Policy Name: High Frequency Oscillatory Ventilation Policy (Adult)

Effective Date: 07/30/12

Policy Primary:

Status: Published

Final Approval:
Approved by: DUH Critical Care Standards Committee Date:

Glossary:
Term:
Definition:

Definitions:
Despite advances in the management of conventional mechanical ventilation (CMV), achieving adequate arterial blood gas parameters using high ventilatory pressures and high FiO₂ causes ventilator-induced lung injury and contributes to a cascade of systemic inflammatory responses that lead to multi-organ failure and death. Growing awareness of ventilator-induced lung injury has placed an emphasis on maintaining alveolar recruitment by avoiding alveolar over-distention and cyclic alveolar collapse and re-expansion. The advantages of HFOV compared to standard mechanical ventilation are that the lung is maximally recruited (i.e., uniformly inflated) while stretch injury is reduced by using very small tidal volumes (VT). HFOV is a lung sparing strategy because it utilizes small tidal volumes to maintain the alveoli open, providing uniform aeration.

Indications: A patient may be a candidate for HFOV if their oxygenation status is inadequate despite aggressive use of conventional mechanical ventilation as evidenced by the presence of three or more of the following:

- Plateau Pressure > 30 cmH₂O
- FiO₂ > 50% to maintain SaO₂ > 90%
- Presence of bilateral infiltrates consistent with Acute Respiratory Distress Syndrome (ARDS)
- Presence of gross air leak due to bronchopleural fistula
- Presence of bilateral lung contusion

Goals: The goals of the HFOV protocol for adult patients include all of the following:

- To maintain the patient's arterial pH between 7.20 and 7.50
- To maintain the patient's PaO₂ between 55 and 80 mmHg
- To maintain the patient's SpO₂ between 88 and 95%

Definitions:

Mean Airway Pressure: The delivered mean airway pressure (mPaw) determines lung expansion and is essential to facilitate oxygenation. mPaw is initially set 5 cmH₂O higher than the mPaw
produced with conventional mechanical ventilation (CMV), usually between 25 and 40 cmH\textsubscript{2}O. The purpose of the consistently higher mPaw used in HFOV is to keep the lung inflated at a pressure greater than the closing pressure of the alveoli, thereby preventing derecruitment and atelectasis. Oxygenation can be improved by increasing FiO\textsubscript{2} or increasing the mPaw. The mPaw can be increased directly or it can be adjusted by increasing the inspiratory time.

**Power / Amplitude:** Power is a control that is used for carbon dioxide removal. Amplitude is the measure of resultant biphasic pressure swings produced by the piston on the oscillator. Power is increased when PaCO\textsubscript{2} is elevated and decreased when PaCO\textsubscript{2} is low. At the start of therapy, the power is set at the level that produces perceptible movement of the chest wall. Movement of the chest wall, thought to influence carbon dioxide elimination, is caused by the tidal volume of gas passing in and out and is considered therapeutic when the patient vibrates, or shakes, down to the level of the groin/mid-thigh. Elevated amplitude measurements or sudden changes in amplitude may be the result of large airway restriction (i.e. mucous plug).

**Inspiratory Time:** Inspiratory time (I-time) refers to the percentage of the respiratory cycle that is allocated to inspiration. In HFOV, the I-time is usually set at 33%, so that two thirds of the time is spent in expiration. A longer expiratory time facilitates gas exchange and allows for more efficient removal of carbon dioxide.

**Hertz (Frequency):** The speed of oscillation. One Hertz (Hz) is the number of breaths delivered per second or 60 breaths per minute. For example, at a setting of 5 Hz, the ventilator delivers 300 breaths a minute. Changes in frequency are inversely proportional to the amplitude and the delivered tidal volume.

**Bias Flow:** The rate at which gas flows through the ventilator circuit.

**Level:** Interdependent - asterisked [*] items require an order from a health care practitioner licensed to prescribe medical therapy.

**Personnel:**
RNs work collaboratively with physicians, respiratory care practitioner (RCP), pharmacist and other members of the health care team.

**Competencies/Skills:**

**Required Resources:**
3100B SensorMedics oscillator

Hemodynamic monitoring

Pulse oximeter

Resuscitative bag with a PEEP valve at bedside

Peripheral nerve stimulator

Bispectral Index Monitor (optional)
TotalCare SpO2Rt® bed

Policy Statement:
Content:

1. **Prior to HFOV initiation, confirm the following (collaborative with MD, RCP, and pharmacist):**
   a. Complete head to toe assessment (for a minimum of 24 hours after initiation of HFOV, patient position changes are minimized to maximize alveolar recruitment).
   b. Adequate patient sedation is achieved before neuromuscular blockade is initiated.
   c. Train of Four (TOF) is assessed; neuromuscular blockade is adequate with 2 out 4 twitches.
   d. TotalCare SPO2RT® bed is in place.
   e. Resuscitative bag with a positive end-expiratory pressure (PEEP) valve is at bedside.

2. **Perform assessment immediately after initiation of HFOV:**
   a. Monitor vital signs.
   b. Monitor pulse oximetry O₂ saturation.
   c. *Review the oscillator ventilator settings with RCP: mPaw, amplitude, I-time, Hz. NOTE: Per HFOV Respiratory Care Protocol, the initial HFOV settings start with FiO₂ 100%, Frequency 5 Hz, Bias 30 Lpm, and iTime 33%.
   d. Assess for equality and symmetry of oscillator transmission sounds in all lung fields. If HFOV sounds are not symmetrical and equal in all lung fields, check tube placement and wiggle, call RT to bedside, and monitor for deterioration of respiratory status.
   e. Verify endotracheal tube (ETT) is secure.
   f. Assess for presence of endotracheal tube cuff leak (collaboratively with RCP).
   g. Assess for chest wiggle from clavicle to mid-thigh (collaboratively with RCP).

3. **Monitor and document (collaboratively with RCP):**
   a. Equality of oscillator transmission sounds in all lung fields and document q 4 hours and prn.
   b. Chest symmetry.
   c. Chest wiggle from clavicle to mid-thigh; document q 4 hours and prn.
   d. ETT cuff for presence of cuff leak; document q 4 hours and prn.
   e. mPaw; document target and trending mPaw q 2 hours and prn.
   f. Amplitude; document q 2 hours and prn.
   g. Continuous pulse oximetry; document q 1 hour and prn.
   h. Patient cardiopulmonary response to HFOV.
   i. Adequate sedation and pain medication prior to initiation and during maintenance with neuromuscular blockade. BIS monitor to be documented Q1 hour.
   j. Train of Four (TOF):
      i. Establish TOF prior to initiation of Neuromuscular Blockade and document in electronic record
      ii. Monitor Q1 hour after paralytic bolus, dosage changes, and during weaning to maintain TOF 2:4*.
      iii. Document Q2 hours during maintenance of neuromuscular blockade
   k. Modify Respiratory Plan of Care as needed.
   l. Document family education on the Interdisciplinary Patient and Family Education Record.
m. Document on Problem/Procedure Summary form.

4. **Ongoing collaboration with pulmonary medical team, RCP, and pharmacist include:**
   a. *Sedation, neuromuscular blockade parameters*
   b. *Pain management regimen*
   c. *Ventilator synchrony, HFOV setting changes/goals, readiness to wean to CMV*
   d. Daily portable chest x-ray
   e. Recruitment maneuvers
   f. Skin integrity, turning capability.
   g. *Nutrition, bowel regimen.*
   h. Family education/updates.

5. **Patient care needs:**
   a. *Obtain ABGs q 4 hours and prn, and 30 minutes after any ventilator change for the first 24 hours.*
   b. Keep head of bed elevated 30 degrees, utilize reverse Trendelenburg position.
   c. Minimize patient position changes for the first 24 hours (to maximize alveolar recruitment).
   d. After 24 hours, initiate continuous lateral rotation as tolerated, monitoring for signs of respiratory decompensation.
   e. Keep feet off bed and away from foot board, utilizing HEEL WAFFLE AIR CUSHIONS when appropriate and monitor all pressure points.
   f. Mouth care q 2 hours and prn.
   g. Turn head q 4 hours and prn.
   h. *Lubrication ointment for eye protection q 4 hours and prn.
   i. *Consider enteral tube placement.
   j. Monitor bowel regimen including rectal tube and/or rectal bag placement.

**Reportable Conditions:**

1. **Notify the physician** for the following patient conditions:
   a. Variances in mPaw of more than 2 cmH\(_2\)O.
   b. Increase or decrease in amplitude in the absence of Power changes.
   c. Decrease in pulse oximetry O\(_2\) saturations.
   d. Changes in bilateral lung oscillator sounds.
   e. Abrupt deterioration of patient (may be significant for acute airway obstruction, bronchospasm, pneumothorax, or right mainstem intubation).
   f. Sudden stoppage of HFOV system.

2. **Notify the RCP** for the following patient conditions:
   a. Variances in mPaw of more than 2 cmH\(_2\)O.
   b. Increase or decrease in amplitude in the absence of Power changes.
   c. Decrease in pulse oximetry O\(_2\) saturations.
   d. Changes in ETT position and/or cuff leak presence.
   e. Changes in chest wiggle (i.e. asymmetry, diminished wiggle).
   f. Changes in bilateral lung oscillator sounds.
   g. Need to reposition patient.
   h. Need for endotracheal/tracheal suctioning.
i. Abrupt deterioration of patient (may be significant for acute airway obstruction, bronchospasm, pneumothorax, or right mainstem intubation)

j. Sudden stoppage of HFOV system; patient should be disconnected from the HFOV and immediately ventilated utilizing a resuscitative bag with a PEEP valve.

REFERENCES

Citations:


Policies:

Authoritative Source:

Additional References:

Attachment Names:

Company:

Entities:

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