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Nursing Care of the Mechanically Ventilated Patient

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Learning Objectives

- Explain the indications for a mechanical ventilator
- Describe the functions of the mechanical ventilator
- Discuss nursing management of patients with a mechanical ventilator
- Identify complications for patients with a mechanical ventilator

Mechanical Ventilation (MV)

- Invasive mechanical ventilation is defined as the delivery of positive pressure to the lungs via an endotracheal or tracheostomy tube.
- Noninvasive ventilation (NIV) is defined as the delivery of positive pressure to the lungs via an alternative method, usually a face mask, nasal mask, or nasal prongs (1).
- The purpose of positive-pressure mechanical ventilation is to promote gas exchange in the lungs by producing positive intrathoracic pressure and positive airway pressure (2).

Mechanical Ventilation Indications

- Mechanical ventilation is indicated for the patient with respiratory or ventilatory failure evidenced by hypoxemia, metabolic acidosis, respiratory acidosis, inadequate tissue oxygenation, and respiratory muscle fatigue.
- These conditions are commonly caused by acute or chronic lung injury, neurological disorders, trauma, chemical or medical respiratory depressants, such as sedation, anesthesia, or pain killers; multiple organ dysfunction syndrome, or disease states such as cardiogenic pulmonary edema, pulmonary hemorrhage, pulmonary thromboembolism, acute severe asthma, sepsis, or septic shock (2).

Respiratory Failure Classifications

- **Type I or hypoxemic** (PaO2 < 60 with normal or low PaCO2)
  - The most common form of respiratory failure
  - Common etiologies include cardiogenic or noncardiogenic pulmonary edema, pneumonia, and pulmonary hemorrhage
- **Type II or hypercapnic** (PaCO2 > 50)
  - Hypoxemia is common in patients with hypercapnic respiratory failure who are breathing room air
  - Common etiologies include drug overdose, neuromuscular disease, chest wall abnormalities, and severe airway disorders (e.g. asthma and chronic obstructive pulmonary disease (COPD))
- Respiratory failure may be further classified as acute, chronic, or acute on chronic (3).

Goals of Mechanical Ventilation

- To protect the airway
- To improve pulmonary gas exchange (e.g. reverse hypoxemia or acute respiratory acidosis)
- To relieve respiratory distress (e.g. decrease oxygen consumption or respiratory muscle fatigue)
- To assist airway and lung healing
- To permit appropriate sedation and neuromuscular blockade (4).

Mechanical Ventilation

- Ventilation: the process of moving air in and out of the lungs. Its most important effect is moving carbon dioxide (CO_2) from the body. In a mechanically ventilated patient, the CO_2 content of the blood can be modified by changing the tidal volume (TV) or the respiratory rate.
- Oxygenation: an intervention that provides a greater oxygen supply to the lungs. In a mechanically ventilated patient, this can be achieved by increasing the fraction of inspired oxygen (FiO_2) or the positive end-expiratory pressure (PEEP) (5).

Mechanical Ventilation: Common Terms

It is important to become familiar with the following terms:

- Fraction of inspired oxygen (FiO2): this is the percentage of oxygen delivered to the patient by the ventilator. This is typically labeled as *oxygen concentration* or *oxygen percentage* on the ventilator.
- Inspiratory-expiratory (I:E) ratio: this ratio compares the duration of inspiration to the duration of expiration. The I:E ratio of normal, spontaneous breathing is 1:2, meaning expiration is twice as long as inspiration.
- Inspiratory flow rate (IFR): the IFR denotes the tidal volume (TV) delivered within a certain time. Its value can range from 20-120 L/minute (2).

Mechanical Ventilation: Common Terms

- Minute ventilation or minute volume (VE): this is measured by multiplying respiratory rate and tidal volume (MV = RR x TV).
- Peak inspiratory pressure (PIP): measured by the pressure manometer on the ventilator, PIP reflects the amount of pressure required to deliver a preset tidal volume (TV).
- Plateau pressure: airway pressure measured after a 0.5 second pause at the end of inspiration; plateau pressure indicates the stiffness of the lungs.
- Positive end-expiratory pressure (PEEP): in PEEP mode, the ventilator is triggered to apply positive pressure at the end of each expiration to increase the area for oxygen exchange by helping to inflate and keep open collapsed alveoli. PEEP is typically set at 5 cm H2O but can go up to 20 cm H2O (2).

Mechanical Ventilation: Common Terms

- Respiratory rate: the number of breaths per minute delivered by the ventilator; also called *frequency*. The rate set is dependent on the patient's condition and the ventilator mode. It's typically set to 12-16 breaths per minute.
- Sensitivity setting: a setting that determines the amount of effort the patient must exert to trigger the inspiratory cycle.
- Tidal volume (TV): this is the volume of air delivered to the patient with each cycle, usually 6 to 10 mL/kg (2).

Modes of Ventilation

1) **Volume-limited ventilation** – volume-limited breaths deliver a predetermined tidal volume (TV) at a set ventilator rate. Inspiration ends when the set tidal volume is reached.

- Assist control (AC)
- Controlled mechanical ventilation (CMV)
- Synchronized intermittent mandatory ventilation (SIMV)
- Intermittent mandatory ventilation (IMV)

- Volume-limited ventilation requires the clinician to set the peak flow rate, flow pattern, tidal volume, respiratory rate, positive end-expiratory pressure (PEEP), and fraction of inspired oxygen (FiO2) (1,7).

Modes of Ventilation

Assist control (AC)

- The clinician determines the respiratory rate and tidal volume which determines the minimal minute ventilation. The ventilator delivers preset breaths in coordination with the respiratory effort made by the patient. In this mode of ventilation, spontaneous breathing is permitted.
- AC is typically used for patients that have just been resuscitated, heavily sedated, or have acute respiratory distress syndrome (7,8).

Modes of Ventilation

Controlled mechanical ventilation (CMV)

- In CMV, the minute ventilation is determined entirely by the set respiratory rate and tidal volume. This mode does not require any patient work; it is all done by the ventilator and the patient needs to be heavily sedated or paralyzed.
- This mode of ventilation should not be used outside of the OR (7,8).

Modes of Ventilation

Synchronized intermittent mandatory ventilation (SIMV)

- This mode of ventilation delivers a preset number of breaths in coordination with respiratory effort of the patient, but permits spontaneous breathing.
- SIMV allows respiratory muscles to work and can improve cardiac output.
- This mode can be used for the weaning process (7,8).

Modes of Ventilation

Intermittent mandatory ventilation (IMV)

- In this mode of ventilation, the clinician determines the minimal minute ventilation by setting the respiratory rate and tidal volume. The ventilator will deliver a set tidal volume regardless of patient effort. The patient can increase the minute ventilation by spontaneously breathing (7,8).

Modes of Ventilation

2) **Pressure-limited ventilation** – pressure-limited breaths deliver an amount of air at a set pressure limit and a set ventilator rate. Inspiration ends when the set pressure is reached.

  - Pressure control (PC)
  - Pressure assist (PA)

- Pressure-limited ventilation requires the clinician to set the inspiratory pressure level, inspiratory to expiratory ratio (I:E), respiratory rate, PEEP, and FiO2. (1,7).

Modes of Ventilation

Pressure control

- The minute ventilation is determined entirely by the set respiratory rate and inspiratory pressure level. The breaths are ventilator-initiated.

Pressure assist

- The minimum minute ventilation is determined by the set respiratory rate and inspiratory pressure level; however, the patient can increase the minute ventilation by triggering additional ventilator-assisted, pressure-limited breaths (1,7).

Modes of Ventilation

3) **Pressure-support ventilation** (PSV) – the ventilator provides the driving pressure for each spontaneous breath, which determines the maximal airflow rate. Inspiration ends once the inspiratory flow has decreased to a predetermined percentage of its maximal value.

- Pressure-support ventilation requires the clinician to set the pressure support level (inspiratory pressure level), applied PEEP, and FiO2 (1,6).
- The patient must trigger each breath because there is no set respiratory rate. The tidal volume, respiratory rate, and minute ventilation are dependent on multiple factors including the ventilator settings and patient-related variables (compliance, sedation).
- This mode of ventilation is used for weaning patients (7,8).

Modes of Ventilation

Noninvasive modes of ventilation

- Bilevel positive airway pressure (BPAP) – delivers a preset inspiratory positive airway pressure (IPAP) and expiratory positive airway pressure (EPAP). Most BPAP devices permit a backup respiratory rate to be set.
- Continuous positive airway pressure (CPAP) – delivers a continuous level of positive airway pressure. It is functionally like PEEP. The patient must initiate all breaths (7,9).

Note: This presentation reviews basic modes of ventilation. There are some advanced modes that were not discussed; refer to your institution's ventilator policies for the modes of ventilation in use.

Artificial Airways

Endotracheal (ET) tubes

- Inserted in the patient's trachea either through the mouth or nose. Oral insertion is preferred and more common since nasal insertion is associated with sinus infections and higher risk of ventilator-associated pneumonia (VAP).
- ET tube sizes are identified by the tube's internal diameter in millimeters (mm ID). The most common sizes used in adults are 7.0 to 9.0 mm ID.
- Complications include laryngeal and tracheal damage, laryngospasm, aspiration, infection, discomfort, sinusitis, and subglottic injury.
- ET tubes can be left in place for two to three weeks, but tracheostomy is often considered after 10 to 14 days of intubation (6).

Artificial Airways

Tracheostomy

- Performed as an elective procedure either in the operating room or at the bedside via a percutaneous insertion.
- Tracheostomy tubes come in a variety of sizes and may be cuffed or uncuffed.
- Complications include hemorrhage, tracheal stenosis, malacia, or perforation; laryngeal nerve injury; aspiration; infection; air leak; device-related pressure injury (6).

Intubation

- Intubation is performed by a trained and certified healthcare professional, usually the physician or anesthetist.
- The RN should assist with intubation by monitoring vital signs, assisting with set-up, and administering sedation, pain medications, and paralytics as ordered.
- After the patient is intubated, the endotracheal (ET) tube cuff will need to be inflated with air. Guidelines recommend a cuff pressure between 20 and 30 cm H2O to ensure ventilation, prevent aspiration, and maintain tracheal perfusion (10).

Intubation

- ET tube placement can be confirmed using physical (auscultating for bilateral breath sounds, observing for bilateral chest expansion) and nonphysical (continuous waveform capnography or carbon dioxide detector) examination techniques.
- Once tube placement is confirmed, oxygen administration or mechanical ventilation can be initiated.
- Secure the tube using a tube holder or tape; use method specific to your institution.
- Obtain a chest X-ray to verify tube position.
- Document the date and time of intubation, the type and size of ET tube, external length measurement of the tube at the patient's lip, medications administered, and techniques used to verify ET tube placement (10).

Nursing Management

Most of the nursing interventions focus on maximizing oxygenation and ventilation, as well as preventing complications.

- Monitor the patient's oxygen saturation level by pulse oximetry. Ensure the monitor alarm limits are set appropriately for the patient's current condition, and that the alarms are turned on, functioning properly, and audible to staff.
- Position the patient with the head of the bed elevated to 30 to 45 degrees, unless contraindicated, to reduce the risk of aspiration and ventilator-associated pneumonia (VAP) (2).

Nursing Management

- Suction the patient’s airway when necessary to maintain airway patency by removing pulmonary secretions. Before performing suctioning, hyperoxygenate the patient, as needed, with 100% oxygen for 30 to 60 seconds. Suction the patient with a closed-suction catheter, limiting suctioning to 15 seconds. After suctioning, hyperoxygenate using the same technique you used before suctioning.
- Document the amount and consistency of the patient's secretions and the patient’s response to the procedure.
- Monitor the patient’s ABG values, as ordered, to determine if patient is being adequately ventilated and to avoid oxygen toxicity. Be prepared to adjust ventilator settings based on ABG analysis.
- ABG analysis should be conducted
  - After the initial ventilator set-up
  - After changes in ventilator settings
  - As the patient’s condition indicates (2).

Nursing Management

- Check the ventilator tubing frequently for condensation, which can cause resistance to airflow and can cause the patient to aspirate. As needed, drain the condensate into a collection trap. Condensate is considered infectious, so avoid accidental drainage into patient's airway and keep the circuit closed during condensate drainage to prevent bacterial contamination.
- Clean, change, or dispose of ventilator tubing and equipment when it is visibly soiled or malfunctioning, per your institution's policy (2).

Nursing Management

- Monitor the patient's vital signs and respiratory status according to your institution's policy.
- Provide emotional support to the patient during all phases of mechanical ventilation to reduce anxiety and promote successful treatment.
- Confirm the ventilator alarms are set appropriately for the patient's current condition. Ensure alarms are turned on, functioning, and audible to staff (2).

Nursing Management

- Turn the patient from side-to-side every one to two hours (unless contraindicated) to facilitate lung expansion and removal of secretions, and perform active or passive range-of-motion exercises for all extremities to reduce the hazards of immobility.
- Assess the patient's peripheral circulation and monitor intake and output to assess for signs of decreased cardiac output. Watch for signs and symptoms of fluid volume excess or dehydration.
- Brush the patient's teeth, gums, and tongue at least twice a day using a soft pediatric or adult toothbrush to prevent VAP.
- Use chlorhexidine rinse daily, as prescribed, to reduce colonization of the oropharynx and prevent subsequent VAP.
- Moisten the patient's lips and oral mucosa every two to four hours to reduce oral inflammation and improve oral health (2).

Nursing Management

- Institute measures to prevent venous thromboembolism (VTE) and peptic ulcer disease (PUD), if prescribed.
- Place the call light within the patient's reach, and establish a method of communication, such as a communication board.
- Administer and titrate the patient's sedative and neuromuscular blocking agent as ordered, following safe medication administration practices. Maintain target sedation levels to avoid oversedation. Remember that the patient receiving a neuromuscular blocking agent requires sedation and close observation since they are unable to communicate or breath spontaneously (2).

Supportive Care

Based on years of research, the evidenced-based approach to supportive care of the ventilated patient has shifted. The main components will be discussed.

Supportive Care

Sedation and pain management

- The use of sedation protocols and daily wake-up trials have each been associated with reduced duration of mechanical ventilation and ICU/hospital lengths of stay.
- Sedation should be delivered using a validated sedation tool such as the Richard Agitation-Sedation Scale (RASS) or the Riker Sedation-Agitation Scale (SAS). By using the agitation scales, you can ensure a calm, interactive, or lightly sedated patient by a RASS target of -2 to 0 or a SAS target of 3-4.
- Pain is a common experience for mechanically ventilated patients and can be caused by suctioning, turning, mobilization, catheter insertion, and wound care. Pain due to these stimuli should be anticipated and prevented with pharmacologic analgesia (11).

Supportive Care

Agitation and delirium

- Delirium is associated with increased mortality and with long-term consequences, for example, post-ICU cognitive impairment.
- Identification of delirium and treatment of the underlying illness is essential. A validated tool to assess delirium should be used. The two most used tools are the Confusion Assessment Method for the ICU (CAM-ICU) and the Intensive Care Delirium Screening Check.
- To minimize environmental factors that trigger delirium, avoid patient-ventilator asynchrony, optimize pain management, and attempt early mobilization. Other interventions that are helpful include frequently reorienting the patient, maintaining a normal day-night routine, and ensuring the patient has his or her hearing aids, eyeglasses, and dentures. (11).

Supportive Care

Sleep in the ICU

- Patients who require mechanical ventilation experience sleep deprivation due to multiple factors (e.g. noise, patient care monitoring, illness, pain, medical equipment).
- To promote better sleep in ventilated patients, it suggested to reduce disruptive factors (pain, noise) as much as possible.
- Hypnotic drugs should only be used when necessary and should be selected based on the patient's condition, age, comorbidities, potential interactions, and whether or not the patient required the use of sleep aids prior to being in the ICU (11).

Supportive Care

The use of physical restraints

- The use of restraints is a very aggressive measure and should be the last (and temporary) resort for the prevention of self-harm or harm to others.
- The goal should be to avoid or reduce the use of restraints whenever possible.
- For patients who are agitated, a non-pharmacological and pharmacological approach should be used to treat the underlying cause of the agitation. Pain is the most frequent cause of agitation and therefore should be assessed and treated (11).

Supportive Care

Early mobilization

- Traditionally, bed rest is promoted as a treatment that supports the patient toward recovery from critical illness. However, there is little evidence to support this concept.
- Bed rest should be reduced and early mobilization implemented to prevent neuromuscular dysfunction.
- Minimum bed rest and early involvement with a multidisciplinary rehabilitation team during the ICU stay is an important strategy to reduce the long-term impact of critical illness (11).

Supportive Care

Family engagement

- An active partnership between caregivers and relatives is known as family engagement.
- A family engagement concept in the ICU setting consists of a multidisciplinary framework, which involves physicians, nurses, social workers, and spiritual care.
- To support families during a patient's critical illness, provide realistic, consistent, and timely information about diagnosis, treatment, and prognosis; encourage the presence of family during nursing and medical rounds; enable family members to assist with direct patient care; provide a variety of resources and support systems (e.g. social services, spiritual care); and be sensitive to family members' personal comfort needs (e.g. waiting room environment) (11).

Complications

Major complications can arise with the use of mechanical ventilation. These include hemodynamic compromise, barotrauma, volutrauma, auto-PEEP, ventilator-associated pneumonia (VAP), hyponatremia and positive fluid balance, and upper gastrointestinal (GI) hemorrhage.

Complications

Hemodynamic compromise

- The use of positive-pressure ventilation increases peak airway pressures during inspiration, which leads to increases in mean airway pressures. This increase in mean airway pressures can impede venous return to the right atrium, thus decreasing CO. The decrease in CO can lead to increased heart rate, decreased blood pressure, and impaired perfusion to vital organs in some patients.
- Increasing the preload of the heart (e.g. fluid administration), decreasing the airway pressures exerted during mechanical ventilation (suctioning, positioning, etc.) and appropriate ventilator settings are some of the methods used to manage hemodynamic compromise (6).

Complications

Barotrauma

- Barotrauma is a complication of positive-pressure ventilation. Consequences include pneumothorax, pneumomediastinum, pneumoperitoneum, or subcutaneous emphysema. Pneumothorax can lead to cardiovascular collapse, so prompt recognition and treatment is crucial. Indications include acute increase in airway pressure, diminished breath sounds unilaterally, or abrupt drop in blood pressure.
- The incidence of barotrauma can be decreased using small TVs, cautious use of PEEP, and avoidance of high airway pressures and development of auto-PEEP (6, 12).

Complications

Volutrauma

- Alveolar damage from high pressures resulting from large-volume ventilation in patients with ARDS is known as volutrauma. This results in alveolar fractures and flooding.
- The use of smaller TVs (4-6 mL/kg of ideal body weight) is a common technique to reduce the risk of volutrauma. This is known as the "low stretch" protocol or low TV ventilation (6).

Complications

Auto-PEEP

- Auto-PEEP occurs when a delivered breath is incompletely exhaled before the onset of the next inspiration. It can be identified when ventilator waveforms, auscultation, and/or palpation demonstrate continued expiratory airflow from the preceding breath when the next breath is triggered.
- Patients with COPD (asthma, emphysema) or high respiratory rates have an increased risk of the development of Auto-PEEP.
- Auto-PEEP can be minimized by
  - Maximizing the length of time for expiration (e.g. increasing inspiratory flow rates by shortening inspiratory times).
  - Decreasing obstructions to expiratory flow (e.g. using larger diameter ET tubes, eliminating bronchospasm and secretions).
  - Avoiding overventilation (6, 12).

Complications

Ventilator-associated pneumonia (VAP)

- VAP is a hospital-acquired complication and is associated with increased patient morbidity and mortality.
- Limiting the use of invasive ventilation, promoting patient safety while undergoing ventilation, and effective protocols for ventilator liberation are evidenced-based practices to prevent VAP.
- Additional practices to prevent VAP include:
  - Elevating the head of the bed 30° to 45° to minimize aspiration of oral and gastric secretions.
  - Continuous aspiration of subglottic secretions with ET tubes.
  - Oral care protocols including chlorhexidine gluconate 0.12% mouth rinse and tooth brushing to remove plaque (6).

Complications

Hyponatremia and positive fluid balance

- Hyponatremia is common and is caused by several factors including applied PEEP, humidification of inspired gases, hypotonic fluid administration and diuretics, and increased levels of circulating antidiuretic hormone (6).

Complications

Upper gastrointestinal (GI) hemorrhage

- Upper GI bleeding may develop secondary to ulceration or gastritis.
- Positive-pressure ventilation for greater than 48 hours is a risk factor for GI bleeding due to stress ulceration.
- Upper GI bleeding can be prevented by ensuring hemodynamic stability and the administration of proton-pump inhibitors, H2 receptor antagonists, antacids, or cytoprotective agents (6,12).

Ventilator Alarms

Ventilator alarms are critical to ensure safe and effective mechanical ventilation. The alarms continuously monitor ventilator function and are set to identify when clinical parameters vary from the set levels.

Ventilator Alarms - Low Pressure

Possible cause	Nursing intervention
ET tube disconnected from ventilator	Reconnect the ET tube to the ventilator.
ET tube displaced	Check ET tube placement and reposition if needed. If extubation has occurred, manually ventilate the patient and call the physician immediately.
Leaking tidal volume from low cuff pressure (from an underinflated or ruptured cuff or a leak in the cuff or one-way valve)	An air leak is indicated by a whooshing sound around the ET tube. Check the cuff pressure. If you can't maintain pressure, call the physician, who may need to insert a new tube.
Ventilator malfunction	Disconnect the patient from the ventilator and ventilate manually if necessary. Obtain another ventilator (2).

Ventilator Alarms – High Pressure

Possible cause	Nursing interventions
Increased airway pressure or decreased lung compliance; bronchospasm	Assess the patient and auscultate the lungs for evidence of barotrauma or wheezing; notify physician if indicated.
Patient biting on ET tube	Insert a bite block and consider pain medication or sedation if appropriate.
Secretions in airway	Look for secretions in the airway, suction the patient, or have the patient cough to remove secretions.
Condensate in large bore tubing	Check tubing and drain condensate as necessary.
Patient coughing, gagging, or attempting to talk	Check tube position for displacement; call physician if warranted.
Chest wall resistance	Check patient for ventilator asynchrony. The physician may need to order sedation or a neuromuscular blocking agent with sedation (2).

Weaning

- The process of transitioning the patient from the ventilator to unassisted spontaneous breathing is known as weaning (5).
- In order to be successfully weaned from the ventilator, the patient must have the ability to breathe independently. The patient is required to have spontaneous respiratory effort for effective gas exchange, a stable cardiovascular system, and sufficient respiratory muscle strength and level of consciousness (12).
- Additional criteria that should be met before a patient is weaned includes:
  - The indication for intubation and mechanical ventilation must be resolved
  - There must be no auto-PEEP
  - There should not be copious amounts of secretions in the ET tube that could generate high airway resistance and obstruction after extubation (5).

Weaning

- A sedation vacation should be done daily to assess readiness for extubation with appropriate mental status. During the sedation vacation, sedation should be decreased to a minimum or stopped, and the patient should be awake, cooperative, and comfortable.
- After the criteria for weaning have been satisfied, it is time to perform a spontaneous breathing trial (SBT).
- To perform the SBT, the ventilator support should be reduced to a minimum. This can be done either via T-piece or pressure-support ventilation (PSV). CPAP has also been used but is thought to be inferior to the other two methods (5).

Weaning

- SBTs are generally performed between 30 minutes and two hours and the patient should be monitored closely for any signs of respiratory distress. If the patient exhibits any signs of respiratory distress, he or she should be placed back on the prior ventilator settings.
- If the patient is ready for extubation, the ET tube should be removed and the patient should be monitored closely (5,6).

Weaning

- To remove the ET tube, hyperoxygenate the patient for 30 to 60 seconds, suction the ET tube and the patient's oropharynx, and hyperoxygenate the patient again for at least one minute.
- Unfasten the ET tube, and while stabilizing the tube, attach a 10 mL syringe to the pilot balloon and aspirate the air until you meet resistance and the balloon deflates.
- Instruct the patient to remain calm and take a deep breath. At the peak of inspiration, remove the ET tube following the natural curve of the patient's mouth.
- Administer supplemental humidified oxygen, suction the oropharynx, if needed, and encourage the patient to cough and deep-breath.
- Document the procedure (14).

Weaning

- After being weaned, the patient should demonstrate:
  - Respiratory rate less than 24 breaths/min
  - Heart rate and blood pressure within 15% of personal baseline
  - Arterial pH greater than 7.35
  - Partial pressure of arterial oxygen maintained at greater than 60 mm Hg
  - Partial pressure of arterial carbon dioxide maintained at less than 45 mm Hg
  - Oxygen saturation level maintained at greater than 90%
  - Absence of cardiac arrhythmias
  - Absence of accessory muscle use
  - *The patient may require supplemental oxygen to achieve these goals (13).

Conclusion

- When patients have difficultly ventilating or oxygenating, mechanical ventilation may be necessary. The nurse must know how to assess, monitor, and care for patients on mechanical ventilation and understand basic ventilator functions.

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