VENTILATORS FOR PEOPLE WHO DON’T LIKE THEM

Amy Bellinghausen, MD, PCCSM Fellow, PGY6, UCSD
Mark Rolfsen, MD, Medicine Resident, PGY2, UCSD
• We have no conflicts of interest to disclose
• Interactive Case
• Ventilator Basics
  • Modes
  • Settings
• Troubleshooting: Peak and Plateau pressures
32M WITH DYSPNEA X3 DAYS

On arrival to the ER:
- 86% on RA, placed on 4L NC
- Temp 102.4

2 hours later:
- O₂ increased to 12L (salter NC), RR 28
- COVID-19 NP swab pending
- 90kg, 5'11”, BMI 27.8, h/o HTN
- Decision made to intubate

What should his ventilator settings be?
WHAT WOULD BE A GOOD INITIAL VENT STRATEGY?

(There may be more than one “right” answer)

A) VC+  
RR 12  TV 500  PEEP 5  F_\text{O}_2 100%

B) Volume control  
RR 24  TV 425  PEEP 10  F_\text{O}_2 80%

C) Pressure control  
RR 12  P_{\text{insp}} 20  PEEP 5  F_\text{O}_2 100%

D) APRV  
T_{\text{low}} 0.5  T_{\text{high}} 5  P_{\text{low}} 0  P_{\text{high}} 25  F_\text{O}_2 100%

E) Ask someone else
SETTNGS

Step 1: Pick a Mode

- **Volume Control**
- **Pressure Control**
- "Hybrid" (VTPC, VC+, PRVC)

- Most studies in ARDS w/ VC
- Other modes are for weaning or salvage therapy

Step 2: Set your parameters

- **Respiratory Rate**
  - Consider pre-intubation minute ventilation
  - Avoid RR >35 (risk of air trapping/autoPEEP)

- **Tidal Volume**
  - 6 mg/kg predicted body weight (range 4-8 mg/kg)

- **PEEP**
  - “Enough” – more on this later

- **F\textsubscript{1}O\textsubscript{2}**
  - 100% and titrate down. Goal PaO\textsubscript{2} >60 (probably)

*Advanced: I:E ratio, trigger, waveform – ask a pulmonologist or RT for more info!*
Tip #1:
Don’t just “set and forget” the vent. Evaluate the response!

Step 3: Evaluate the response
• Look at the patient
  • Cough? Irregular breathing? “Fighting” the vent?
• Look at the vent
  • Peak & plateau pressure
• Look at the monitor
  • SpO₂, Blood pressure, HR, +/- EtCO₂
• Look at the blood gas
  • pH, pCO₂ and pO₂
The vent is set on VC, RR 22, TV 425, PEEP 5 and F_{iO2} 50%
Blood gas in 30 minutes: 7.20/54/52

What now?
A) Increase the respiratory rate
B) Increase the tidal volume
C) Increase the PEEP
D) Increase the FiO2
E) Panic
ABG: OXYGENATION

Tip #2:
Make vent changes based on the whole patient, not just on the blood gas.

- RT reports that patient still appears paralyzed, no alarms, actual RR = set RR
- Oxygenation (O₂): PEEP & F_iO₂
  - F_iO₂ = fast
  - PEEP = slow
  - ARDSnet PEEP ladder

<table>
<thead>
<tr>
<th>Lower PEEP/higher FiO2</th>
<th>FiO₂</th>
<th>0.3</th>
<th>0.4</th>
<th>0.4</th>
<th>0.5</th>
<th>0.5</th>
<th>0.6</th>
<th>0.7</th>
<th>0.7</th>
</tr>
</thead>
<tbody>
<tr>
<td>PEEP</td>
<td></td>
<td>5</td>
<td>5</td>
<td>8</td>
<td>8</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>12</td>
</tr>
<tr>
<td>FiO₂</td>
<td>0.7</td>
<td>0.8</td>
<td>0.9</td>
<td>0.9</td>
<td>0.9</td>
<td>1.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PEEP</td>
<td>14</td>
<td>14</td>
<td>14</td>
<td>16</td>
<td>18</td>
<td>18-24</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Higher PEEP/lower FiO2</th>
<th>FiO₂</th>
<th>0.3</th>
<th>0.3</th>
<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></td>
<td>5</td>
<td>8</td>
<td>10</td>
<td>12</td>
<td>14</td>
<td>14</td>
<td>16</td>
<td>16</td>
</tr>
<tr>
<td>FiO₂</td>
<td>0.5</td>
<td>0.5-0.8</td>
<td>0.8</td>
<td>0.9</td>
<td>1.0</td>
<td>1.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PEEP</td>
<td>18</td>
<td>20</td>
<td>22</td>
<td>22</td>
<td>22</td>
<td>24</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
\[ \Delta RR \text{ and } V_T \rightarrow \Delta CO_2 \] (mostly)

Mild acidemia \((7.15 \leq pH < 7.30)\):

i. Increase ventilator rate up to maximum of 35 or until pH > 7.30 or PaCO_2 < 25 mm Hg.

[Link to Ventilator Protocol]

• You set the vent to the following:
  • VC, RR 26, TV 425, PEEP 12 and FiO2 70%
  • Repeat ABG: 7.32/46/73, SpO2 on monitor is 95%
• An hour later you are called to bedside because the patient is desaturating
• Looking through the door, you see that he is sating 83%
• What next?
  A) Increase PEEP
  B) Increase FiO2
  C) Change to prone position
  D) Get more information
PUT ON YOUR PPE!

Going in without PPE puts you, your other patients and all of the staff at risk.
Peak pressure alarm going off

**Tip #3:**
- High peak pressure but normal plateau
  - Airway or tubing problem
- High peak and high plateau
  - Alveolar, pleural or chest wall problem

**DDx:**
- Mucus plug, clot, biting, bronchospasm
- Worsening lung compliance, PTX, chest wall rigidity and more

More on troubleshooting hypoxemia next week!
1. Don’t just “set and forget” the vent. Evaluate the response!

2. Make vent changes based on the whole patient, not just on the blood gas.

3. High peak pressure but normal plateau = airway or tubing problem.

   High peak and high plateau = alveolar, pleural or chest wall problem.

Thank you to Laura Crotty Alexander for facilitating and inviting me to present!

• Some slides/info borrowed from Mark Hepokoski & Atul Malhotra