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MECHANICAL VENTILATOR AND NURSING RESPONSIBILITIES

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ABSTRACT

Mechanical ventilation, or assisted ventilation, is that the medical term for artificial ventilation where mechanical means are wont to assist or replace spontaneous breathing. This may involve a machine called a ventilator. A mechanical ventilator may be a machine that helps a patient breathe (ventilate) once they are having surgery or cannot breathe on their own thanks to a critical illness. The patient is connected to the ventilator with a hollow tube (artificial airway) that goes in their mouth and down into their main airway or trachea. They remain on the ventilator until they improve enough to breathe on their own. There are many benefits, but a major risk is infection. Nurse in critical areas of hospital are providing care to the patient thoroughly. To prevent the complications related to mechanical ventilator nurse should know about the basics of mechanical ventilator and care of patient on ventilator. Nurses caring for patients on mechanical ventilation require specialist knowledge and skills to monitor, identify and prevent the potential deleterious effects associated with it. Nurse practitioners in critical care areas are specially trained within the care of patients who are connected to mechanical ventilators.

INTRODUCTION

A mechanical ventilator may be a machine that generates a controlled flow of gas into a patient's airways. Oxygen and air are received from cylinders or wall outlets, the gas is pressure reduced and blended consistent with the prescribed inspired oxygen tension (FiO2), accumulated during a receptacle within the machine, and delivered to the patient using one of many available modes of ventilation.Mechanical ventilation is indicated when the patient's spontaneous breathing is inadequate to maintain life. It is also indicated as prophylaxis for imminent collapse of other physiologic functions, or ineffective gas

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exchange within the lungs. Because mechanical ventilation serves only to supply assistance for breathing and doesn't cure a disease, the patient's underlying condition should be identified and treated so as to resolve over time. In addition, other factors must be taken into consideration because mechanical ventilation isn't without its complications.

INDICATIONS FOR MECHANICAL VENTILATION

- Acute lung injury (including ARDS, trauma)
- Apnea with respiratory arrest, including cases from intoxication
- Chronic obstructive pulmonary disease (COPD)
- Acute respiratory acidosis with partial pressure of carbon dioxide (pCO2) > 50 mmHg and pH < 7.25, which may be due to paralysis of the diaphragm due to Guillain-Barré syndrome, Myasthenia Gravis, spinal cord injury, or the effect of anesthetic and muscle relaxant drugs.
- Increased work of breathing as evidenced by significant tachypnea, retractions, and other physical signs of respiratory distress.
- Hypoxemia with arterial partial pressure of oxygen (PaO2) with supplemental fraction of inspired oxygen (FiO2) < 55 mm Hg.
- Hypotension including sepsis, shock, congestive heart failure
- Neurological diseases such as Muscular Dystrophy and Amyotrophic Lateral Sclerosis
- Brain injury or stroke
- Drug overdose

CONTRAINDICATIONS FORMECHANICAL VENTILATION:

- No indications for ventilator supports exist.
- Noninvasive ventilation is indicated
- DNR (Do not resuscitate) policy

INTUBATION: Intubation is that the process of inserting a tube, called an catheter (ET), through the mouth then into the airway. This is done in order that a patient are often placed on a ventilator to help with breathing during anesthesia, sedation, or severe illness.

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MECHANISM OF ACTION

Ventilators blow air—or air with extra oxygen—into the airways then the lungs. The airways are pipes that carry oxygen-rich air to your lungs. They also carry carbon dioxide, a waste gas, out of lungs.

The Breathing Tube : A ventilator blows air into your airways through a breathing tube. One end of the tube is inserted into your windpipe and therefore the other end is attached to the ventilator. The breathing tube is an airway by letting air and oxygen from the ventilator flow into the lungs. The process of inserting the tube into your windpipe is called intubation. Usually, the breathing tube is put into your windpipe through your nose or mouth. The tube is then moved down into your throat. A tube placed like this is called an endotracheal tube. In an emergency, patient is given medicine to make patient sleepy and ease the pain of the breathing tube being put into your windpipe.

MODES OF MECHANICAL VENTILATION

Classification of modes of ventilators:

1) Volume control
2) Pressure control
3) Others modes

A. VOLUME MODES

1. Assist-Control Ventilation (ACV)**:** Also known as continuous mandatory ventilation (CMV). Each breath is either an assist or control breath, but they're all of an equivalent volume. The larger the quantity , the more expiratory time required. If the I:E ratio is less than 1:2, progressive hyperinflation may result. ACV is especially undesirable for patients who breathe rapidly – they'll induce both hyperinflation and alkalosis .Note that mechanical ventilation doesn't eliminate the work of breathing, because the diaphragm should be very active.Delivers pre-set volumes at a pre-set rate and a pre-set flow .The patient cannot generate spontaneous volumes, or flow rates during this mode. Each patient generated respiratory effort over and above the set rate are delivered at the set volume and flow . This mode is employed most frequently within the paralyzed or apneic patient because it can increase the work of breathing if respiratory effort is present.

2. Synchronized Intermittent-Mandatory Ventilation (SIMV) : Guarantees a certain number of breaths, but unlike ACV, patient breaths are partially their own, reducing the risk of hyperinflation or alkalosis. Mandatory breaths are synchronized to coincide with spontaneous respirations.The ventilator delivers pre-set breaths in coordination with the

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respiratory effort of the patient. Spontaneous breathing is allowed between breaths.Here ventilator delivers set tidal volume and rate as set by doctor. But when patent is awake and not paralysed , and starts his breathing, ventilator detects efforts and supports it. So it is used partially awake and non parlayed patients and during weaning.Synchronization attempts to limit barotrauma that may occur with IMV when a preset breath is delivered to a patient who is already maximally inhaled (breath stacking) or is forcefully exhaling. The initial choice of ventilation mode (eg, SIMV, A/C) is institution and practitioner dependent. A/C ventilation, as in CMV, may be a full support mode therein the ventilator performs most, if not all, of the work of breathing. These modes are beneficial for patients who require a high minute ventilation. Full support reduces oxygen consumption and CO2 production of the respiratory muscles.

ACV vs. SIMV

Personal preference prevails, except in the following scenarios:

1. Patients who breathe rapidly on ACV should switch to SIMV

2. Patients who have respiratory muscle weakness and/or left-ventricular dysfunction should be switched to ACV

B. PRESSURE MODES

1. Pressure-Controlled Ventilation (PCV) :A set peak inspiratory pressure (PIP) is applied, and the pressure difference between the ventilator and the lungs results in inflation until the peak pressure is attained and passive exhalation follows.Less risk of barotrauma as compared to ACV and SIMV. Does not allow for patient-initiated breaths. The inspiratory flow pattern decreases exponentially, reducing peak pressures and improving gas exchange.The major disadvantage is that there are not any guarantees for volume, especially when lung mechanics are changing. Thus, PCV has traditionally been preferred for patients with neuromuscular disease but otherwise normal lungs

2. Pressure Support Ventilation (PSV) :Allows the patient to determine inflation volume and respiratory frequency (but not pressure, as this is pressure-controlled), thus can only be used to augment spontaneous breathing.Pressure support are often wont to overcome the resistance of ventilator tubing in another cycle (5 – 10 cm H20 are generally used, especially during weaning), or to reinforce spontaneous breathing. PSV can be delivered through specialized face masks.

3. Pressure Controlled Inverse Ratio Ventilation (PCIRV) :Pressure controlled ventilatory mode in which the majority of time is spent at the higher (inspiratory) pressure.Early trials

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were promising, however the risks of auto PEEP and hemodynamic deterioration thanks to the decreased expiratory time and increased mean airway pressure generally outweigh the tiny potential for improved oxygenation.

4. Airway Pressure Release Ventilation (APRV) :Airway pressure release ventilation is similar to PCIRV – instead of being a variation of PCV in which the I:E ratio is reversed, APRV is a variation of CPAP that releases pressure temporarily on exhalation. This unique mode of ventilation leads to higher average airway pressures. Patients are ready to spontaneously ventilate at both low and high pressures, although typically most (or all) ventilation occurs at the high .In the absence of attempted breaths, APRV and PCIRV are identical. As in PCIRV, hemodynamic compromise may be a concern in APRV. Additionally, APRV typically requires increased sedation.

C. OTHER MODES:

I. DUAL MODE

Pressure Regulated Volume management (PRVC) :A volume target backup is more to a pressure assist-control mode.This is a volume targeted, pressure restricted mode. (available in SIMV or AC). every breath is delivered at a group volume with a variable rate of flow ANd an absolute pressure limit.The vent delivers this pre-set volume at the bottom needed peak pressure and regulate with every breath.

II. INTERACTIVE MODE:

Proportional Assist Ventilation (PAV) :During PAV, the practician sets the proportion of labor of respiratory to be provided by the ventilator.PAV uses a feedback loop to accomplish this, which needs information of resistance and electrical phenomenon to properly attenuate the signal.

NON-INVASIVE VENTILATION/ BIPAP:

- The application of mechanical ventilatory support through a mask in place of endotracheal intubation is becoming increasingly accepted and used in the emergency department.
- Considering this modality for patients with mild-to-moderate respiratory failure is appropriate. The patient must be mentally alert enough to follow commands.
- Clinical situations in which it has proven useful include acute exacerbation of chronic obstructive pulmonary disease (COPD) or asthma, decompensated congestive heart failure (CHF) with mild-to-moderate pulmonary edema, and pulmonary edema from hypervolemia.

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- It is most commonly applied as continuous positive airway pressure (CPAP) and biphasic positive airway pressure (BiPAP).
- BiPAP is commonly misunderstood to be a form of pressure support ventilation triggered by patient breaths; in actuality, BiPAP is a form of CPAP that alternates between high and low positive airway pressures, permitting inspiration (and expiration) throughout.
- Reviews of the literature have shown non-invasive positive-pressure ventilation to be beneficial for COPD, reducing the rate of tracheal intubations as well as length of stay.Their benefit increases with increasing severity of disease.
- In patients with mild cases of COPD and CHF who would not otherwise require ventilatory support do not benefit from non-invasive positive-pressure ventilatory support.
- The use of non-invasive positive-pressure ventilation has been less well studied in asthma, but, in one small randomized trial, it reduced hospital admission rates.

NURSING RESPONSIBILITIES

- Cardiac monitor, blood pressure, and pulse oximetry (SaO2) are recommended. The authors' practice with stable patients is to titrate down FiO2 to the minimum value necessary to maintain maximal SaO2.
- An arterial blood gas (ABG) measurement is frequently obtained 10-15 minutes after the institution of mechanical ventilation. The measured arterial PaO2 should verify the transcutaneous pulse oximetry readings and direct the reduction of FiO2 to a value less than 0.5.
- The measured PaCO2 can suggest adjustments of minute ventilation but should be interpreted in light of the patient's overall acid-base status. Forexample, full correction of PaCO2 in a chronically hypercarbic COPD patient will lead to unopposed metabolic alkalosis.
- It is of paramount importance that all cares and procedures are carried out with maintaining a patent airway always in mind
- Always check the patient first. Observe the patient's facial expression, color, respiratory effort, vital signs and ECG tracing
- Check and adjust (if necessary) the cuff pressure of the ETT/trachi. In order to minimize tracheal damage, the cuff pressure should be at the lowest pressure necessary to prevent an air leak.

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- An alternative means of ventilation e.g. Ambo bag must be available & functional suction catheters and functioning suction unit, airways and masks should be available**.**
- Check the ventilator and document the settings. Look at the alarm parameters and reset if necessary.
- Check the type of humidification, and when the filters and ventilation tubing were last changed.
- Document the patient's vital signs hourly and when there is a deviation from the usual.
- NG tubes should be flushed with 20-30 mls of water before and after administering medications.
- Prevents the development of pressure areas, joint stiffness and deformities
- Hourly urine monitoring is carried out and medical staff informed of abnormally high or low measurements. Aim for a urine output of 0.5ml/kg.
- Elevating the head of the bed to 30 - 45 degrees (unless contraindicated) is effective in reducing the risk of aspiration
- Nutrition and hydration are essential to build respiratory muscle strength necessary when a patient is being weaned from a ventilator. Patients who have inadequate nutritional stores are prone to infection, fluid and electrolyte imbalance, intestinal fluid retention, weight loss, pressure areas and poor wound healing
- Check and document a manual blood pressure to assess the accuracy of the arterial trace once a shift.
- An alternative means of ventilation e.g. Ambo bag must be available & functional suction catheters and functioning suction unit, airways and masks should be available
- The lips should be kept moisturized to stop them becoming sore and cracked.
- When you enter the patient's room, take vital signs, check oxygen saturation, listen to breath sounds, and note changes from previous findings.
- Also assess the patient's pain and anxiety levels. Read the patient's order and obtain information about the ventilator.
- A mechanical ventilator is a positive or negative pressure breathing device that can maintain ventilation and oxygen delivery for a prolonged period.

COMPLICATIONS

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- Decreased Cardiac Output-it can be treated with fluid administration
- Barotrauma- use of PEEP
- Positive Water Balance – it can be Treat with decreasing fluid intake
- Decreased Renal Perfusion – can be treated with low dose dopamine therapy
- Increased Intracranial Pressure (ICP) – reduce PEEP
- Hepatic congestion – reduce PEEP
- Worsening of intracardiac shunts –reduce PEEP Associated with ventilator malfunction

CONCLUSION

In Hospital, mechanical ventilator is indicated for so many clinical and physiological causative factors. The nursing management of the mechanically ventilated patient is a challenging aspect on many levels: from the acquisition of highly technical skills; expert knowledge on invasive monitoring; and implementation of interventions to care for the patient. However, there are many collaborative principles which includes the nursing management of such patients in the intensive care unit (ICU), those being patient safety: patient and equipment assessment; and patient comfort: patient position; hygiene; management of stressors and; pain and sedation management.

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