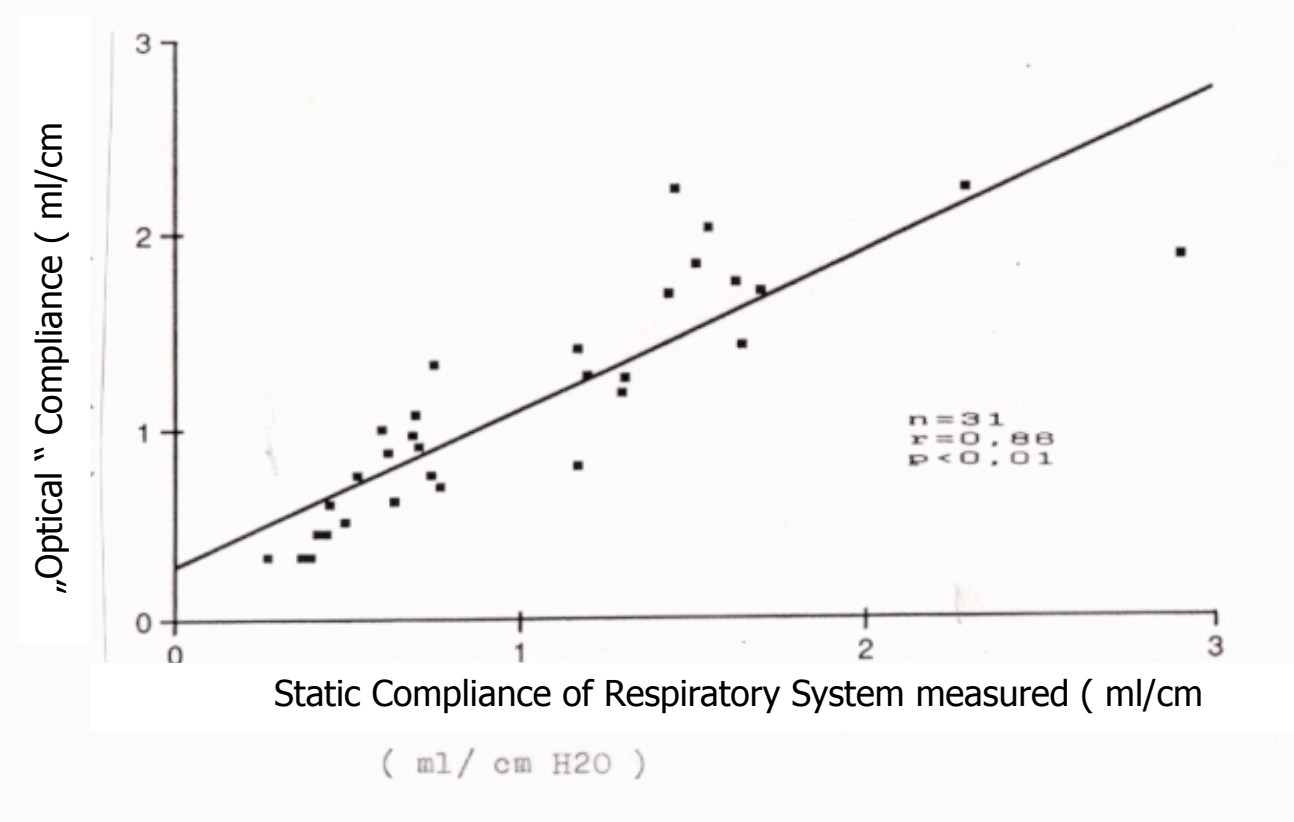
Compliance / weight:

Weight: 1 Kg PIP: 25 PEEP: 5 VT: 6	Weight: 2 Kg PIP: 25 PEEP: 5 VT: 12	Weight: 3 Kg PIP: 25 PEEP: 5 VT: 18
C = 0.3	C = 0.6	C = 0.9
C/kg = 0.3	C/kg = 0.3	C/kg = 0.3

Normal = 1-2 /kg

Optical tidal volume (ml) = Amount of chest expansion . Kg Bodyweight

Chest expansion
normal = 6 ml
distinctly visible = 9 ml
barely visible = 3 ml



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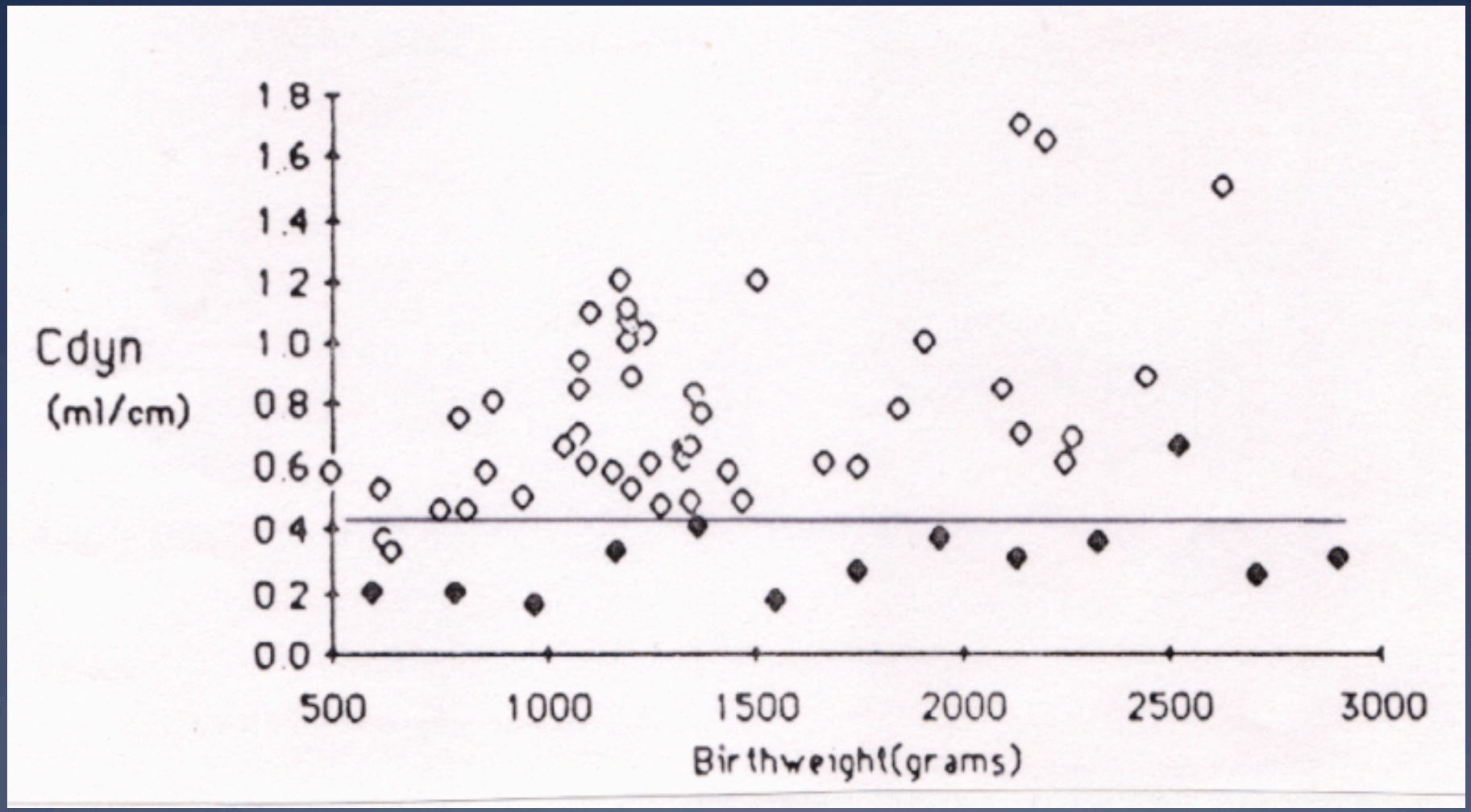
Predictive Power of Compliance

	Sens (%)	Spec (%)
Mortality		
Simbruner et al 1982	89	99
Graff et al 1986	85	96
Tarnow-Mordi et al 1994	80	100
Need of Mech Ventil		
Simbruner et al 1982	94	84
Morbidity (BPD)		
Bhutani et al 1992	PPV 78	NPV 100



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Resumiendo:

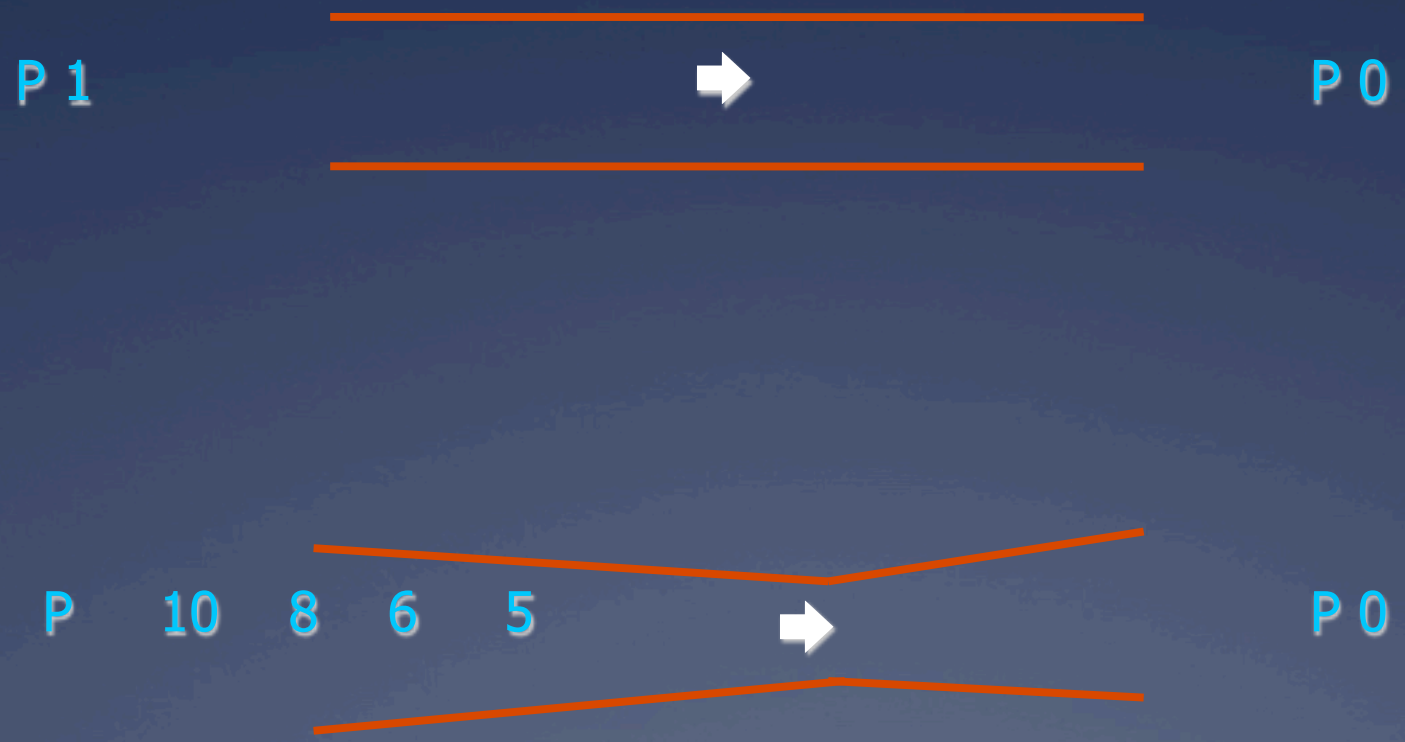
- La distensibilidad pulmonar en el RN está determinada principalmente por la distensibilidad pulmonar
- La alta distensibilidad torácica tiene un efecto aledaño a la de la distensibilidad pulmonar
- ¡El diafragma es la pared inferior del tórax!

Resistencia

Resistance

$$R = \frac{\text{Viscosity}}{r^4}$$

$$R = \frac{\text{Pressure}}{\text{Flow}}$$



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Resistencia:

- Valor normal:
  - 50 cmH2O/l/s
- Pacientes con BPD:
  - 200 cmH2O/l/s
- El factor más importante es el diámetro del tubo endotraqueal
  - 3.5mm = 50 cmH20/l/s
  - 2.5mm = 150 cmH2O/l/s

Falla respiratoria

Respiratory Failure

Work Load

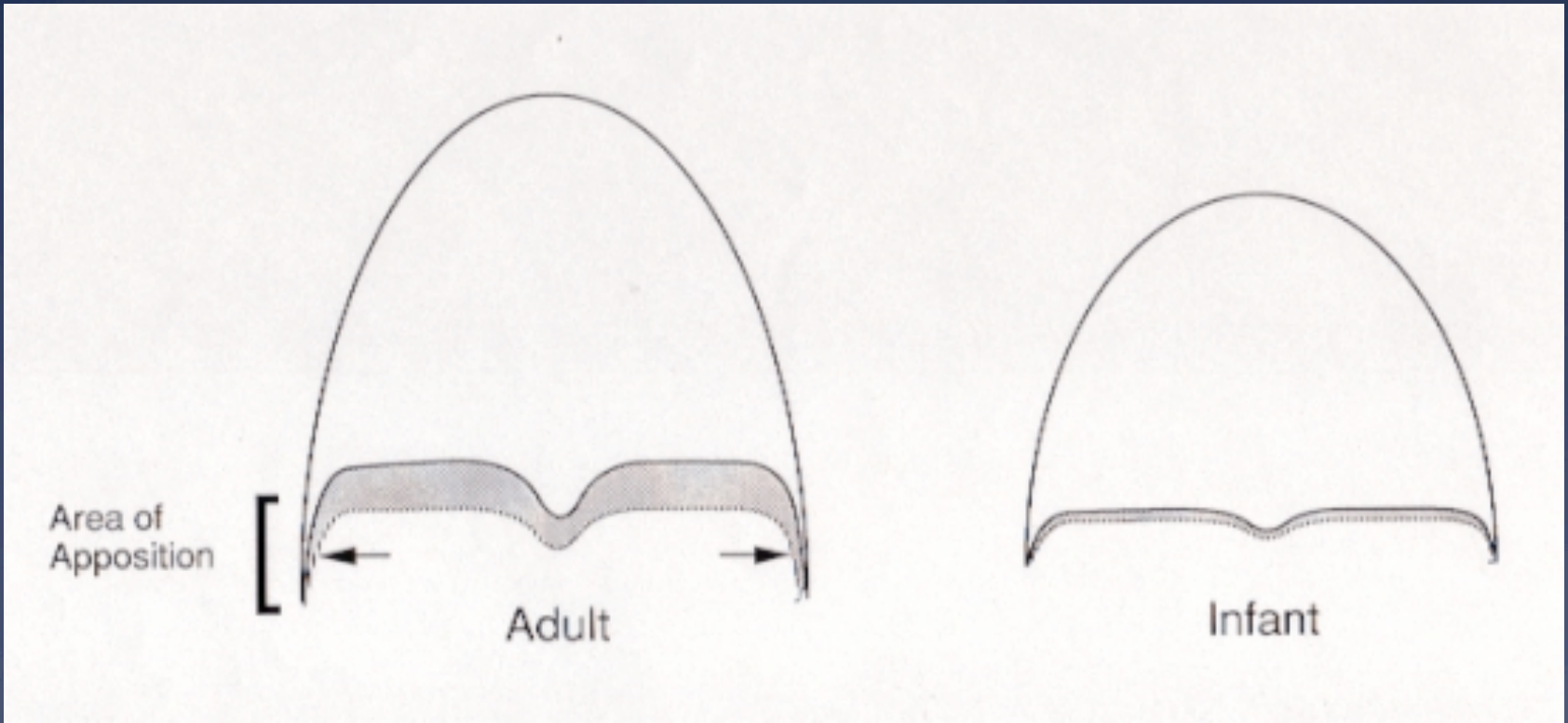
1. Parenchym
2. Nosocomial

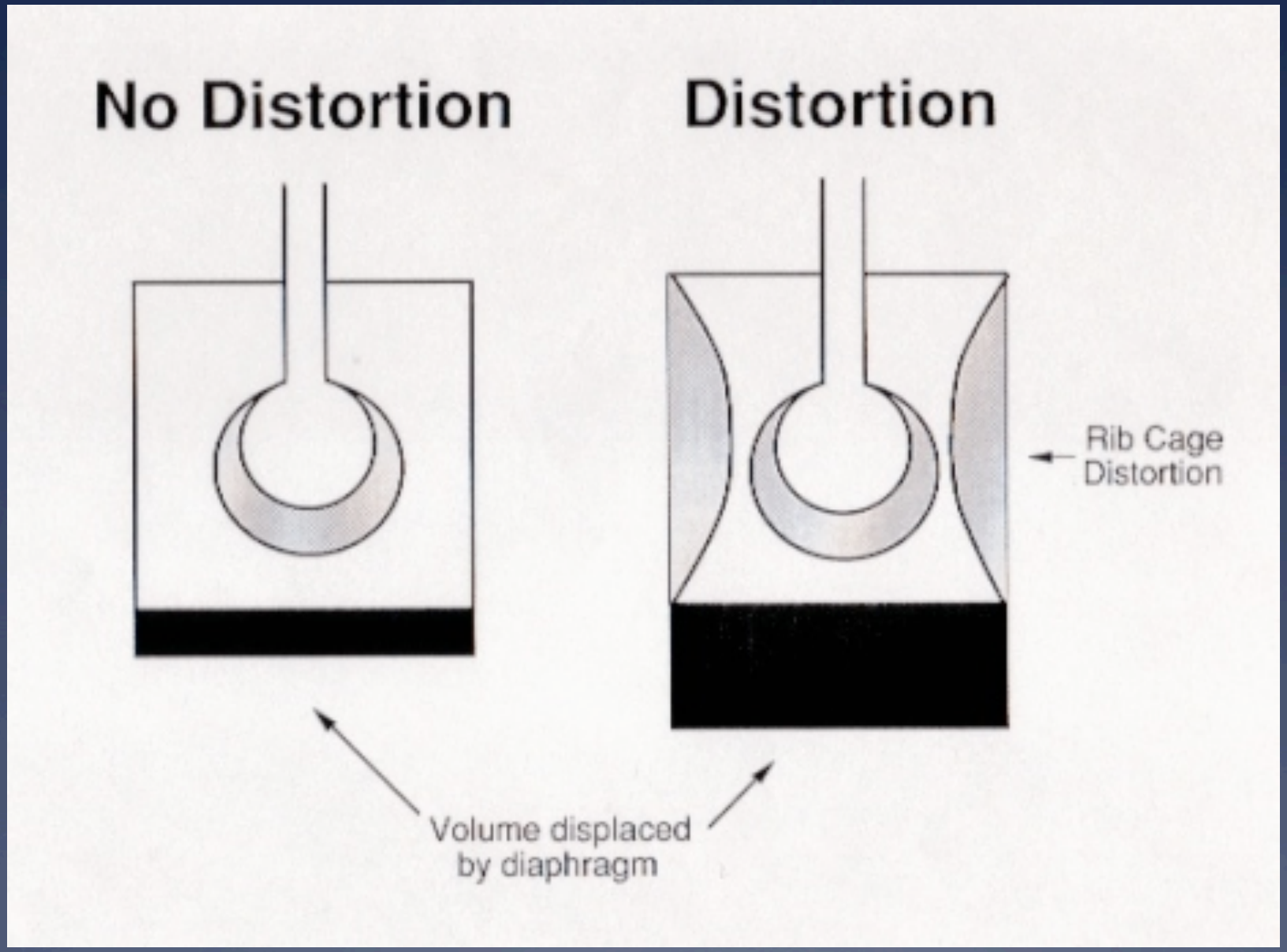
Efficiency

1.Chest Deformation
2. Diaphragma
3. Uncoordinated Breaths

Energy

1. Regulation
2. Power


Area of
Apposition
Adult
Infant



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Alteraciones fisiopatológicas

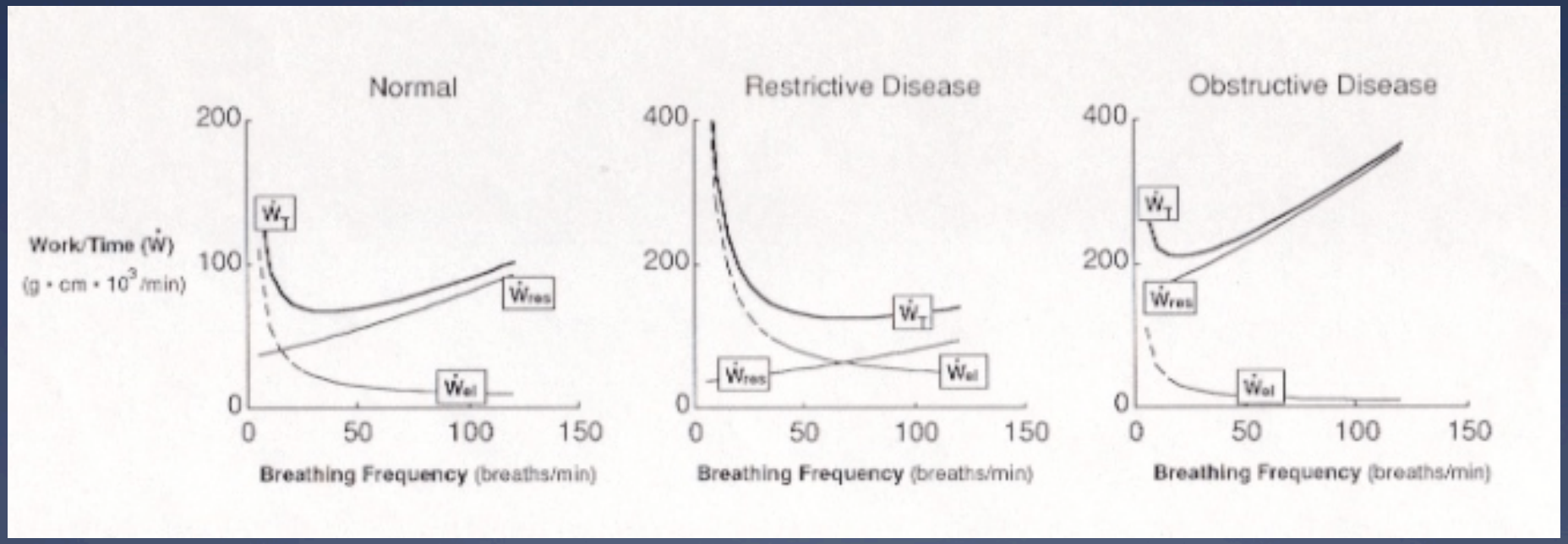
- El aumento del trabajo respiratorio condiciona:
  - ↑ demanda metabólica de los músculos respiratorios
  - ↑ Catecolaminas
  - ↑ Perfusión sanguínea de los músculos respiratorios
  - ↑ Postcarga cardiaca
  - Choque distributivo

Signos de incremento del trabajo respiratorio

- ↓ de la distensibilidad:
  - ↑ frecuencia respiratoria
  - Tiraje intercostal
  - Opacificación del parénquima en la radiografía
- ↑ Resistencia:
  - Estridor
  - Sibilancias, prolongación de la espiración
  - Tiraje intercostal

Signos clínicos de falla energética

- ↓ De la actividad general „Concentración solo en la respiración“
- Vasoconstricción cutánea
- Choque circulatorio con:
  - ↑ Frecuencia cardiaca
  - Acidosis metabólica
- Apnea


Normal
Restrictive Disease
Obstructive Disease
Work/Time (Ẇ)
(g • cm • 10³/min)
200
100
0
400
200
0
400
200
0
Ẇ_T
Ẇ_res
Ẇ_el
0
50
100
150
Breathing Frequency (breaths/min)

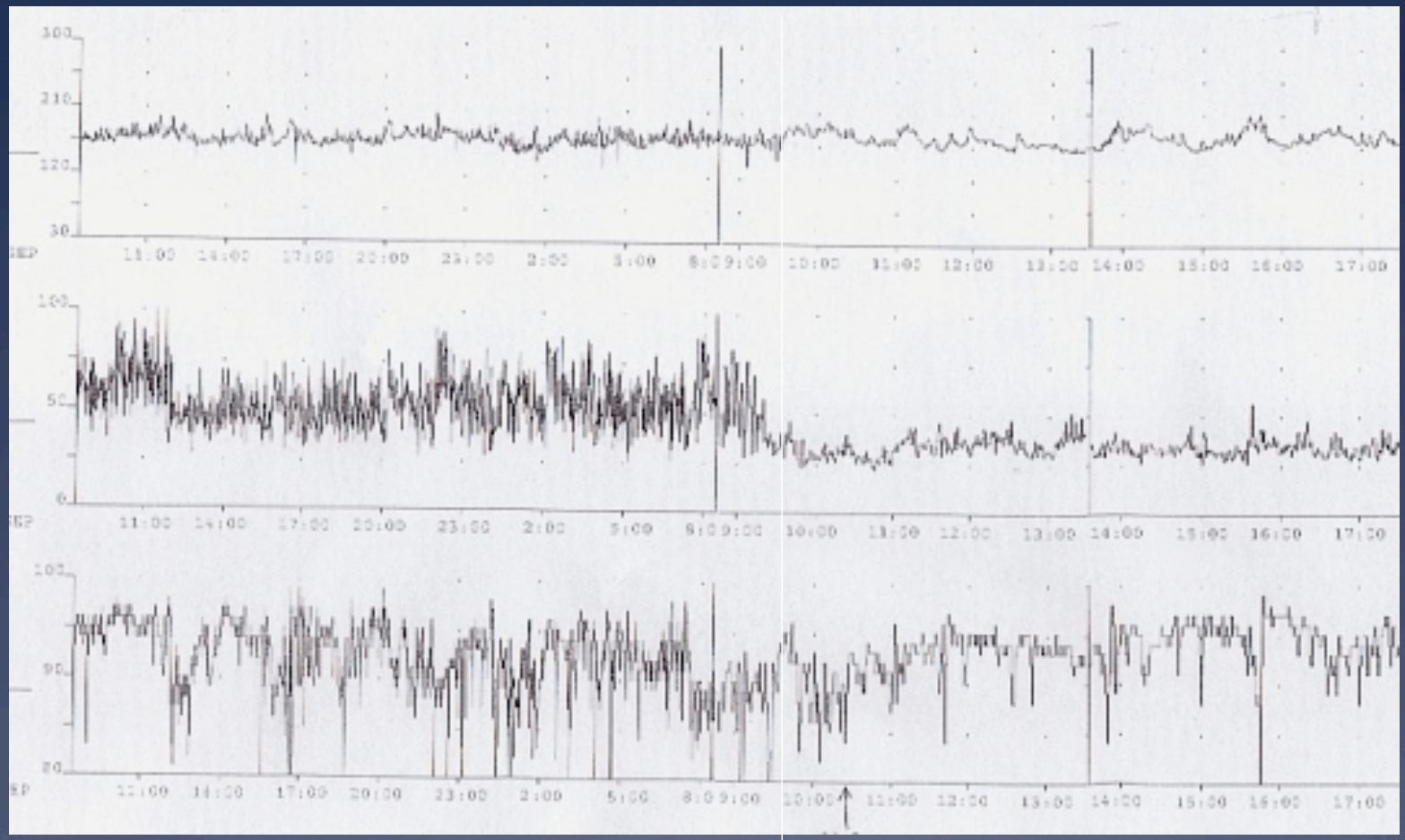
No CPAP

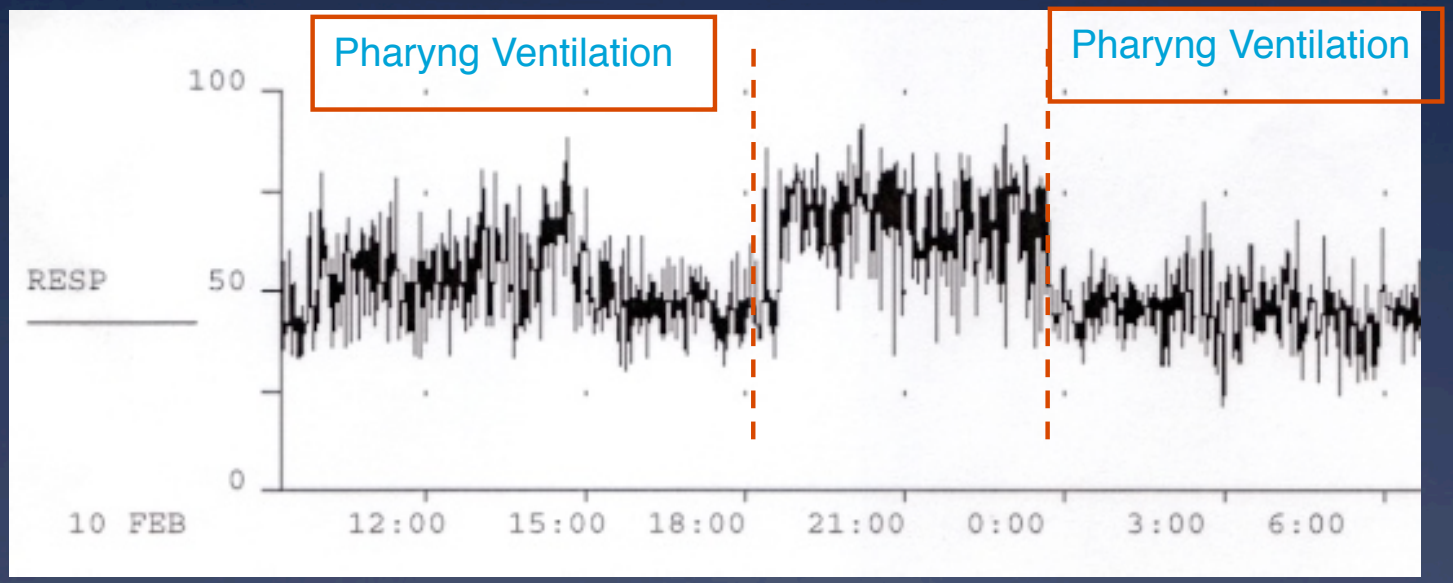
CPAP

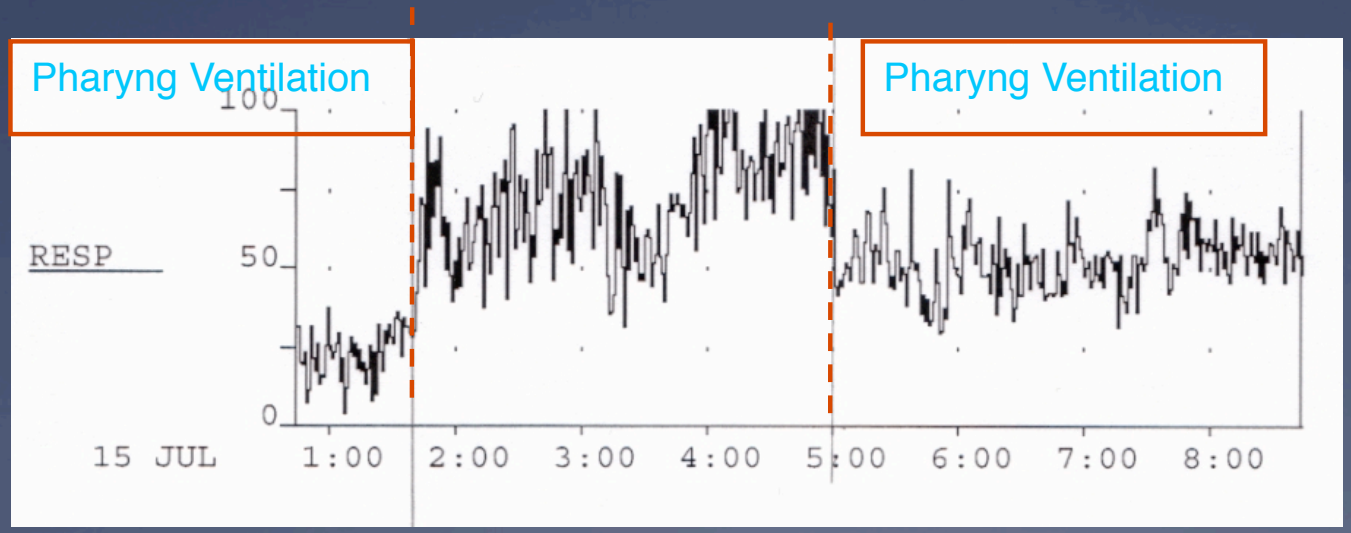
FC

FR

Sat



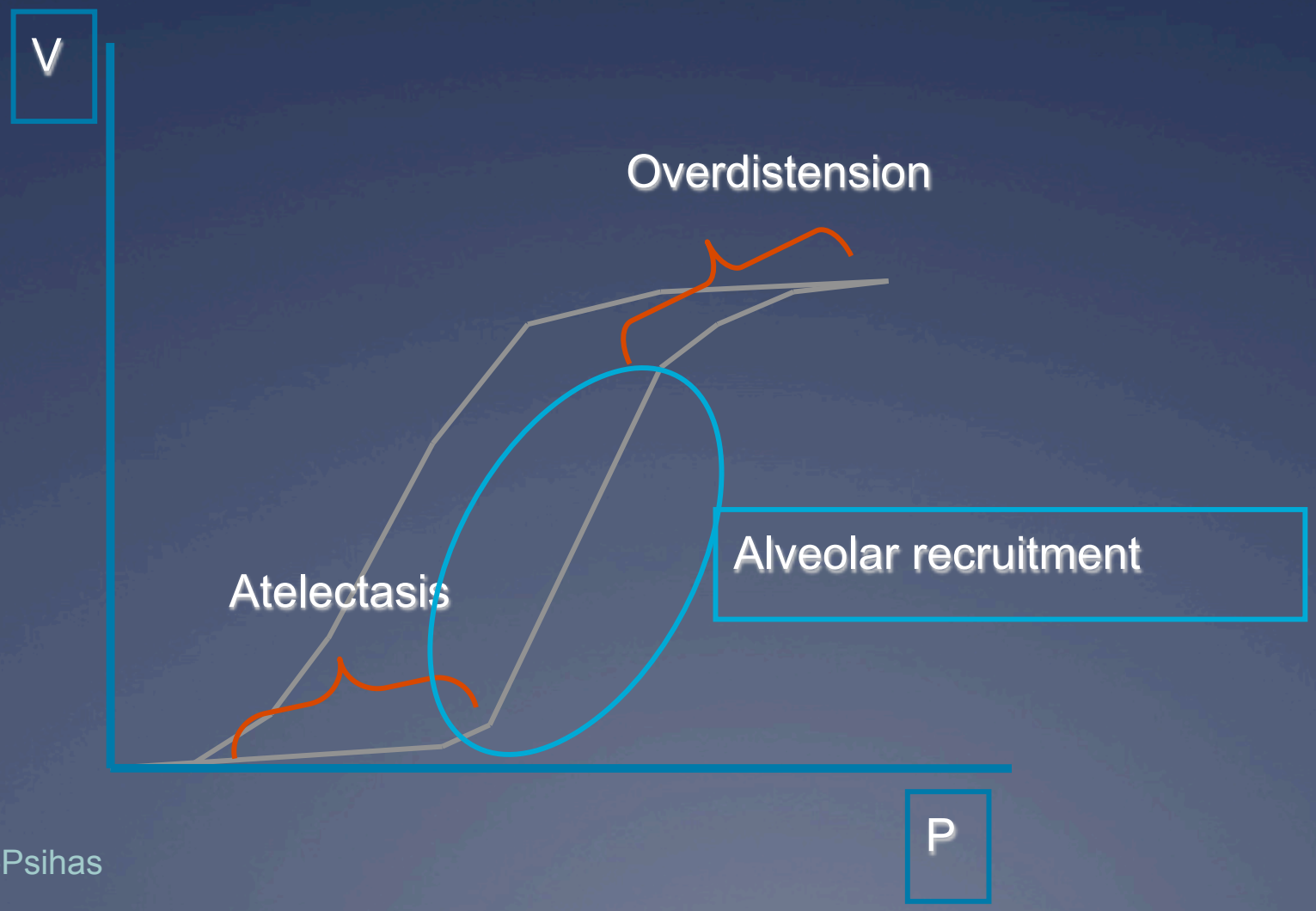

Pharyng Ventilation
Pharyng Ventilation
100
RESP
50
0
10 FEB
12:00
15:00
18:00
21:00
0:00
3:00
6:00


Pharyng Ventilation
Pharyng Ventilation
100
RESP
50
0
15 JUL
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00

Indicaciones para ventilación mecánica

- Fatiga evidente (apnea)
- Tiraje severo
- Aumento progresivo del requerimiento de oxígeno
- Hipercapnia progresiva

Volume targeted ventilation:



¡Gracias!