ICU Ventilator Management Basics

Initial Ventilator Settings for Adults

- **Ventilator Mode:** Choose the mode that you are most comfortable managing.
- **Refer to Provided MICU And SICU Ventilator Protocols For More Information.**
- Most common choices:
  - SIMV-PRVC = Synchronized Intermittent Mandatory Ventilation – Pressure Release Control Ventilation
  - AC = Assist (Volume) Control
- **Fraction of Inspired Oxygenation (FiO2) = 100%**
  - Start all patients at 100%
  - Wean every 15 minutes as able based on SpO2 to lowest tolerated FiO2 between 40 and 100%
- **Positive End Expiratory Pressure (PEEP) = 5 – 8 cmH2O**
  - Prevents alveolar collapse and increases oxygenation
  - WILL increase intrathoracic pressure and decrease preload – monitor hemodynamics if patient is hypovolemic
- **Respiratory Rate = 15**
  - Component of minute ventilation. Consider higher rate if patient is hypercapnic.**
  - **Unless there is a contraindication, mild hypercarbia is OK.**
- **Tidal Volume = 6 – 8 cc/kg**
- **Predicted Body Weight (PBW)**
  - **For patients presenting with ARDS start with 6 cc/kg and may need to decrease to 4 cc/kg PBW**
  - Calculating **Predicted Body Weight:**
    - Males = 50 + 2.3 x [height (inches) – 60]
    - Females = 45.5 + 2.3 x [height (inches) – 60]

Management Goals and Setting Adjustments

- **OXYGENATION** is measured using SpO2 and PaO2
  - Target oxygenation is an SpO2 > 92% or a PaO2 > 60 mmHg
  - For patients with ARDS or chronic hypoxia from lung disease (i.e. COPD), the target oxygenation is reduced to SpO2 88-92% or a PaO2 55-80 mmHg
  - To **treat hypoxia:**
    - Increase the FiO2 by 10-20%. Effects should be seen within minutes.
    - **OR**
    - Increase the PEEP by 2-3 cmH20. Effects may take up to 20 minutes.
    - Consider the use of incremental FiO2/PEEP combination from the ARDS Network. (See Table)

- **VENTILATION** is measured using PaCO2 and by assessing the pH. Normal parameters are featured in the table below

<table>
<thead>
<tr>
<th>Patient Category</th>
<th>pH</th>
<th>PaCO2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>7.35-7.45</td>
<td>35-45 mmHg</td>
</tr>
<tr>
<td>Chronic CO2 Retention</td>
<td>7.30-7.45</td>
<td>45-55 mmHg</td>
</tr>
<tr>
<td>Open Heart Patients</td>
<td>7.35-7.50</td>
<td>35-50 mmHg</td>
</tr>
<tr>
<td>ARDS*</td>
<td>7.25-7.45</td>
<td>Adjust to pH range</td>
</tr>
</tbody>
</table>

- PaCO2 is determined by **minute ventilation**
- If the patient is **Hypercapnic** and has **Respiratory Acidosis** (i.e. PaCO2 > 45 mmHg):
  - Increase the respiratory rate
  - **OR**
  - Increase the tidal volume. When increasing tidal volume, be mindful of peak inspiratory and plateau pressures. See below.
  - You may have to allow some degree of **Permissive Hypercapnea** if unable to meet the pressure parameters below and to avoid injuring the lungs. Always keep the pH above 7.1.

- **PRESSURE GOALS:**
  - **Peak Airway Pressures ≤ 40 cmH20**
    - Peak pressures are measured by the ventilator with each breath
  - **Plateau Pressure ≤ 30 cmH20**
    - To measure plateau pressure, use the inspiratory hold button. Hold inspiration for 0.5 sec and look at the pressure gauge
  - If pressures are too **HIGH:**
    - Decrease the tidal volume by 0.5-1 cc/kg PBW until the pressures return to an acceptable range
ICU Ventilator Management Basics

Weaning the Ventilator
- As the patient’s respiratory function and mechanics improve, patients are weaned towards minimum ventilator settings with the goal of extubation.
- Patients should be evaluated continuously throughout the shift (minimum every 4 hours) for opportunities to wean the ventilator.
- If appropriate, each patient should receive a Spontaneous Awakening Trial and a Spontaneous Breathing Trial each day.

Minimum Ventilator Settings:
- \( \text{FiO}_2 = 40\% \)
- \( \text{PEEP} = 5 \text{ cmH}_20 \)
- Mode \( \rightarrow \) Pressure Support with 5 cmH20

To Wean the Ventilator:
- If the \( \text{SpO}_2 > 95\% \) or \( \text{PaO}_2 > 90 \text{ mmHg} \):
  - Wean \( \text{FiO}_2 \) by 10% **OR**
  - Wean \( \text{PEEP} \) by 2-3 cmH20
  - Consider following PEEP/FiO2 table on Page 1 for ARDS patients
  - Monitor for results of changes over the next 20 minutes
- If the \( \text{PaCO}_2 < 35 \text{ mmHg} \):
  - Decrease the respiratory rate by 2-3 breaths per minute. At some point, the patient will begin to breathe spontaneously. **OR**
  - Decrease the tidal volume by 1 cc/kg PBW until you have reached 6 cc/kg PBW

Spontaneous Awakening and Breathing Trials
- Spontaneous Awakening Trials (SAT) are a cessation of sedation or decrease to lighter levels of sedation that allow the patient to be more alert and interactive
- Spontaneous Breathing Trials (SBT) allow patients to attempt to breathe spontaneously and should be performed at the same time as the awakening trial

Safety Screen for SAT (must meet ALL criteria)
- No active seizures
- No alcohol withdrawal
- No agitation
- No chemical paralytics
- No myocardial ischemia
- Normal intracranial Pressure

Safety Screen for SBT (must meet ALL criteria)
- No severe agitation
- \( \text{SpO}_2 > 87\% \)
- \( \text{FiO}_2 \leq 50\% \)
- \( \text{PEEP} \leq 8 \text{ cmH}_20 \)
- Spontaneous inspiratory effort
- Minimal vasopressor support

To Perform an SAT/SBT:
- Complete the SAT Safety Screen
- If the patient passes, hold all sedative infusions/medications
  - If the patient fails, restart sedatives at \( \frac{1}{2} \) previous rate and titrate as needed
- If the patient passes, perform the SBT safety screen
  - If the patient fails, continue to wean ventilator as able
- If the patient passes the SBT safety screen, transition the ventilator to pressure support mode with 5 cm H2O pressure support for 30 minutes, continuously monitoring the first 10 minutes of the trial
  - If the patient fails, resume previous mode of ventilation
- If the patient passes the SBT, consider extubation

SAT Failure Criteria
- Uncontrollable anxiety, agitation, or pain
- Respiratory rate \( \geq 35 \) breaths/minute
- Oxygen saturation <88%
- Respiratory distress
- Acute cardiac arrhythmia

SBT Failure Criteria
- Respiratory rate >35 breaths/minute
- Respiratory rate <8 breaths/minute
- Oxygen saturation <88%
- Respiratory distress
- Mental status change
- Acute cardiac arrhythmia

Extubation Criteria (SOAP)
- Secretions
  - Moderate to minimal secretions
  - Intact cough with the ability to clear secretions without excessive deep suctioning
- Oxygenation
  - \( \text{SpO}_2 > 92\% \) on \( \text{FiO}_2 \) 40%
- Airway/Alertness
  - Patient is awake, alert, and appropriately interactive
  - Patient will be able to protect the airway if extubated
- Parameters (Pulmonary Mechanics)
  - \( \text{Respiratory Rate} < 25 \)
  - \( \text{Tidal Volume} > 5 \text{ cc/kg} \)
  - \( \text{Minute Ventilation} < 12 \text{ L/min} \)
  - \( \text{Vital Capacity} > 15 \text{ cc/kg} \)
  - \( \text{Negative Inspiratory Pressure}** \leq -25 \text{ cm H}_20 \)
    - **We do not routinely measure this and it is not required for every extubation
  - Cuff leak present when cuff is deflated

If patient meets all criteria above, move to EXTUBATE!