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 cmH20**
  - 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 hypercapneic.**
  - **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)

Lower PEEP/higher FiO2

FiO_2	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

FiO_2	0.7	0.8	0.9	0.9	0.9	1.0
PEEP	14	14	14	16	18	18-24

Higher PEEP/lower FiO2

FiO_2	0.3	0.3	0.3	0.3	0.4	0.4	0.5
PEEP	5	8	10	12	14	14	16	16

FiO_2	0.5	0.5-0.8	0.8	0.9	1.0	1.0
PEEP	18	20	22	22	22	24

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

Patient Category	pH	$PaCO_2$
Normal	7.35-7.45	35-45 mmHg
Chronic CO_2 Retention	7.30-7.45	45-55 mmHg adjust to pH range
Open Heart Patients	7.35-7.50	35-50 mmHg
ARDS*	7.25-7.45	Adjust to pH range

  - PaCO2 is determined by **minute ventilation**
  - If the patient is **Hypercapneic** 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:

- **FiO2** = 40%
- **PEEP** = 5 cmH20
- **Mode** → Pressure Support with 5 cmH20

To Wean the Ventilator:

- If the **SpO2 > 95%** or **PaO2 > 90 mmHg:**
  - Wean **FiO2** by 10%
    OR
  - Wean **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 **PaCO2 < 35 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
- SpO2 >87%
- FiO2 ≤ 50%
- PEEP ≤ 8 cmH20
- 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 ½ 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 H20 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 ≥ 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)

- **S**ecretions
  - Moderate to minimal secretions
  - Intact cough with the ability to clear secretions without excessive deep suctioning
- **O**xygenation
  - SpO2 > 92% on FiO2 40%
- **A**irway/Alertness
  - Patient is awake, alert, and appropriately interactive
  - Patient will be able to protect the airway if extubated
- **P**arameters (Pulmonary Mechanics)
  - Respiratory Rate < 25
  - Tidal Volume > 5 cc/kg
  - Minute Ventilation < 12 L/min
  - Vital Capacity > 15 cc/kg
  - Negative Inspiratoy Pressure** < -25 cm H20
    - **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!