Mechanical Ventilation

Contents

- Anatomy and Physiology Of Respiratory System
- Introduction About Mechanical Ventilation
- History
- Meaning of Mechanical Ventilation
- Indications for use
- Types or Forms Of Mechanical Ventilation
- Settings of Mechanical Ventilation
- Modes of Mechanical Ventilation
- Complications associated with Mechanical Ventilation
- Nursing Management of ventilator patients

Introduction About Mechanical Ventilation

Mechanical ventilation is typically used after an invasive intubation, a procedure wherein an endotracheal or tracheostomy tube is inserted into the airway. It is used in acute settings such as in the ICU for a short period of time during a serious illness. It may be used at home or in a nursing or rehabilitation institution if patients have chronic illnesses that require long-term ventilation assistance.

History

The roman physician Galen may have been the first to describe mechanical ventilation: "If you take a dead animal and blow air through its larynx [through a reed], you will fill its bronchi and watch its lungs attain the greatest distention." Vesalius too describes ventilation by inserting a reed or cane into the trachea of animals. In 1908 George Poe demonstrated his mechanical respirator by asphyxiating dogs and seemingly bringing them back to life.

Meaning of Mechanical Ventilation

In medicine, **mechanical ventilation** is a method to mechanically assist or replace spontaneous breathing.

Indications for use

- Common medical indications for use include:
- 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 (pCO_2) > 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 anaesthetic 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 (PaO_2) with supplemental fraction of inspired oxygen (FiO_2) < 55 mm Hg
- Hypotension including sepsis, shock, congestive heart failure
- Neurological diseases such as Muscular Dystrophy Amyotrophic Lateral Sclerosis

Types or Forms Of Mechanical Ventilation

The two major types of Mechanical Ventilation are Negative pressure and positive Pressure ventilation

The main form of mechanical ventilation is positive pressure ventilation, which works by increasing the pressure in the patient's airway and thus forcing air into the lungs. Less common today are negative pressure ventilators (for example, the "iron lung") that create a negative pressure environment around the patient's chest, thus sucking air into the lungs.

Types or Forms Of Mechanical Ventilation

Negative Pressure Ventilator

Positive Pressure Ventilator

Settings of Mechanical Ventilation

- Mechanical Ventilator Settings regulates the rate, depth and other characteristics of ventilation. Settings are based on the patient's status (ABGs, Body weight, level of consciousness and muscle strength)

PARAMETERS OF MECHANICAL VENTILATION ARE

- Respiratory Rate (f) :-Normally 10-20b/m
- Tidal Volume (V_T) :-5-15ml/kg
- Oxygen Concentration(FIO_2):-b/w 21-90%
- I:E Ratio:-1:2
- Flow Rate:-40-100L/min
- Sensitivity/Trigger:- 0.5-1.5 cm H_2O
- Pressure Limit:-10-25cm H_2O
- PEEP :- Usually, 5-10 cmH2O

Connection to Ventilators

- Face Mask

- Airway

- Laryngeal Mask

- Tracheal Intubation

- Tracheostomy

Modes of Mechanical Ventilation

- Controlled Mandatory Ventilation (CMV)
- Asst-Control Mandatory Ventilation (ACV)
- Synchronized Intermittent Mandatory Ventilation(SIMV)
- Positive Expiratory End Pressure(PEEP)
- Continuous Positive Airway Pressure (CPAP)
- Pressure Support Ventilation (PSV)

Modes of Mechanical Ventilation

Asst-Control Mandatory Ventilation (ACV)

- Assist Control (AC). In this mode the ventilator provides a mechanical breath with either a pre-set tidal volume or peak pressure every time the patient initiates a breath. Traditional assist-control used only a pre-set tidal volume--when a preset peak pressure is used this is also sometimes termed Intermittent Positive Pressure Ventilation or IPPV. However, the initiation timing is the same--both provide a ventilator breath with every patient effort. In most ventilators a back-up minimum breath rate can be set in the event that the patient becomes apnoeic. Although a maximum rate is not usually set, an alarm can be set if the ventilator cycles too frequently. This can alert that the patient is tachypneic or that the ventilator may be auto-cycling (a problem that results when the ventilator interprets fluctuations in the circuit due to the last breath termination as a new breath initiation attempt)

Synchronized Intermittent Mandatory Ventilation(SIMV)

- Synchronized Intermittent Mandatory Ventilation (SIMV). In this mode the ventilator provides a pre-set mechanical breath (pressure or volume limited) every specified number of seconds (determined by dividing the respiratory rate into 60 - thus a respiratory rate of 12 results in a 5 second cycle time). Within that cycle time the ventilator waits for the patient to initiate a breath using either a pressure or flow sensor. When the ventilator senses the first patient breathing attempt within the cycle, it delivers the preset ventilator breath. If the patient fails to initiate a breath, the ventilator delivers a mechanical breath at the end of the breath cycle. Additional spontaneous breaths after the first one within the breath cycle do not trigger another SIMV breath. However, SIMV may be combined with pressure support (see below). SIMV is frequently employed as a method of decreasing ventilatory support (weaning) by turning down the rate, which requires the patient to take additional breaths beyond the SIMV triggered breath.

Positive End Expiratory Pressure(PEEP)

- PEEP) is functionally the same as CPAP, but refers to the use of an elevated pressure during the expiratory phase of the ventilatory cycle. After delivery of the set amount of breath by the ventilator, the patient then exhales passively. The volume of gas remaining in the lung after a normal expiration is termed the *functional residual capacity* (FRC). The FRC is primarily determined by the elastic qualities of the lung and the chest wall. In many lung diseases, the FRC is reduced due to collapse of the unstable alveoli, leading to a decreased surface area for gas exchange and intrapulmonary shunting (*see above*), with wasted oxygen inspired. Adding PEEP can reduce the work of breathing (at low levels) and help preserve FRC.

Continuous Positive Airway Pressure (CPAP)

- (CPAP). A continuous level of elevated pressure is provided through the patient circuit to maintain adequate oxygenation, decrease the work of breathing, and decrease the work of the heart (such as in left-sided heart failure — CHF). Note that no cycling of ventilator pressures occurs and the patient must initiate all breaths. In addition, no additional pressure above the CPAP pressure is provided during those breaths. CPAP may be used invasively through an endotracheal tube or tracheostomy or non-invasively with a face mask or nasal prongs.

Pressure Support Ventilation

- Pressure Support Ventilation (PSV). When a patient attempts to breath spontaneously through an endotracheal tube, the narrowed diameter of the airway results in higher resistance to airflow, and thus a higher work of breathing. PSV was developed as a method to decrease the work of breathing in-between ventilator mandated breaths by providing an elevated pressure triggered by spontaneous breathing that "supports" ventilation during inspiration

Complication

- Hypotension
- Pneumothorax
- Decreased Cardiac Output
- Nosocomial Pneumonia
- Positive Water Balance
- Increased Intracranial Pressure (ICP)
- Alarms turned off or nonfunctional
- Sinusitis and nasal injury
- Mucosal lesions
- Aspiration, GI bleeding, Inappropriate ventilation (respiratory acidosis or alkalosis, Thick secretions, Patient discomfort due to pulling or jarring of ETT or tracheostomy, High PaO2, Low PaO2, Anxiety and fear, Dysrhythmias or vagal reactions during or after suctioning, Incorrect PEEP setting, Inability to tolerate ventilator mode.

Terminologies Used in Mechanical Ventilation

- APRV Airway pressure release ventilation
- ASB Assisted spontaneous breathing—also *ASV* = assisted spontaneous ventilation
- ASV Adaptive support ventilation—a patented technology—closed-loop mechanical respiration, a further development of MMV. Can also stand for assisted spontaneous ventilation.
- ATC Automatic tube compensation
- BIPAP Biphasic positive airway pressure
- CMV Continuous mandatory ventilation
- CPAP Continuous positive airway pressure
- CPPV Continuous positive pressure ventilation
- EPAP Expiratory positive airway pressure

Conti…….

- HFV High frequency ventilation
  - HFFI High frequency flow interruption
  - HFJV High frequency jet ventilation
  - HFOV High frequency oscillatory ventilation
  - HFPPV High frequency positive pressure ventilation
- ILV Independent lung ventilation—separate sides positive pressure ventilation.
- IPAP Inspiratory positive airway pressure
- IPPV Intermittent positive pressure ventilation
- IRV Inversed ratio ventilation— mechanical ventilation with switched respiration phases/time rate.
- LFPPV Low frequency positive pressure ventilation
- MMV Mandatory minute volume
- NAVA Neurally adjusted ventilatory assist

Nursing Management

How to keep the Ventilator ready to receive the case ?

Check the Air and oxygen connections

Connect the Ventilator tubes to ventilator

How to keep the Ventilator ready to receive the case ?

- 

Connect the chest lung to

the ventilator tubing's

Make sure that you correctly connected the tubing's and check for any looseness

How to keep the Ventilator ready to receive the case ?

Connect the servo guard

(From the patient)

Connect the filter

(To the Patient)

How to keep the Ventilator ready to receive the case ?

- 

Check the tubing's for any leakage

Change the Bacteria filter

How to keep the Ventilator ready to receive the case ?

Change the bacteria filter

Nursing Interventions

- Inspect thorax for symmetry of movement. Determines adequacy of breathing pattern; asymmetry may indicate hemothorax or pneumothorax. . Measure tidal volume and vital capacity.
- Asses for pain
- Monitor chest x-rays
- Maintain ventilator settings as ordered.

Nursing Interventions

- Elevate head of bed 60-90 degrees. This position moves the abdominal contents away from the diaphragm, which facilitates its contraction.
- Monitor ABG's. Determines acid-base balance and need for oxygen.
- Observe skin color and capillary refill. Determine adequacy of blood flow needed to carry oxygen to tissues.

Nursing Interventions

- Assess for GI problems. Preventative measures include relieving anxiety, antacids or H2 receptor antagonist therapy, adequate sleep cycles, adequate communication system.
- Maintain muscle strength with active/active-assistive/passive ROM and prevent contractures with use of span-aids or splints.

Nursing Interventions

- Explain purpose/mode/and all treatments; encourage patient to relax and breath with the ventilator; explain alarms; teach importance of deep breathing; provide alternate method of communication; keep call bell within reach; keep informed of results of studies/progress; demonstrate confidence.

Which we should not forget

Suctioning

Mouth care

Nubulization