MECHANICAL VENTILATION

GOALS:

1. Maintain adequate ventilation
2. Deliver precise concentrations of FIO_2
3. Deliver adequate tidal volumes (V_T)
4. Lessen the work of breathing

OVERALL INDICATION: Pt exhibits a continuous decrease in oxygenation (PaO_2), an increase in arterial carbon dioxide levels ($PaCO_2$), and a persistent acidosis (decreased pH)

UNDERLYING INDICATIONS FOR VENTILATION:

1. Respiratory muscle dysfunction
2. Neuromuscular disease
3. Decreased ventilatory drive (Drug overdose)
4. Increased airway resistance
5. Atelectasis
6. Refractory hypoxemia

POSITIVE PRESSURE VENTILATORS:

1. **Pressure cycled**
   Ends inspiration when a preset pressure has been reached (Pre-selected pressure). Good for neurologically depressed patients. Helps patients overcome the resistance of breathing.
2. **Volume cycled (most common)**
   Delivers a preset tidal volume of inspired air. Tidal volume delivered to client regardless of the pressure but pressures can be set. Exhalation occurs passively.
3. **Time cycled**
   Terminate when a preset inspiratory time has elapsed. Volume of air patient receives is regulated by length of time and the flow rate of the air. Rarely used for adults, mostly children.

MODES OF VENTILATION

- **Continuous mechanical ventilation (Control Mode)**
  Ventilator is not responsive to patient. Total control. Delivers a preset tidal volume and respiratory rate. Patient should be chemically paralyzed.
- **Assist/Control (A/C) mode**
  The clients own inspiratory effort "triggers" the ventilator, initiating the mechanical inspiratory phase to deliver a preset tidal volume. If client does not breathe, machine is preset to deliver a breath.

- **Synchronized intermittent mandatory ventilation (SIMV)**
  Similar to IMV except preset breaths are synchronized with clients spontaneous breaths.
- **Pressure Support**
  Preset positive pressure is delivered with spontaneous breaths
- **Positive end-expiratory pressure (PEEP)**
  Preset amount of pressure stays in the lungs at the end of expiration.
- **CPAP Continuous positive airway pressure**: spontaneous ventilation with continuous positive airway pressure. Use only with spontaneous breathers. Provides elevated baseline pressure through out the breathing cycle.

CONTROLS AND SETTINGS
Tidal volume: Volume of air that the patient receives with each breath.
Rate: Number of ventilator breaths delivered per minute.
F_{IO2}: Fraction of inspired oxygen or the oxygen concentration delivered to the patient, which is ultimately determined by condition and ABG's.
Peak airway inspiratory pressure (PIP) Pressure needed by the ventilator to deliver a set tidal volume at a given compliance (reflects changes in lung compliance).

VENTILATOR ORDERS
TROMPP
Tidal Volume (Vt)
Rate
Oxygen – FIO2
Mode
Pressure Support (PS)
Peep (positive end expiratory pressure)

ALARMS
High pressure alarms may be from a variety of reasons:
- Increased secretions in airway
- Wheezing or bronchospasm causing decreased airway size
- Displacement of ET tube
- Obstructed ET tube
- Client fighting "bucking" the ventilator
- Client coughs or gags
- Anxiety, hypoxia

    - ❖ **If you can't find the cause of alarm , ventilate manually until cause is discovered**

SUCTIONING

- Use sterile technique
- Hyperoxygenate the patient
- Insert sterile catheter into the artificial airway quickly until resistance is met
- Withdraw catheter while suctioning, should take less than 10 seconds

Nursing:

Prevent Ventilator Associated Pneumonia (VAP)

- Wean and extubate as early as able
- Elevate patients head 45 degrees to prevent aspiration
- Proper oral care to prevent dental plaque associated microbes.

Managing Anxiety

- Assess closely for nonverbal symptoms (pulling on tubes, restlessness, agitation)
- Rule out most obvious causes: hypoxia, metabolic abnormalities, drug reactions
- Minimum amount of sedation
- Communication plan and music therapy.

Malnutrition and Nutritional Support

- Enteral provides better calories and nutrients, keeps gut working, is less expensive and has fewer complications than parenteral
- Monitor proteins
- Monitor gastric residual volumes.

Disrupted Sleep Pattern

- Assess and manage pain
- Promote HS care
- Communicate with patient and reduce anxiety
- Coordinate care to minimize interruptions
- Drugs last resort

WEANING FROM MECHANICAL VENTILATION

Weaning does not mean the removal of the airway. Airway should be removed after the patient demonstrates successful spontaneous ventilation for 12-48 hours and can maintain a patent airway. There are situations where this may not be true and extubation may occur rapidly.

Best case scenario criteria:

1. Improvement or stabilization of the disease process
2. Nutritional and fluid status sufficient to maintain the metabolic needs of spontaneous respiration
3. Adequate physical strength and mental alertness
4. Stable cardiovascular, renal, and cerebral status
5. Optimal blood gas, electrolyte and hemoglobin levels
6. Achievement of the physiological parameters of mechanical ventilation

Modes for Weaning:

1. Assist/Control
2. SIMV
3. Pressure Support Ventilation: This weaning mode augments the patient's efforts during inspiration by generating a preset amount of pressure in the ventilatory circuit. (Receives a larger tidal volume with less work)
4. CPAP: Allows patient to breathe spontaneously while applying positive pressure throughout the respiratory cycle to keep alveoli open.
5. T-Piece: receives humidified oxygen only

Nursing Diagnosis for Ventilator care:

1. Impaired gas exchange related to underlying illness, or ventilator setting adjustment during stabilization or weaning.
2. Ineffective airway clearance related to increased mucous production associated with continuous positive pressure ventilation.
3. Risk for trauma, infection related to ET intubation or trach.
4. Impaired physical mobility.
5. Impaired verbal communication.
6. Defensive coping and powerlessness related to ventilator dependency.

Ventilation without Intubation

Noninvasive positive pressure ventilation (NPPV)

Who?
- COPD patients
- Sleep disorders
- Reversible hypoxic respiratory failure
- DNR patients
- Heart failure pulmonary edema
- Neuromuscular disorders

Who Not?
- Overwhelming secretions
- Uncontrolled cardiac arrhythmia
- Moderate to severe hypoxia
- Hypotension
- Severe anxiety, inability to follow directions

Why?
- Less trauma
- Less dependence
- Less chance of pneumonia, arrhythmia's, hypotension, aspiration
- Less chance of difficulty swallowing post removal

What?
BiPap vs CPAP

How?
BiPAP (Bilevel Positive Airway Pressure)
BiPAP delivers two cycles of positive pressure; higher pressure in inhalation then on exhalation
1. Pre-determined inspiratory positive airway pressure (IPAP)
2. Pre-set expiratory positive airway pressure (EPAP)
    - Patient can initiate each inspiration or machine is set with backup rate (as would be used for sleep apnea)
    - Often used for patients prone to respiratory muscle fatigue and potential respiratory failure

CPAP (Continuous Positive Airway Pressure)

1. Maintains a set positive airway pressure through out the breathing cycle
    - Splints the airway open preventing collapse and allowing the patient to breathe more normally
    - Often used for sleep apnea, pulmonary edema, post op atelectasis

Nursing?

- Monitor O_2 sats
- Monitor ABG's
- Response to treatment would indicate a decreased heart rate, a decreased respiratory rate, and diminished use of accessory muscles.
- Breath sounds should improve, anxiety should decrease
- Help patient adapt to the devise with coaching, reassurance, and lots of explanations
- Appropriate mask and fit