

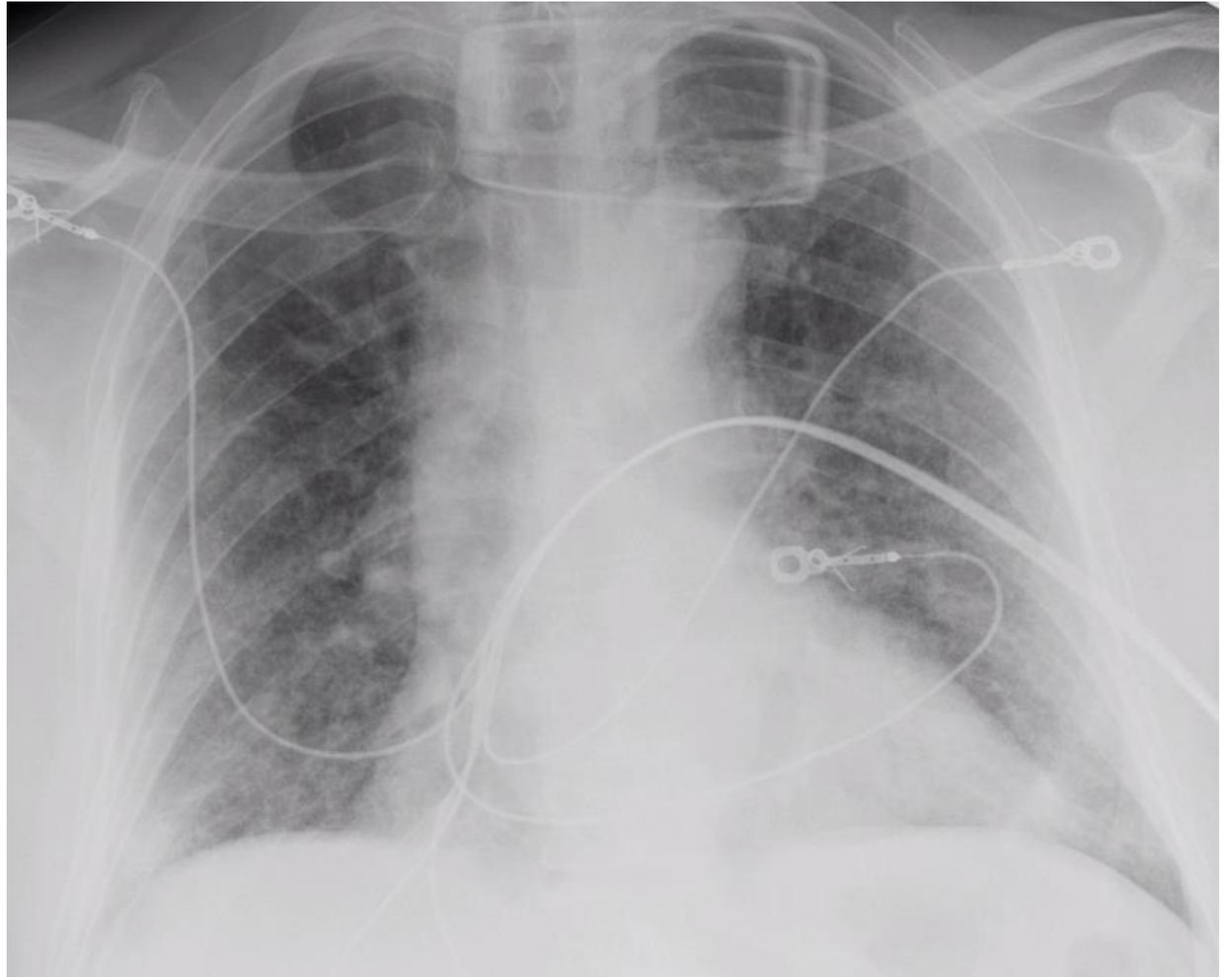
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Case Presentation 1

COVID-19 and Mechanical Ventilation

67 yo male smoker presented to the emergency room with shortness of breath.

His wife tested positive for COVID-19 five days ago and since then he has developed progressive dyspnea accompanied by fevers and a dry cough.

On auscultation he has diffuse bilateral crackles.



Initial SpO₂ 63%

He was placed on a non-rebreather mask at 15L/min with improvement in SpO₂ to low 90s

Intermittent desaturations with positional changes (SpO₂ in the 80s)

The patient continued to feel short of breath with respiratory rate 28-34. He reported feeling weak and could not speak in full sentences.

Given the patient's deteriorating respiratory status, the decision was made to intubate.

What is the most important piece of information you want to know about the patient when choosing his ventilator settings?

- A. Initial ABG
- B. Chest CT scan findings
- C. Height
- D. Renal function
- E. Liver function

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This patient has developed ARDS and should be put on “lung-protective” ventilation strategy: tidal volume is kept low at 6 ml/kg of ideal body weight.

Initial ventilator settings:

Tidal Volume: 400 mL
Set Respiratory Rate: 20
Observed Respiratory Rate: 26
PEEP: 10 cm H₂O
FiO₂: 100%

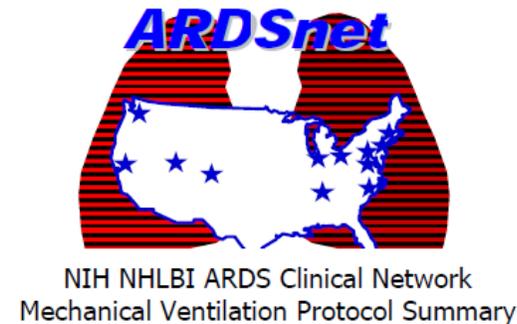
What changes to the ventilator would you consider making at this time ?

- A. Decrease the PEEP
- B. Increase the respiratory rate
- C. Increase the tidal volume
- D. Decrease the FiO₂
- E. No changes

BLOOD GAS	
FIO ₂	100.0
Temp	38.4
Art Site	Arterial *
pH, Art (T)	7.36
pCO ₂ , Art (T)	46
pO ₂ , Art (T)	196 ▲
HCO ₃ , Art	25
BE, Art	0.0
O ₂ Sat, Art (Est)	99.6

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OXYGENATION GOAL: PaO₂ 55-80 mmHg or SpO₂ 88-95%

Use a minimum PEEP of 5 cm H₂O. Consider use of incremental FiO₂/PEEP combinations such as shown below (not required) to achieve goal.

Lower PEEP/higher FiO₂

FiO₂	0.3	0.4	0.4	0.5	0.5	0.6	0.7	0.7
PEEP	5	5	8	8	10	10	10	12

FiO₂	0.7	0.8	0.9	0.9	0.9	1.0
PEEP	14	14	14	16	18	18-24

Higher PEEP/lower FiO₂

FiO₂	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.5
PEEP	5	8	10	12	14	14	16	16

FiO₂	0.5	0.5-0.8	0.8	0.9	1.0	1.0
PEEP	18	20	22	22	22	24

The patient's condition worsens overnight. He now requires PEEP of 16 mm H₂O and FiO₂ of 0.5. CXR demonstrates increased diffuse, bilateral infiltrates.

His sedation requirements are unchanged (on propofol 20 mcg/kg/min and fentanyl 50 mcg/mg/min) but he developed hypotension and is requiring norepinephrine at 6 mcg/min.

What about the patient's pulmonary findings or ventilator settings may be contributing to the hypotension?

- A. Low tidal volumes
- B. Low FiO₂
- C. Increased pulmonary edema
- D. High PEEP
- E. Sedatives

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High levels of PEEP (> 15 H₂O) can impair venous return and decrease cardiac output and blood pressure. While the PaO₂ improved on higher PEEP, a drop in cardiac output will impair oxygen delivery to tissues.

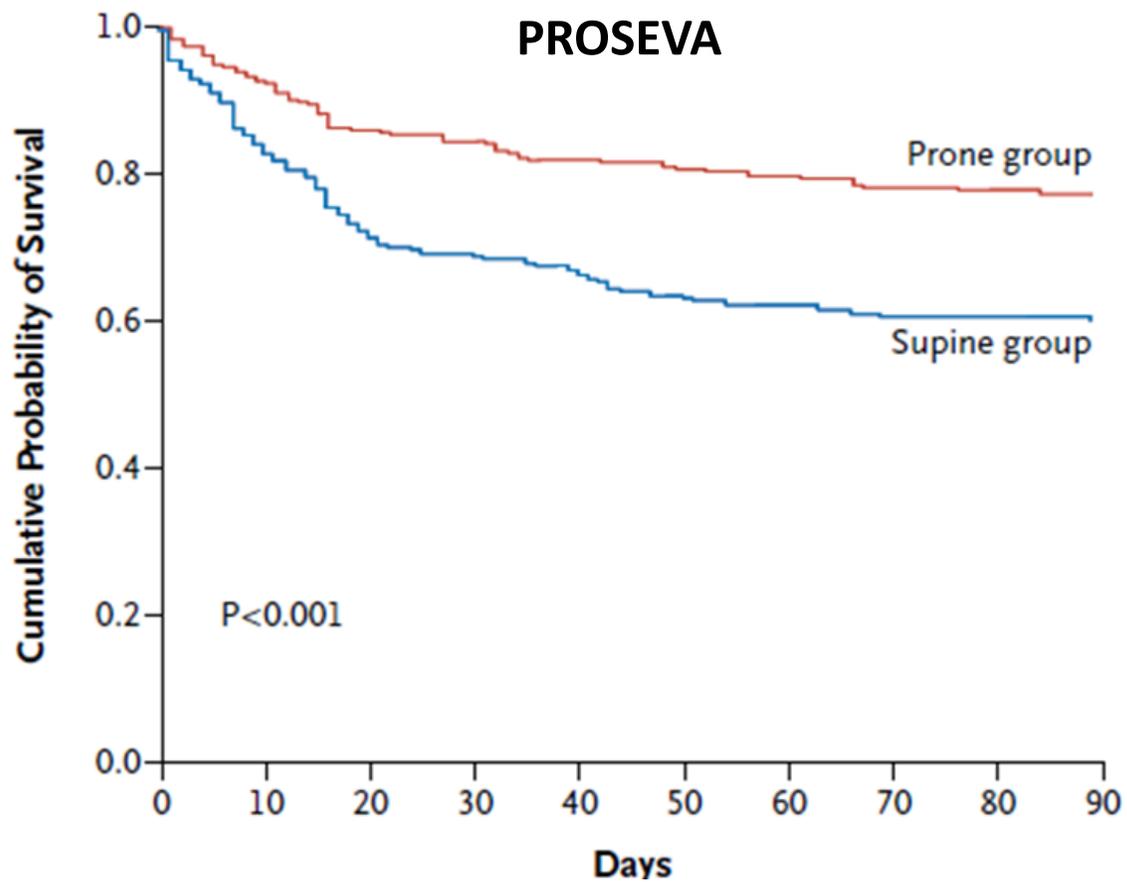
Propofol commonly causes hypotension through negative effects on inotropy as well as vasodilation.

The ICU team is unable to decrease the patient's PEEP and the patient continues to be hypoxemic despite a net negative fluid balance. He has been started on empiric antibiotic therapy due to concern of a superinfection.

What is the next best step in managing this patient's hypoxemia?

BLOOD GAS	
FIO2	50.0
Temp	37.0
Art Site	Arterial *
pH, Art (T)	7.46
pCO2, Art (T)	44
pO2, Art (T)	57 ▼
HCO3, Art	30 ▲
BE, Art	6.6 ▲
O2 Sat, Art (Est)	90.8

- A. Inhaled nitric oxide (pulmonary vasodilator)
- B. Prone positioning
- C. Extracorporeal membrane oxygenation
- D. Permissive hypercapnia
- E. High frequency oscillatory ventilation



	Prone	Supine	Prone
BLOOD GAS			
FIO ₂	50.0	40.0 *	40.0
Temp	37.4	37.4	37.6
Art Site	Arterial	Arterial	Arterial *
pH, Art (T)	7.36	7.41	7.42
pCO ₂ , Art (T)	62 ▲	54 ▲	50 ▲
pO ₂ , Art (T)	144 ▲	56 ▼	157 ▲
HCO ₃ , Art	31 ▲	31 ▲	30 ▲
BE, Art	7.8 ▲	8.3 ▲	6.9 ▲

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Take away points



Low tidal volume ventilation using ideal body weight (calculated based on height)



PEEP to recruit atelectatic lung and thus increase oxygen exchange



Proning (ditto)