
بسم الله الرحمن الرحيم

MECHANICAL VENTILATION MANGEMENT OF ARDS

Intensive Care Unit

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Objectives

1. Definition of ARDS
2. Ventilatory management of ARDS
3. Non-ventilatory management of ARDS

Respiratory distress syndrome RDS includes

- Severe Dyspnea, Tachypnea, Hypoxemia which is refractory to oxygen therapy with
- Stiff, low compliance lungs and diffuse alveolar infiltration seen on chest x-ray

Does this patient have ARDS?

Acute Respiratory Distress Syndrome
The Berlin Definition

Table 3. The Berlin Definition of Acute Respiratory Distress Syndrome

	Acute Respiratory Distress Syndrome
Timing	Within 1 week of a known clinical insult or new or worsening respiratory symptoms
Chest imaging[a]	Bilateral opacities—not fully explained by effusions, lobar/lung collapse, or nodules
Origin of edema	Respiratory failure not fully explained by cardiac failure or fluid overload Need objective assessment (eg, echocardiography) to exclude hydrostatic edema if no risk factor present
Oxygenation[b]	
Mild	200 mm Hg < PaO_2/FIO_2 ≤ 300 mm Hg with PEEP or CPAP ≥5 cm H_2O[c]
Moderate	100 mm Hg < PaO_2/FIO_2 ≤ 200 mm Hg with PEEP ≥5 cm H_2O
Severe	PaO_2/FIO_2 ≤ 100 mm Hg with PEEP ≥5 cm H_2O

Diagnostic Criteria for the New Global Definition of ARDS

	Criteria That Apply to Specific ARDS Categories		
	Nonintubated ARDS[†]	Intubated ARDS	Modified Definition for Resource-Limited Settings[‡]
Oxygenation[§‖]	$Pa_{O_2}:Fi_{O_2} \leq 300$ mm Hg or $Sp_{O_2}:Fi_{O_2} \leq 315$ (if $Sp_{O_2} \leq 97\%$) on HFNO with flow of ≥30 L/min or NIV/CPAP with at least 5 cm H_2O end-expiratory pressure	Mild[¶]: $200 < Pa_{O_2}:Fi_{O_2} \leq 300$ mm Hg or $235 < Sp_{O_2}:Fi_{O_2} \leq 315$ (if $Sp_{O_2} \leq 97\%$) Moderate: $100 < Pa_{O_2}:Fi_{O_2} \leq 200$ mm Hg or $148 < Sp_{O_2}:Fi_{O_2} \leq 235$ (if $Sp_{O_2} \leq 97\%$) Severe: $Pa_{O_2}:Fi_{O_2} \leq 100$ mm Hg or $Sp_{O_2}:Fi_{O_2} \leq 148$ (if $Sp_{O_2} \leq 97\%$)	$Sp_{O_2}:Fi_{O_2} \leq 315$ (if $Sp_{O_2} \leq 97\%$)[†]. Neither positive end-expiratory pressure nor a minimum flow rate of oxygen is required for diagnosis in resource-limited settings.

	Criteria That Apply to All ARDS Categories
Risk factors and origin of edema	Precipitated by an acute predisposing risk factor, such as pneumonia, nonpulmonary infection, trauma, transfusion, aspiration, or shock. Pulmonary edema is not *exclusively or primarily* attributable to cardiogenic pulmonary edema/fluid overload, and hypoxemia/gas exchange abnormalities are not primarily attributable to atelectasis. However, ARDS can be diagnosed in the presence of these conditions if a predisposing risk factor for ARDS is also present.
Timing	Acute onset or worsening of hypoxemic respiratory failure within 1 week of the estimated onset of the predisposing risk factor or new or worsening respiratory symptoms.
Chest imaging	Bilateral opacities on chest radiography and computed tomography or bilateral B lines and/or consolidations on ultrasound* not fully explained by effusions, atelectasis, or nodules/masses.

Table 2. Summary of Key Differences between the New Global Definition of ARDS and the Berlin Definition Together with the Rationale for Updating Specific Diagnostic Criteria

Berlin Definition	Rationale for Updating Criteria	How This is Addressed in the Global Definition
Acute onset within 1 week of known insult or new or worsening respiratory symptoms	Onset may be more indolent for some insults, such as COVID-19	The inclusion of patients with HFNO will capture patients with more indolent courses, and therefore the timing criterion has not been changed
Bilateral opacities on chest radiography or computed tomography not fully explained by effusions, lobar/lung collapse, or nodules	Chest radiography and computed tomography not available in some clinical settings	Ultrasound can be used to identify bilateral loss of lung aeration (multiple B lines and/or consolidations) as long as operator is well trained in the use of ultrasound
Three severity categories defined by Pa_{O_2}:FI_{O_2}	Pulse oximetric measurement of Sp_{O_2}:FI_{O_2} is widely used and validated as a surrogate for Pa_{O_2}:FI_{O_2}	Sp_{O_2}:FI_{O_2} can be used for diagnosis and assessment of severity if Sp_{O_2} is $\leqslant$97%
Requirement for invasive or noninvasive mechanical ventilation such that PEEP $\geqslant$ 5 cm H_2O is required for all categories of oxygenation severity except mild, which can also be met with CPAP $\geqslant$ 5 cm H_2O	HFNO increasingly being used in patients with severe hypoxemia who otherwise meet ARDS criteria	New category of nonintubated ARDS created for patients on HFNO at $\geqslant$30 L/min who otherwise meet ARDS criteria
	Invasive and noninvasive mechanical ventilation not available in resource-limited settings	Modified definition of ARDS for resource-limited settings does not require Pa_{O_2}:FI_{O_2}, PEEP, or HFNO

Definition of abbreviations: ARDS = acute respiratory distress syndrome; COVID-19 = coronavirus disease; CPAP = continuous positive airway pressure; HFNO = high-flow nasal oxygen; PEEP = positive end-expiratory pressure; Sp_{O_2} = oxygen saturation as measured by pulse oximetry

The Berlin Definition
Increasing Intensity of Intervention
ECMO
Inhaled NO
HFOV
Prone Positioning
Lower Tidal Volume/Pplat+ECCO$_2$R
Neuromuscular Blockade
Higher PEEP
Low-Moderate PEEP
Low Tidal Volume Ventilation
Mild ARDS
Moderate ARDS
Severe ARDS
300
250
200
150
100
50
0

Murray score (lung injury scoring LIS)define severity of ARDS Indication of ECMO(>3)

	0	1	2	3	4
Pao2/Fio2 100% oxygen	>300	225-299	175-224	100-174	<100
CXR	normal	one point for Each gauadrent	one point for Each gauadrent	one point for Each gauadrent	one point for Each gauadrent
PEEP	<5	6-8	9-11	12-14	>15
compliance	>80	60-79	40-59	20-39	<19

Leaking of protien rich plasma out of cap

Increase permeability of tissue

Inflammation of alveolar capillary membran

Incomplete filling of alveoli with edema, cell debris

Collapsed alveoli
V/Q mismatch dead space increaesd

Normal Alveolus
Injured Alveolus during the Acute Phase
Alveolar air space
Type I cell
Epithelial basement membrane
Interstitium
Type II cell
Alveolar macrophage
Surfactant layer
Endothelial cell
Endothelial basement membrane
Red cell
Capillary
Fibroblast
Protein-rich edema fluid
Sloughing of bronchial epithelium
Necrotic or apoptotic type I cell
Inactivated surfactant
Activated neutrophil
Red cell
Leukotrienes
Oxidants
PAF
Proteases
Intact type II cell
Cellular debris
Denuded basement membrane
TNF-α, IL-1
Hyaline membrane
Alveolar macrophage
Fibrin
Migrating neutrophil
Proteases
IL-6, IL-10
Widened, edematous interstitium
MIF
TNF-α, IL-8
Procollagen
Gap formation
IL-8
IL-8
Platelets
Neutrophil
Swollen, injured endothelial cells
Fibroblast
Neutrophil

Polytrauma with lung contusion

Polytrauma patient

Weight: 70 kg
Height: 170 cm

Chest trauma
Lung contusion

Oxygen mask
15 Liter/min

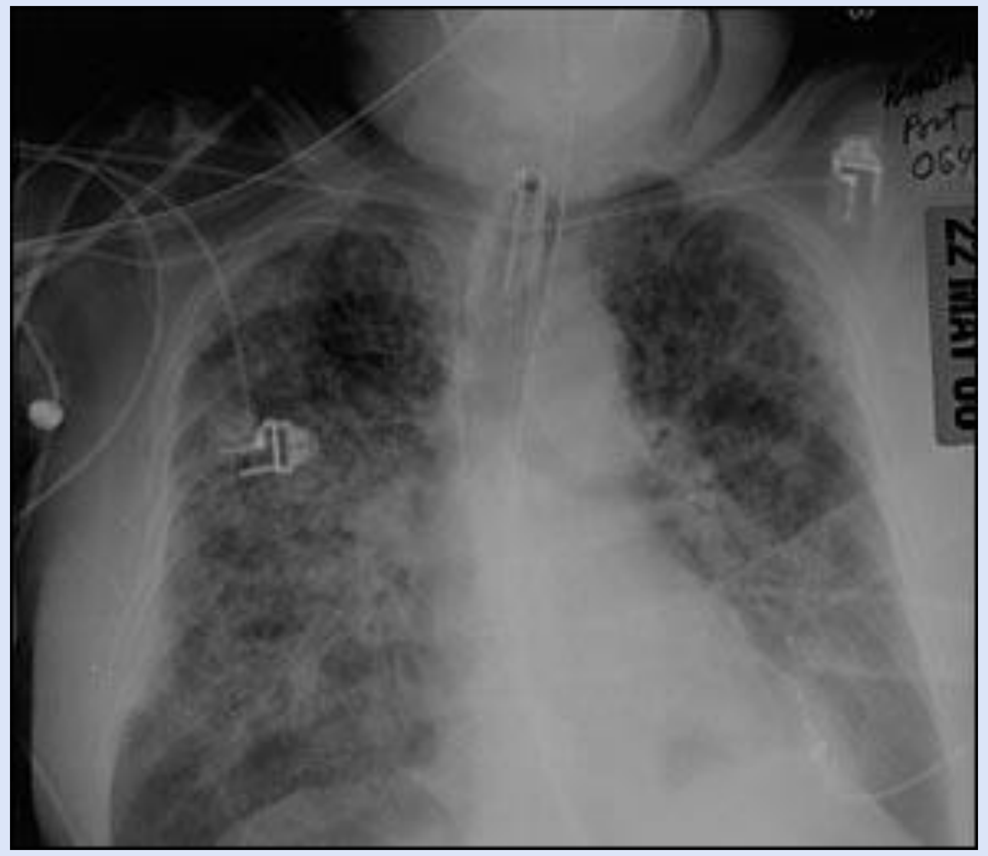
Respiratory rate
35 b/min

SpO2 89%

Bilateral lung infiltrate

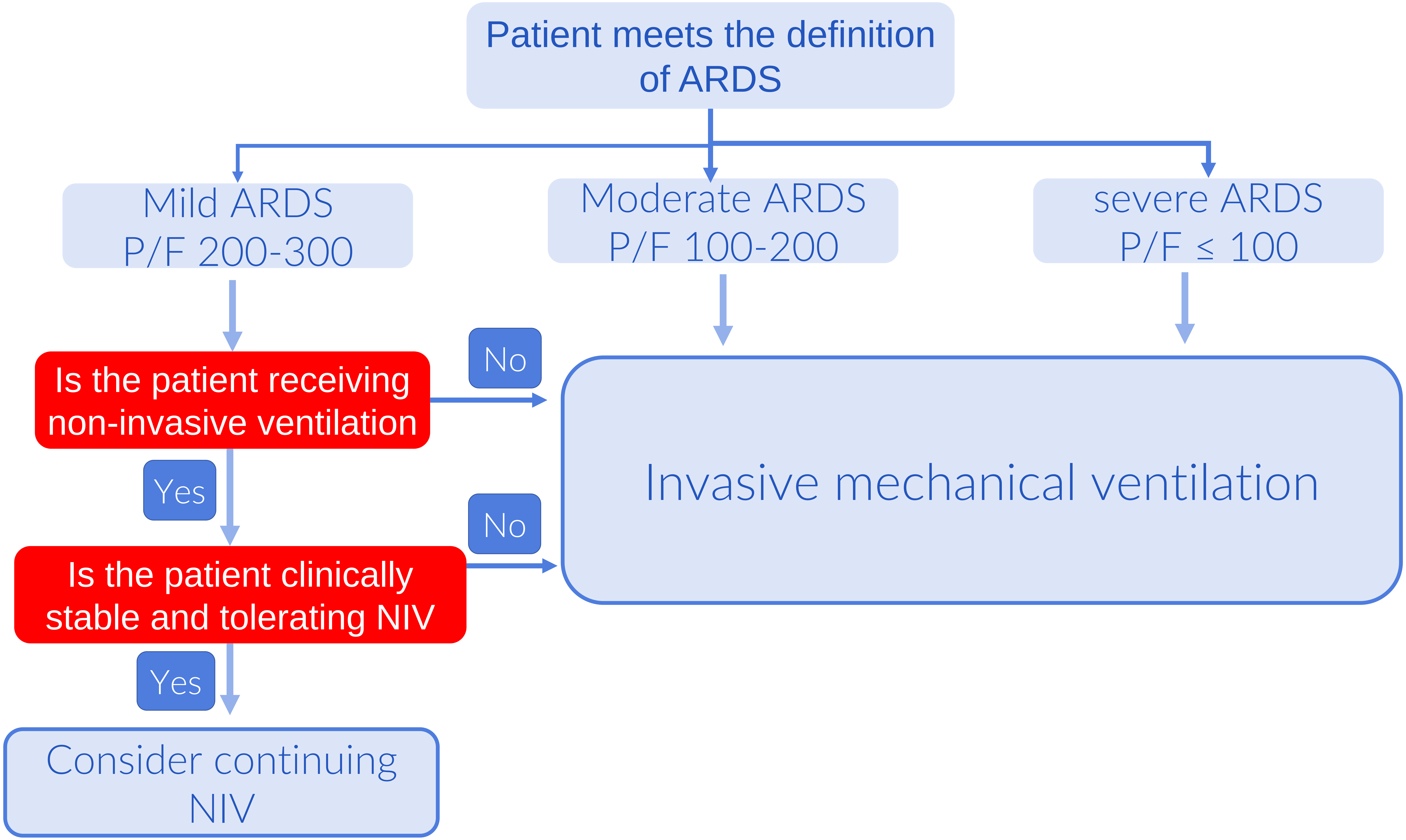
Echocardiography is normal

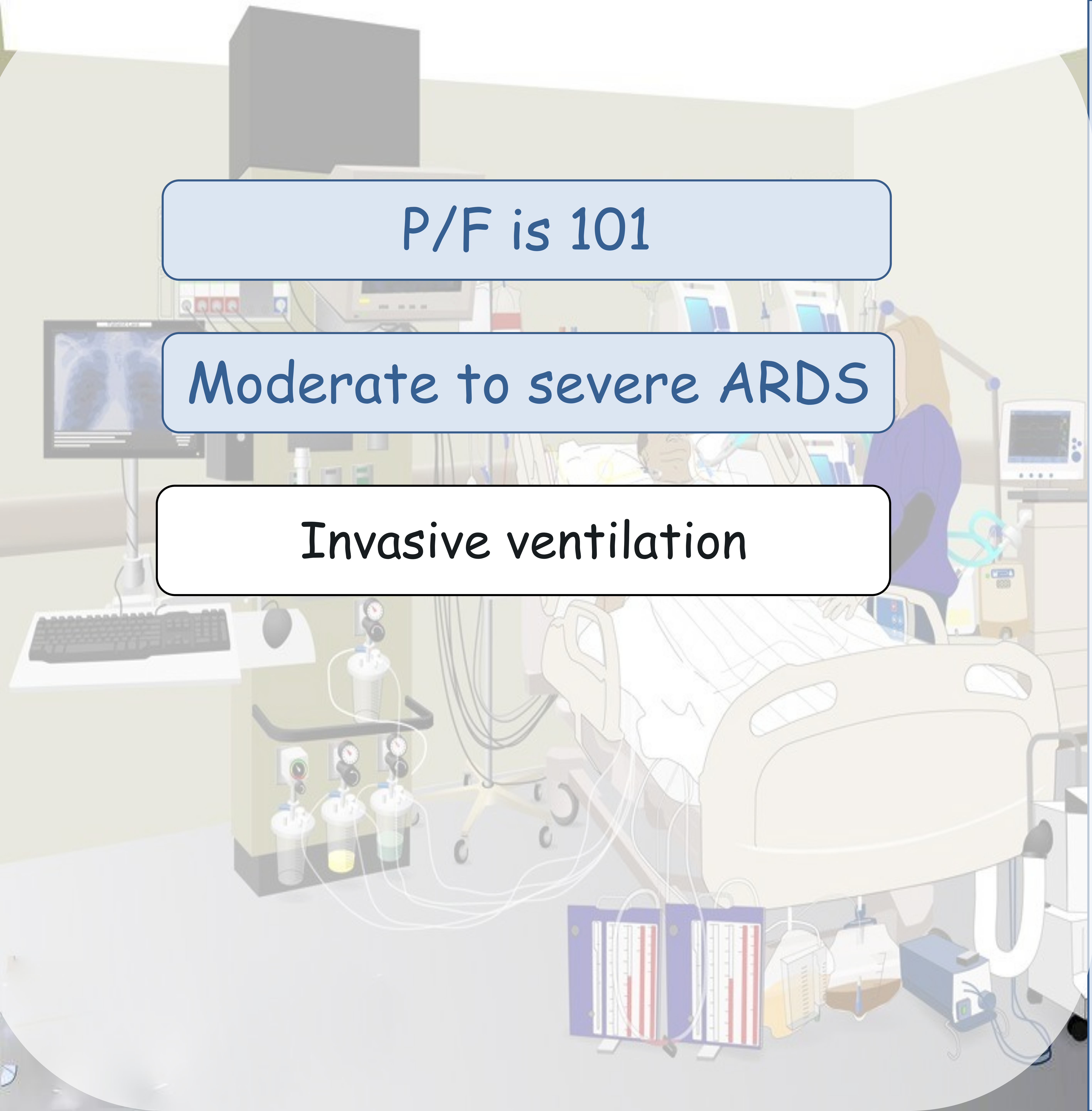
pH	7.4
pCO2	34 mmHg
pO2	61 mmHg
Na	135 mmol/l
HCO3	14 mmol/L
FiO2	0.6



Does this patient have ARDS?

Do you propose non-invasive ventilation for this patient?


Patient meets the definition of ARDS
Mild ARDS
P/F 200-300
Moderate ARDS
P/F 100-200
severe ARDS
P/F ≤ 100
Is the patient receiving non-invasive ventilation
No
Yes
Is the patient clinically stable and tolerating NIV
No
Yes
Invasive mechanical ventilation
Consider continuing NIV



P/F is 101

Moderate to severe ARDS

Invasive ventilation

Polytrauma with lung contusion

Polytrauma patient

Weight: 70 kg
Height: 170 cm

Chest trauma
Lung contusion

Oxygen mask
15 Liter/min

Respiratory rate
35 b/min

SpO2 89%

Bilateral lung infiltrate

P/F 101

pH	7.4
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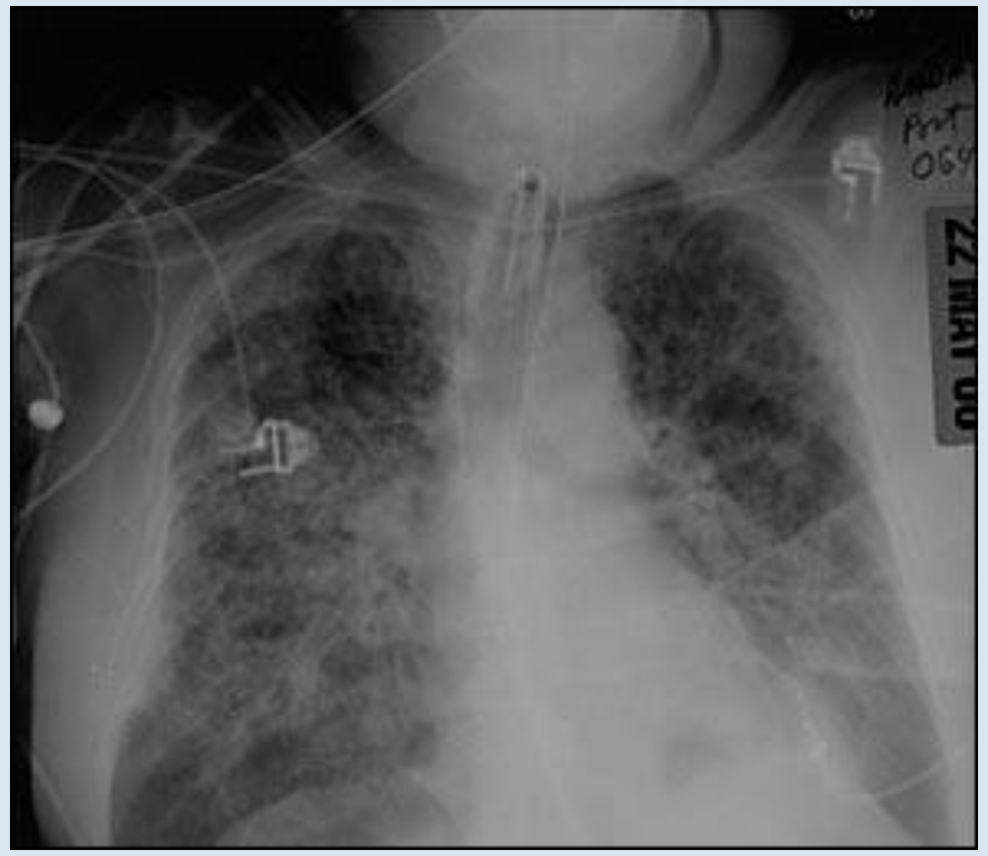
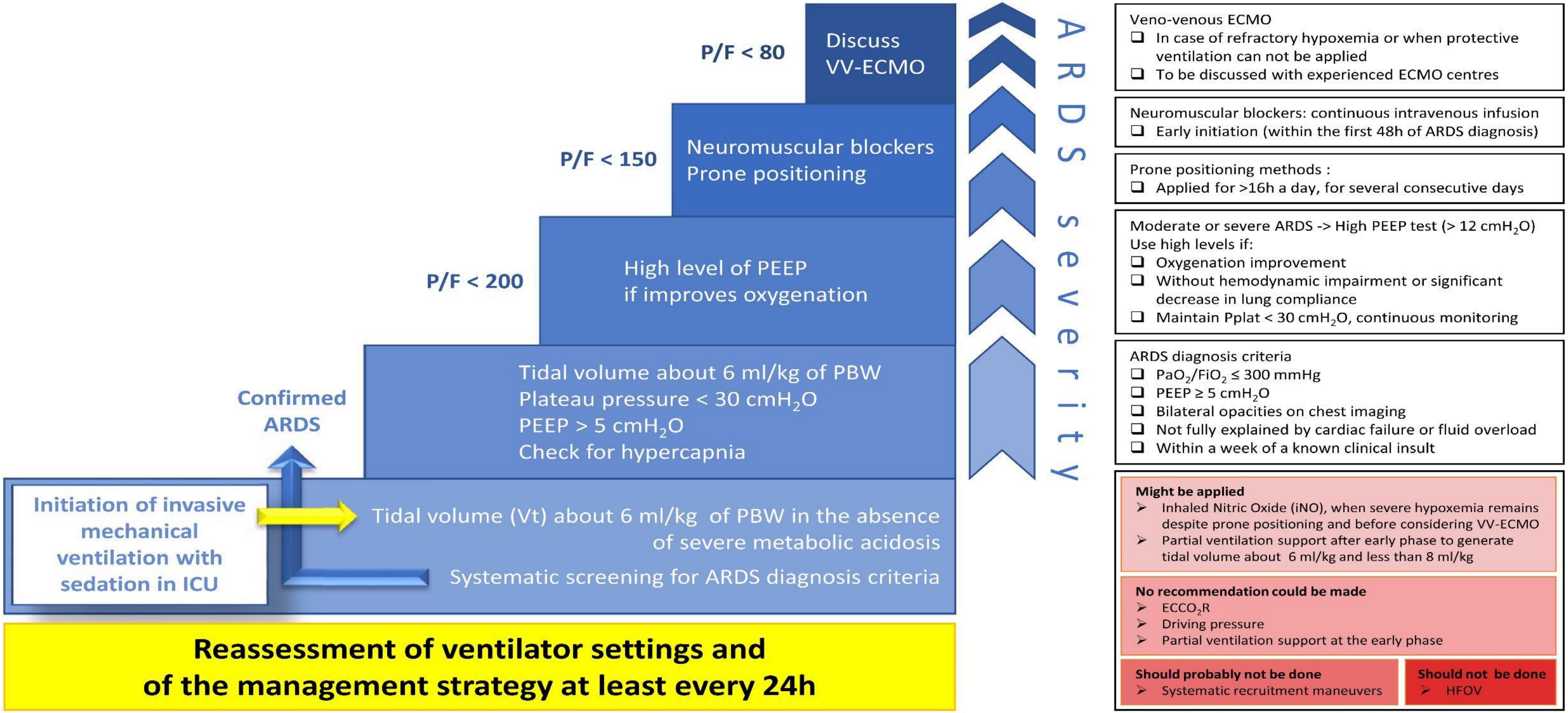


How can we manage patient with ARDS?

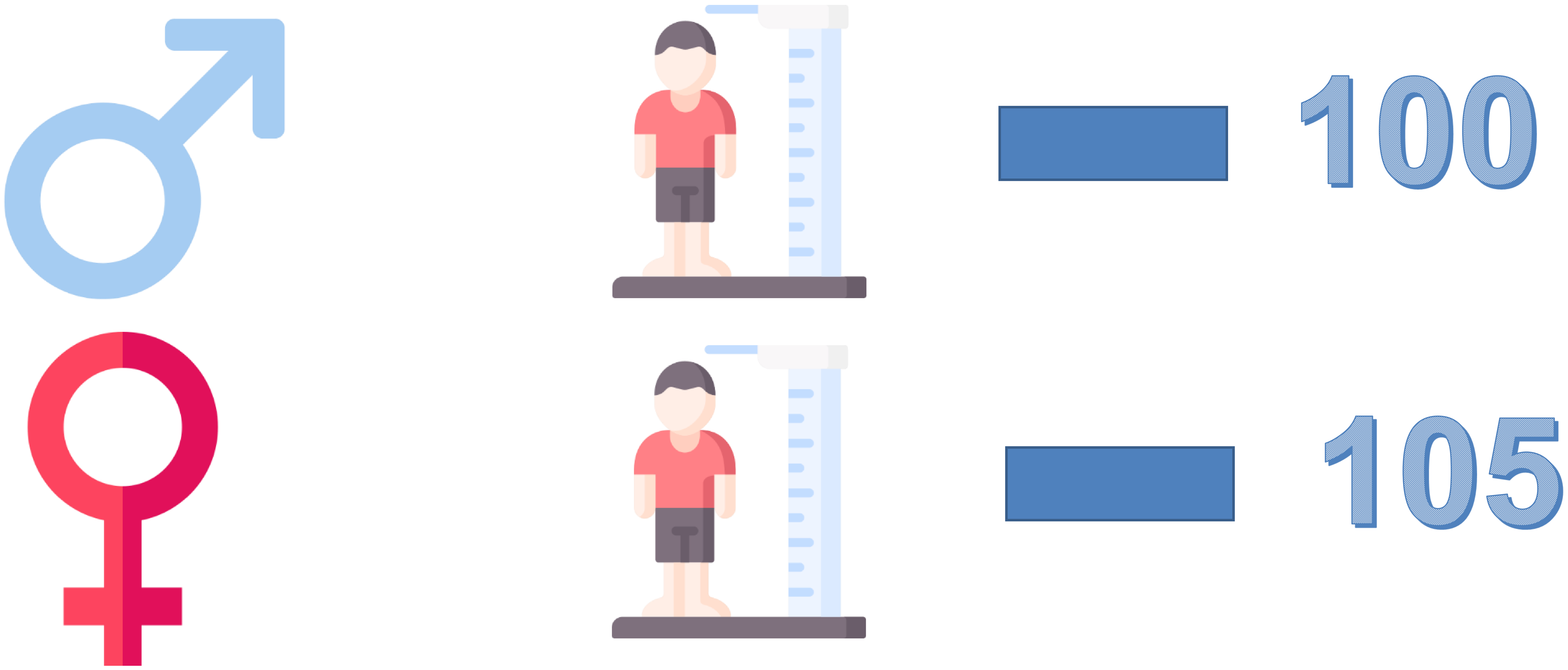
Early management of ARDS in 2019



How to ventilate this patient?

Mechanical ventilation protocol of patients with ARDS

1 Calculate the predicted body weight



Mechanical ventilation protocol of patients with ARDS

1 Calculate the predicted body weight

1

Calculate ideal body weight

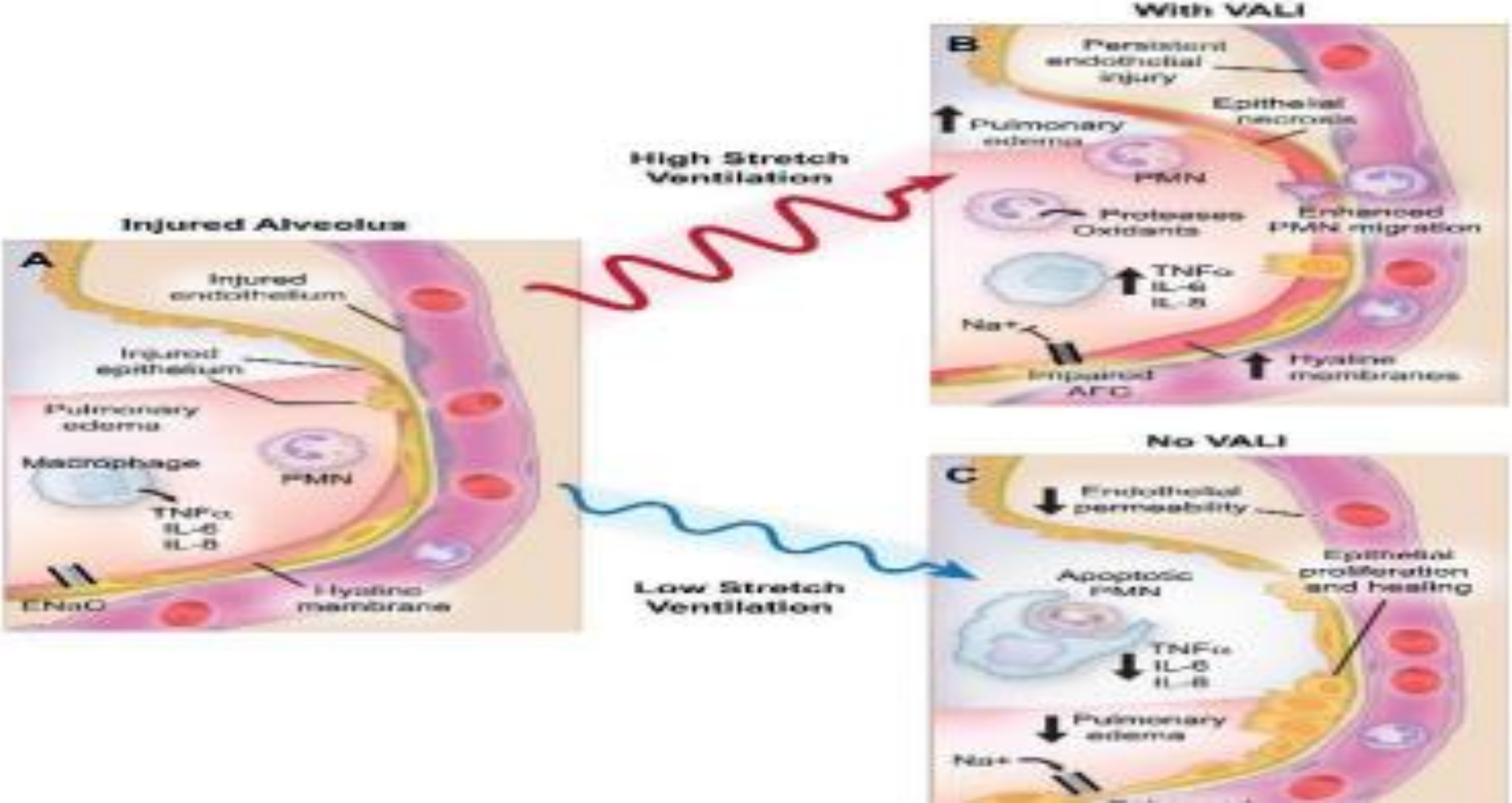
Male				
Height(cm)	PBW	8 ml/kg	6 ml/kg	4 ml/kg
140	39	312	234	156
145	44	352	264	176
150	48	384	288	192
155	53	424	318	212
160	57	456	342	228
165	62	496	372	248
170	67	536	402	268
175	71	568	426	284
180	76	608	456	304
185	80	640	480	320
190	85	680	510	340
195	89	712	534	356
200	94	752	564	376
205	98	784	588	392

Female				
Height(cm)	PBW	8 ml/kg	6 ml/kg	4 ml/kg
140	35	280	210	140
145	39	312	234	156
150	44	352	264	176
155	48	384	288	192
160	53	424	318	212
165	57	456	342	228
170	62	496	372	248
175	67	536	402	268
180	71	568	426	284
185	76	608	456	304
190	80	640	480	320
195	85	680	510	340
200	89	712	534	356
205	94	752	564	376

Lung protective strategy

Low TV, High PEEP, Pressure Plateau not exceeding 30 mmgh

Lung Protective Ventilation Reduced Lung Endothelial and Epithelial Injury



- Fluid distribution, accumulation and lung collapse appeared to be influenced by GRAVITY i.e., dependent zones zone 3

- To set **VT** at 10 to 15 mL/kg for ventilated patients with ARDS, these large volumes primarily entered the normally aerated tissue in the independent regions. Thus, a relatively small area of the lungs received most of the volume causing **overdistention** and injury to the alveoli in the independent lung regions. As a result ,**lung compliance appeared to be low.**

- It is important to note that this is one rationale for using pressure-controlled ventilation in patients with ARDS because it limits the amount of pressure and distention to all lung regions.

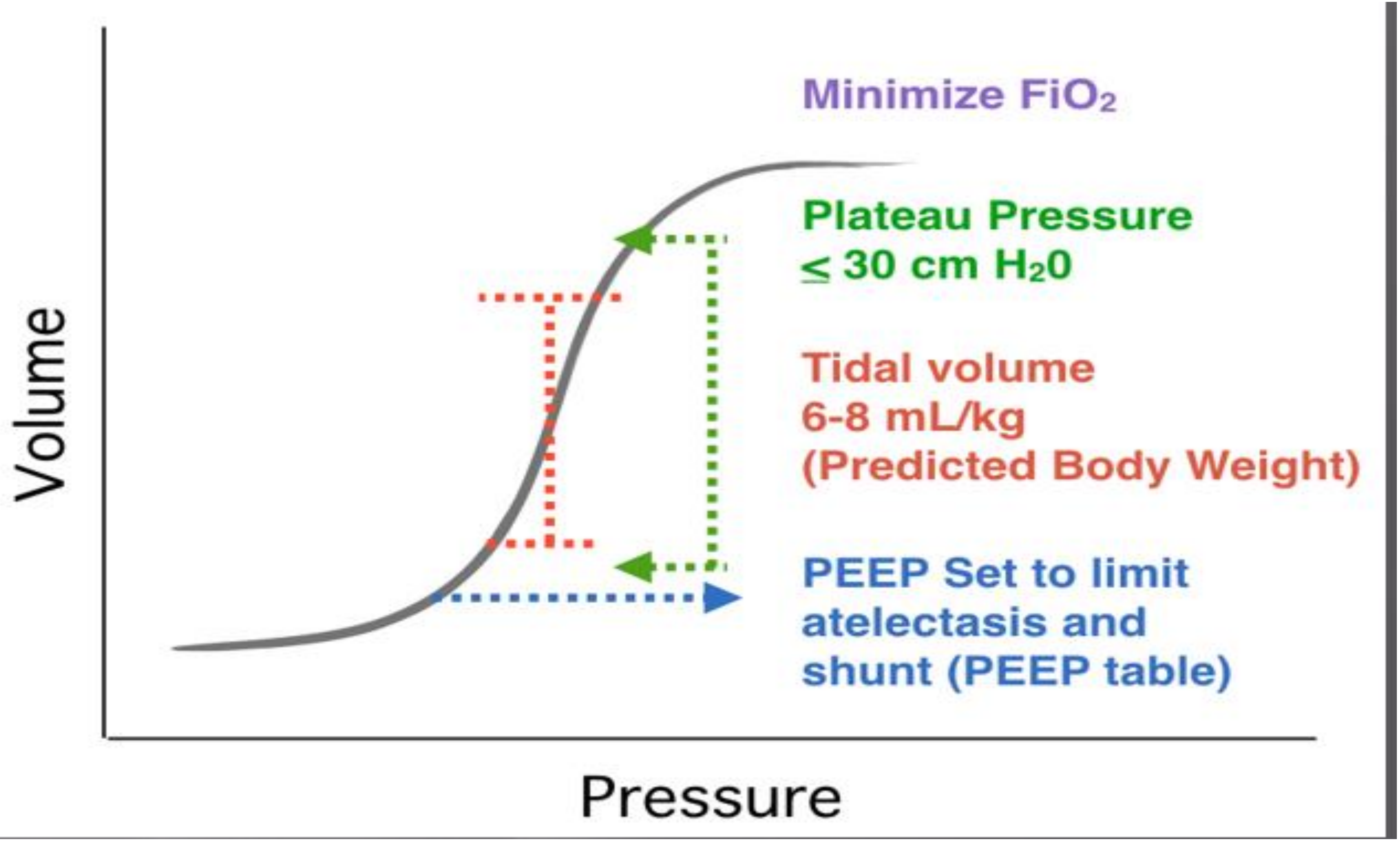
Several basic points should be kept in mind when managing ventilated patients with ARDS using an lung protective strategy:

1. Use of low VT in ARDS (4 to 6 mL/kg) has been shown to be effective. Clinical studies have confirmed that the use of high VT can be harmful in ARDS. Use of low VT should be accompanied by the use of a PEEP level to avoid alveolar Collapse
2. PEEP has a protective effect against lung damage, and it helps to keep the lung open. Maintaining a minimum end expiratory volume with PEEP helps avoid the widespread alveolar edema, bronchial damage, and shear stress between alveoli that can occur when lung units are repeatedly opened and and closed at low lung volume

- **3.** As PEEP is increased, PaO_2 increase. PaO_2 increases because of recruitment of lung tissue in alveoli open in a perfused area (i.e., shunt fraction is reduced). VA increases and $PaCO_2$ decreases. When Paw increases, cardiac output usually decreases. In addition,blood can be shifted from one area of the lung to another if alveoli become over distended. Thus, ventilation can be directed to non perfused areas improve shunting

4. PEEP should be applied early (during first 7-10 days after diagnosis of ARDS)

The level of applied PEEP should be set 3 to 4 cm H_2O above the upper inflection point of the of the P-V curve to help maintain an open lung. This may require a PEEP of 15 cm H_2O or greater


Minimize FiO_2
Plateau Pressure
≤ 30 cm H_20
Tidal volume
6-8 mL/kg
(Predicted Body Weight)
PEEP Set to limit
atelectasis and
shunt (PEEP table)
Volume
Pressure

Mechanical ventilation protocol of patients with ARDS

1. Calculate the predicted body weight

2. Start with assisted controlled volume

Initial setting

- Tidal volume 6 ml/kg
- Ti:0.8-1.2
- PEEP 5 cmH_2O
- RR: 20-30 /min

Target

- SpO_2 88-94%
- PaO_2 55-80 mmHg
- $PaCo_2$ < 45 mmHg
- Plateau ≤ 30 cmH_2O

Mechanical ventilation protocol of patients with ARDS

1. Calculate the predicted body weight
2. Start with assisted controlled volume
3. PEEP adjustment

PEEP adjustment

PaO2/FiO2 table

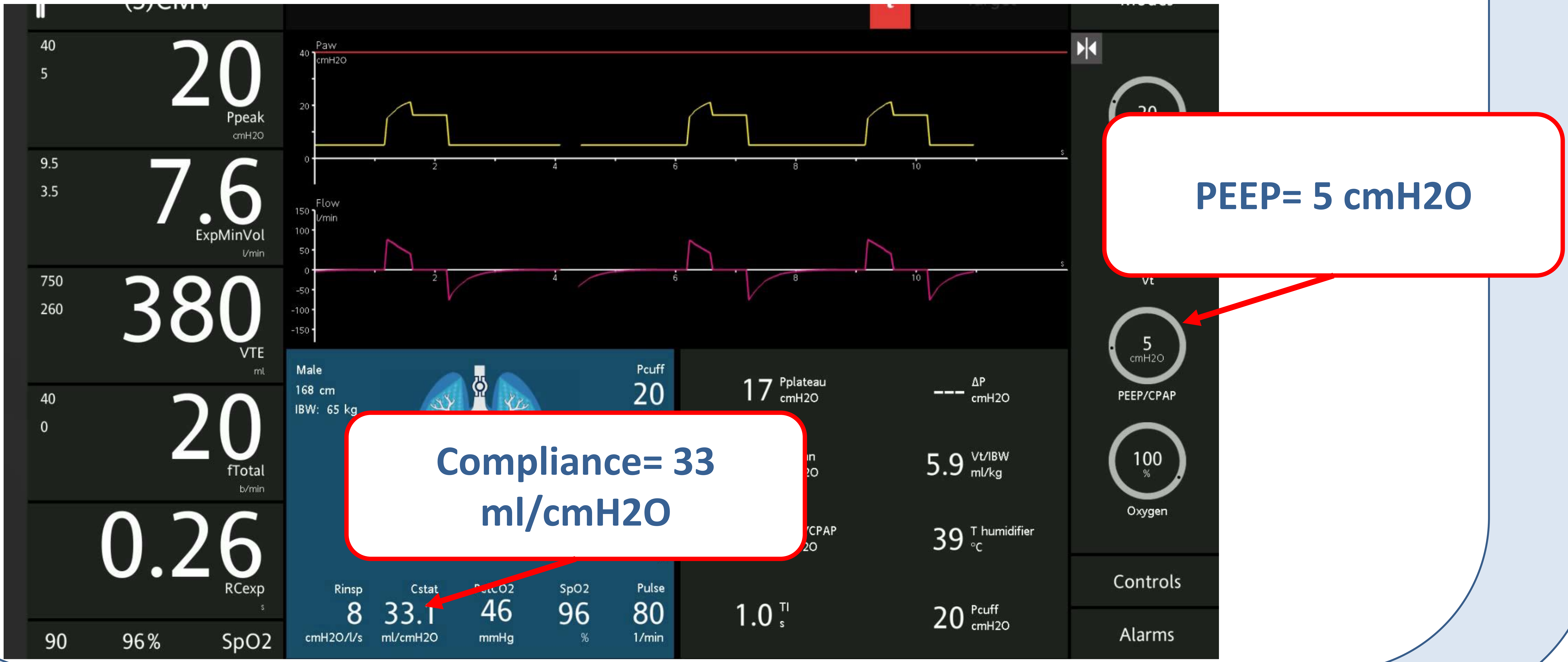
Highest compliance approach

Open lung approach "Recruitment"

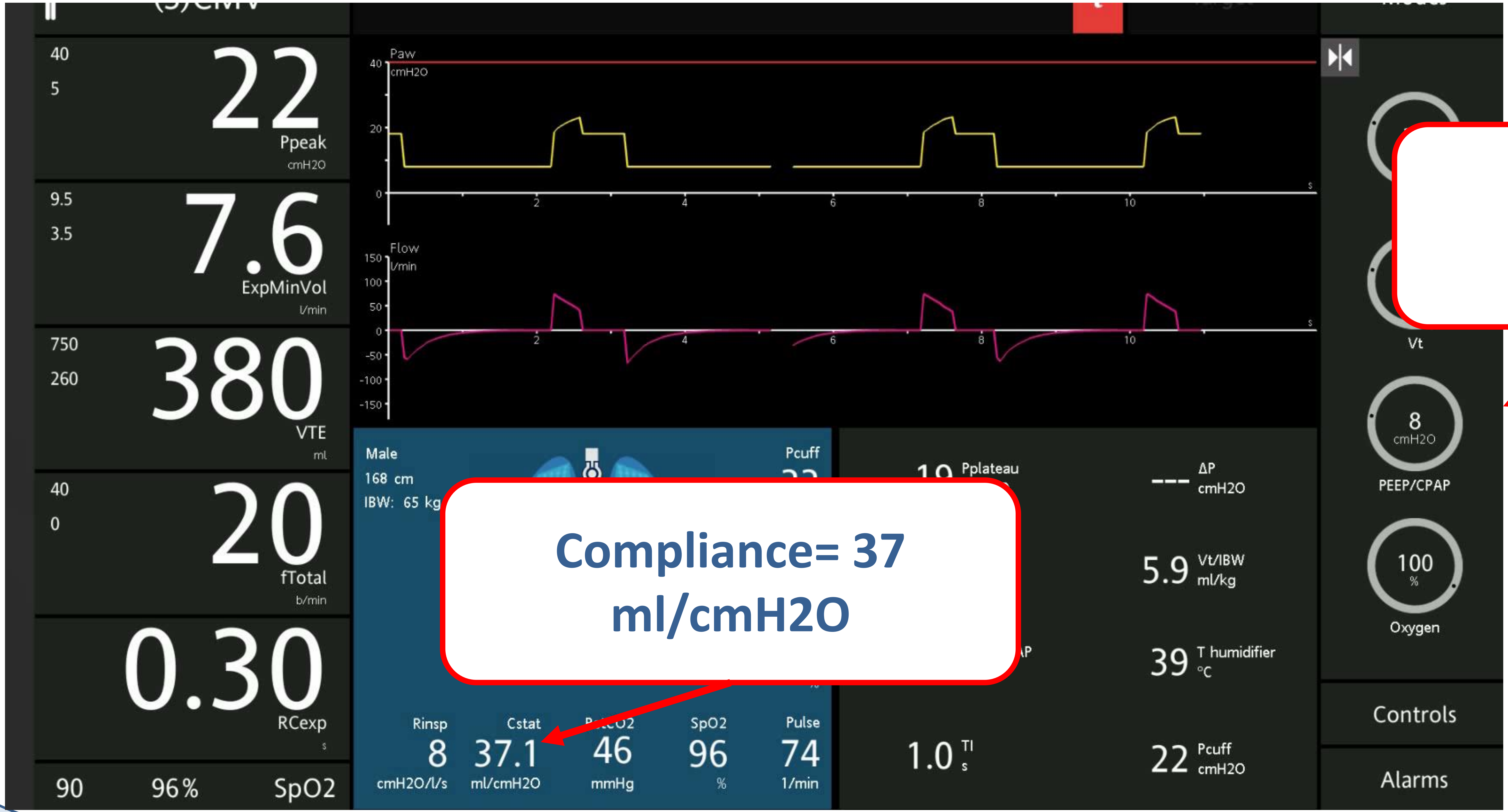
FiO2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
PEEP	5	5 – 8	8-10	10	10-14	14	14-18	18-24

PEEP adjustment by titration

PEEP adjustment by titration



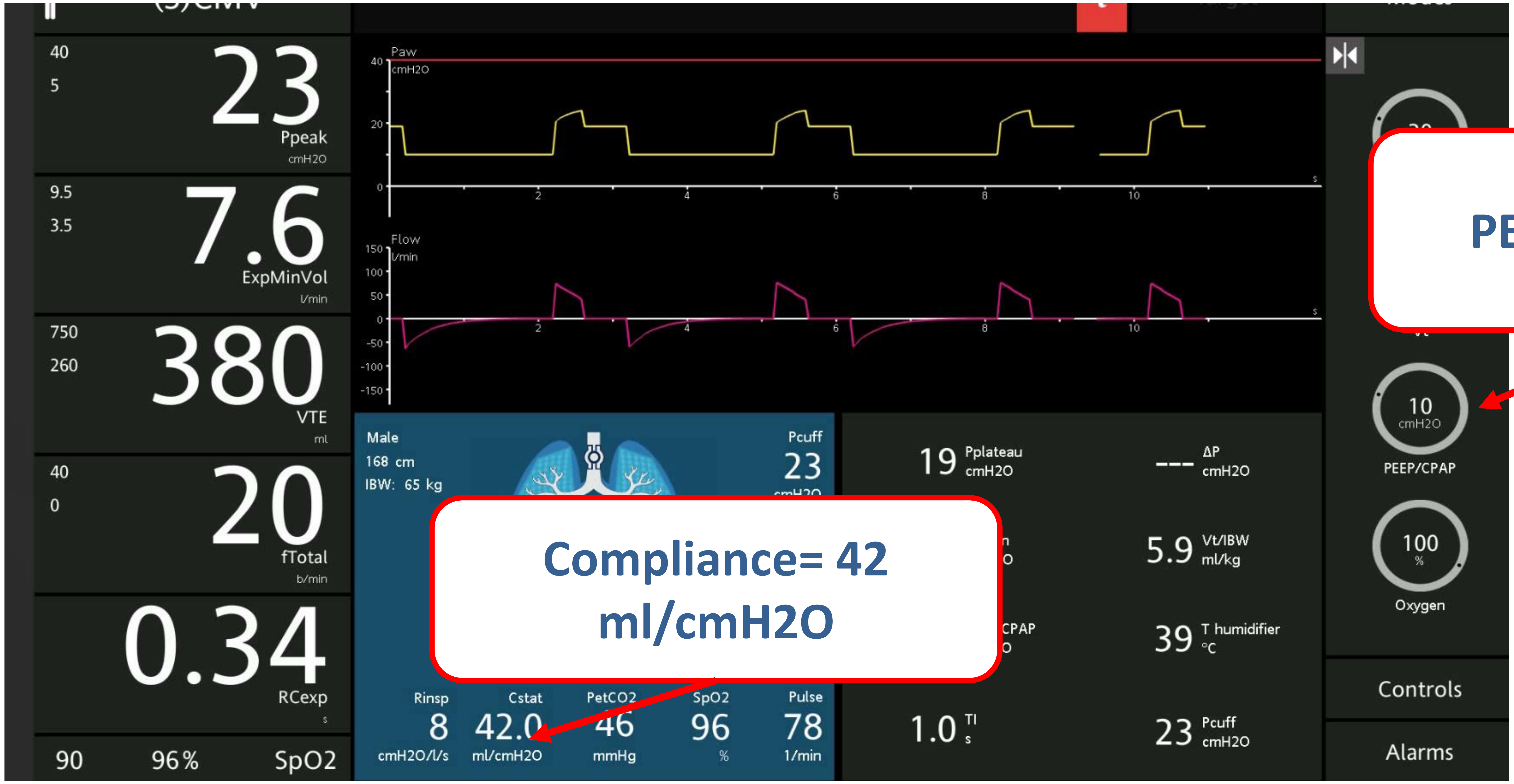
PEEP adjustment by titration



PEEP= 8 cmH2O

Compliance= 37 ml/cmH2O

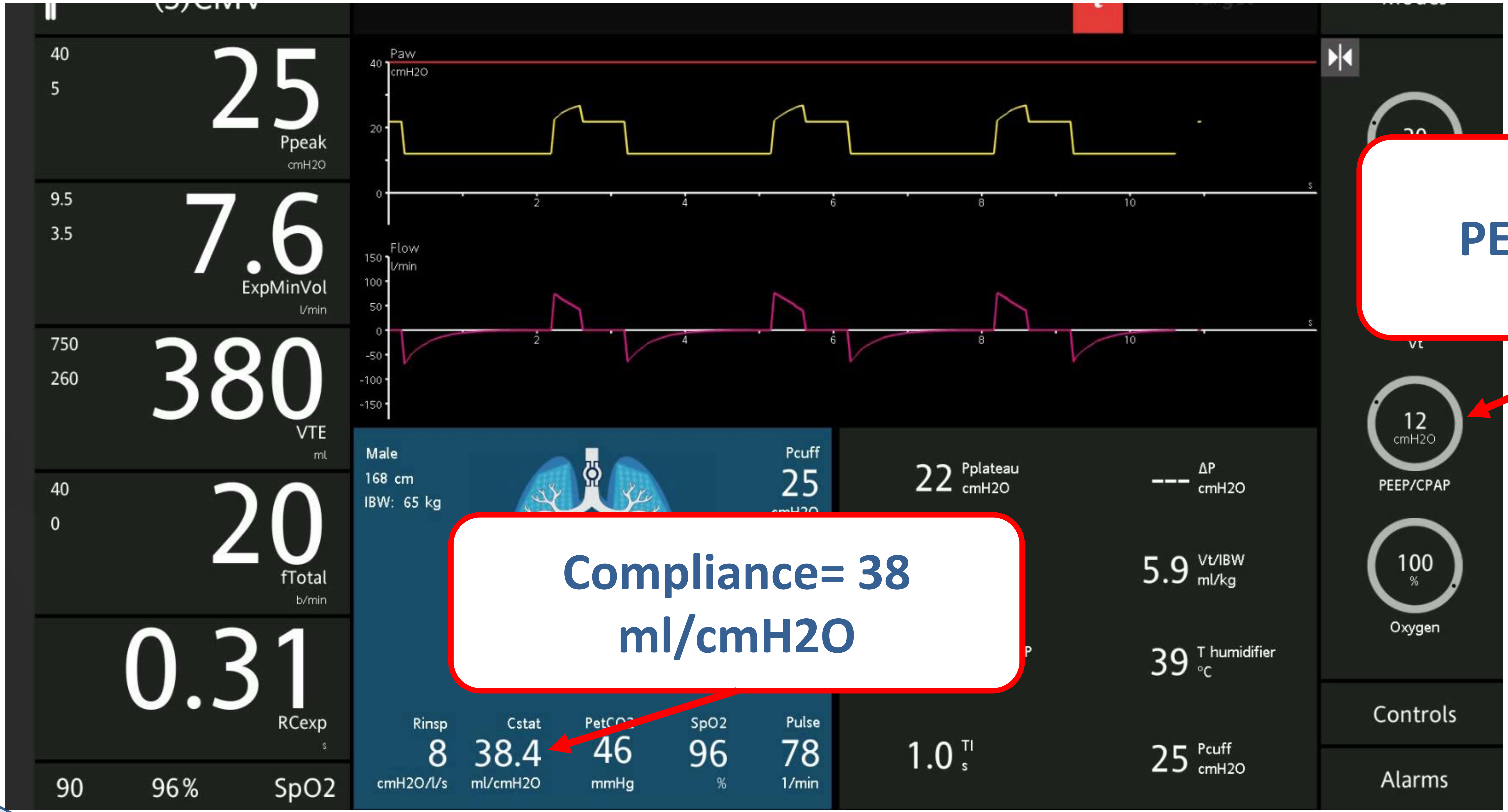
PEEP adjustment by titration



PEEP= 10 cmH2O

Compliance= 42 ml/cmH2O

PEEP adjustment by titration



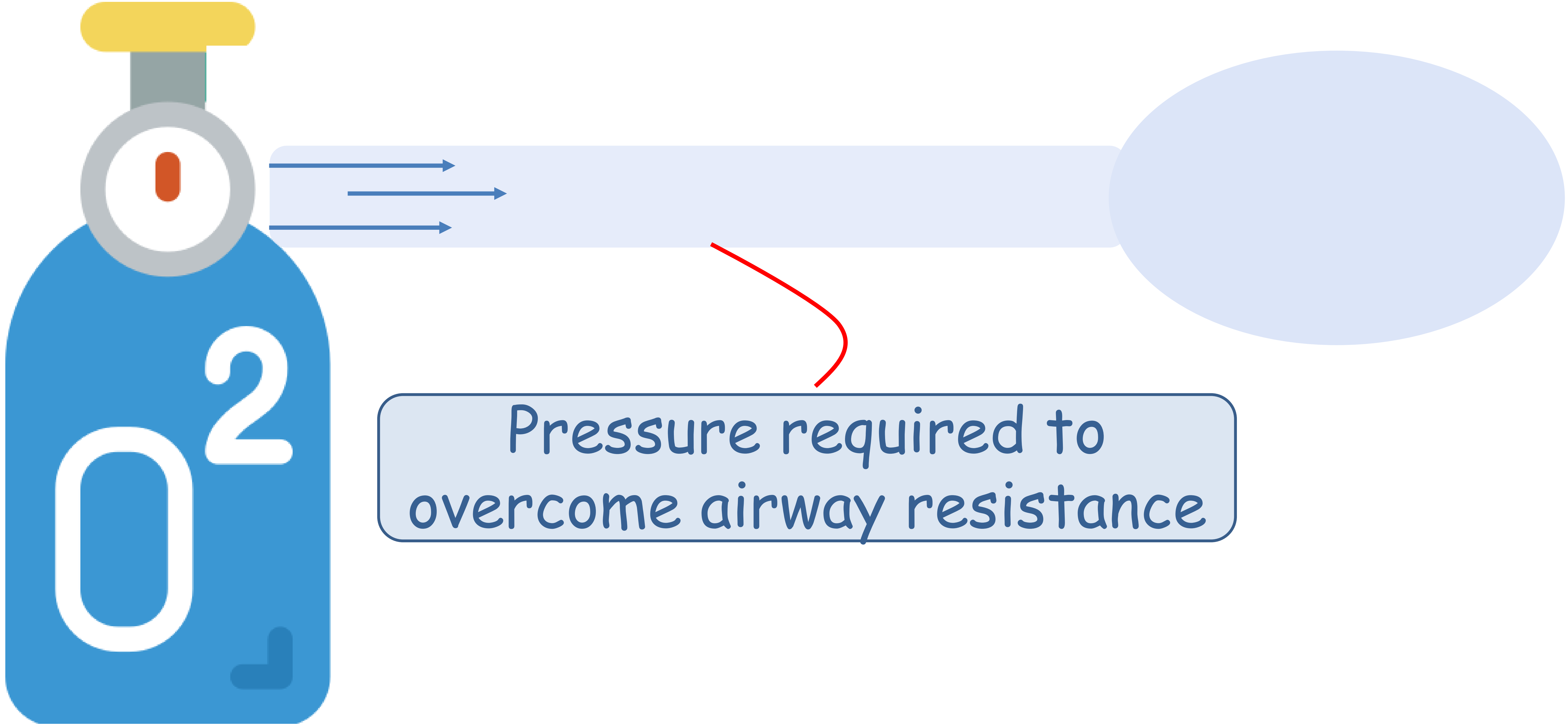
PEEP= 12 cmH2O

Compliance= 38 ml/cmH2O

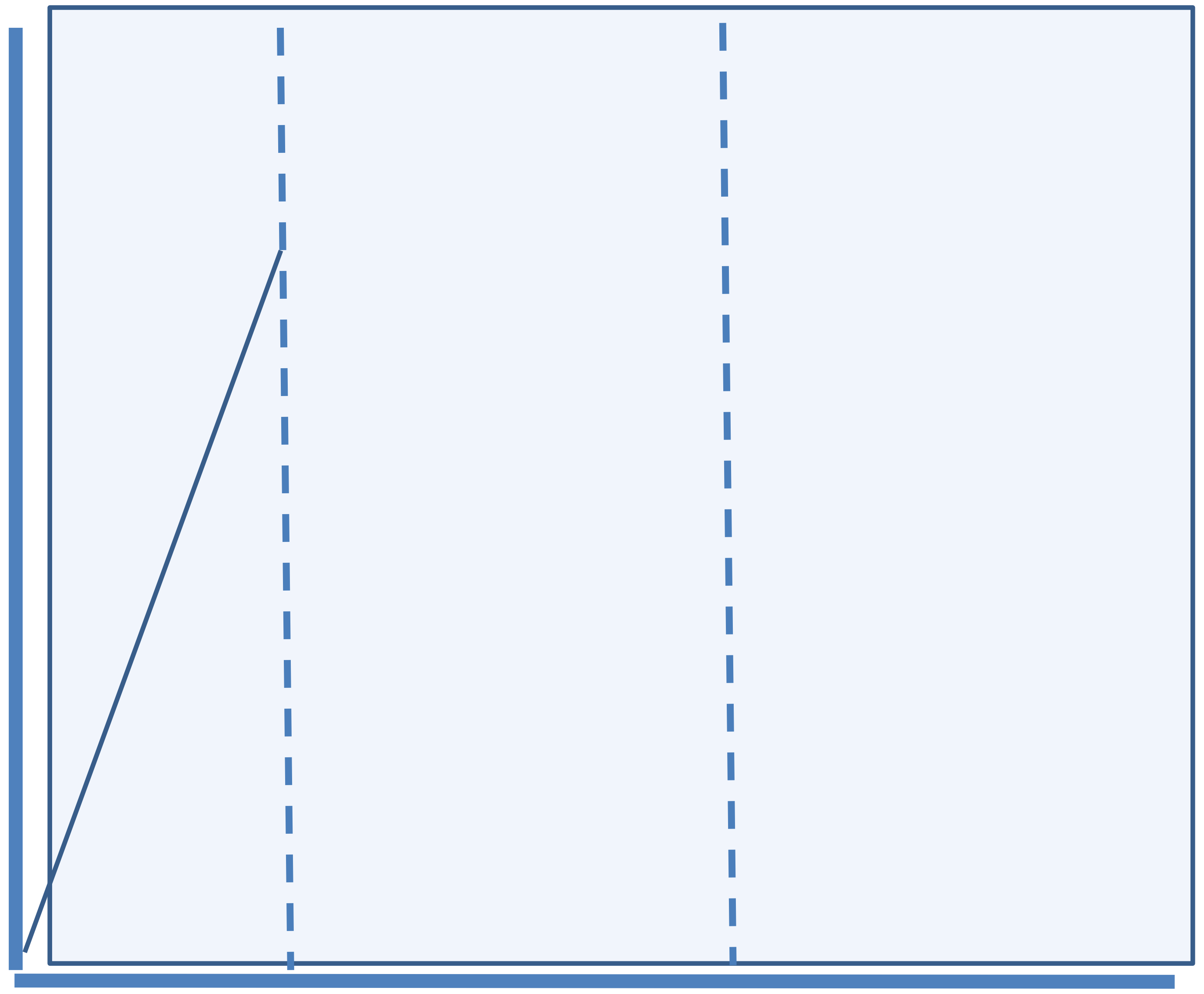
Mechanical ventilation protocol of patients with ARDS

1. Calculate the predicted body weight
2. Start with assisted controlled volume
3. PEEP adjustment
4. Check the plateau pressure

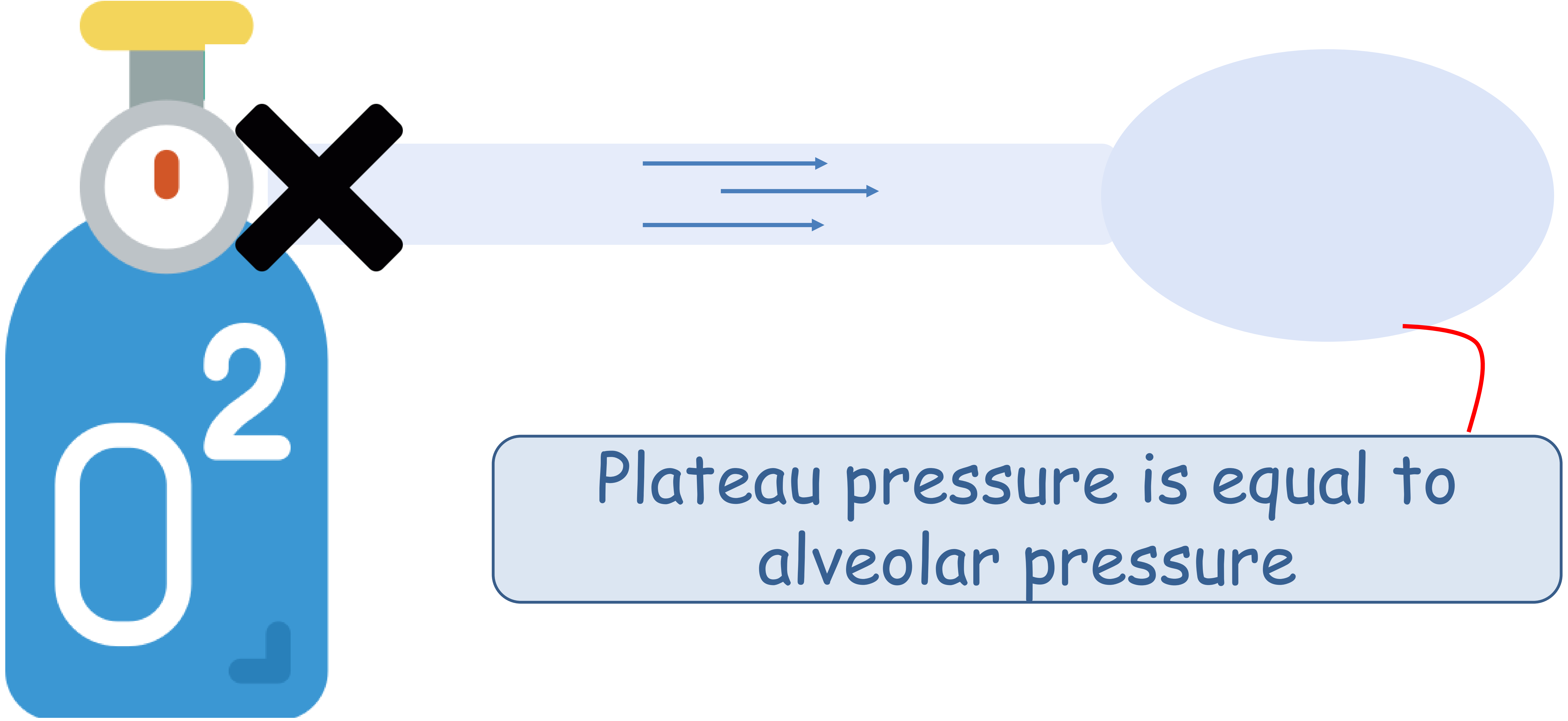
Peak pressure



Peak pressure
Maximal pressure at proximal airway

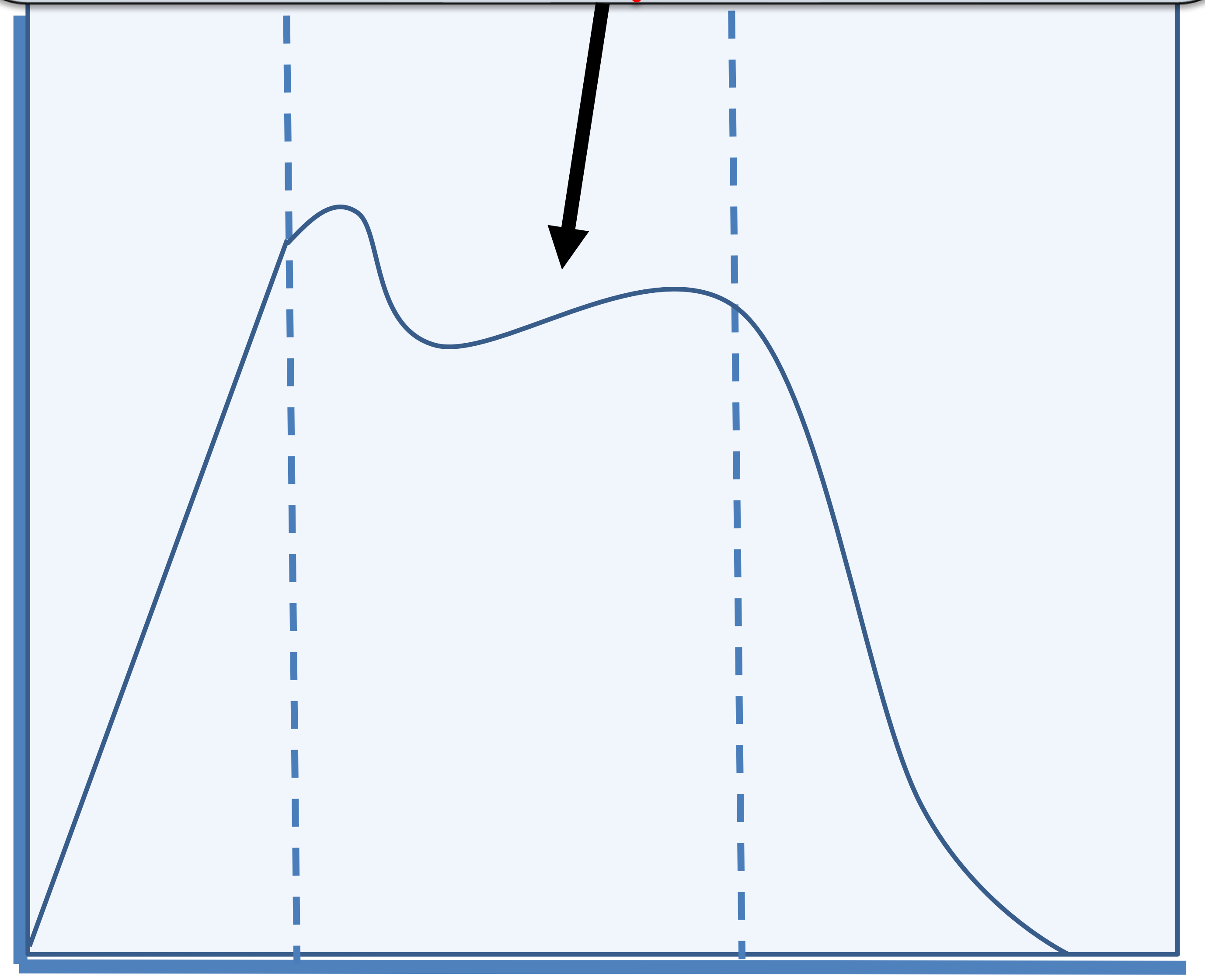


Plateau pressure



Plateau pressure is equal to alveolar pressure

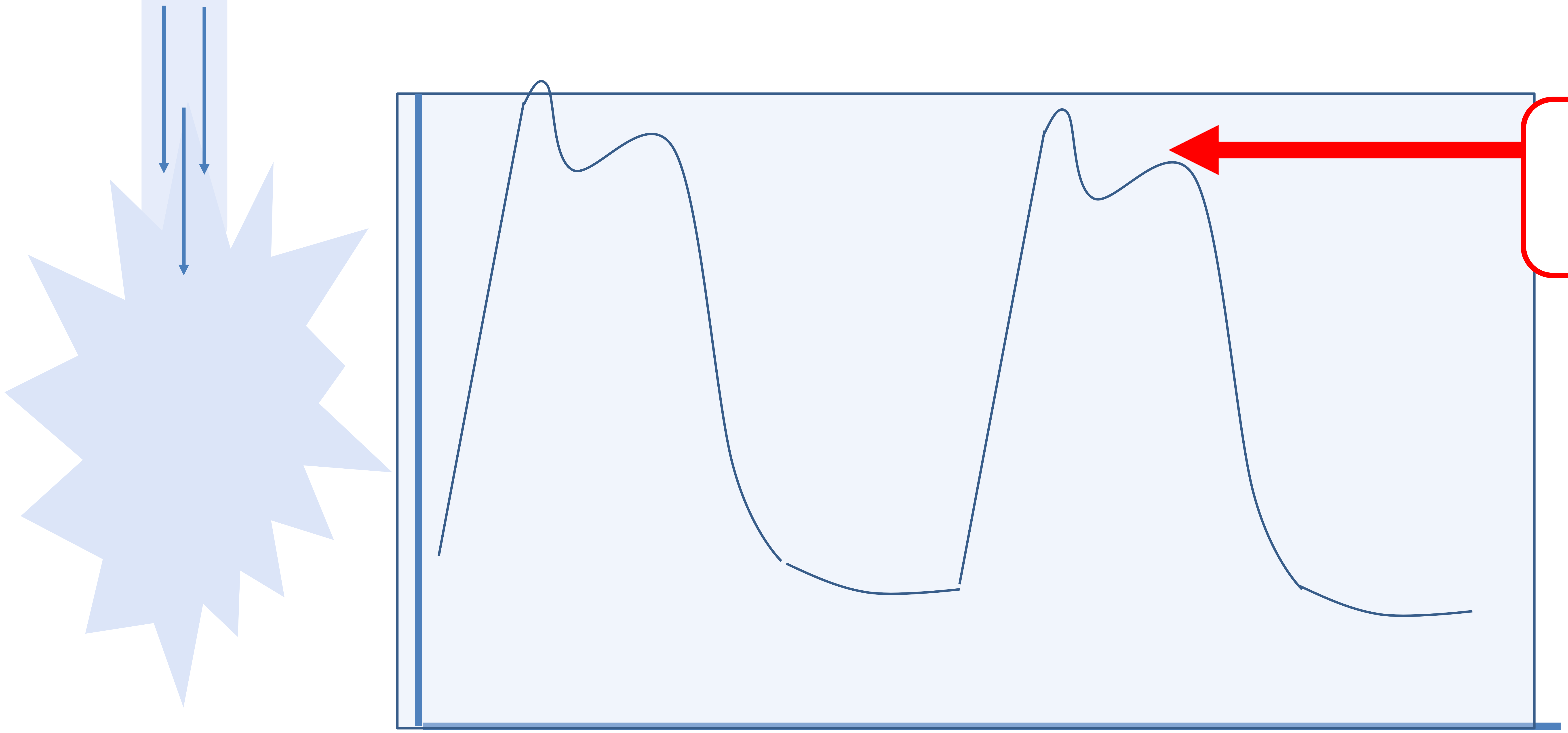
Plateau pressure = Alveolar pressure after airway occlusion



Check plateau

VT = 6 ml/kg

↓VT by 1 ml/kg to 5-4 ml/kg

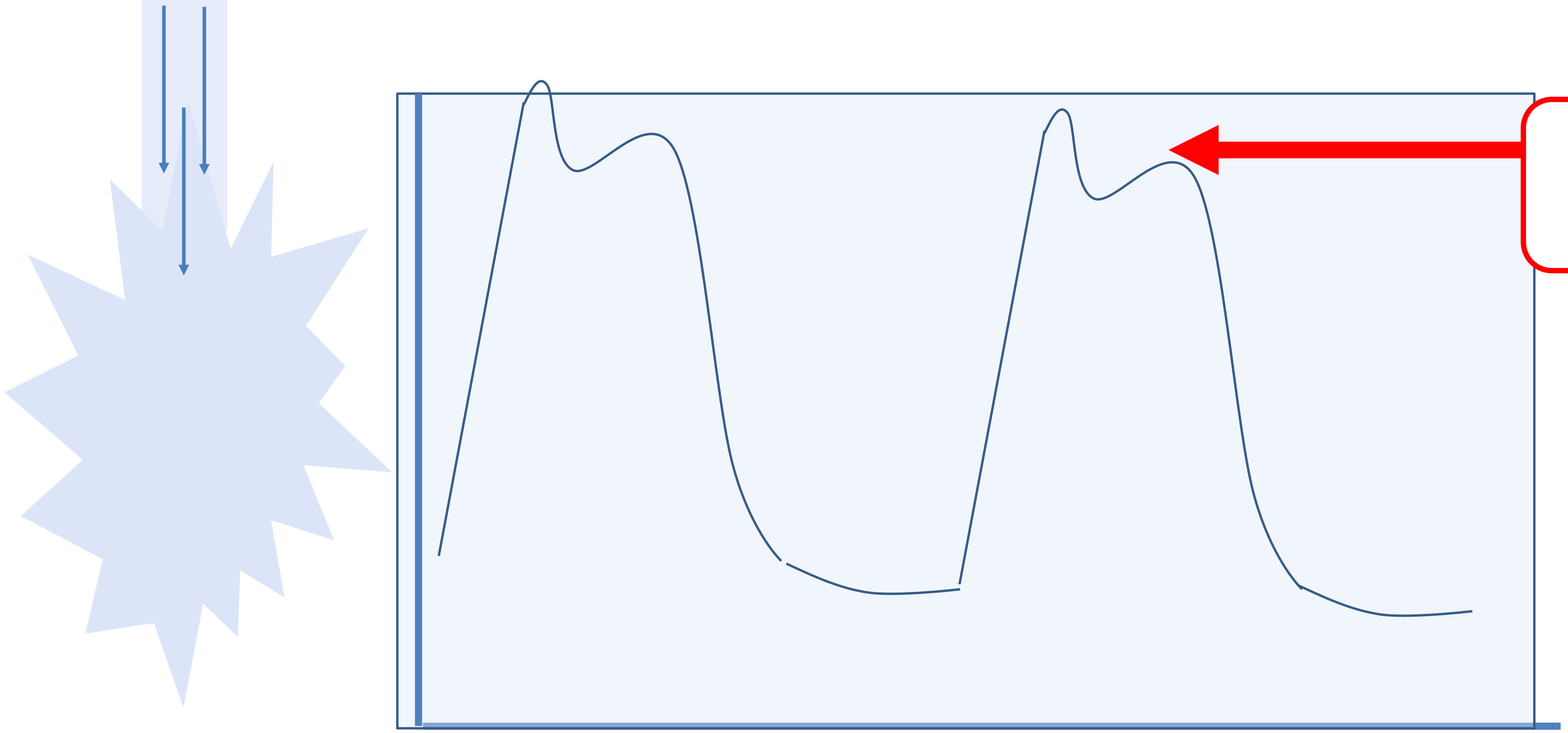


Plateau=35
(>30 cmH2O)

Check plateau

VT < 6 ml/kg

↑VT by 1 ml/kg until plateau >25 or vt=6 ml/kg



Plateau=18 (<25 cmH2O)

Mechanical ventilation protocol of patients with ARDS

1. Calculate the predicted body weight
2. Start with assisted controlled volume
3. PEEP adjustment
4. Check the plateau pressure
5. Check the pH

pH

pH: 7.15-7.3

↑ RR (max=35)

pH <7.15

↑ RR (max=35)
VT by 1ml/kg until pH >7.15

Plateau pressure may exceed 30 cmH2O

TV	RR	Ti	PEEP	FiO2
380 ml	30/min	1 sec	10 cmH2O	0.9

Is ventilatory setting satisfactory?

YES NO

Polytrauma with ARDS

Polytrauma patient

Weight: 70 kg
Height: 170 cm

Fentanyl 100 ug/hr

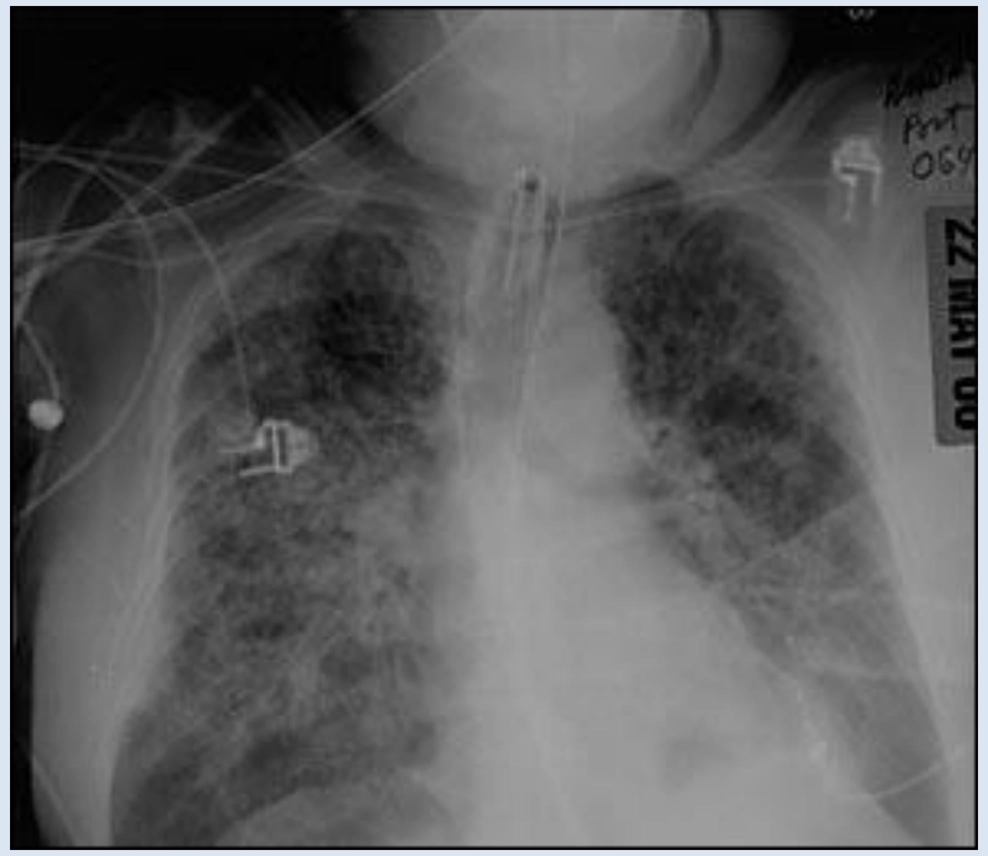
Midazolam 5 mg/hr

Respiratory rate 30 b/min

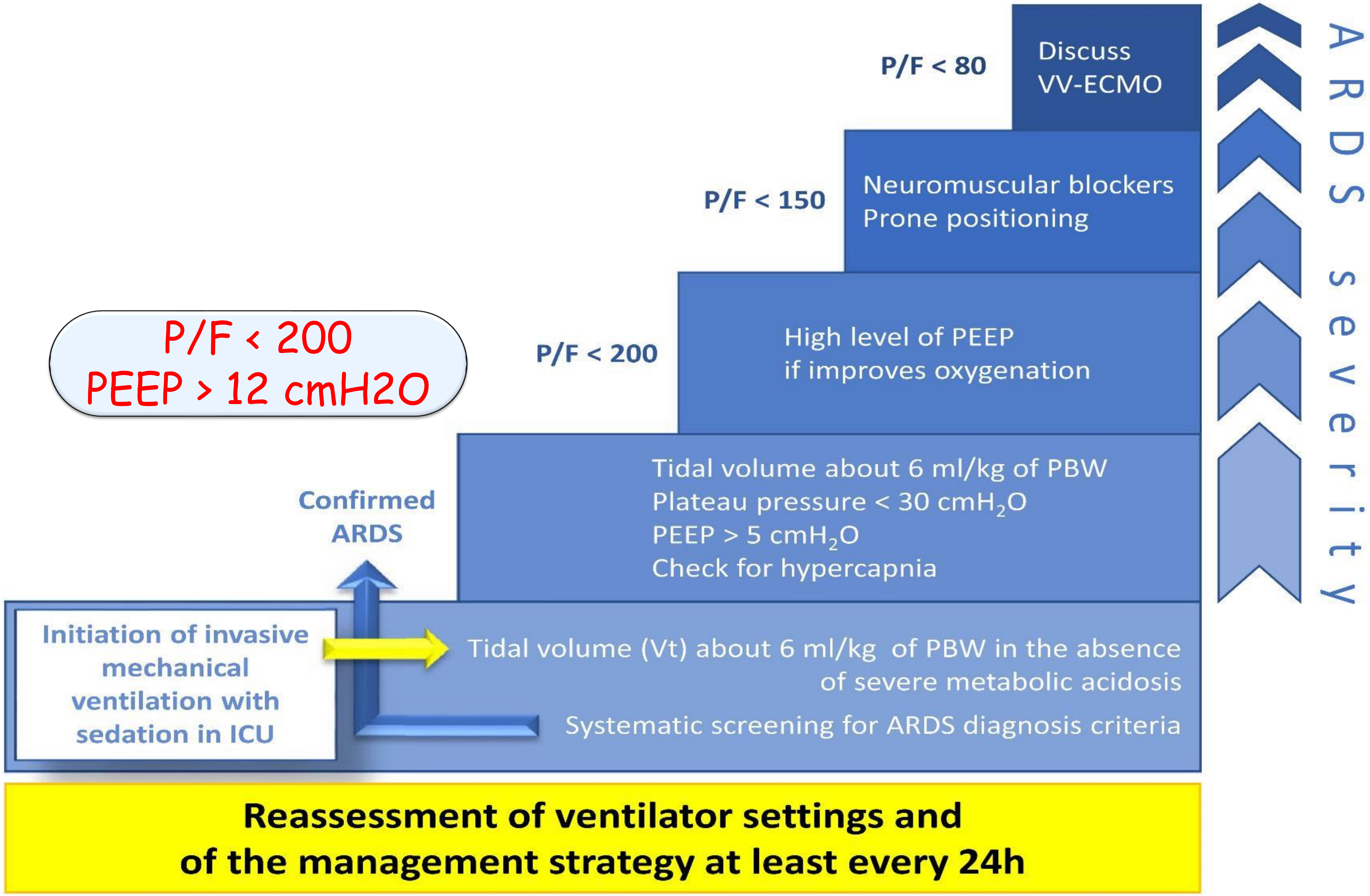
SpO2 94%

P/F 80

pH	7.34
pCO2	34 mmHg
pO2	72 mmHg
HCO3	22 mmol/L
FiO2	0.9



Early management of ARDS in 2019



Veno-venous ECMO
- In case of refractory hypoxemia or when protective ventilation can not be applied
- To be discussed with experienced ECMO centres

Neuromuscular blockers: continuous intravenous infusion
- Early initiation (within the first 48h of ARDS diagnosis)

Prone positioning methods :
- Applied for >16h a day, for several consecutive days

Moderate or severe ARDS -> High PEEP test (> 12 cmH_2O)
Use high levels if:
- Oxygenation improvement
- Without hemodynamic impairment or significant decrease in lung compliance
- Maintain Pplat < 30 cmH_2O, continuous monitoring

ARDS diagnosis criteria
- $PaO_2/FiO_2 \leq 300$ mmHg
- PEEP ≥ 5 cmH_2O
- Bilateral opacities on chest imaging
- Not fully explained by cardiac failure or fluid overload
- Within a week of a known clinical insult

Might be applied
- Inhaled Nitric Oxide (iNO), when severe hypoxemia remains despite prone positioning and before considering VV-ECMO
- Partial ventilation support after early phase to generate tidal volume about 6 ml/kg and less than 8 ml/kg

No recommendation could be made
- $ECCO_2R$
- Driving pressure
- Partial ventilation support at the early phase

Should probably not be done
- Systematic recruitment maneuvers

Should not be done
- HFOV

TV	RR	Ti	PEEP	FiO2
380 ml	30/min	1 sec	15 cmH2O	0.7

What is your next step?

- Do nothing
- Increase PEEP
- Neuromuscular blocker & prone

Polytrauma with ARDS

Polytrauma patient

Weight: 70 kg
Height: 170 cm

Fentanyl 100 ug/hr

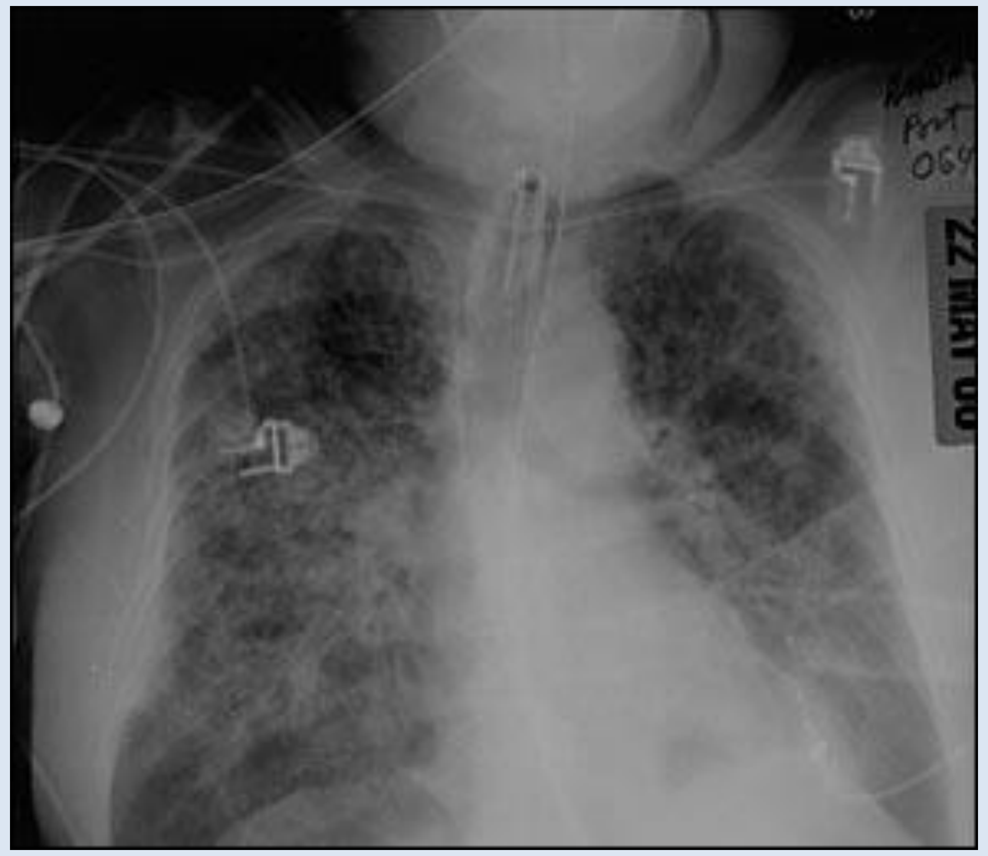
Midazolam 5 mg/hr

Respiratory rate 30 b/min

SpO2 94%

P/F 125

pH	7.34
pCO2	44 mmHg
pO2	88 mmHg
HCO3	22 mmol/L
FiO2	0.7



Early management of ARDS in 2019

Prone & neuromuscular blocker

P/F < 80 — Discuss VV-ECMO

P/F < 150 — Neuromuscular blockers; Prone positioning

P/F < 200 — High level of PEEP if improves oxygenation

Confirmed ARDS — Tidal volume about 6 ml/kg of PBW; Plateau pressure < 30 cmH_2O; PEEP > 5 cmH_2O; Check for hypercapnia

Initiation of invasive mechanical ventilation with sedation in ICU — Tidal volume (Vt) about 6 ml/kg of PBW in the absence of severe metabolic acidosis; Systematic screening for ARDS diagnosis criteria

ARDS severity

Reassessment of ventilator settings and of the management strategy at least every 24h

Veno-venous ECMO
- In case of refractory hypoxemia or when protective ventilation can not be applied
- To be discussed with experienced ECMO centres

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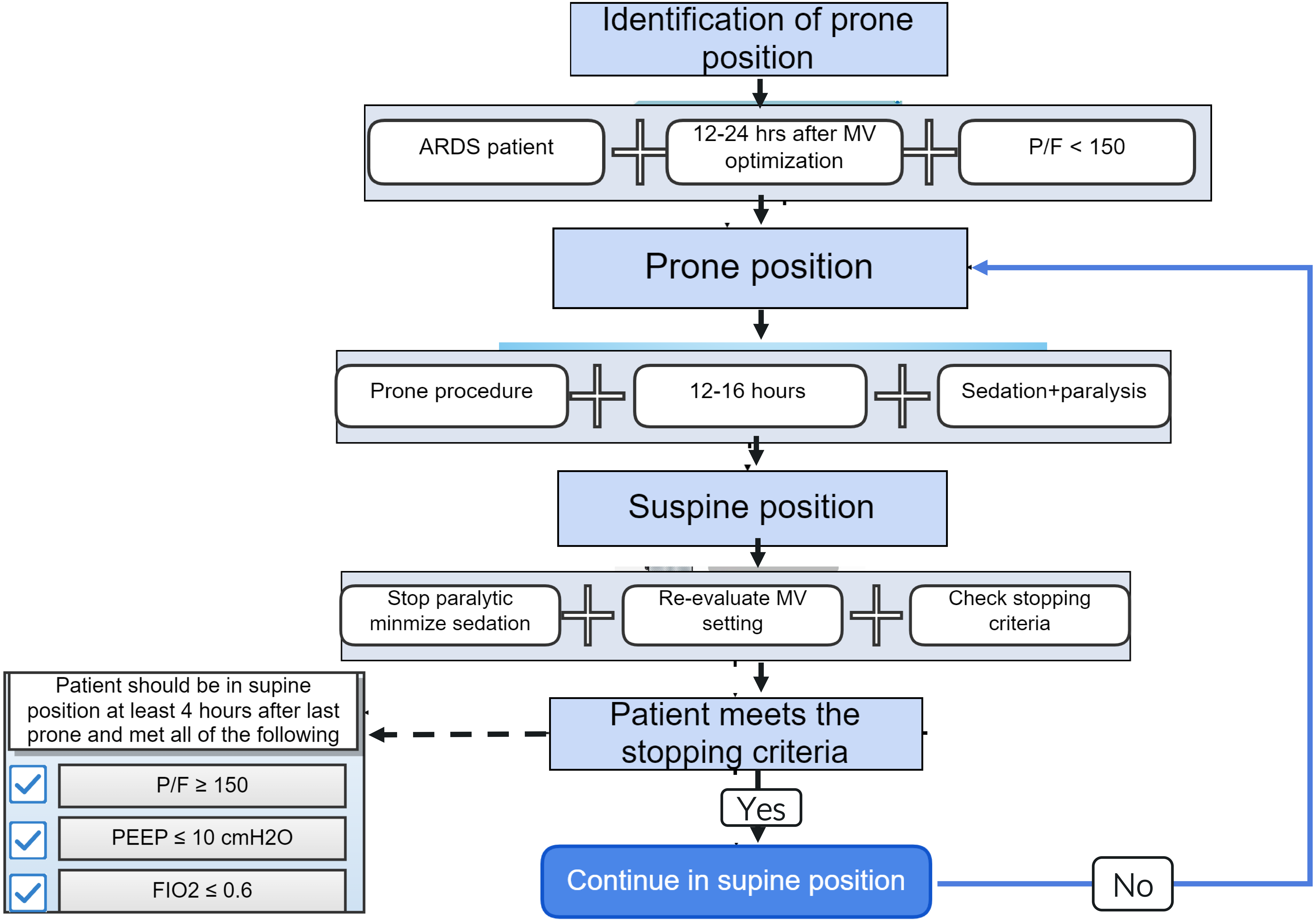
No recommendation could be made
- $ECCO_2R$
- Driving pressure
- Partial ventilation support at the early phase

Should probably not be done
- Systematic recruitment maneuvers

Should not be done
- HFOV

How to do prone position?


Identification of prone position
ARDS patient
12-24 hrs after MV optimization
P/F < 150
Prone position
Prone procedure
12-16 hours
Sedation+paralysis
Suspine position
Stop paralytic minmize sedation
Re-evaluate MV setting
Check stopping criteria
Patient meets the stopping criteria
Patient should be in supine position at least 4 hours after last prone and met all of the following
P/F ≥ 150
PEEP ≤ 10 cmH2O
FIO2 ≤ 0.6
Yes
Continue in supine position
No

WHY WE DO PRONE POSITION?

ARDS &Prone Positioning:

Body position can affect the distribution of ventilation. Normally during spontaneous breathing, ventilation is higher in the dependent areas of the lungs because the pleural pressure changes during breathing are greater in the dependent areas compared with the independent areas due to asymmetry of lung shape leads to a greater gravitationally induced pleural pressure gradient in the supine posture compared with prone positioning

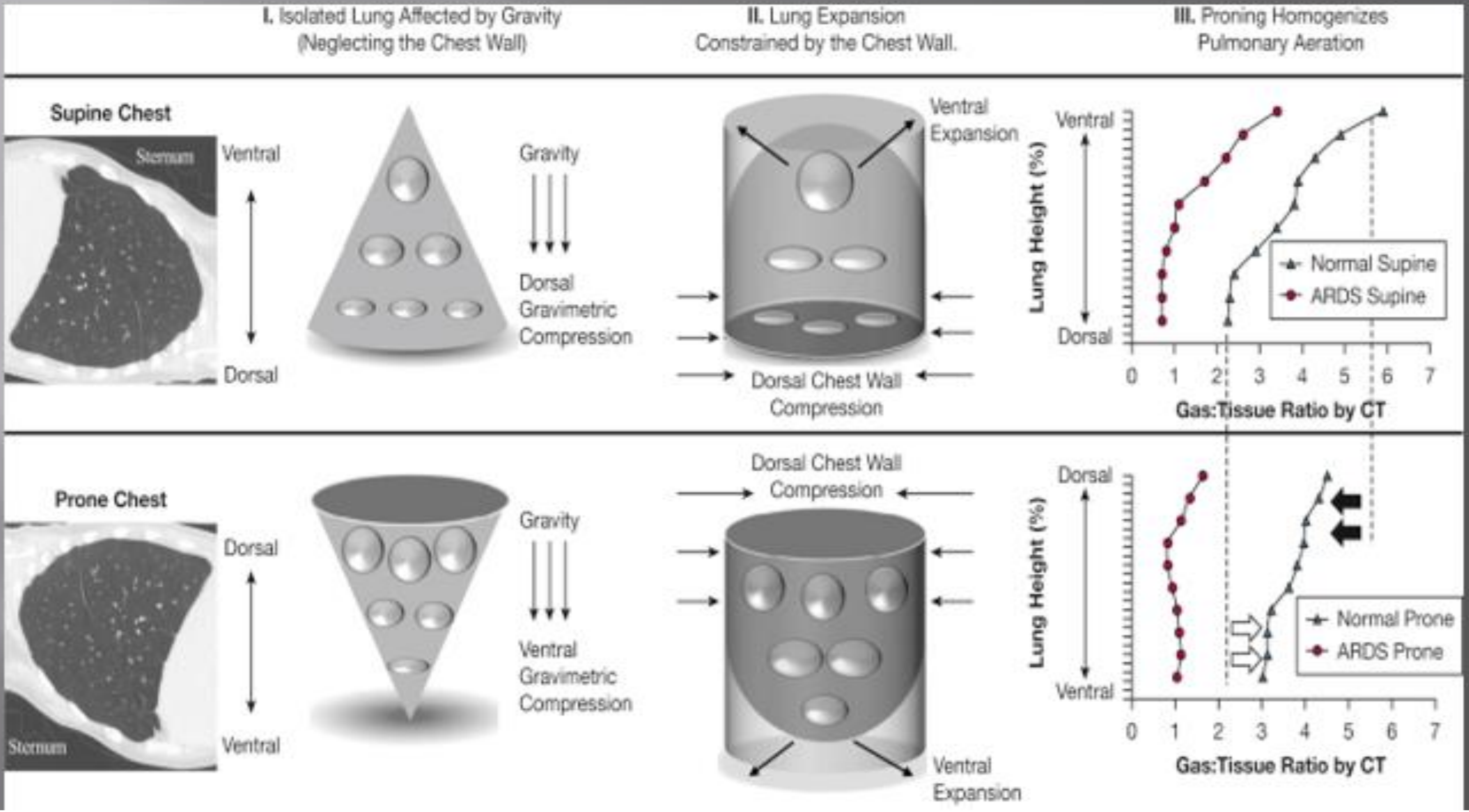
- Blood and ventilation redistributed to least affected thus Redistribution of fluid and gas results in an improved relation between ventilation and perfusion. and shunting

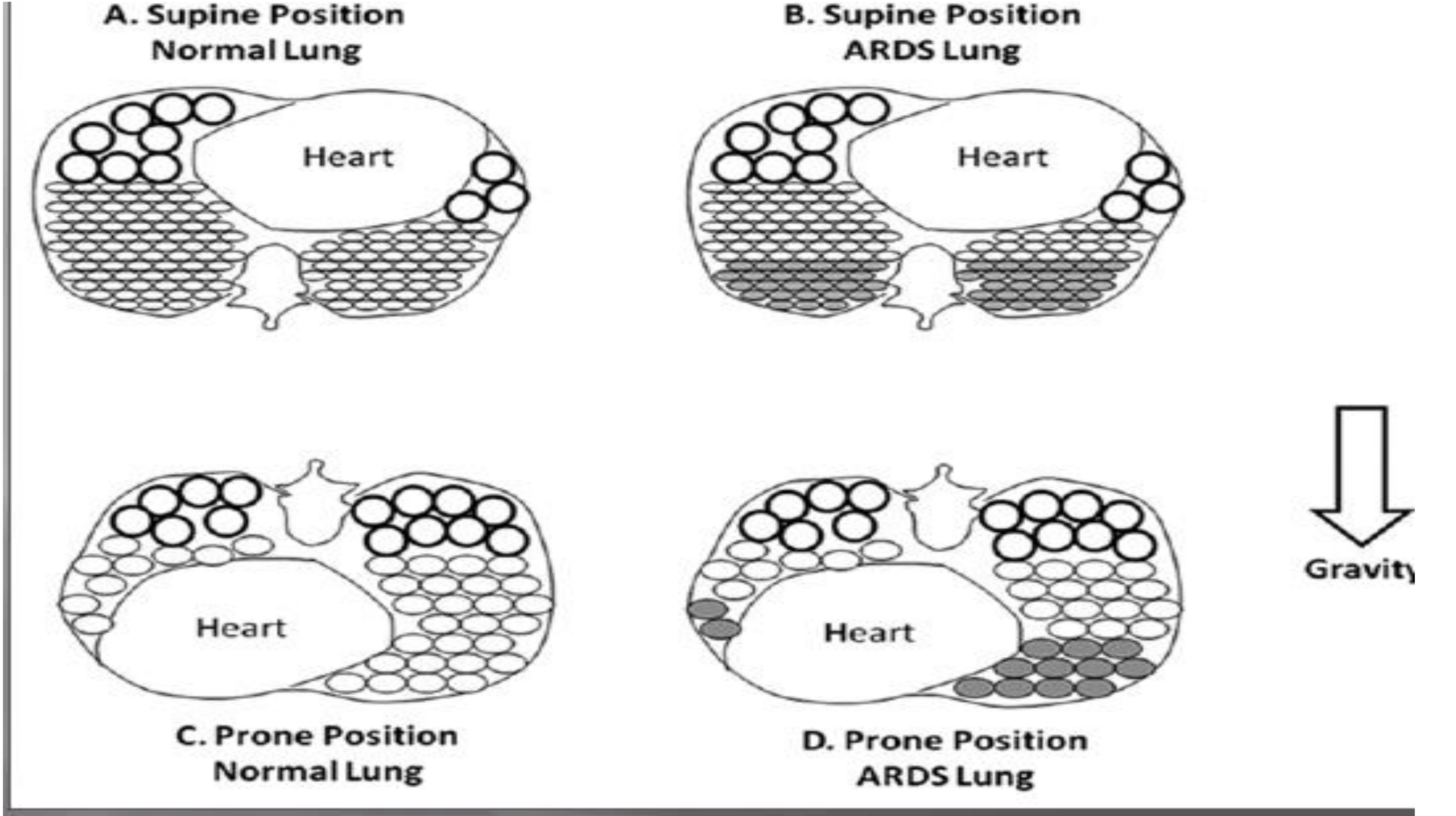
- Blood redistribution may also improve alveolar recruitment in previously closed areas of the lung Secertion clearance

- Prone positioning changes the position of the heart more so it no longer puts weight on underlying lung tissue. also delaoded weight of abdominal contents

- Pleural pressure is more uniformly distributed, which could improve alveolar recruitment.

- Prone positioning changes the regional diaphragm motion.


I. Isolated Lung Affected by Gravity
(Neglecting the Chest Wall)
II. Lung Expansion
Constrained by the Chest Wall.
III. Proning Homogenizes
Pulmonary Aeration
Supine Chest
Sternum
Ventral
Dorsal
Gravity
Dorsal
Gravimetric
Compression
Ventral
Expansion
Dorsal Chest Wall
Compression
Ventral
Dorsal
Lung Height (%)
Normal Supine
ARDS Supine
0 1 2 3 4 5 6 7
Gas:Tissue Ratio by CT
Prone Chest
Dorsal
Ventral
Sternum
Gravity
Ventral
Gravimetric
Compression
Dorsal Chest Wall
Compression
Ventral
Expansion
Dorsal
Ventral
Lung Height (%)
Normal Prone
ARDS Prone
0 1 2 3 4 5 6 7
Gas:Tissue Ratio by CT


A. Supine Position
Normal Lung
B. Supine Position
ARDS Lung
Heart
Heart
Heart
Heart
Gravity
C. Prone Position
Normal Lung
D. Prone Position
ARDS Lung

Supine position
a
End of expiration
b
End of inspiration
D
H
S
Bed mattress
Normally aerated
Poorly aerated
Non-aerated
Higher elastance
Lower elastance
• Chest wall elastance is constant during insufflation
• Overdistention and increased elastance are in the most anterior part of the lung at the end of insufflation
Prone position
c
End of expiration
d
End of inspiration
S = Spine
D = Diaphragm
H = Heart
• Chest wall elastance is higher in prone position
• Lung elastance is homogenous across the lung
e
Supine position
f
Prone position
• Lung perfusion is predominantly in the dorsal lung regions in both the supine and prone positions
• Better VA/Q matching
• Less shunt

Who to place in prone position?

Patients with severe ARDS ($PaO_2/FiO_2 < 150$ mm Hg)

Early in the course (ideally within 48 h)

Best outcomes reported when prone positioning is used in combination with both low tidal volume ventilation (6 cc/kg) and neuromuscular blockade

Who not to place in prone position?

Patients with facial/neck trauma or spinal instability.

Patients with recent sternotomy or large ventral surface burn

Patients with elevated intracranial pressure.

Patients with massive hemoptysis.

Patients at high risk of requiring CPR or defibrillation

How long to have patient in prone position each day?

Successful trials use at least 16 hours of daily proning

Long prone positioning sessions likely avoid derecruitment

When to stop?

Prone positioning was stopped when Pao_2/Fio_2 remained > 150 mm Hg 4 h after supinating (with PEEP < 10 cm H_2O and Fio_2 < 0.6)

Optimal strategy is unclear: consider continuing prone positioning until clear improvement in gas exchange, mechanics, and overall clinical course

Polytrauma with ARDS

TV	RR	Ti	PEEP	FiO2
380 ml	30/min	1 sec	15 cmH2O	0.7

What is your next step?

- Do nothing
- ECMO
- Pulse dose of steroid

Polytrauma patient

Weight: 70 kg
Height: 170 cm

Fentanyl 100 ug/hr

Midazolam 5 mg/hr

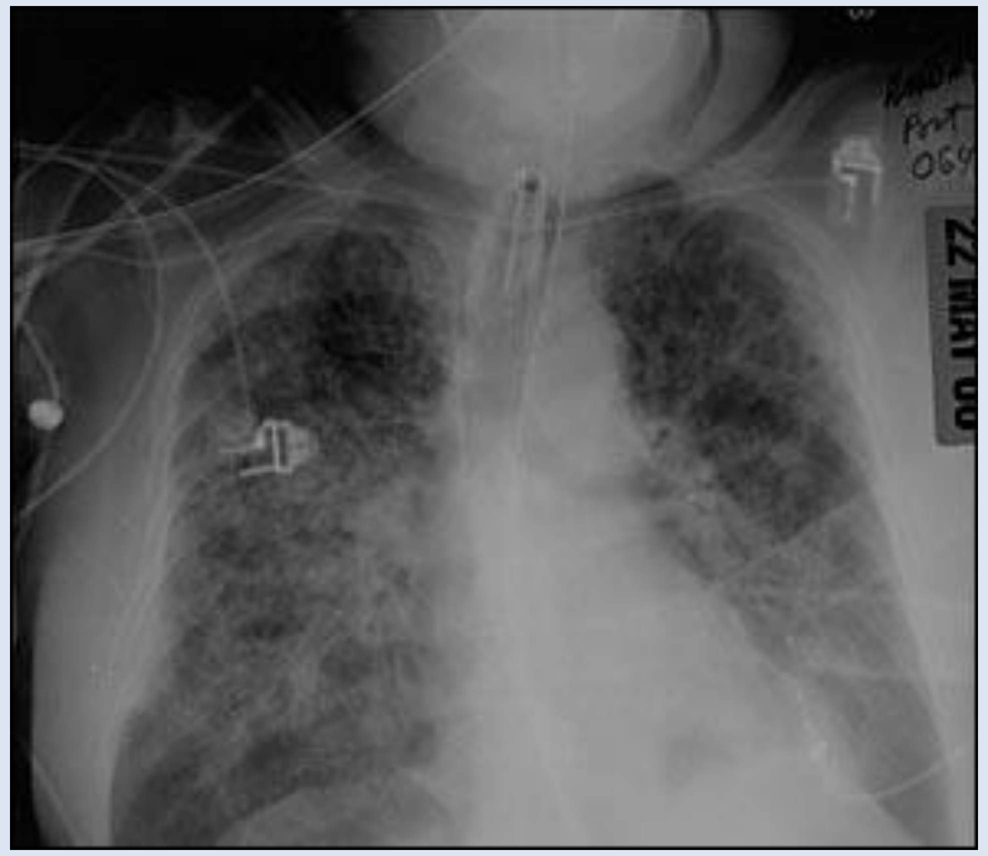
Atracurium 25mg/hr

Respiratory rate 30 b/min

SpO2 94%

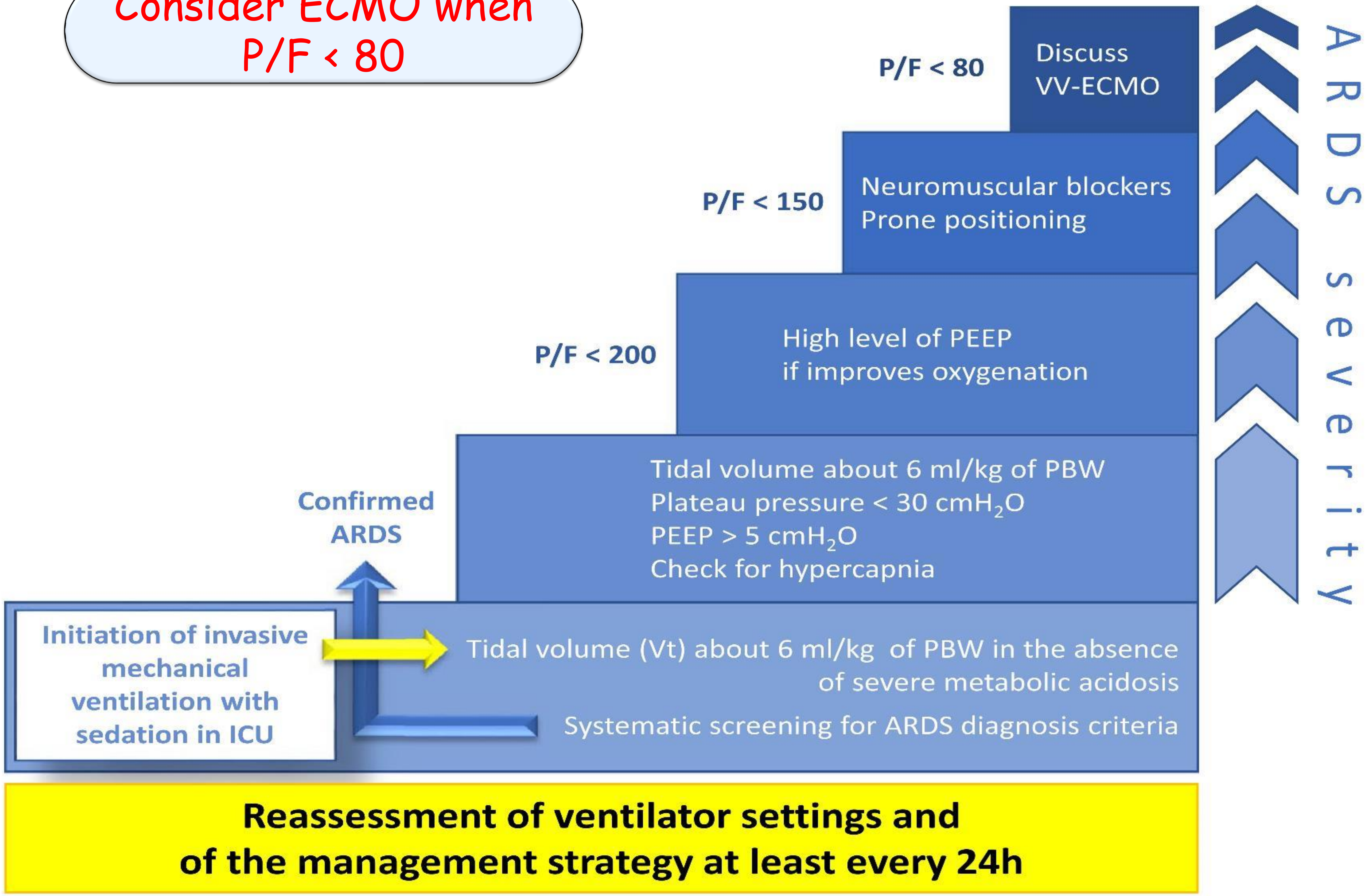
P/F 77

pH	7.24
pCO2	52 mmHg
pO2	71 mmHg
HCO3	22 mmol/L
FiO2	0.9



Early management of ARDS in 2019

Consider ECMO when P/F < 80



Veno-venous ECMO
- In case of refractory hypoxemia or when protective ventilation can not be applied
- To be discussed with experienced ECMO centres

Neuromuscular blockers: continuous intravenous infusion
- Early initiation (within the first 48h of ARDS diagnosis)

Prone positioning methods :
- Applied for >16h a day, for several consecutive days

Moderate or severe ARDS -> High PEEP test (> 12 cmH_2O)
Use high levels if:
- Oxygenation improvement
- Without hemodynamic impairment or significant decrease in lung compliance
- Maintain Pplat < 30 cmH_2O, continuous monitoring

ARDS diagnosis criteria
- $PaO_2/FiO_2 \leq 300$ mmHg
- PEEP ≥ 5 cmH_2O
- Bilateral opacities on chest imaging
- Not fully explained by cardiac failure or fluid overload
- Within a week of a known clinical insult

Might be applied
- Inhaled Nitric Oxide (iNO), when severe hypoxemia remains despite prone positioning and before considering VV-ECMO
- Partial ventilation support after early phase to generate tidal volume about 6 ml/kg and less than 8 ml/kg

No recommendation could be made
- $ECCO_2R$
- Driving pressure
- Partial ventilation support at the early phase

Should probably not be done
- Systematic recruitment maneuvers

Should not be done
- HFOV

What other interventions can be done for this patient?

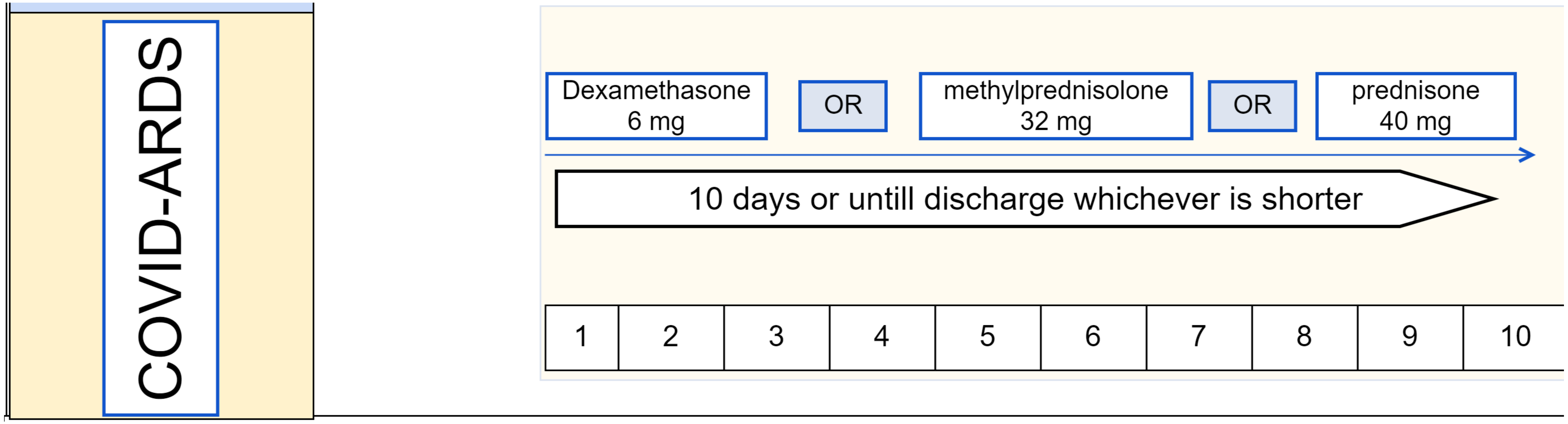
Other interventions

Steroid therapy

Conservative fluid management

Steroid therapy in non-COVID ARDS

Steroid therapy in COVID ARDS



Conservative fluid therapy

Allow +ve fluid balance in first day if the patient is dehydrated from fever and diarrhea

Active de-resuscitation of patient to maintain neutral cumulative balance by 3rd to 5th day

Conservative fluid therapy

- Stop maintenance fluid
- Continue medication and nutrition
- Maintain urine output from 0.5 to 1 ml/kg
- Assess fluid balance every 4 hours
- Diuretics in case of +ve fluid balance

Thank You