

## **AARC - ADULT MECHANICAL VENTILATOR PROTOCOLS**

1. Guidelines for Using Ventilator Protocols
2. Definition of Modes and Suggestions for Use of Modes
3. Adult Respiratory Ventilator Protocol - Guidelines for General Practice

From AARC Protocol Committee; Subcommittee Adult Critical Care  
Version 1.0a (Sept., 2003), Subcommittee Chair, Susan P. Pilbeam

Adult mechanical ventilation protocols have been developed to serve as introductory guides to therapists/physicians/hospitals desiring to institute invasive mechanical ventilation protocols in their adult intensive care units. Inherently built into any protocol should be the concept that these tools need to be evaluated and updated on an ongoing basis in order to maintain evidence-based, best practice procedures.

A signature page including all physicians, respiratory care staff and necessary administrative individuals should be included to demonstrate approval and support of the protocol by the primary group involved in the management of adult patients requiring invasive mechanical ventilation within any institution.

Adult Mechanical Ventilation Protocol will be intended for invasive ventilation and will include the following sections:

1. Guidelines for Using Ventilator Protocols
2. Definition of Modes and Suggestions for Use of Modes
3. Adult Respiratory Ventilator Protocol - Guidelines for General Practice

### **Guidelines for Using Ventilator Protocols**

#### **I. Process for Ordering Adult Respiratory Ventilator Protocols (ARVP) for Intubated Patients**

##### **A. Adult patients should be on the Adult Respiratory Ventilator Protocols (ARVP) with a physician's order.**

1. A physician's order for intubation and ventilation per protocol should be written on the physician's order sheet.
2. Initial ventilator parameters and subsequent ventilator parameter changes made based on the ARVP should be documented on the respiratory therapy department ventilator rounds/flow sheet.
3. Physician ventilator parameter orders and physician orders not covered by the protocols should be written in the physician's order sheets.

##### **B. The attending physician may write "discontinue ARVP" at any time. The patient may also meet ARVP exclusion criteria and not be managed using the protocol.**

C. A pulmonary consult should be obtained, if possible, from the attending physician if any of the following patient evaluations exist: chest, spinal or neurological trauma, pulmonary aspiration or status asthmaticus.

D. The attending physician should request a pulmonary consult in patients requiring mechanical ventilation longer than 24-36 hours.

1. The attending physician and pulmonary physician can then determine the need for a pulmonary consult.
2. If a pulmonary consult has not occurred in a timely manner, the respiratory therapist will contact the department medical director.

II. Exclusion from ARVP includes the following criteria and will require physician management of the ventilated patient:

- A. Patient less than 16 years old
- B. A physician writes a ventilator order that varies from the current ARVP and does not permit adjustment of ventilator parameters based on ARVP. The physician will be contacted and advised that ventilator adjustments must be made based on ARVP and has the choice to approve use of ARVP or to discontinue ARVP.

### **Definition of Modes and Suggestions for Use of Modes**

I. Definition - Mandatory breath modes

A. Volume ventilation (VV): a preset volume is delivered. VV is used in either assist/control, where every breath receives minimally the set volume; or SIMV, where the minimum set volume is delivered at a rate based on the breath rate set for mandatory breaths (SIMV rate).

B. Pressure ventilation (PV) or pressure control ventilation (PCV): a preset pressure is delivered. PV (PCV) is used in either assist/control, where every breath receives minimally the set volume; or SIMV, where the minimum set pressure is delivered at a rate based on the breath rate set for mandatory breaths (SIMV rate).

C. PRVC (pressure regulated volume control)\*: pressure ventilation is delivered such that the pressure is automatically adjusted by the ventilator to provide a set tidal volume. This mode is used in either assist/control, where every breath receives minimally the set volume; or SIMV, where the minimum set volume is delivered at a rate based on the breath rate set for mandatory breaths (SIMV rate).\*[Institution can provide the name used by the ventilator manufacturer for this mode/breath type.]

D. APRV (airway pressure release ventilation)\*: pressure ventilation in which the following parameters are set: P<sub>high</sub> (high pressure), P<sub>low</sub> (low pressure or low PEEP/CPAP), T<sub>high</sub> (time during which high pressure is delivered; T<sub>low</sub> – time during which low pressure. \*[Institution can provide the name used by the ventilator manufacturer for this mode/breath type.]

## II. Definition - Support breath modes

A. Pressure support (PS): a patient-triggered, pressure targeted, flow-cycled mode. This can be a stand-alone breath type in patients who have an intact respiratory drive, or it can be used in combination with mandatory breath types.

B. Volume support (VS): a patient-triggered, pressure targeted, flow-cycled mode that guarantees a set volume delivery. This can be a stand-alone breath type in patients who have an intact respiratory drive, or it can be used in combination with mandatory breath types.

C. Spontaneous/CPAP: Spontaneous breathing through the ventilator, which allows for monitoring and alarms and also allows for adjustment of the baseline to a continuous positive airway pressure value. This breath type provides only pressure or flow assist to the patient. It can be used alone in patients with adequate respiratory drive and ventilation capabilities or in combination with mandatory breath types.

## III. Suggestions for Use of Modes

- A. The selection of the ventilation mode should take into consideration the familiarity of the staff with the mode.
- B. The specific goal for using ventilation should be established for each patient.
  1. In the initial phases of acute respiratory failure, near total ventilator support is recommended.
  2. As the patient's condition improves, methods of ventilation (support breath modes) that allow some amount of spontaneous ventilatory activity can be used in lieu of total support.
- C. Example Uses
  1. Volume ventilation using assist/control is familiar to most practitioners and can provide basic management of patients.
  2. Pressure ventilation using assist/control (pressure-limited, time-cycled assist/control) may help to reduce the work of breathing, in patients with a high work of breathing, compared to other modes. Since volume delivery varies, monitoring of tidal volume is important.
  3. Pressure support by itself may be effective in patients who have an adequate respiratory drive and who might tolerate mechanical ventilation better when a variable I:E ratio is available.

## Adult Respiratory Ventilator Protocol

### I. Adult Invasive Ventilation Protocol Initial Parameters and Goals

A. Volume-Ventilation may be used for the majority of patients, but pressure-ventilation (PV or PRVC) should be considered if peak pressures rise over 40 cm H<sub>2</sub>O or plateau pressures rise  $\geq 30$  cm H<sub>2</sub>O.

B. Tidal Volume: 4 to 12 mL/Kg of ideal body weight (IBW), while maintaining plateau pressure  $\leq 30$  cm H<sub>2</sub>O and delta P  $\leq 20$  cm H<sub>2</sub>O.

C. Minute ventilation:  $4.0 \times \text{BSA (Body Surface Area)} = V_E$  (L/min) for males and  $3.5 \times \text{BSA} = V_E$  (L/min) for females adjusted for altitude and body temperature ( DuBois BSA Nomogram) while maintaining plateau pressure  $\leq 30$  cm H<sub>2</sub>O and delta P  $\leq 20$  cm H<sub>2</sub>O.

D. Rate: 8 to 26 breaths/minute adjusted to achieve optimum total cycle time and maintain desired minute ventilation, while maintaining plateau pressure  $\leq 30$  cm H<sub>2</sub>O and delta P  $\leq 20$  cm H<sub>2</sub>O.

E. FiO<sub>2</sub>: Initial setting of 0.6 to 0.9 until results from arterial blood gases (ABG) can be obtained and the setting adjusted.

1. Initial ABG should be obtained 15-45 minutes from start of ventilation
2. Pulse oximetry should be correlated with initial ABG and the patient subsequently monitored with continuous pulse oximetry to maintain SpO<sub>2</sub> at or above patient's normal or  $>90\%$  SpO<sub>2</sub> (Oxygen saturation by pulse oximetry).
3. PEEP 5 to 15 cm H<sub>2</sub>O. Set initial PEEP at 5 cm H<sub>2</sub>O, unless otherwise indicated. Higher PEEPs may be required with acute lung injury (ALI) or acute respiratory distress syndrome (ARDS). [Note: See ALI/ARDS Protocol]

F. Pressure Support (PS): 8 to 20 cm H<sub>2</sub>O. Maintain Pplateau  $\leq 30$  cm H<sub>2</sub>O and delta P  $\leq 20$  cm H<sub>2</sub>O. PS should be adjusted to reduce work of breathing and patient fatigue and support effective ventilation.

G. I:E ratio less than 1:1 (example 1:3). The I:E ratio should be optimized along with total cycle time (TCT) to provide optimum mean airway pressure, lung filling, lung emptying (minimizing air-trapping/Auto-PEEP), patient/ventilator synchrony.

### II. Ventilator Adjustments Based on Patient Assessment

A. Initial assessment will be performed within 15-45 minutes from start of ventilation.

B. Assessment will include evaluation of the patient's general appearance, blood pressure, heart rate, breath sounds, ventilating pressures and volumes and arterial blood gases (ABG).

- C. Assessment may also include additional data, when available, such as PetCO<sub>2</sub> (end-tidal CO<sub>2</sub>), SpO<sub>2</sub>, and hemodynamic data.
- D. Adjust the ventilator settings so that ABG results are acceptable.

Patient Category	pH	PaCO <sub>2</sub>	PaO <sub>2</sub>	SpO <sub>2</sub>
Normal	7.35-7.45	35-45 mmHg	≥ 80 mm Hg	92-97%
Chronic CO <sub>2</sub> Retention	7.30-7.45	45-55 mmHg adjust to pH range	55-75 mmHg	>89%
Open Heart Patients	7.35-7.50	35-50 mmHg	≥ 65 mm Hg	90-95%
ARDS*	7.25-7.45	Adjust to pH range	≥ 60 mmHg	90-95%

\*See ALI/ARDS Protocol

E. Ventilator adjustments should be made as follows:

1. Regular assessment of general appearance, vital signs, breath sounds and hemodynamic stability should be evaluated prior to and during any ventilator adjustments.
2. For a pH ≤ 7.30, evaluate to ensure the cause is respiratory. If appropriate, increase rate to a maximum of 24 breaths/min until pH is ≥ 7.30. If further adjustment is needed increase V<sub>T</sub> until PIP ≥ 40 cm H<sub>2</sub>O or Pplateau ≥ 30 cm H<sub>2</sub>O. If unable to maintain these parameters, consider allowing permissive hypercapnia.
3. For a pH ≥ 7.45, evaluate to ensure the cause is respiratory. If appropriate, reduce rate to a minimum of 8 breaths/minute or until pH is ≤ 7.45. After rate is decreased to 8 breaths/minute, if pH is still ≥ 7.45, reduce volume to a minimum of 4 mL/Kg (IBW).
4. PaO<sub>2</sub> or SpO<sub>2</sub> should be maintained based on patient's targeted values (see table). Hemoglobin should be checked to ensure the absence of anemia. Hemodynamic data should be checked to ensure adequate circulation. If PaO<sub>2</sub>/FiO<sub>2</sub> ratio is < 300, or, should settings of FiO<sub>2</sub> = 0.5 and PEEP = 12 cm H<sub>2</sub>O be insufficient to maintain an appropriate oxygenation level, an intensivist or pulmonologist should be contact and the ALI/ARDS protocol considered.

IV. Partial Support and Discontinuation of Ventilatory Support

- A. Once the problem that resulted in the need for ventilatory support has been resolved, the patient should be considered for reduction of support.
- B. When assessment indicates partial support or discontinuation to be appropriate, change to a weaning protocol.

## **Resources Used in the Development of Adult Invasive Mechanical Ventilation Protocol**

1. Cox Health, Adult Respiratory Ventilator Protocol, RVP Version 3.2, Respiratory Care Department, Springfield, MO.
2. MICU Guidelines – Mechanical Ventilation, Respiratory Therapy Section of Pulmonary Disease Department, Cleveland Clinic, Cleveland OH
3. Interdisciplinary Mechanical Ventilator Protocol: Acute Phase, Southwest General Hospital, Platteville, WI
4. Respiratory Care Department Ventilator Management Protocol, Revision 4, Respiratory Care Department, Lakeland Regional Medical Center, Lakeland, FL.