Presión Positiva Espiratoria Final

PEEP

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Junio 2025

JE

Historia.-

Barach y Fulton años 30
Ashbaug años 60

PEEP

- **Extrínseco**
- **Intrínseco**
- **(Auto-Peep)**

Válvulas especiales colocadas
En los ventiladores mecánicos.

CPAP

JE

Definiciones

PEEP : Aplicación de Presión Positiva durante la fase espiratoria utilizando cualquier modo de Ventilación Mecánica.

CPAP : Aplicación de presión Positiva continua durante el ciclo Ventilatorio espontaneo del paciente:

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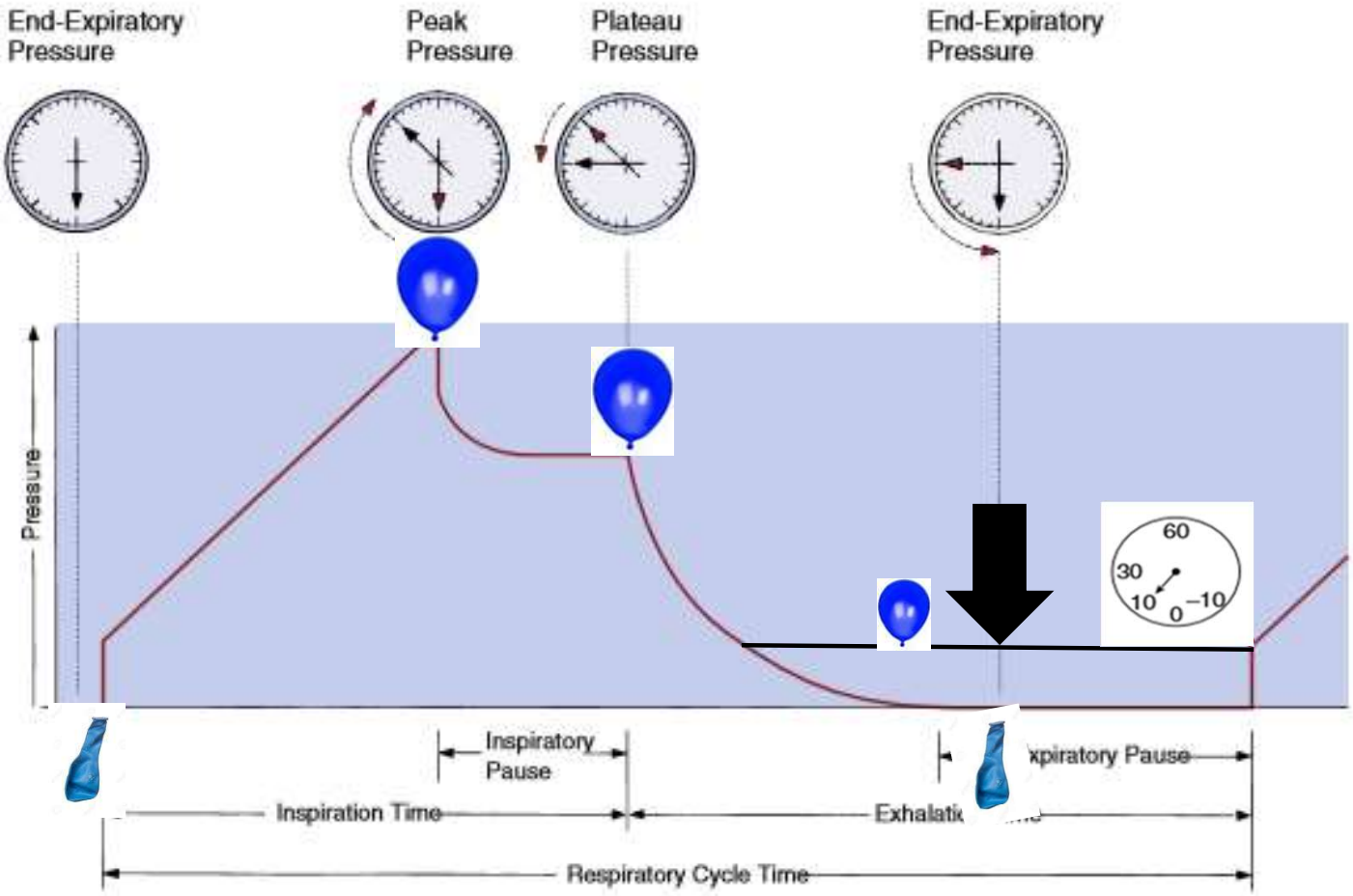

Figure 3-23 A pressure-time curve for passive positive pressure lung inflation, followed by a momentary inspiratory pause (breath hold) and passive exhalation. Peak pressure and plateau pressure correspond to points *B* and *D* in Figure 3-22. (Modified from DuPuis YG: *Ventilators: theory and clinical applications*, ed 2, St Louis, 1992, Mosby.)

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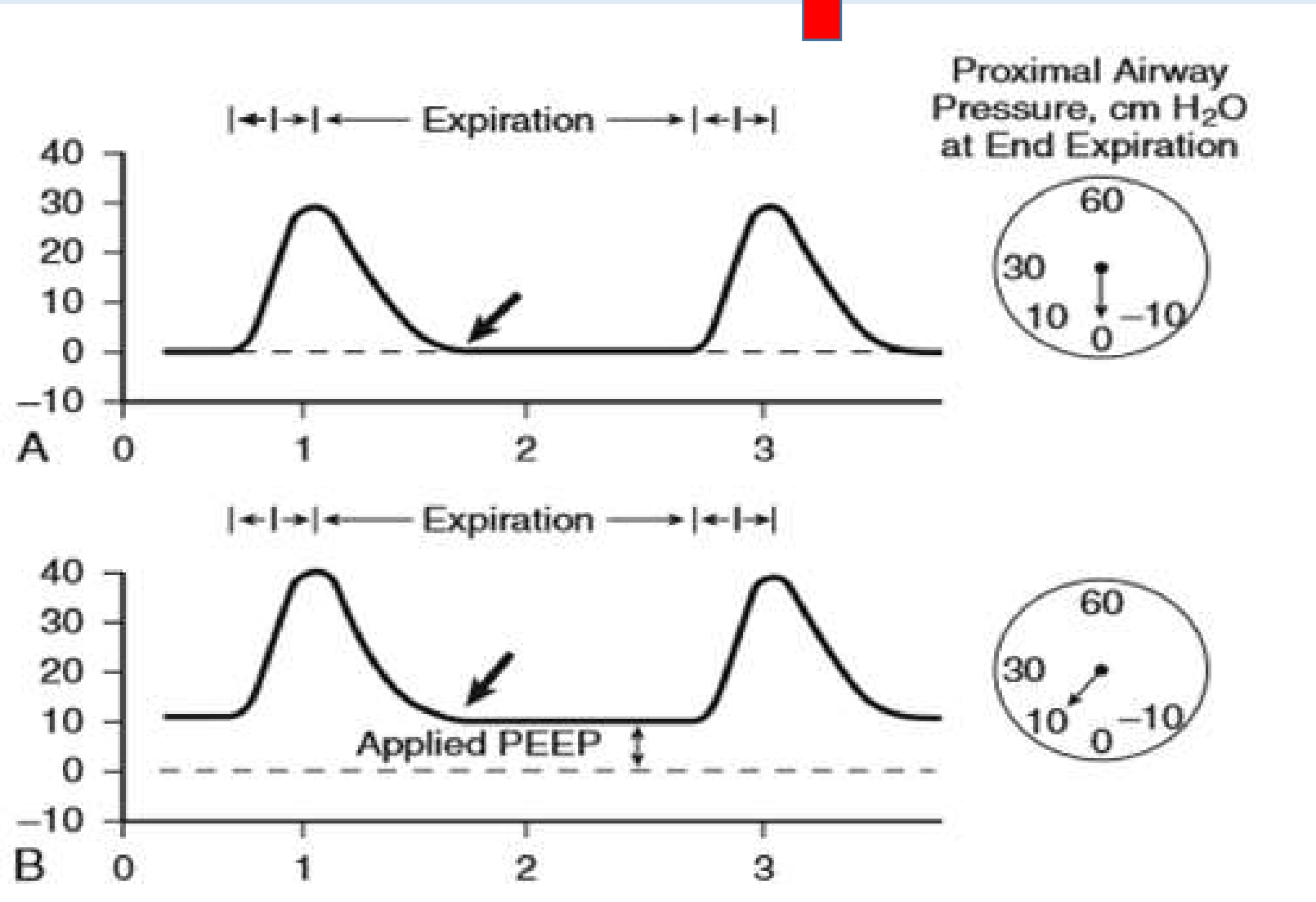
PEEP

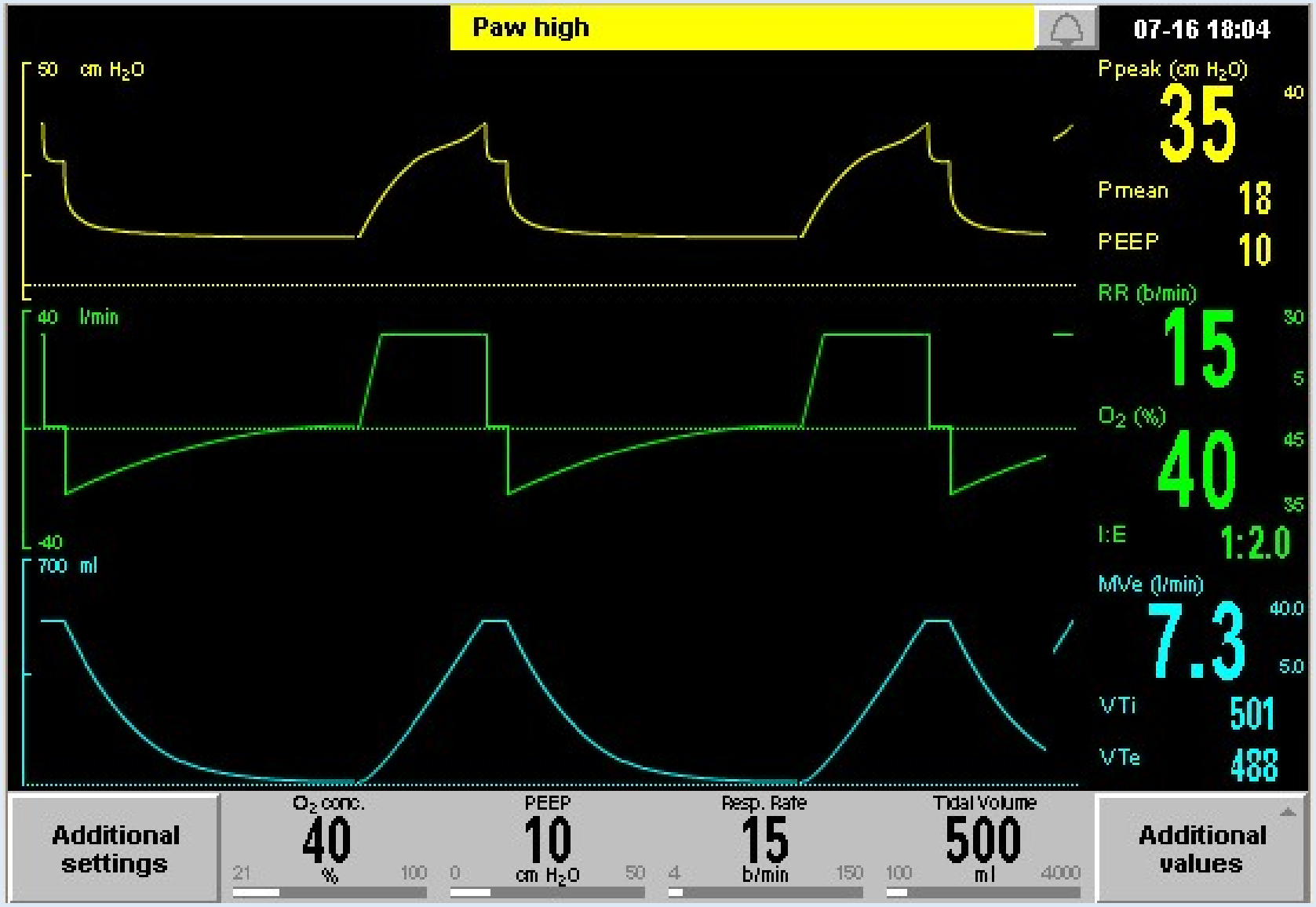
El paciente debe estar en Ventilación Mecánica



JE


Mode
Volume Control
Automode
Admit patient
Nebulizer
Status
07-16 18:10
40 cm H2O
50 l/min
-50
700 ml
Ppeak (cm H2O)
25
Pmean
8
PEEP
0
RR (b/min)
15
O2 (%)
40
I:E
1:2.0
MVe (l/min)
7.4
VTi
504
VTe
494
Additional settings
O2 conc.
40
%
PEEP
0
cm H2O
Resp. Rate
15
b/min
Tidal Volume
500
ml
Additional values

JE


Paw high
07-16 18:04
50 cm H2O
40 l/min
-40
700 ml
Ppeak (cm H2O)
35
40
Pmean
18
PEEP
10
RR (b/min)
15
30
5
O2 (%)
40
45
35
I:E
1:2.0
MVe (l/min)
7.3
40.0
5.0
VTi
501
VTe
488
Additional settings
O2 conc.
40
21 % 100
PEEP
10
0 cm H2O 50
Resp. Rate
15
4 b/min 150
Tidal Volume
500
100 ml 4000
Additional values

JE

Ventilación espontanea

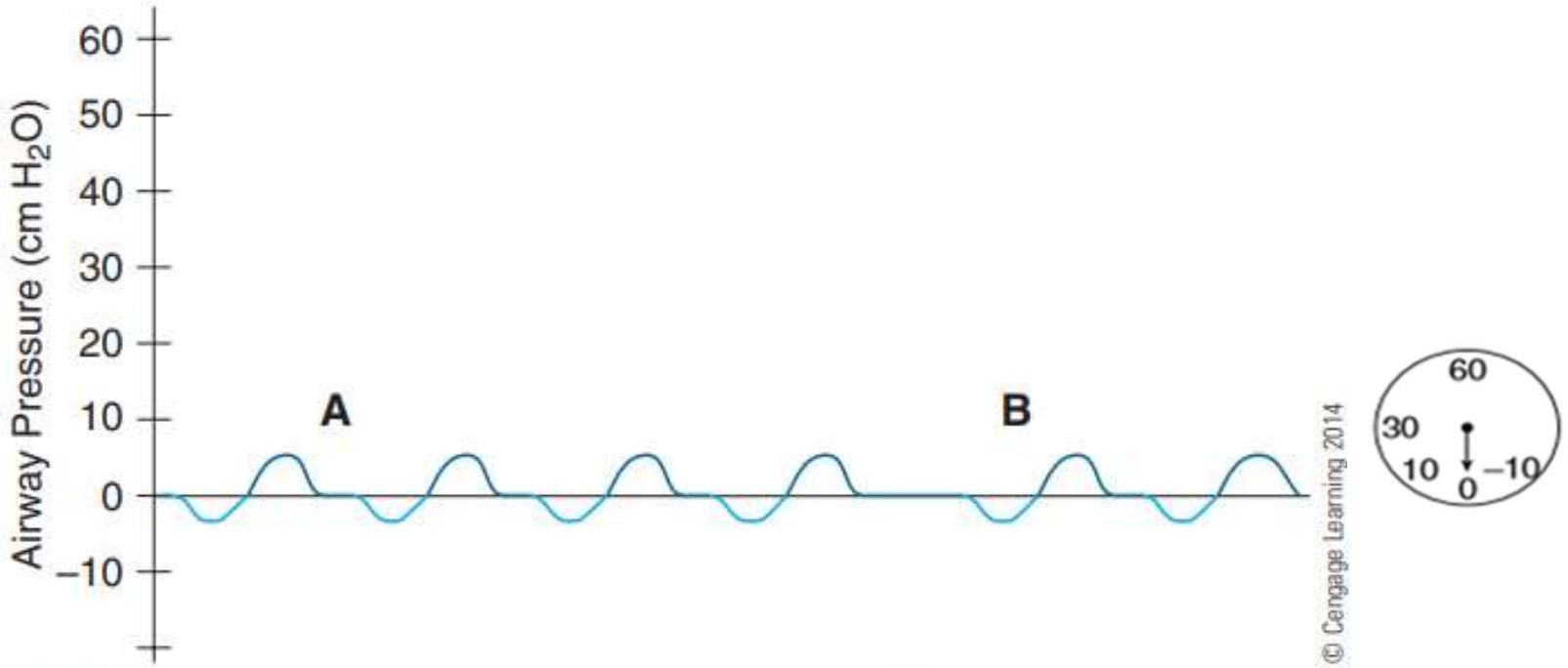


FIGURE 4-1 Spontaneous breathing pressure tracing. (A) The spontaneous rate is at a normal pattern. (B) The spontaneous breath is delayed by the patient.

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Ventilación espontanea + PEEP

CPAP

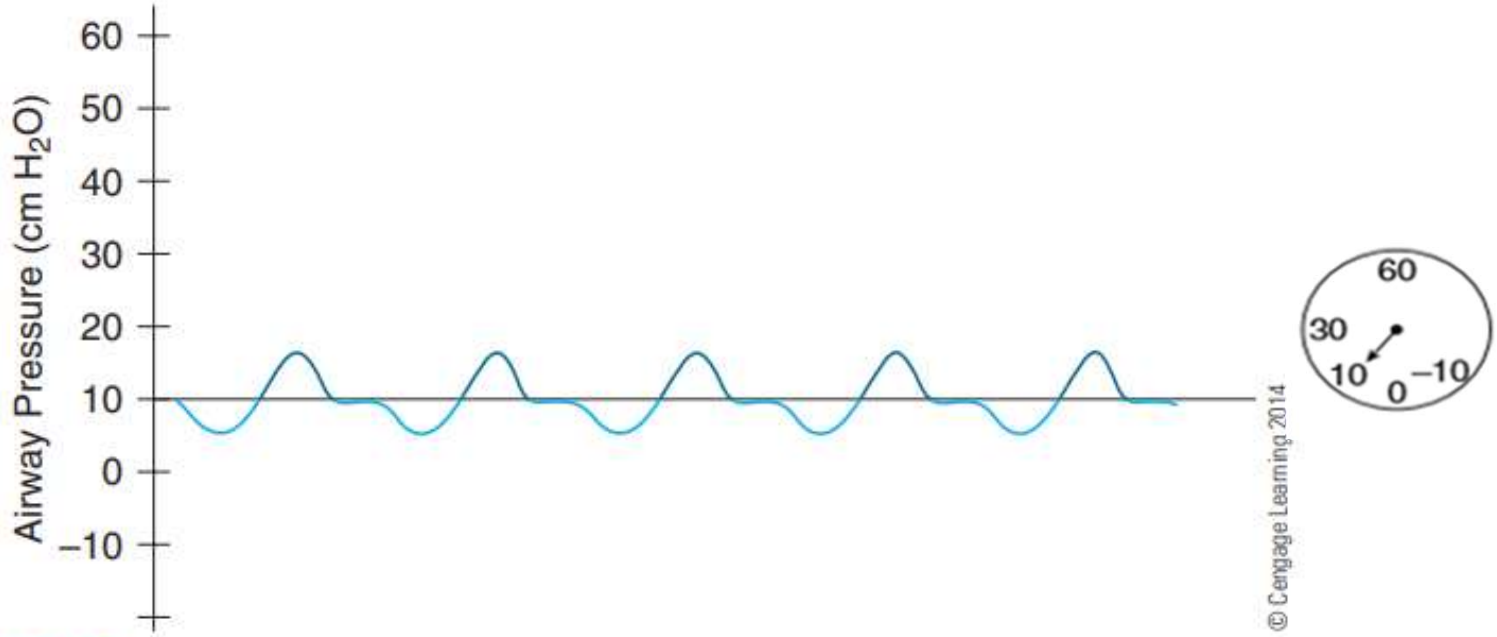

FIGURE 4-3 Continuous positive airway pressure (CPAP) of 10 cm H_2O.

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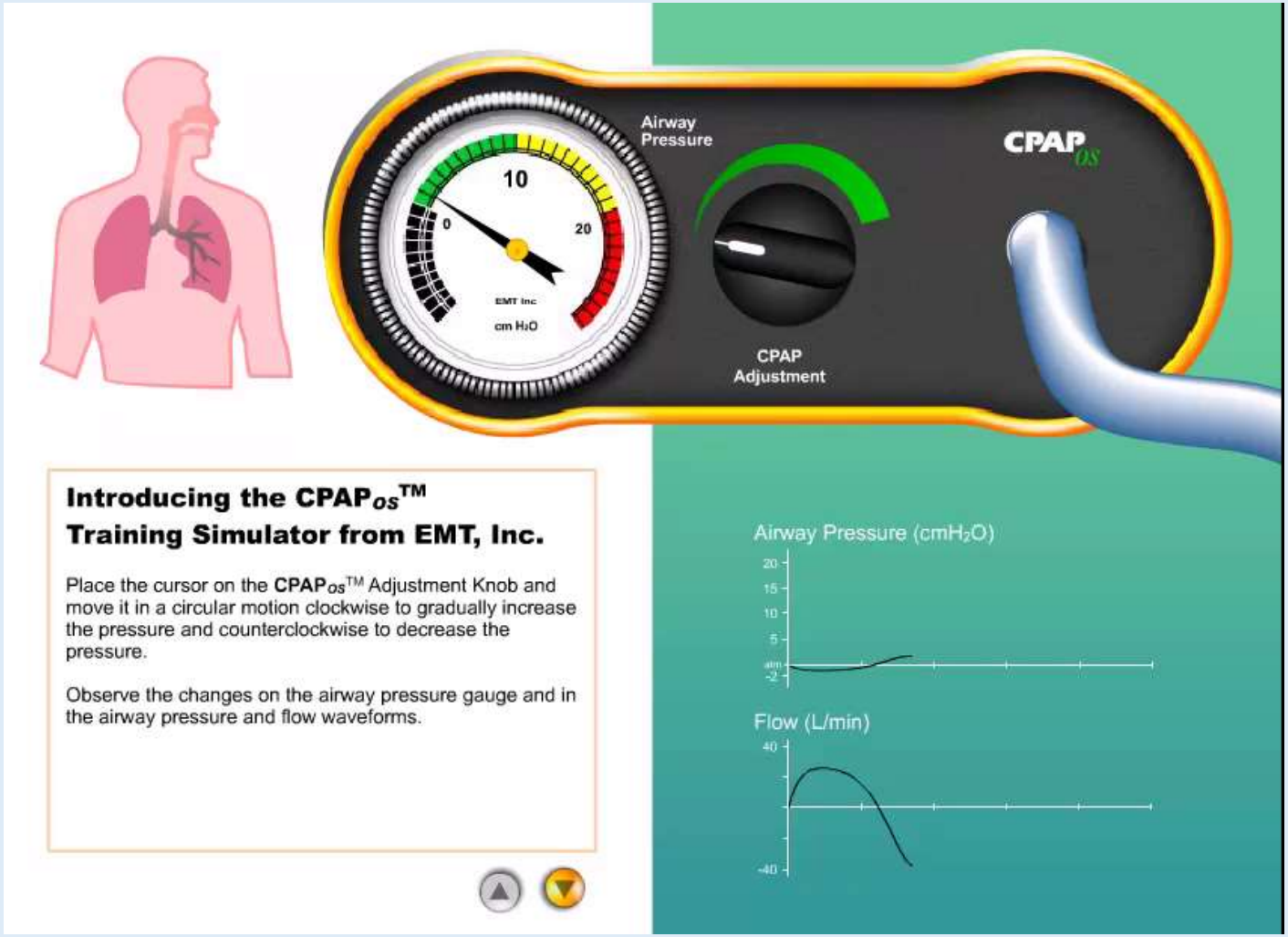
Airway Pressure
10
0
20
EMT Inc
cm H2O
CPAP os
CPAP Adjustment
Introducing the CPAPos™ Training Simulator from EMT, Inc.
Place the cursor on the CPAPos™ Adjustment Knob and move it in a circular motion clockwise to gradually increase the pressure and counterclockwise to decrease the pressure.
Observe the changes on the airway pressure gauge and in the airway pressure and flow waveforms.
Airway Pressure (cmH2O)
20
15
10
5
-2
Flow (L/min)
40
-40

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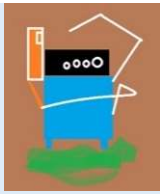
Efectos diversos del PEEP

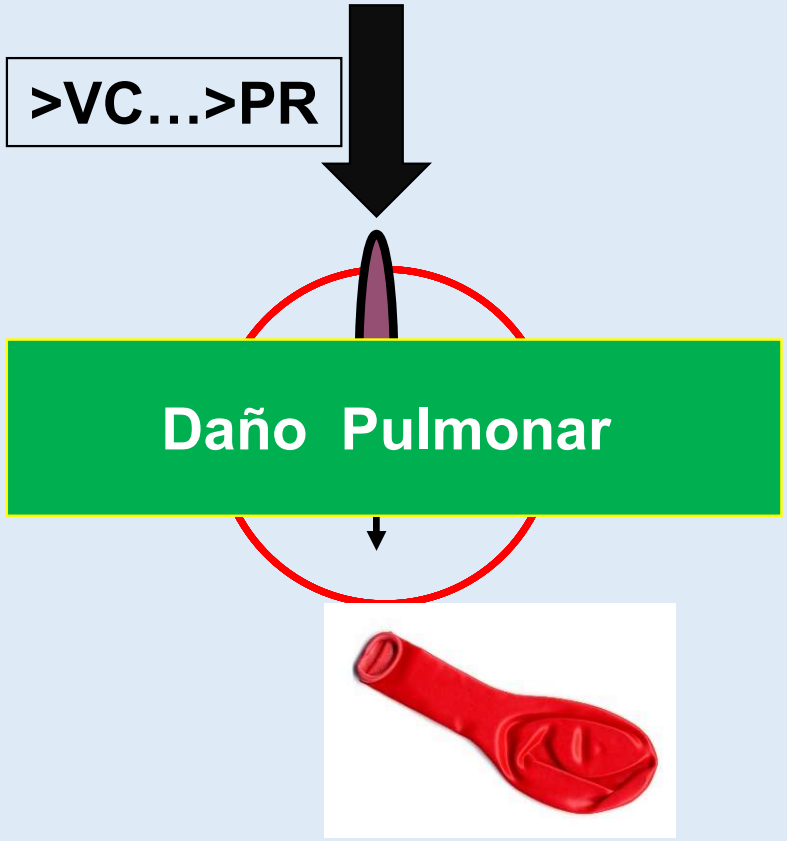


- Respiratorios
- Cardiovasculares
- Renales
- Sistema Nervioso Central
- Gastrointestinales
- Misceláneos

JE

Efectos Respiratorios

ESQUEMA DE VENTILACION MECANICA TRADICIONAL



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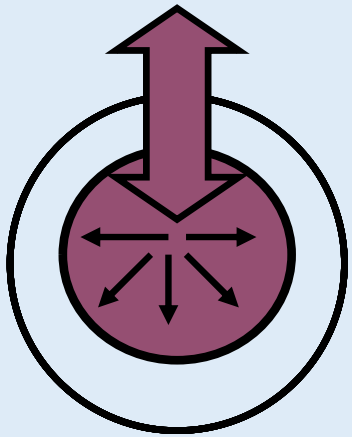
Efectos Respiratorios

NUEVO ESQUEMA DE VENTILACION MECANICA PARA EL S.D.R.A.

Pulmón abierto

PEEP + ↓ VC



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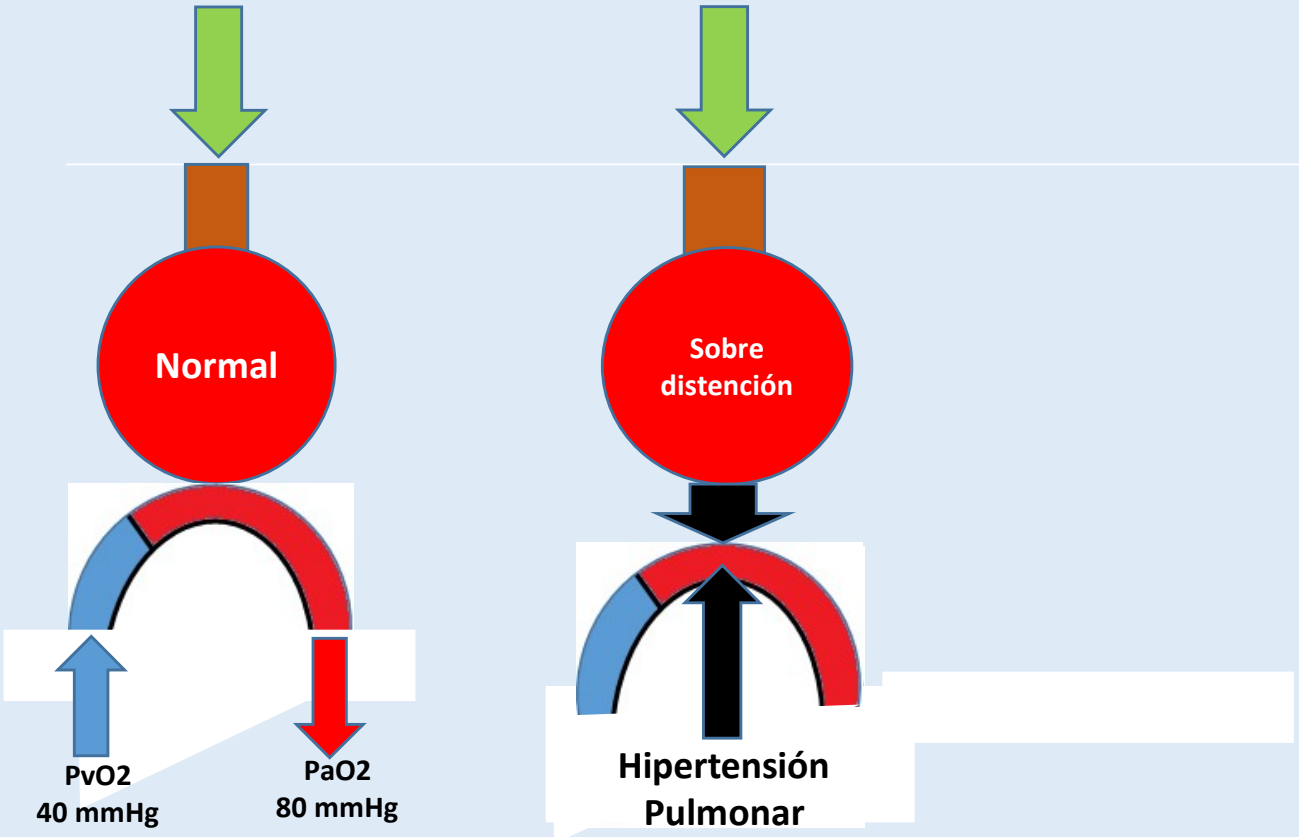
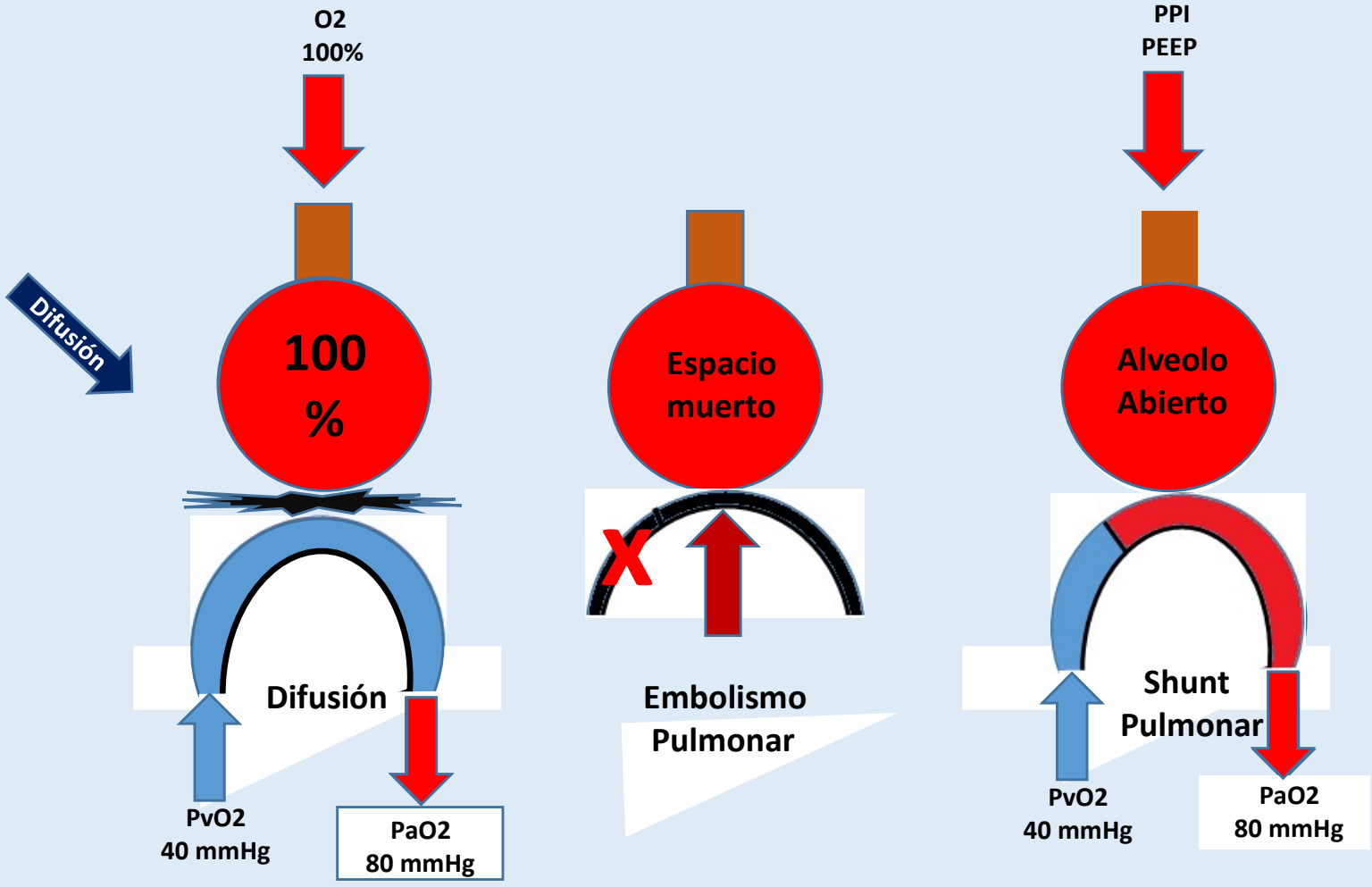
Relaciones de la Ventilación-Perfusión V/Q



JVEP

JE

Alteraciones de la relación V/Q

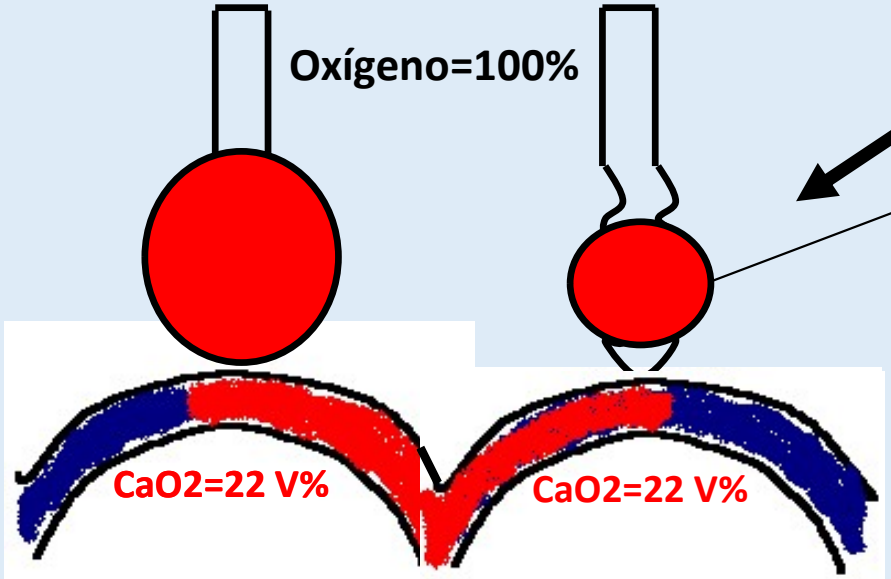


JVEP

JE

Efectos Respiratorios

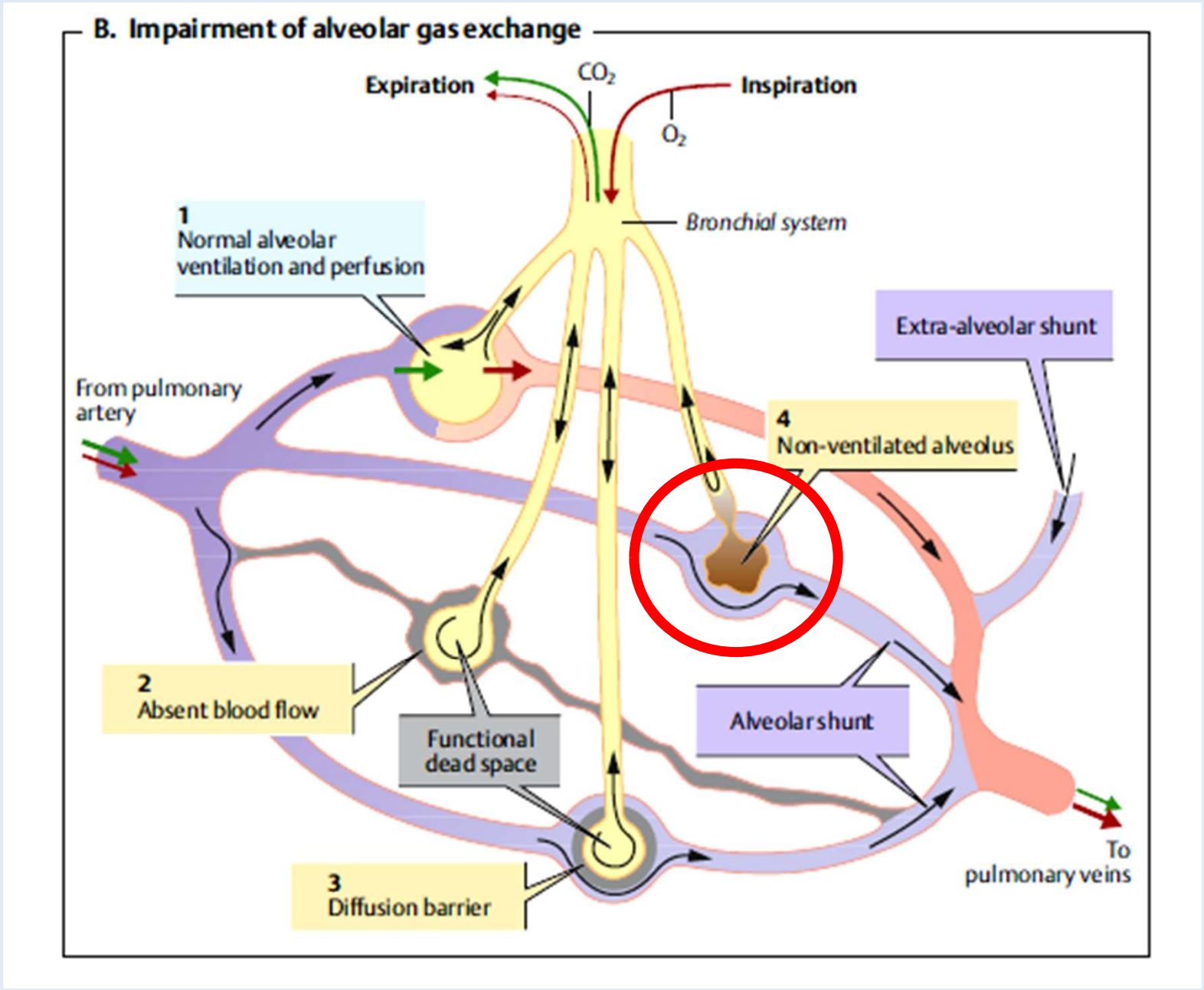
PEEP



Reapertura de alvéolos colapsados

CaO2= 18.5 Vol%
PaO2= 60

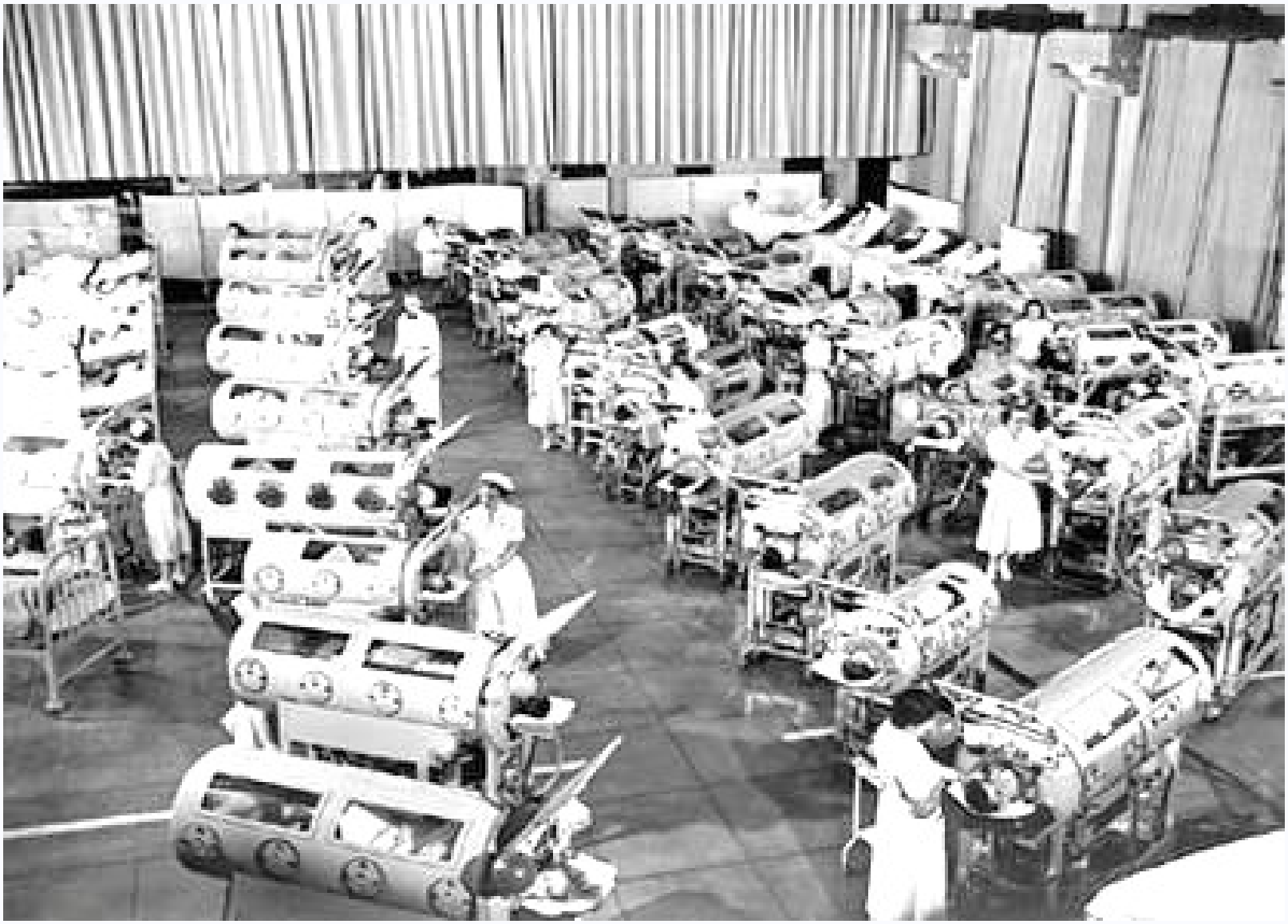
JE

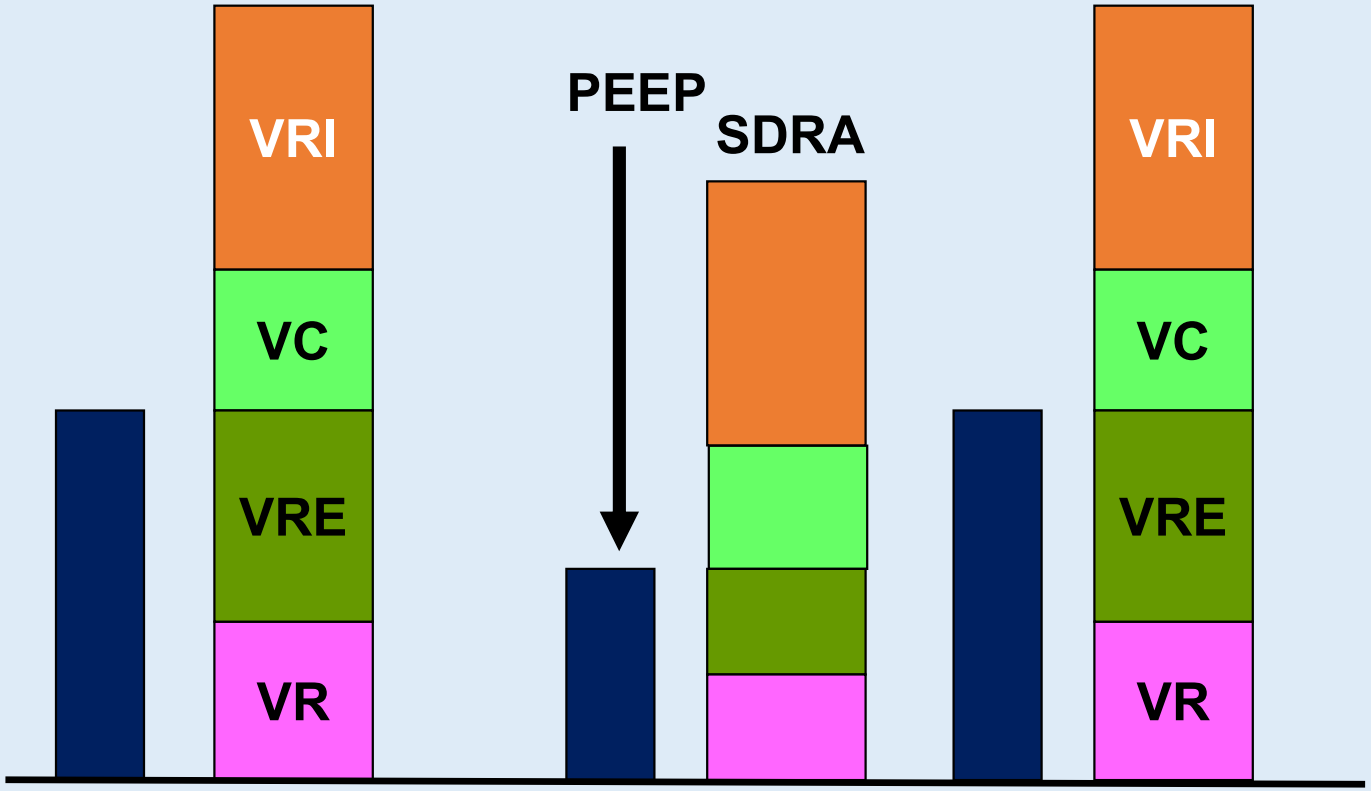

B. Impairment of alveolar gas exchange
Expiration
CO_2
Inspiration
O_2
Bronchial system
1
Normal alveolar ventilation and perfusion
Extra-alveolar shunt
From pulmonary artery
4
Non-ventilated alveolus
2
Absent blood flow
Functional dead space
Alveolar shunt
3
Diffusion barrier
To pulmonary veins

JE

Fin de la primera parte

PEEP

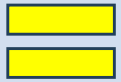



VRI
VC
VRE
VR
PEEP
SDRA
VRI
VC
VRE
VR

Relación V/Q

V= ventilación

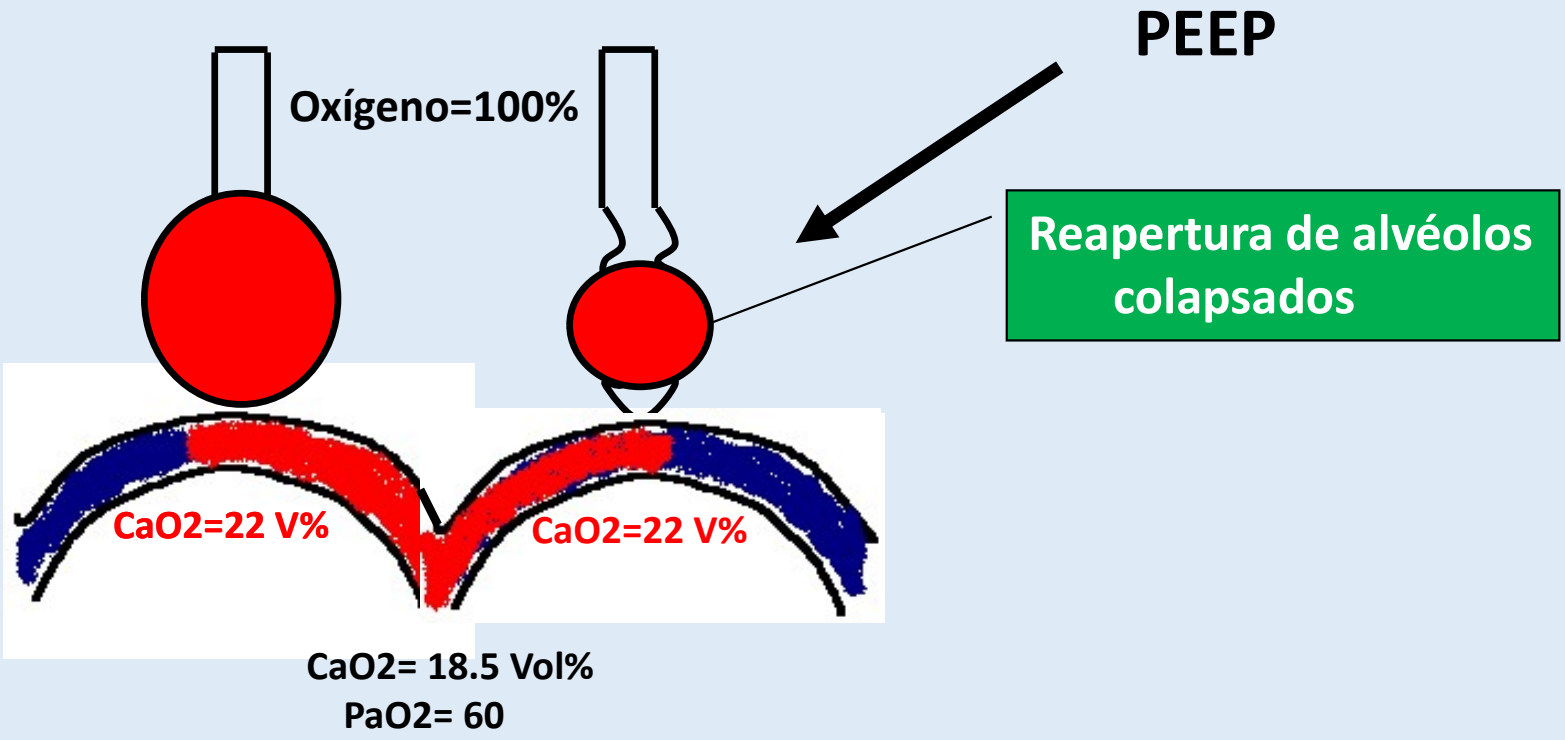
Q= perfusión

Ventilacion		**+1**				**1**
Perfusion				-1		

Shunt Pulmonar

Ventilación 0

Perfusión 100



Unidad de espacio muerto

Ventilación	100
Perfusión	0

Efectos Respiratorios

TABLE 3. $\dot{V}/\dot{Q}$ relationships (Hammon et al.[113])

Lung area	Normal	Oleic Acid
Nongravity-dependent	1.52	0.81
Gravity-dependent	0.82	1.20

TABLE 4. $\dot{V}/\dot{Q}$ relationships (Hammon et al.[113])

	PEEP			
	0	5	10	15
Normal				
Nongravity-dependent $\dot{V}/\dot{Q}$	1.51	1.41	1.35	1.96
Gravity-dependent $\dot{V}/\dot{Q}$	0.82	1.00	1.16	1.20
Oleic acid				
Nongravity-dependent $\dot{V}/\dot{Q}$	0.81	0.90	0.92	1.04
Gravity-dependent $\dot{V}/\dot{Q}$	1.20	1.12	1.16	1.01

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Efectos Respiratorios

A. Control group					
Shunt units[a]	0	0	0	0	0
Dead-space units[b]	0	0	↑	↑↑	↑↑↑
Acceptable units[c]	Baseline	No change	No change	↓	↓↓
B. Group I—shunt <40%					
Shunt units	↑↑	↑	0	0	0
Dead-space units	0	0	↑	↑	↑↑
Acceptable units	Baseline	↑	No change	↓	↓↓
C. Group II—shunt >40%					
Shunt units	↑↑↑↑	↑↑↑	↑↑	↑	0
Dead-space units	0	0	0	0	↑
Acceptable units	Baseline	↑	↑↑	↑↑↑↑↑↑↑↑	

[a] Zero $\dot{V}/\dot{Q}$ and $\dot{V}/\dot{Q}$ <0.1.
[b] $\dot{V}/\dot{Q}$ >10.
[c] $\dot{V}/\dot{Q}$ between 0.1 and 10.

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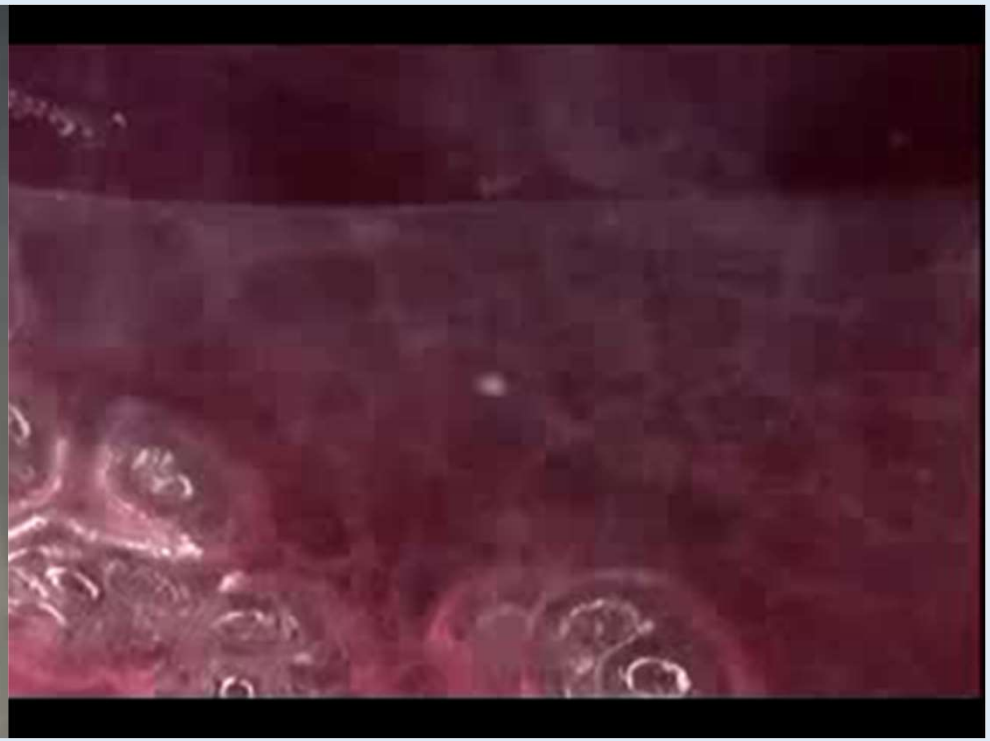
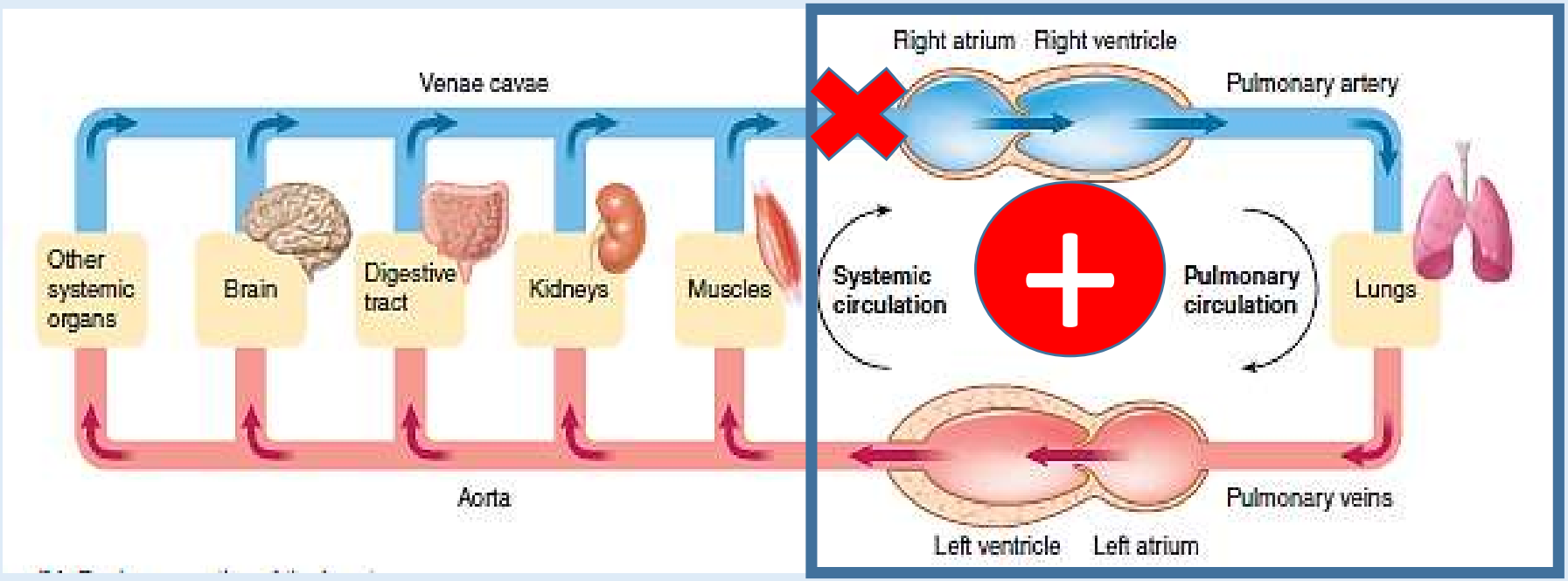
Efectos Respiratorios



Efectos Cardiovasculares

Inspiración

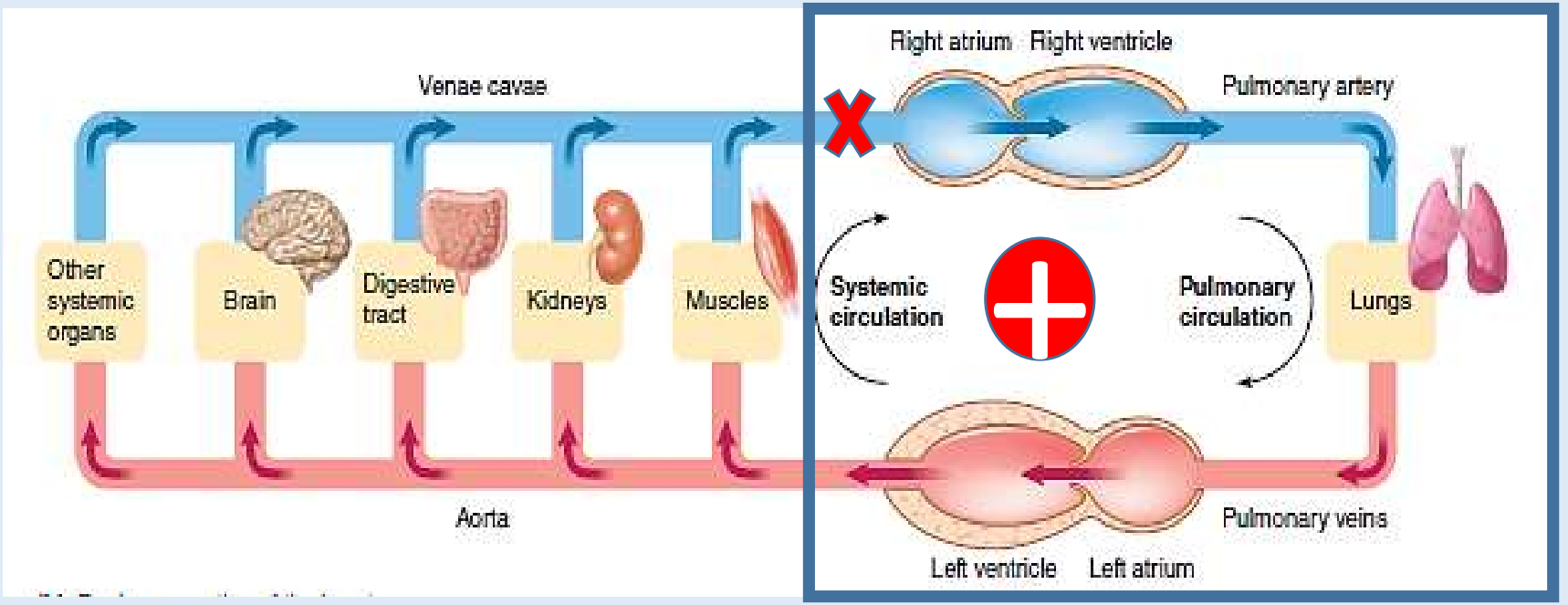


Presión positiva en inspiración

Inspiración

Efectos Cardiovasculares

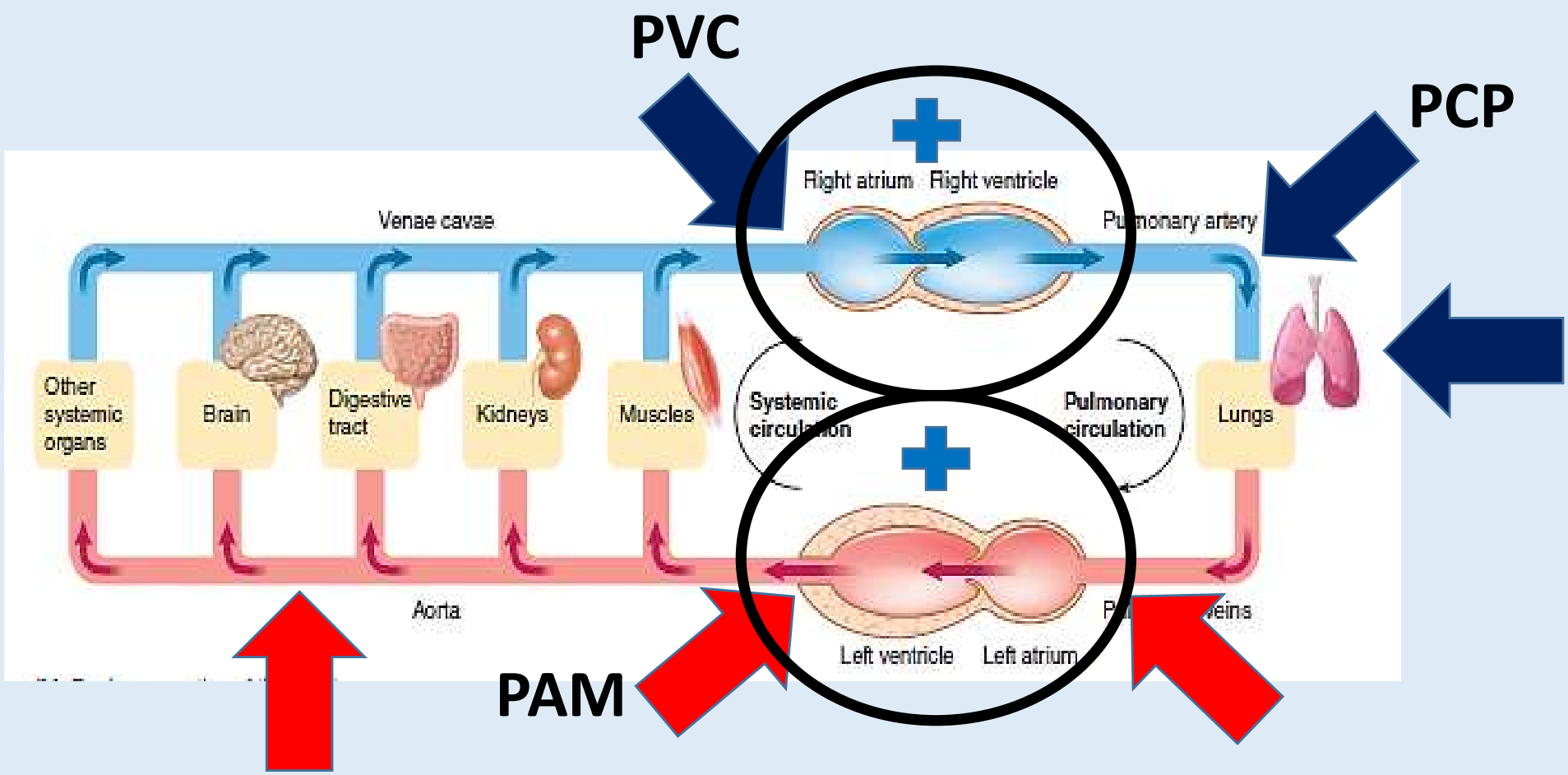
Espiración

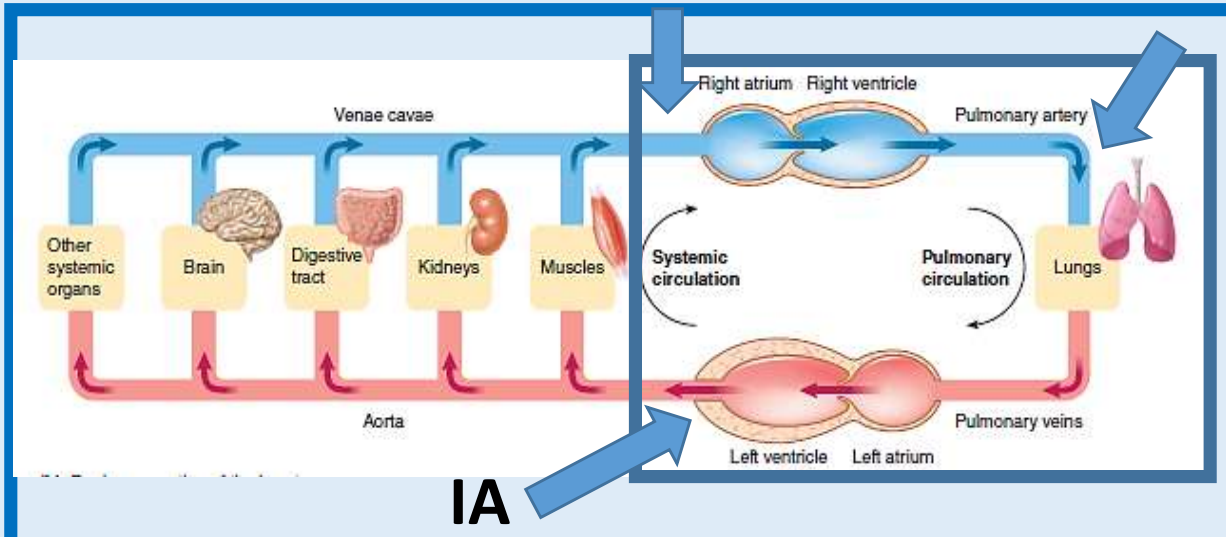


Espiración

Presión positiva en las dos fases ventilatorias

Efectos Cardiovasculares





Presión Pleural
Balón Intra esofágico

IA

Pre-carga del VD PVC 12

PIIVD= PVC - (- pl) 12 + 6 = 18

PIIVD= PVC - (+pl) 12 - 6 = 6

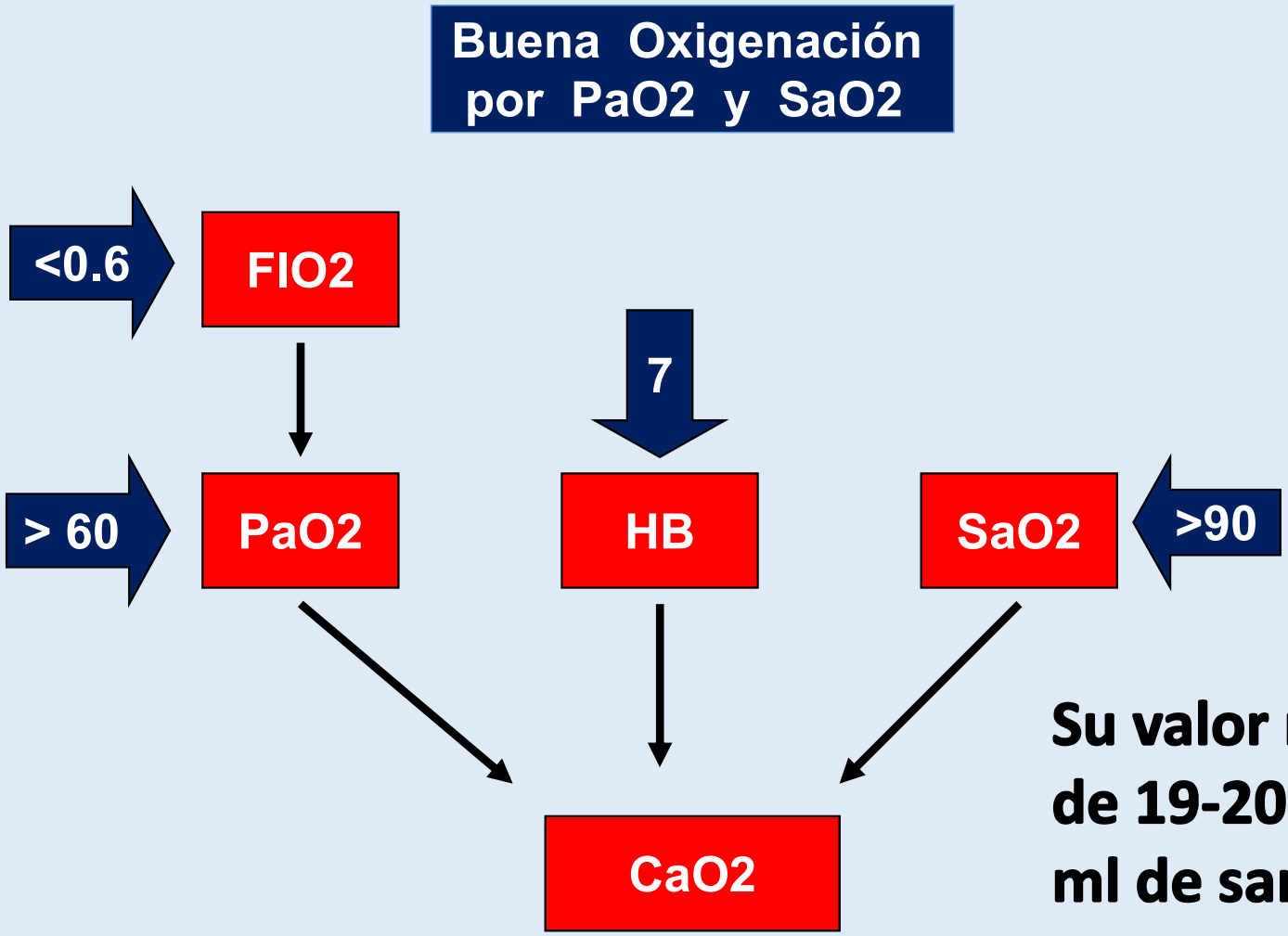
Pre-carga del VI PCP 12

Impedancia Aortica (Post carga del VI)

PAM - (- pl) 80 + 6 = 86

PAM -(+pl) 80 - 6 = 74

Buscando el PEEP adecuado

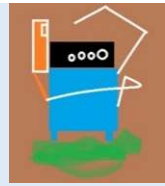


Su valor normal es de 19-20 ml/100 ml de sangre

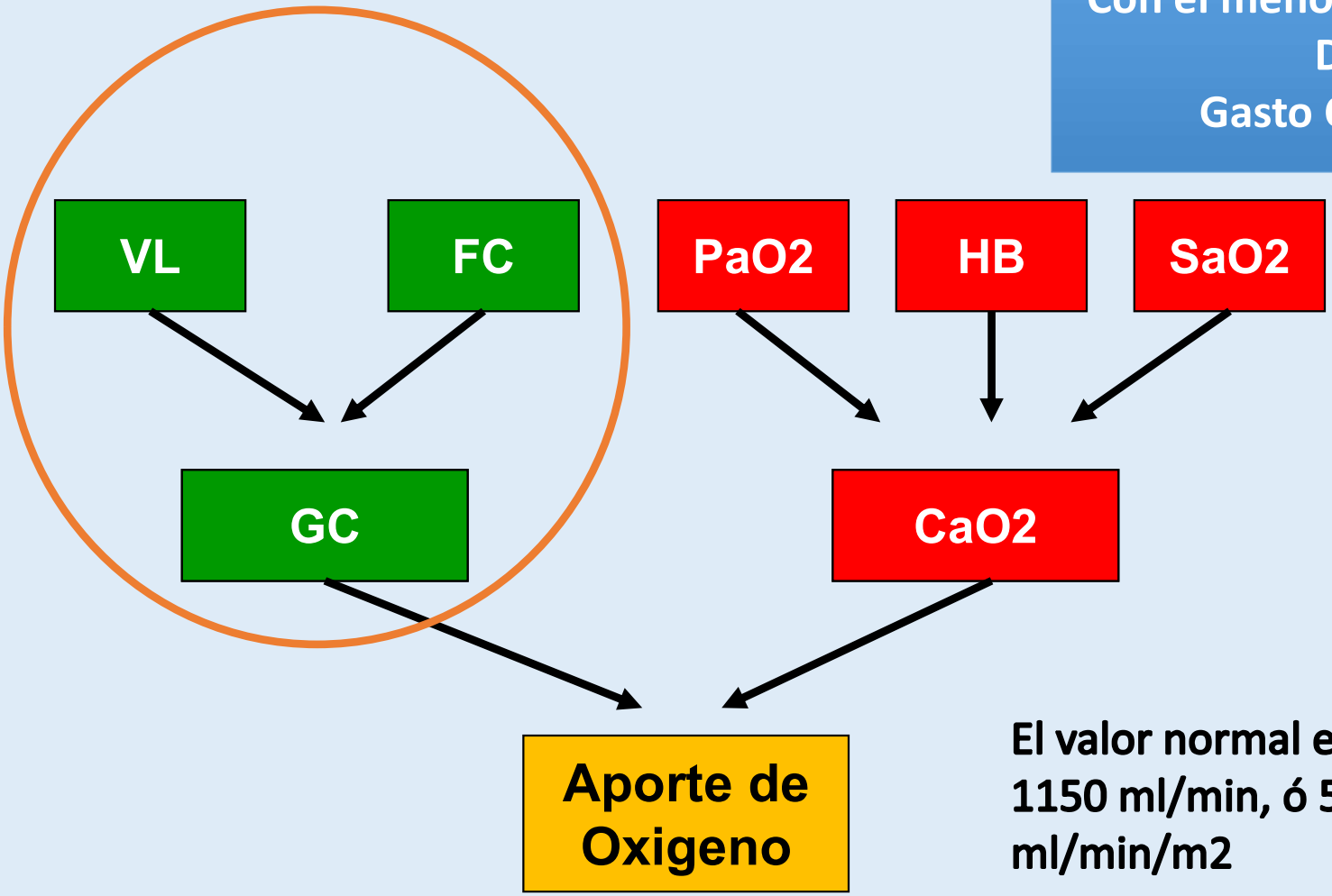
$$CaO2 = (1{,}34 \times Hb \times (SaO2 / 100)) + (0{,}003 \times PaO2).$$

JVEP

Buscando el PEEP adecuado



Hay que lograr la mejor Oxigenación Con el menor compromiso Del Gasto Cardíaco



El valor normal es 950-1150 ml/min, ó 500-600 ml/min/m2

DO_2 = Gasto cardiaco(en x min) x (CaO_2) en ml/100 x 10

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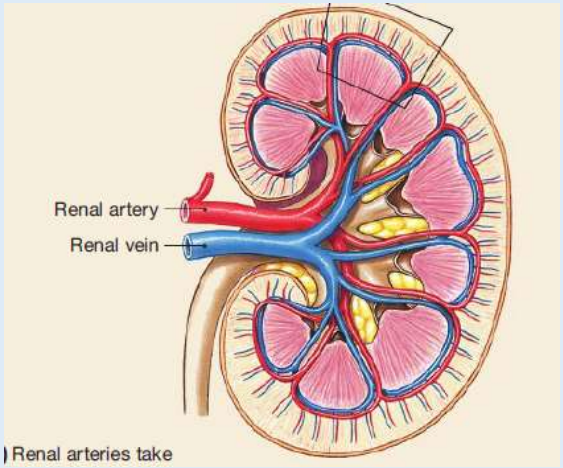
Efectos Renales



Cambios Hemodinámicos

Respuesta Endocrina

Cambios en PaCO2 y PaO2

H. Antidiurética

Renina-Angiotensina-Aldosterona

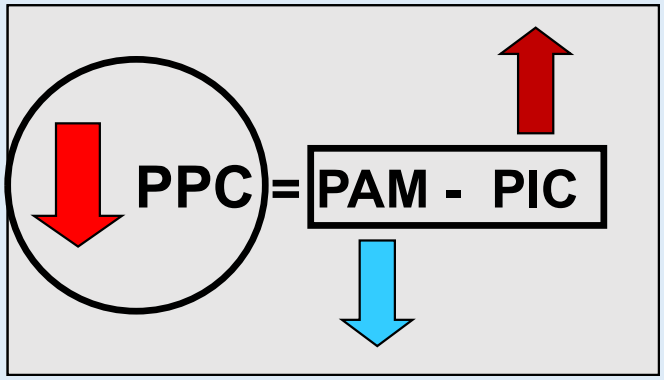
Dism Hormona Natriurética

Disminución De la Diuresis

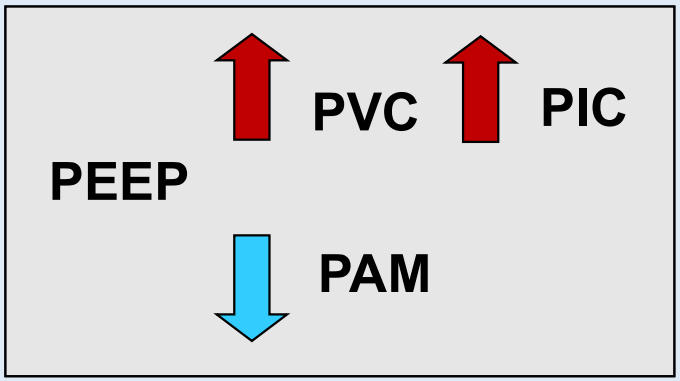
JVEP

EFECTOS SOBRE EL SNC

PPC = PAM - PIC



PPC > 60 mmHG
PAM > 70 .....
PIC < 20 .....



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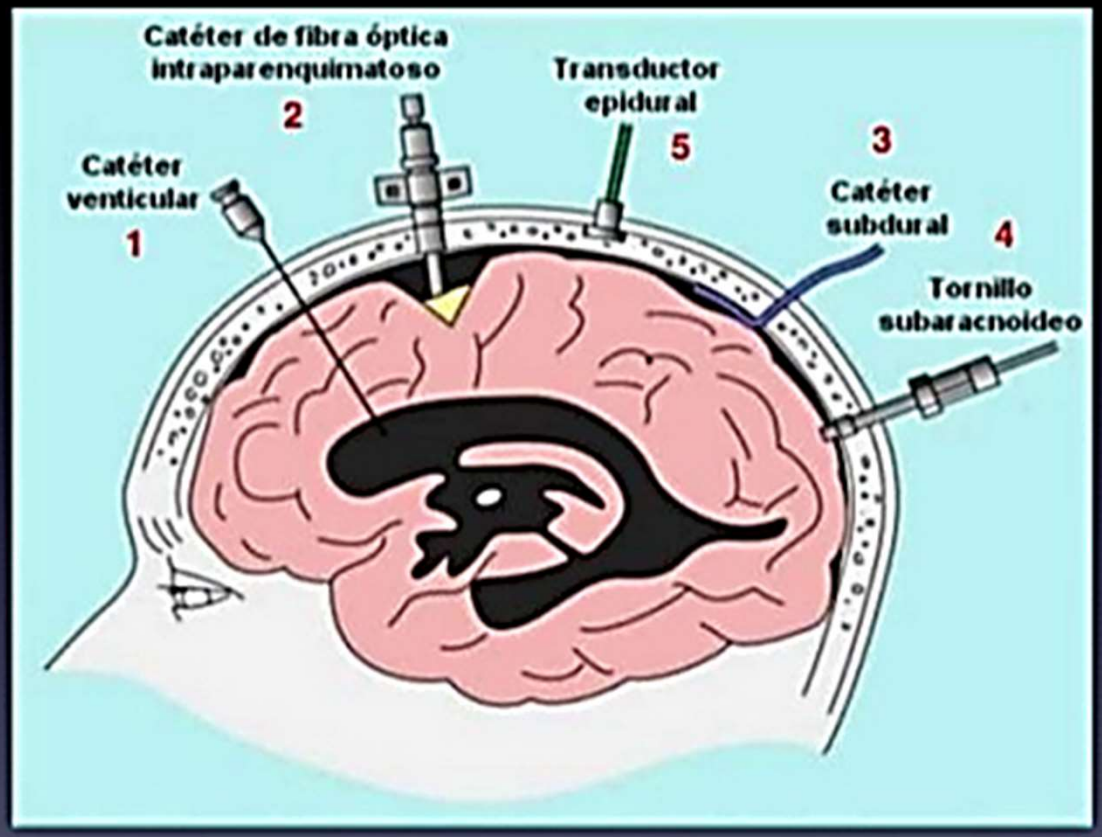
¿Qué es lo que realmente le importa al cerebro?

* Evitar la hipoxémia
* Proteger la presión de perfusión cerebral:
  * Evitar la hipotensión
  * Controlar la PIC
  * Evitar la hipocapnia

Mantener PPC > 60 mmHg.

Medición PIC



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PEEP, COMPLIANCE Y PIC

* Compliance del sistema respiratorio (Crs)
  * El impacto hemodinámico e hidrostático de la PEEP es atenuado en pacientes con baja Crs.

Pacientes en quienes queremos usar PEEP , con frecuencia pueden tolerarlo.

Caricato A, et al. J Trauma 2005

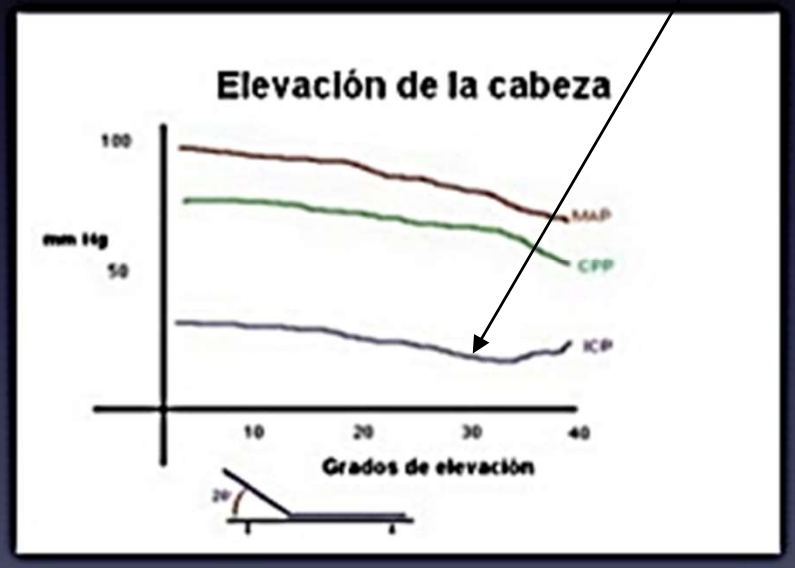
JVEP

Asociación frecuente de trauma torácico y craneal

Posición de la cabeza

- **Plana o 0°:**
  - Favorece el input arterial
  - Disminuye el retorno venoso

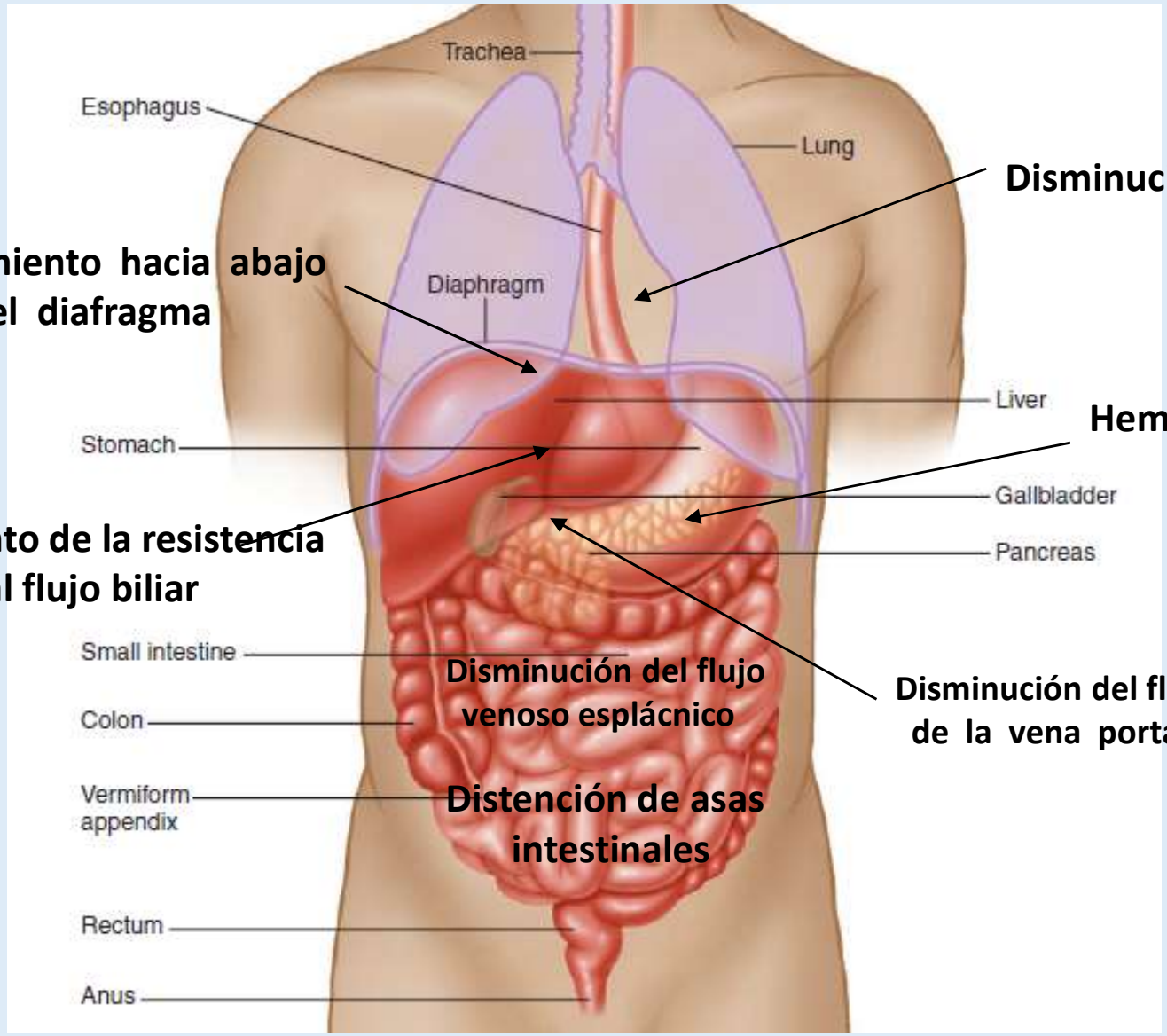
- **Vertical o 180°:**
  - Disminuye el input arterial
  - Mejora el retorno venoso



PEEP, En conclusión…

* Usar PEEP si se requiere:
  * Asegurar un adecuado volumen intravascular
  * Cabecera elevada
  * Monitorizar PIC
  * Considerar PEEP < PIC

Efectos Gastrointestinales



Disminución del GC

Movimiento hacia abajo del diafragma

Hemorragia Digestiva Superior

Aumento de la resistencia al flujo biliar

Disminución del flujo venoso esplácnico

Disminución del flujo de la vena porta

Distención de asas intestinales

Maniobras de Reclutamiento Alveolar

Figure 33.3 Thoracic CT scan of a patient suffering from multiple trauma with severe pulmonary contusion who developed acute respiratory distress syndrome. The PEEP was 10 cm H_2O at the time of the CT.

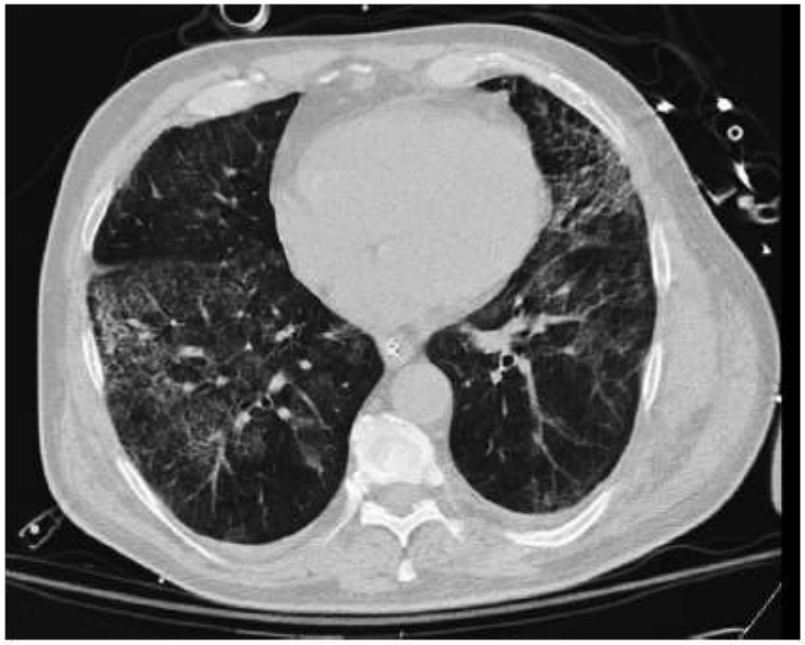


Figure 33.4 The same patient as in Figure 33.3, 48 hours after a recruitment maneuver (opening pressure 65 cm H_2O) and a decremental PEEP trial. The PEEP was 16 cm H_2O at the time of the CT.

Maniobras de Reclutamiento Alveolar

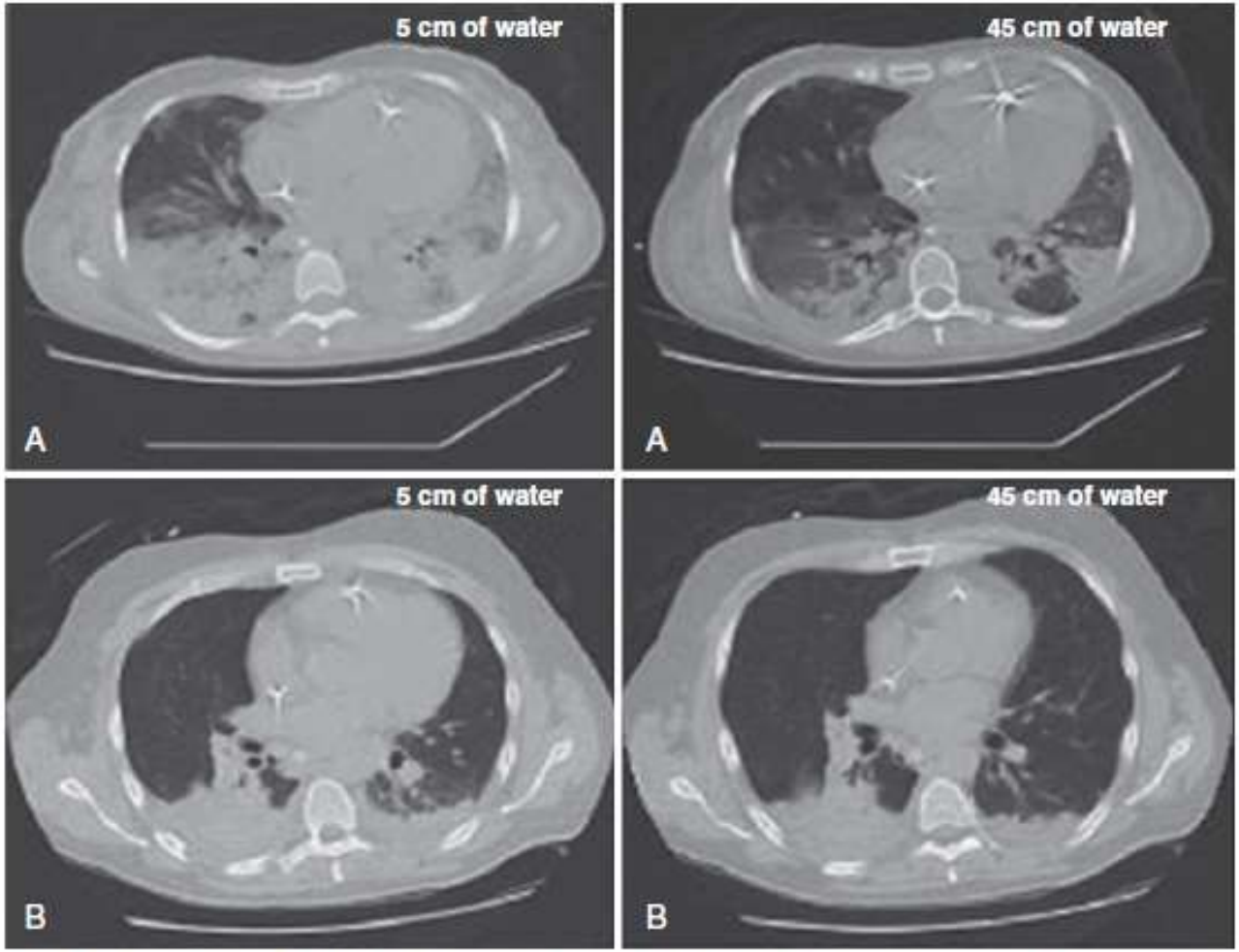


Figure 1-2. Computed tomography (CT) of the chest at low (5 cm H_2O) and high (45 cm H_2O) airway pressure in two patients with ARDS. **A,** Shifting of lung regions from poor to normal aeration suggests a significant potential for alveolar recruitment in this patient, who might benefit from increased levels of positive end-expiratory pressure (PEEP). **B,** High airway pressure only results in overdistention of previously aerated lung without achieving recruitment of poorly aerated lung tissue, suggesting that this patient may possibly not respond to high PEEP. *(From Gattinoni L, Caironi P, Cressoni M, et al. Lung recruitment in patients with the acute respiratory distress syndrome.* N Engl J Med. *2006;354: 1775-1786.)*

Como Podemos Hacer la Maniobra

Con CPAP

Si no Mantiene
PaO2 >60
Sat >90
FiO2 < 0.6
PM < 30

1-2 Horas

M.R.A.

CPAP (30-40) 40 seg.

Aumento Sat O2

No

VM PEEP

Si

VM PEEP + 3

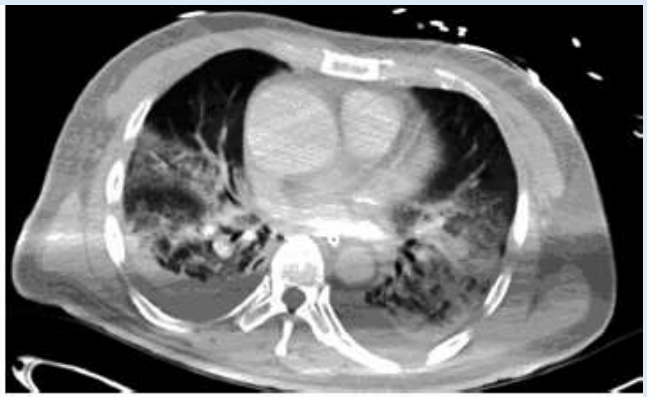


Figure 14-3. Computed tomography scan of a patient with ARDS due to extrapulmonary disease (i.e., trauma) illustrating diffuse pulmonary infiltrates with prominence of ground-glass opacities.

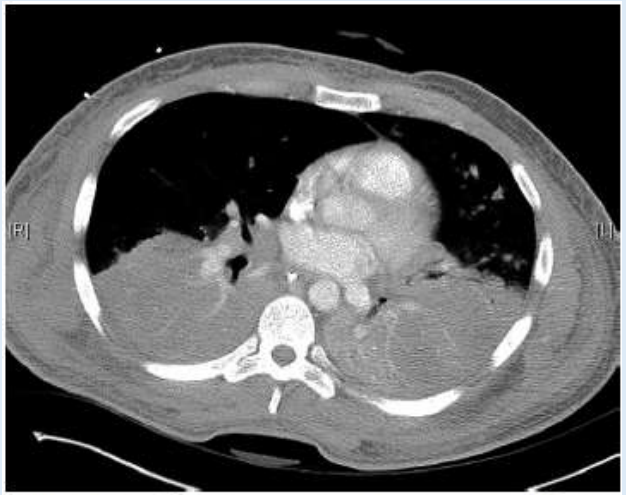
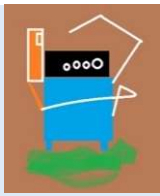


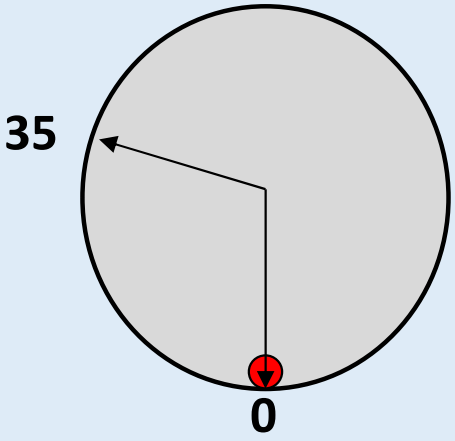
Figure 14-2. Computed tomography scan of a patient with ARDS due to pulmonary disease (i.e., pneumonia) showing extensive consolidations in the dependent regions and normal aeration in the nondependent regions.

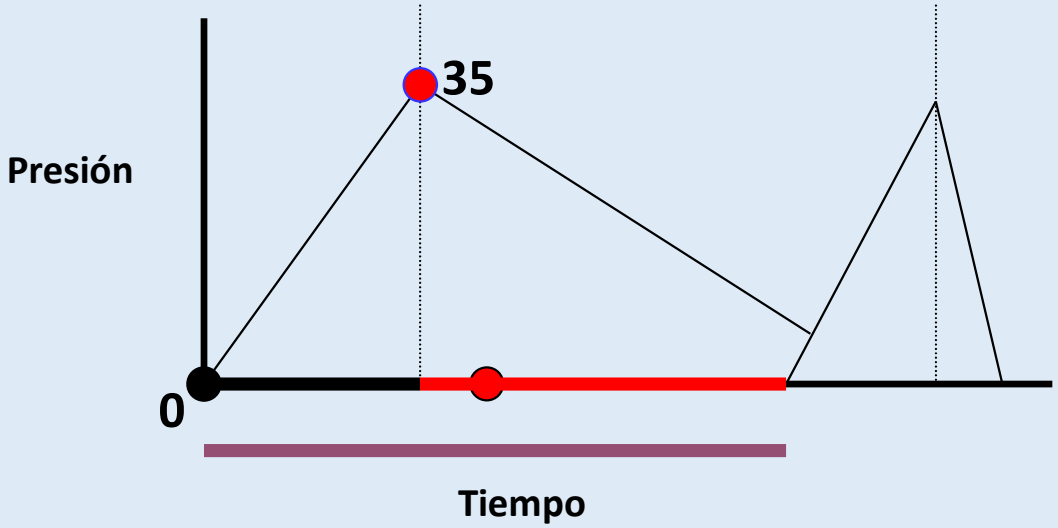
Maniobras de reclutamiento alveolar

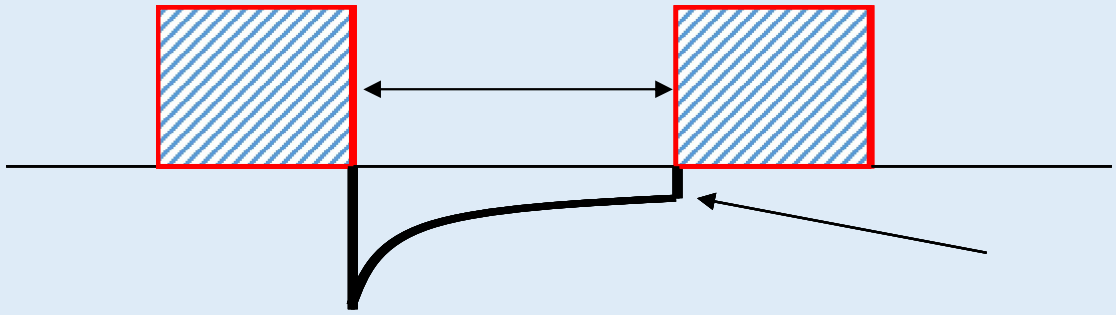


- **La meta de las MRA es convertir la Lesión pulmonar aguda en una estructura mas homogénea y de esta forma disminuir el riesgo de la lesión pulmonar inducida por el ventilador.**
- **Puede estar asociada con hipotensión y barotrauma.**
- **Muchos ensayos clínicos han reportado una mejoría transitoria (< 4 horas) en el intercambio gaseoso y en la mecánica respiratoria.**
- **Dada la falta de una eficacia demostrada tanto en mortalidad y tiempo de ventilación, el uso rutinario de MRA permanece controversial y no es recomendado su uso rutinario en pacientes con SDRA.**

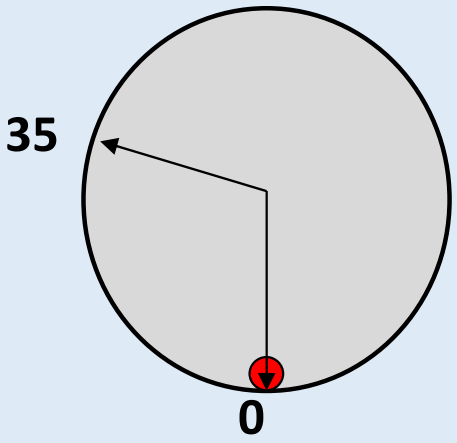
Presión positiva espiratoria final Auto-PEEP

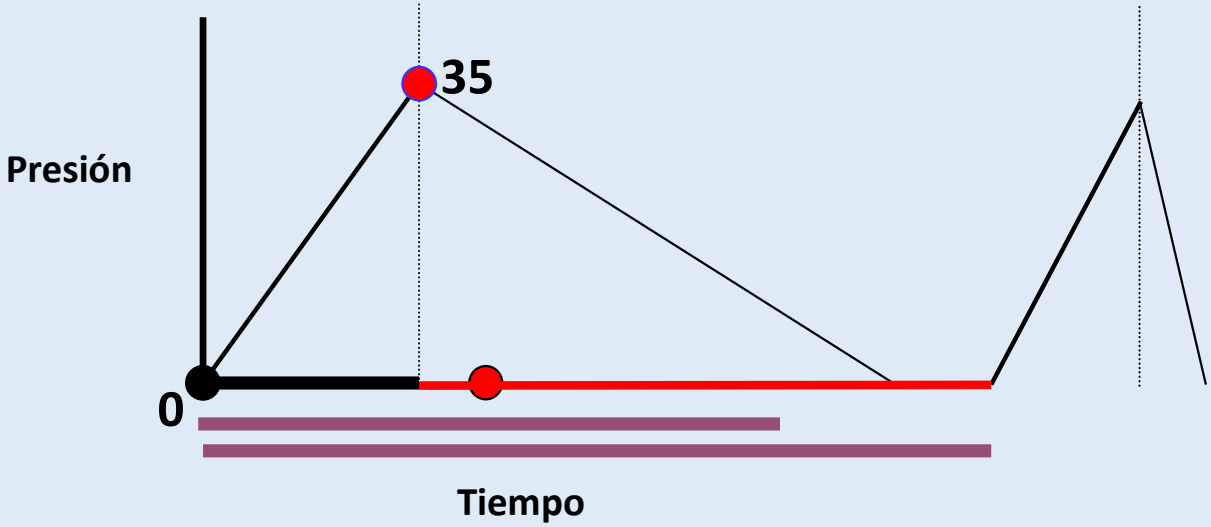


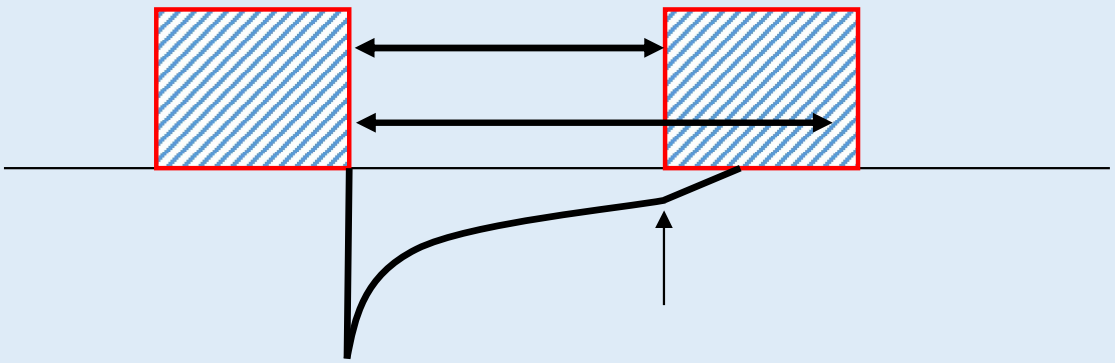




Presión positiva espiratoria final Auto-PEEP







JVEP

Como medir el auto PEEP :

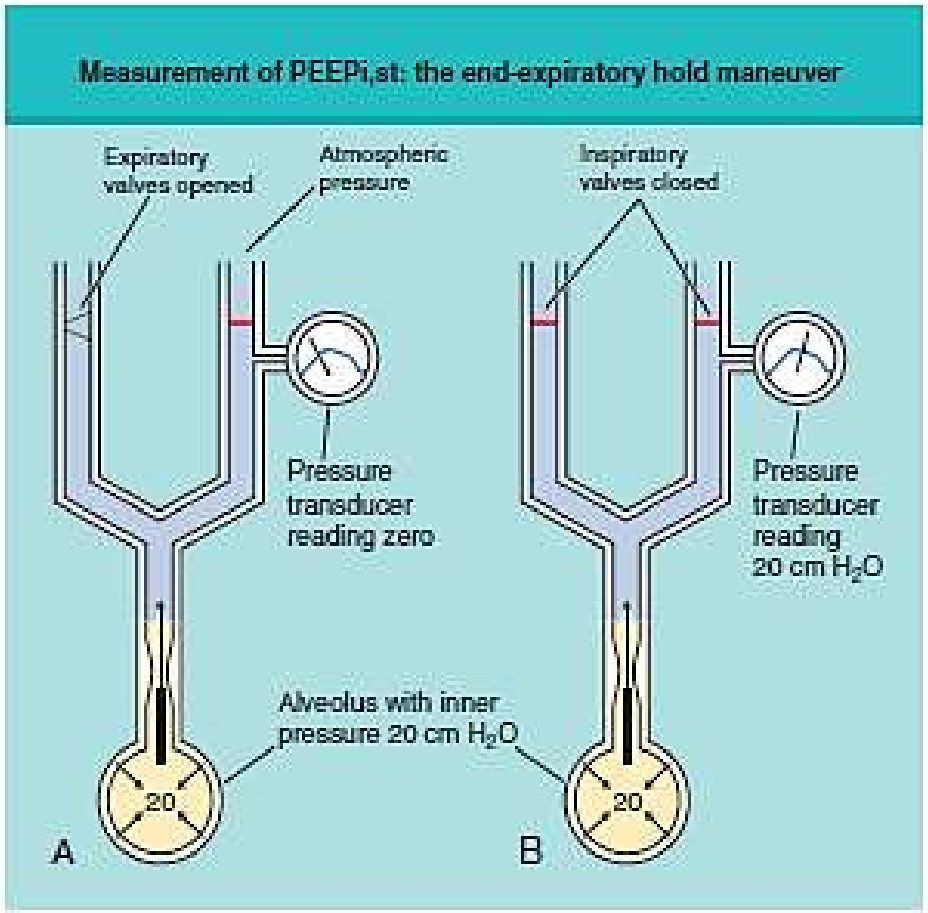


Figure 15.6. Schematic representation of the respiratory system and a ventilatory circuit. *A*, During the expiratory phase, the ventilator opens the expiratory valve while the inspiratory valve is closed. Consequently, the pressure transducer reads atmospheric pressure. *B*, At end expiration, both inspiratory and expiratory valves are closed (end-expiratory hold maneuver). The pressure transducer now reads the end-expiratory alveolar pressure.

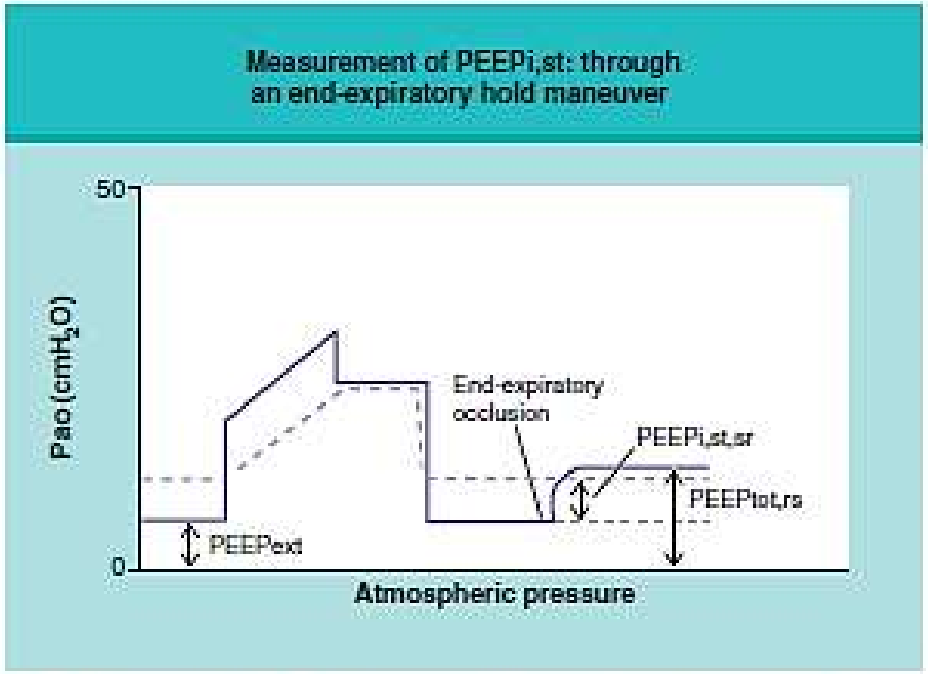


Figure 15.7. Recording of the Pao tracing obtained during a cycle of constant-flow mechanical ventilation followed by an end-expiratory hold maneuver. At the end of the maneuver, the PEEPtot value is obtained. The dotted line indicates the theoretical value of alveolar pressure.

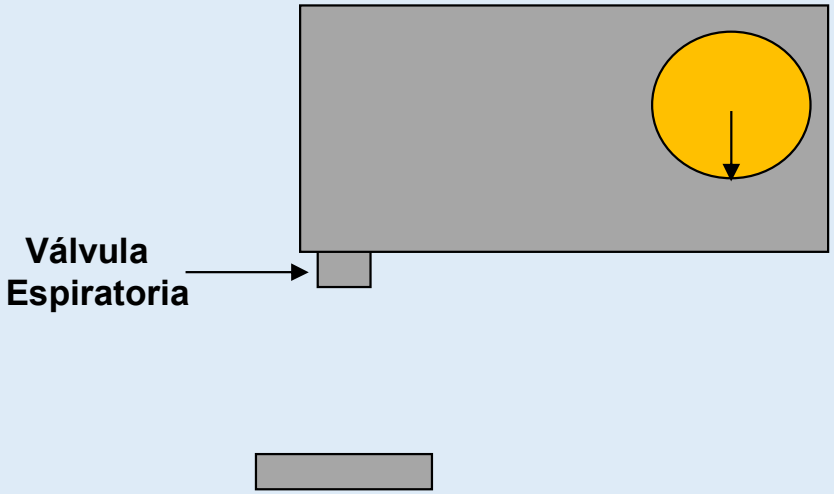
$$Est,rs = (Pao,plat - PEEPtot)/VT \qquad \text{(Equation 9)}$$

PEEPtot is used instead of PEEPext for the calculation of Cst,rs in order to discriminate between an increase in Pao,plat due to dynamic hyperinflation (where PEEPtot is higher than PEEPext

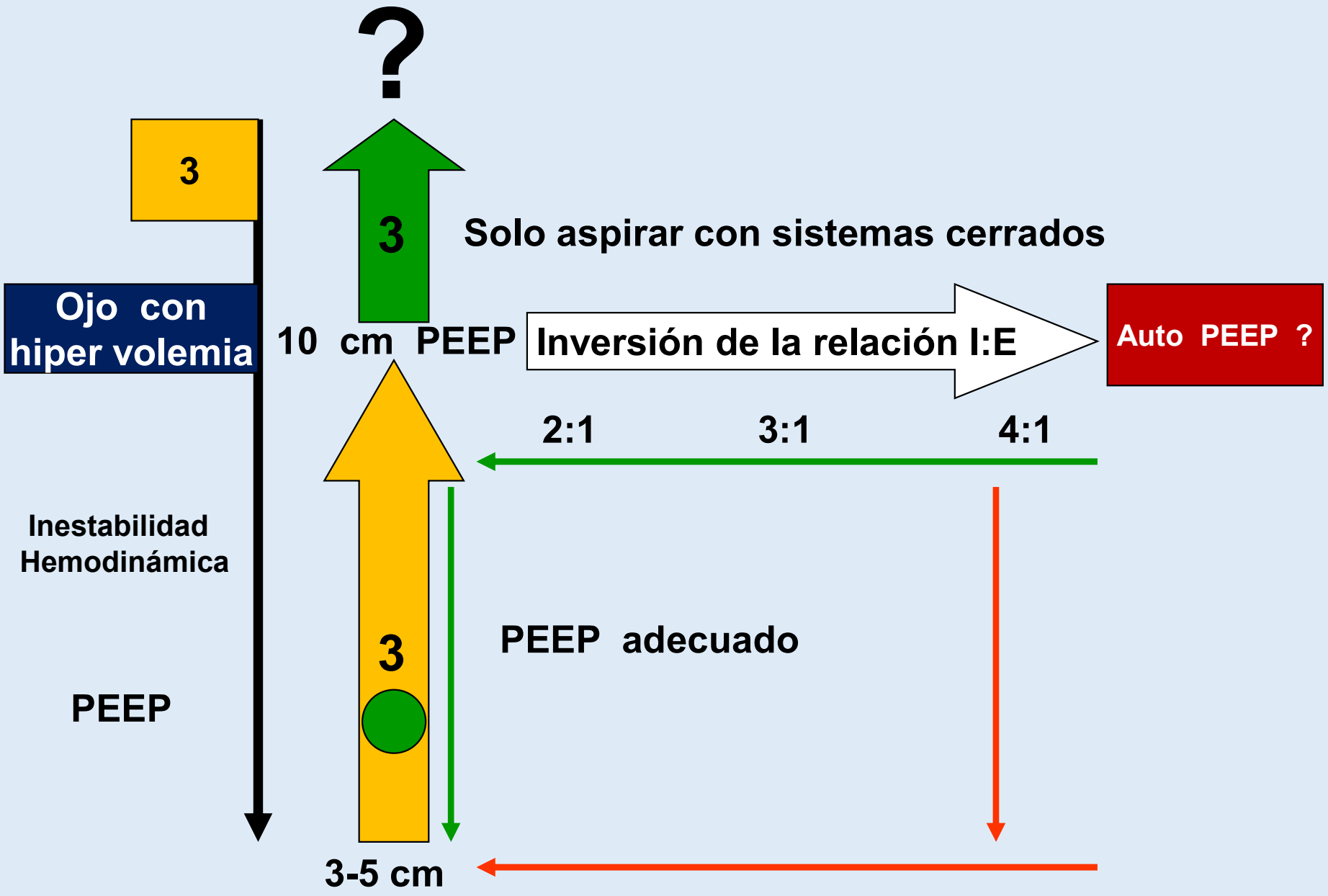
JVEP

Como medir el auto PEEP :

Final de la espiración



Propuesta para el manejo del PEEP



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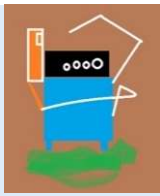
Conclusiones



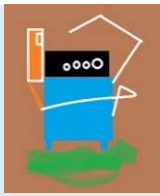
- **1.- El PEEP es un recurso ventilatorio mecánico de amplio uso en Medicina Crítica, Emergencia, quirófanos, permitiendo un mejor manejo de la oxigenación en los pacientes.**

- **2.-Hasta 5 cmH2O se considera sin efectos secundarios.-**

- **3.-A partir de 5cmH2O los efectos mas frecuentes son la hipotensión arterial de diversos grados de severidad.-**

- **4.-Se puede emplear bajo ciertas condiciones en los pacientes con trauma craneal.**

Conclusiones



- **5.- Su ascenso debe hacerse de manera progresiva hasta lograr los efectos deseados.**
- **6.-El descenso también debe realizarse pausadamente.**
- **7.-La mejoría de la oxigenación puede no ser inmediata.-**
- **8.-Puede enmascarar en el paciente una falla cardíaca oculta.-**
- **9.-El mejor PEEP es el que mas oxigena con el menor compromiso cardiovascular.**

Fin de la presentación