



Critical Care Therapy and Respiratory Care Section

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| Category: | Clinical |
| Section: | Ventilator Management |
| Title: | Ventilator Weaning |
| Policy #: | 02 |
| Revised: | 03/00 |

1.0 DESCRIPTION

1.1 Definition: Weaning of the mechanical ventilator is the gradual withdrawal of ventilatory support through utilization of a variety of ventilator modes, periods of total spontaneous ventilation, and appropriate rest periods for muscle unloading. Discontinuation of mechanical ventilation should occur as soon as the patient is able to protect his/her airway and sustain a physiologically-competent minute ventilation while important indicators of disease show resolution. The plan of weaning is not static but requires continual reassessment so that the particular ventilatory needs of the patient are met while the disease process is corrected. Bedside measures of cardiopulmonary function aid in the assessment of weaning fitness; these should not take the place of careful bedside observation and "hands-on" care, however. Patients should not be allowed to fatigue during weaning trials, and interventions to ensure an adequate nutritional status and good bronchial hygiene should be applied.

1.2 Indications: The mechanically ventilated adult patient is generally ready for a plan of ventilator weaning if:

1.2.1 Arterial blood gas data are within normal limits for the patient including adequate oxygenation on no more than 50% supplemental oxygen requirement.

1.2.2 The dead space to tidal volume ratio (V_d/V_t) is less than 0.60.

1.2.3 The alveolar-arterial oxygen gradient ($PAO_2 - PaO_2$) is less than 350 mmHg on 100% oxygen.

1.2.4 The PaO_2/FiO_2 ratio is greater than 300.

1.2.5 Physiologic shunt (Q_s/Q_t) is less than 20%.

1.2.6 Vital capacity is at least 10 ml per kg of body weight.

- 1.2.7 Maximum negative inspiratory pressure is more negative than -30 cmH₂O.
- 1.2.8 Minute ventilation is no more than 10 L/min.
- 1.2.9 Static lung compliance is at least 25 ml/cmH₂O.
- 1.2.10 The patient can be effectively treated without neuromuscular blocking agents or high dose narcotics.

NOTE: Determination of the readiness to wean for the pediatric patient may depend on some of the factors above adjusted for age/size appropriateness, or the determination may be made on a subjective case-by-case basis. The age of the child may preclude measurement of some parameters above. In all cases, patients should be on no more than 50% oxygen, and current management should not require the use of high dose narcotics.

1.3 Contraindications: The converse of any of the above indications are considered contraindications to beginning a trial of weaning.

1.4 Potential Complications

- 1.4.1 Excessive fatigue as a result of inappropriate weaning trials
- 1.4.2 Prolonged requirement for ventilator due to excessive fatigue
- 1.4.3 Compromise in cardiopulmonary or oxygenation status due to inappropriate weaning maneuvers and/or lack of careful observation

1.5 Precautions

- 1.5.1 Fatiguing the patient should be avoided. Steps to decrease the level of ventilatory support should only be taken when one can be reasonably assured that the patient can bear the imposed workload.
- 1.5.2 Assessment must be ongoing to prevent situations deleterious to the patient's progress.

1.6 Adverse Reactions and Interventions

- 1.6.1 Abort the weaning trial anytime the patient demonstrates the following indicators of weaning failure: respiratory rate greater than 35, minute ventilation greater than 13 L/min, spontaneous tidal volume less than four ml/kg body weight, SpO₂ or SaO₂ less than 90%, increases in heart rate or blood pressure greater than 20% of baseline, new-onset cardiac dysrhythmias, and/or abnormal arterial blood gas data. Notify the physician.
- 1.6.2 Abort the weaning trial anytime the patient exhibits signs of fatigue, i.e. use of accessory muscles, nasal flaring, retractions, diaphoresis, and/or paradoxical breathing. Notify the physician.

- 1.6.3 Abort the weaning trial anytime the patient demonstrates acute signs of deterioration to include the indices listed above in 1.6.1 and 1.6.2 and/or the following: new onset fever, hypotension, bradycardia, wheezing, cyanosis, etc. Support the patient as needed to restore vital signs to baseline levels. Notify the physician.

2.0 EQUIPMENT AND SUPPLIES

- 2.1 Cardiopulmonary monitor with ECG, respiratory rate, and blood pressure monitoring
- 2.2 Pulse oximetry
- 2.3 Bicore pulmonary monitor
- 2.4 Capnometer or transcutaneous carbon monitoring (as desired and available)
- 2.5 Arterial blood gas sampling
- 2.6 Stethoscope
- 2.7 Weaning plan
- 2.8 Aerosolized oxygen supplies as needed for T-piece or tracheostomy trials
- 2.9 Wright respirometer or other volume monitor and maximal inspiratory pressure gauge (when desired for measurement of weaning parameters)

3.0 PROCEDURE

- 3.1 Determine an appropriate weaning plan. Patients with underlying lung disease and those who have been on the ventilator for several days or more require a longer strategy with smaller steps towards reducing ventilatory support. Uncomplicated post-operative patients simply require an organized plan of ventilator discontinuation. A multidisciplinary approach to the care plan should be taken. The Bicore pulmonary monitor should be utilized to make judgements about acceleration of the weaning plan or discontinuation of weaning efforts [refer to "Normal Values and Indications for Weaning (Adults)" at the end of this procedure]. The monitor should be used for its flow and volume monitoring capabilities alone when it is impossible to perform esophageal manometry.
- 3.2 Obtain baseline assessment parameters including heart rate and pattern, respiratory rate and pattern, blood pressure, minute ventilation, spontaneous tidal volume, SpO₂, arterial blood gas parameters (as desired), end-tidal volume or transcutaneous carbon dioxide level, breath sounds, and weaning parameters (spontaneous minutes ventilation, tidal volume, vital capacity, respiratory rate, and negative inspiratory pressure) if desired.
- 3.3 Explain the plan to the patient. Provide assurance to the patient and/or family as needed to gain cooperation and to minimize anxiety.

- 3.4 Implement the weaning trial and continually assess the patient for tolerance and fatigue. Reassure the patient as needed.
- 3.5 Obtain arterial blood gas data only when needed to verify monitored data or to document the success or failure of the trial. Continuous cardiopulmonary monitoring alleviates the need for frequent arterial blood gas analysis.
- 3.6 Return the patient to pre-trial parameters after a pre-determined length of time and to provide adequate rest between trials.
- 3.7 Discuss with the patient his/her performance and elicit feedback; modify the plan as appropriate.

4.0 DOCUMENTATION AND COMMUNICATION

- 4.1 Chart baseline assessment results, data from ongoing assessment during trials (including Bicore data, when available), and changes to the care plan on the Continuous Ventilation Record and the nursing flowsheet.
- 4.2 Update the Patient Daily Sheet/weaning plan to reflect changes to the plan.
- 4.3 Communicate outcomes to oncoming staff.

5.0 REFERENCES

- 5.1 Tobin MJ, Alex CG. Discontinuation of mechanical ventilation. In" Tobin MJ, editor. Principles and practice of mechanical ventilation. McGraw-Hill, Inc., 1994.
- 5.2 CCTRCS "Procedure for Use of the CP-100 (Bicore) Pulmonary Monitor"
- 5.3 CCTRCS Patient Assessment Policy
- 5.4 CCTRCS Procedure "Continuous Aerosol Therapy"
- 5.5 CCTRCS "Procedure for Collection of Blood for Analysis of Blood Gases, Acid-Base Status and Oxygen-Carrying Capacity"
- 5.6 CCTRCS "Pulse Oximeter Procedure"
- 5.7 CCTRCS :Novamatrix Capnogard ETCO₂ Monitor Procedure"
- 5.8 CCTRCS "Fastrac SaO₂/tCO₂ Monitor Procedure"

SIGNATURE: _____
Assistant Section Chief, CCTRCS, CCMD

DATE: _____

SIGNATURE: _____
Section Chief, CCTRCS, CCMD

DATE: _____

SIGNATURE: _____
Medical Director, CCTRCS, CCMD

DATE: _____

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