Case Presentation 1

COVID-19 and Mechanical Ventilation

Alex Cypro, MD
UCSD Internal Medicine PGY-3
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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A. Initial ABG
B. Chest CT scan findings
C. **Height**
D. Renal function
E. Liver function

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**

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<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>FIO2</td>
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</tr>
<tr>
<td>Temp</td>
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</tr>
<tr>
<td>Art Site</td>
<td>Arterial *</td>
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<tr>
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<td>HCO3, Art</td>
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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

<table>
<thead>
<tr>
<th>FiO₂</th>
<th>0.3</th>
<th>0.4</th>
<th>0.4</th>
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<th>0.5</th>
<th>0.6</th>
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<table>
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<th>0.9</th>
<th>0.9</th>
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<td>14</td>
<td>16</td>
<td>18</td>
<td>18-24</td>
</tr>
</tbody>
</table>

### Higher PEEP/lower FiO₂

<table>
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<th>0.3</th>
<th>0.3</th>
<th>0.3</th>
<th>0.4</th>
<th>0.4</th>
<th>0.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>PEEP</td>
<td>5</td>
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<td>12</td>
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<td>16</td>
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<table>
<thead>
<tr>
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<th>0.8</th>
<th>0.9</th>
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<td>PEEP</td>
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<td>20</td>
<td>22</td>
<td>22</td>
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A. Decrease the PEEP  
B. Increase the respiratory rate  
C. Increase the tidal volume  
D. Decrease the FiO₂  
E. No changes
The patient’s condition worsens overnight. He now requires PEEP of 16 mm H$_2$O and FiO$_2$ 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 FiO$_2$  
C. Increased pulmonary edema  
D. High PEEP  
E. Sedatives
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

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?

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