APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
(KTU COVID-19 CELL & CERD)

Specifications of Portable CMV Ventilator

Description of Function

The portable ventilator is used to transport a patient with artificial respiration support or home care of a patient after discharge from a hospital.

Technical Specifications

- Portable ventilator (weight< 10 kg)
- Microprocessor controlled
- Operate with main electric supply as well as with battery
- Employing turbine/venturi/jet mixingtechniques
- Should have CMV mode of ventilation:
  Continuous mandatory ventilation (CMV) is a mode in which breaths are delivered based on predefined set variables.
- Audio-visual alarms for
  a. Low supply pressure
  b. High/low airway pressure
  c. Leakage/disconnection
  d. Power failure
  e. Apnea
  f. Low battery
- Should have following settings (refer last page for explanations):
  a. TV: 50 – 1500ml
  b. PEEP
  c. RR up to 40bpm
  d. I:E ratio 1:3 to 2:1
  e. FiO_2:40 – 100%

Specifications for Mechanical CMV Ventilator

Description of Function

Mechanical ventilator a device utilized in intensive care and long-term care settings to assist patients who require additional respiratory support. It is indicated for acute or chronic respiratory failure, which is defined as insufficient oxygenation, insufficient alveolar ventilation, or both. Benefits of mechanical ventilation are improved gas exchange and decreased work of breathing.

Technical Specifications

- Microprocessor controlled
- Operate with main electric supply as well as with battery
- Employing turbine / venturi / jet mixingtechniques
- Should have CMV mode of ventilation:
  Continuous mandatory ventilation (CMV) is a mode in which breaths are delivered based on predefined set variables.
- Audio-visual alarms for
  a. Low supply pressure
  b. High/low airway pressure
  c. Leakage/disconnection
  d. Power failure
  e. Low battery
- Should have following settings (refer last page for explanations):
  f. TV: 50 – 1500ml
  g. PEEP
  h. RR up to 40bpm
  i. I:E ratio 1:3 to 2:1
  j. FiO_2:40 – 100%

Glossary

Tidal Volume (TV) - is the amount of air that can be inhaled and exhaled during one normal (quiet) breathing cycle

Positive End Expiratory Pressure (PEEP)- Pressure remaining in the lungs at end expiration. Used to keep alveoli open and "recruit" more alveoli to improve oxygenation for patients.

Respiratory Rate (RR) - number of breaths per minute.

Inspiratory- Expiratory (I:E) Ratio - Normal: longer expiratory phase than Inspiratory phase (1:2, 1:3). Inverse ratios provide a longer Inspiratory phase (1:1, 2:1, 3:1and 4:1).

Fraction of Inspired Oxygen (FiO2) - Concentration of oxygen in the inspired air. Use the lowest FiO2 that achieves the targeted oxygenation.

Assist-control Mode (ACMV) - Each breath is either an assist (patient-initiated) or control (ventilator initiated) breath with guaranteed tidal volume.

Synchronized Intermittent Mandatory Ventilation (SIMV) - The patient is allowed to take additional breaths in between the mechanical breaths. The patient's own breaths are called "spontaneous breaths".

Airway Pressure Release Ventilation (APRV) - CPAP level support with the addition of short (1-1.5 second) pressure releases to improve oxygenation and eliminate CO2.

Pressure Support Ventilation (PSV) - Set pressure during inspiration to augment spontaneous breathing. Used to decrease the work of breathing. Tidal volume depends on patient's effort and lung elasticity.

Continuous Positive Airway Pressure (CPAP) - Spontaneous mode: no set Vt or f (RR). PEEP keeps alveoli open, and PS overcomes work of breathing through tubing.

Reference: IS 1079- Specification for Lung Ventilator: Bureau of Indian Standards

Why CMV Ventilator:

Regular ventilators provide many types of operations including CMV, ACMV, SIMV, APRV, PSV and CPAP modes. The realisation of such a device would require a large number of sensors, associated electronics and instrumentation, autocalibration functions, extensive programming to monitor and control these functions. Over and above these, the safety and alarm conditions also need to be addressed.

Students shall take up the designs incorporating all these functionalities but taking into account the short time span, for the ventilator challenge, the simple CMV system is suggested.

(Specifications in consultation with SCTIMST, Trivandrum)