

UNIT STANDARD FOR: Respiratory Services	SITE:	REF. #
SECTION: Procedures: Adult	DATE APPROVED: May 2009	
SUBJECT: Status Asthmaticus: Ventilation and Management		TOTAL PAGES: 8
REVISIONS		

Manager	Clinical Chief	Director
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## 1.0 INTENT:

- 1.1 To ensure ventilation and management of a status asthmaticus patient is initiated and maintained according to standard.

### Definitions:

- **Permissive hypercapnia or controlled hypoventilation:**  
A strategy for management of patients requiring mechanical ventilation whereby priority is given to the prevention or limitation of severe pulmonary hyperinflation over the maintenance of normal alveolar ventilation. This involves allowing arterial CO<sub>2</sub> to be as high as 90mmHg, with no particular emphasis on acidosis correction.
- **Effective tidal volume (V<sub>Teff</sub>):**  
The exhaled tidal volume minus volume lost to tubing compliance.
- **Minimum alveolar concentration (MAC):**  
The concentration of an agent in alveolar gas necessary to prevent reflex movement in 50% of patients when a standard surgical incision is made.
- **VILI:**  
Ventilator induced lung injury.
- **Heliox:**  
A colorless, odourless, and tasteless inert gas. It has a lower density and Reynold's number than Nitrogen, the normal balance gas in air. The lower Reynold's number allows it to remain in a state of laminar flow even in very small airways, where air normally tends to switch to turbulent flow. The laminar flow pattern improves alveolar emptying, and ventilation.
- **Isoflurane:**  
A volatile agent that is used for general anesthesia but has been shown to dilate the airway through B-adrenergic receptor stimulation. It has minimal cardiovascular side effects however it can decrease systemic vascular resistance and may cause cerebral vasodilation, with increases in ICP seen in concentrations of > 1.1%.

## 2.0 STANDARD STATEMENT:

- 2.1 Patients who meet the following criteria and have a history of asthma will be intubated and ventilated as per this standard.
- Minimal response to bronchodilator therapy (Unable to do PEFR's)
  - Pt unable to speak
  - Depressed level of consciousness
  - Refractory hypoxemia

UNIT STANDARD FOR: Respiratory Services	SITE:	REF. #
SECTION: Procedures: Adult	DATE APPROVED: May 2009	
SUBJECT: Status Asthmaticus: Ventilation and Management		TOTAL PAGES: 8
REVISIONS		

- Hemodynamically unstable (Pulses paradoxus >25mmHg)

**2.2** Unless otherwise ordered by the physician, the Respiratory Therapist (RT) will initiate standard ventilation on a Status Asthmaticus patient in critical care areas as per implementation section of this standard.

#### Heliox

**2.3** Heliox Therapy may be initiated and maintained by the RT when ordered by the physician and can be considered as front line therapy in conjunction with conventional treatment.

#### Isoflurane

**2.4** The use of isoflurane via the Siemens 900c will be initiated when the patient remains refractory to treatment with optimal ventilatory and pharmacological management (see special circumstances).

**2.5** The RT will initiate isoflurane delivery upon receiving the intensivist/respirologist order and with the presence of the intensivist/respirologist or, if unavailable, the anaesthetist.

**2.6** The RT will communicate directly with an anaesthetist and give enough notice as possible for them to be present for the initiation of Isoflurane. For Q24h anaesthesia consults, contact the on-call anaesthetist.

**2.7** The RT may adjust isoflurane from .5 - 2% in .5 increments, waiting 10 minutes between changes. When the intensivist/respirologist or anaesthetist is present, 3 - 4% may be initiated in the first 10 minutes to achieve an immediate effect and then decreased to maintenance range of .5 - 2%.

#### **Positive Effect:**

- decrease in Paw
- decrease in Auto PEEP
- decrease in PaCO<sub>2</sub>

**2.8** Once a positive effect is seen and patient stabilized, Isoflurane may be decreased in increments as mentioned above until weaned to .5%, then discontinued. If an increase > 10 cmH<sub>2</sub>O in above pressures are seen when weaning, isoflurane should be reinitiated or increased back to the level at which a positive effect was seen.

**2.9** Notify physician if any of the following occur:

- Any new arrhythmias
- Heart rate increases > 20 bpm over baseline
- Systolic BP deviates from the range specified by the physician or when a change of 20 mmHg occurs.
- Pupils become fixed and dilated due to **increased** ICP

UNIT STANDARD FOR: Respiratory Services	SITE:	REF. #
SECTION: Procedures: Adult	DATE APPROVED: May 2009	
SUBJECT: Status Asthmaticus: Ventilation and Management		TOTAL PAGES: 8
REVISIONS		

### 3.0 EQUIPMENT:

Ventilator: PB 840 or Viasys Avea

#### Heliox Delivery

Viasys Avea ventilator with Heliox Option

H size Heliox tank in 80/20 mixture

Heliox high pressure hose and regulator

Adjustable wrench

#### Isoflurane Delivery

Siemens 900c ventilator with vaporizer and scavenging system

Isoflurane (**obtain first two bottles from the OR and then order from Pharmacy**)

Vuelink cable and module

### 4.0 IMPLEMENTATION:

- 4.1 Ensure patient is intubated with largest endotracheal tube possible ( $\geq 8.0$ ).

**To facilitate suctioning and minimize airway resistance (Raw).**

- 4.2 Post intubation, patient manually ventilated with a RR < 10 to maximize expiratory time and minimize lung hyperventilation.

**In severe exacerbations, airway narrowing causes airtrapping/autopeep, dynamic hyperinflation, increases in residual volume and functional residual capacity. Every effort should be made to keep the RR as low as possible to allow for complete exhalation. Permissive hypercapnia is therefore required.**

- 4.3 Ensure heated humidity is used.

**Humidification of inspired gas is particularly important to prevent thickening of secretions and drying of airway mucosa, a stimulus for bronchospasm in itself. Heated humidity is preferred over HME as the latter may cause unnecessary increased resistance if not changed routinely.**

UNIT STANDARD FOR: Respiratory Services	SITE:	REF. #
SECTION: Procedures: Adult	DATE APPROVED: May 2009	
SUBJECT: Status Asthmaticus: Ventilation and Management		TOTAL PAGES: 8
REVISIONS		

- 4.3** The RT will initiate and maintain ventilation as per guidelines in the below table and as directed by Physician.

	Parameter	Rationale and Maintenance
Mode	Volume Assist Control (AC)	Square flow wave will help maximize expiratory time
RR	<10	Maximize expiratory time Minimize autopeep
Vt effective	4-8 ml/kg (aim for 6ml/kg)	Minimize VILI Prevent over distension -Aim for plateau < 35 cmH2O Minimize autopeep
FiO2	.50	Maintain SpO2 > 90% (optimally 93-95%)
PEEP	0-5 cmH2O	Minimize end expiratory volume <b>- Patient will be paralyzed or heavily sedated, therefore extrinsic PEEP is not required to enable the patient to trigger the ventilator</b>
Inspiratory Flowrate	80-120 lpm	Maximize expiratory time Minimize autopeep
Waveform	Optimally square	Maximize expiratory time Minimize autopeep Allows Raw calculation to be accurately trended.
Pplateau	< 35 cmH2O	Minimize VILI
Blood gas goals	ph > 7.15 (seek to maintain >7.2) SpO2 > 90 (seek to maintain 93-95%)	Minimize VILI by allowing for permissive hypercapnia

**4.4 Heliox Delivery**

**Setup (See figure 1)**

- i) Disconnect the air valve on the back of the ventilator by turning the black dial to the right.
- ii) Replace the air valve with the heliox valve.

**Ensure pins slip into holes.**

- iii) Connect the heliox regulator to the heliox tank.
- iv) Connect the high pressure hose to the regulator and then to the heliox valve of the AVEA ventilator and turn the heliox tank on.
- v) Let ventilator run for approx. 90 sec after initiating heliox to allow the accumulator to fill.

UNIT STANDARD FOR: Respiratory Services	SITE:	REF. #
SECTION: Procedures: Adult	DATE APPROVED: May 2009	
SUBJECT: Status Asthmaticus: Ventilation and Management		TOTAL PAGES: 8
REVISIONS		

- vi) Ensure the green heliox button appears in the lower right hand window of Avea screen.

**If the swirl appears that means the compressor is running and your tank is empty.**

**Ventilation Parameters:**

- i) Continue to ventilate as per current settings.

**The ventilator makes all the adjustments for volume and flows automatically.**

- ii) Keep FiO<sub>2</sub> as low as possible to maximize heliox concentration.

**Do not increase FiO<sub>2</sub> greater than 0.40 as this will impact the benefit of heliox.**

**Positive Effect (Usually seen within 1 hour):**

- decrease in Paw ( **decreased** Raw)
- decrease in Auto PEEP
- decrease in PaCO<sub>2</sub>

**Changing Tanks:**

- Change tank once it registers 500 psi
- Tanks only last approximately 4-5 hours therefore turn flow trigger off and if possible turn PEEP to zero to reduce Heliox consumption.

**Add the following to the ventilation flow sheet:**

- Heliox tank pressure

**4.5 Isoflurane Delivery**

- i) Ventilation will be initiated on the 900C with the same parameters as the patient was ventilated on previously.

**The mode will have to be changed to SIMV on the 900C to obtain higher flowrates and a Ti% as low as possible.**

**Working pressure must be 30 cmH<sub>2</sub>O > Paw to deliver a square wave form.**

- ii) Add the following to the ventilation flowsheet:

UNIT STANDARD FOR: Respiratory Services	SITE:	REF. #
SECTION: Procedures: Adult	DATE APPROVED: May 2009	
SUBJECT: Status Asthmaticus: Ventilation and Management		TOTAL PAGES: 8
REVISIONS		

- Isoflurane % and fill time
- Scavenging system check

- iii) Isoflurane will be initiated at .5% with HR, BP and airway pressures documented and monitored.
- iv) Concentration will be gradually increased in .5% increments, allowing 10 minutes between each increase for gas equilibration to occur.
- v) Concentration will be increased up to 2% - 4%\* maximum (as per 2.7), or until a response is seen.

**A decrease in Raw, airway pressures, auto PEEP or PaCO<sub>2</sub> would indicate a response.**

- vi) If blood pressure decreases below the range specified by the physician, the Isoflurane will be decreased by increments of 0.5% until the blood pressure stabilizes.
- vii) Isoflurane will be administered in conjunction with other therapies and will be given until it is apparent that the patient's bronchospasm is improving.

**Indicated by a decrease in Raw, airway pressures, auto PEEP or PaCO<sub>2</sub>.**

#### Weaning and Discontinuation:

- i) Once a positive effect is seen and patient stabilized, Isoflurane may be decreased in increments as mentioned above until weaned to .5%, then discontinued. If an increase > 10 cmH<sub>2</sub>O in above pressures are seen when weaning, Isoflurane should be reinitiated or increased back to the last level at which a positive effect was seen.

#### **4.6 Correcting Acidosis:**

If the patient has been hypercapnic:

- < 24 hours the PaCO<sub>2</sub> should be decreased by 10-20 mmHg/hour until it is within normal range.
- > 24 hours normalization should be extended over at least 24 hours and up to 72 hours.

UNIT STANDARD FOR: Respiratory Services	SITE:	REF. #
SECTION: Procedures: Adult	DATE APPROVED: May 2009	
SUBJECT: Status Asthmaticus: Ventilation and Management		TOTAL PAGES: 8
REVISIONS		

**Too rapid of a reduction of PaCO<sub>2</sub> may lead to development of a metabolic alkalosis and therefore weaning difficulties.**

## **5.0 DOCUMENTATION:**

- 5.1** Ventilator parameters monitored Q3H as per standard 2.2-17.

## **6.0 SPECIAL CIRCUMSTANCES:**

**The following pharmacological agents should be considered:**

- 6.1 Magnesium sulphate**, when given intravenously, has been shown to be a useful adjunctive therapy for status asthmaticus patients. Its bronchodilating effect comes from inhibiting calcium-mediated smooth muscle contraction.
- 6.2 IV salbutamol**, like inhaled salbutamol, relaxes smooth muscle and inhibits the release of mast cell mediators and can be considered when pt's refractory to conventional treatments. IV salbutamol has a high incidence of side effects such as tachycardia, hypokalemia, dysrhythmias, myocardial ischemia and lactic acidosis.
- 6.3 Ketamine** is an IV anaesthetic that produces dose related unconsciousness and analgesia. Ketamine has also been shown to cause bronchial smooth muscle relaxation by increasing plasma concentrations of catecholamines. Although ketamine should be used when conventional methods fail, it has been shown that the addition of ketamine potentiates conventional treatment.
- 6.4 Corticosteroids**, most importantly systemic, should be considered early on in the exacerbation as they take 6-24 hrs to improve pulmonary function. Corticosteroids are the single most important medication in reducing airway inflammation by way of up-regulating postsynaptic receptors resulting in a potentiated adrenergic physiological effect.

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UNIT STANDARD FOR: Respiratory Services	SITE:	REF. #
SECTION: Procedures: Adult	DATE APPROVED: May 2009	
SUBJECT: Status Asthmaticus: Ventilation and Management		TOTAL PAGES: 8
REVISIONS		

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