

# PR29: Mechanical Ventilation

## Applicable To

■ CCP only

## Introduction

Patients in out-of-hospital settings may benefit from mechanical ventilation. In cases where mechanical ventilation represents a component of a treatment plan (such as hypoxemic respiratory failure secondary to pneumonia), it should be initiated as early as practicable. For other patients requiring mechanical support, the use of a ventilator provides consistent ventilation, allows close monitoring of ventilatory parameters, and frees paramedics from the need to ventilate by hand.

Despite these benefits, patients with time-dependent emergencies, such as traumatic injuries, should not have their conveyance delayed. Paramedics must make the decision to initiate mechanical ventilation based on clinical presentation, anticipated complications, and logistical factors (including availability of assistance and conveyance time).

## Procedure

### General approach

1. Determine type of ventilator (LTV 1000 / LTV 1200, Hamilton T1).
  - PEEP compensated
  - Non-PEEP compensated
2. Connect power source.
3. Assemble ventilator circuit:
  - Circuit
  - $E_t\text{CO}_2$  detector
  - HME filter
  - Tracheal suction
4. Perform initial checks:
  - Start up
  - Leak test

### Basic approach to ventilation

1. Select Assist Control -- Volume or (S)CMV+.
2. Select tidal volume ( $V_T$ ) of 6-8 mL/kg.
  - May select higher volumes in patients without lung injury as required
  - Monitor for elevated  $P_{\text{plat}}$  ( $> 30 \text{ cmH}_2\text{O}$ )
3. Set respiratory rate:
  - Rate and  $V_T$  must provide a minute volume ( $V_E$ ) that adequately meets the patient's metabolic demands unless a permissive hypercapnia strategy is being used
  - Monitor for presence of auto-PEEP
4. Set desired  $\text{FiO}_2$ :
  - For patients with any degree of hypoxia, an initial  $\text{FiO}_2$  of 1.0 is appropriate
  - $\text{FiO}_2$  should be titrated down as soon as practical, assuming adequate oxygenation can be maintained in the context of the patient's condition and metabolic demands
5. Set desired PEEP:
  - Set initial PEEP with consideration of the physiological context; 5-10  $\text{cmH}_2\text{O}$  is appropriate for most patients
  - Hypoxemic patients will likely require higher levels of PEEP; titrate as required
  - Ensure plateau pressures ( $P_{\text{plat}}$ ) are  $\leq 30 \text{ cmH}_2\text{O}$

6. Set inspiratory time ( $T_i$ ):
  - Adjust  $T_i$  for flows ( $V_{calc}$ ) of 40-60 liters/minute
7. Set sensitivity to allow for patient-triggered breaths, if desired.
8. Set appropriate initial alarm parameters:
  - High pressure limit: 10 cmH<sub>2</sub>O above current peak inspiratory pressure (PIP)
  - Low pressure: 5 cmH<sub>2</sub>O above set PEEP
  - Low minute volume: 10-20% below set minute volume
  - Monitor the patient's vital signs including SpO<sub>2</sub>, EtCO<sub>2</sub>, vital signs, arterial blood gas, and P<sub>plat</sub> and adjust ventilator settings appropriately
9. In case of refractory hypoxia, consider:
  - Increasing PEEP and FiO<sub>2</sub>, with due consideration of trans-pulmonary pressures and/or P<sub>plat</sub>
  - Performing a recruitment maneuver if indicated (e.g., inspiratory hold at 40 cmH<sub>2</sub>O for 40 seconds); use caution in cases of hemodynamic compromise
  - Adjusting mode of ventilation
  - Switching to pressure control ventilation
    - If changing to pressure control, monitor for auto-PEEP and adjust alarm parameters to appropriate settings:
      - High pressure limit: 10 cmH<sub>2</sub>O above set total pressure
      - Low pressure: 5 cmH<sub>2</sub>O above set PEEP
      - Low minute volume: 10-20% below actual minute volume
  - Increasing  $T_i$
  - Inserting an esophageal balloon
  - Using inverse-ratio ventilation (IRV)

