Microlaryngoscopy with Hunsaker Mon-Jet Tube

Anesthesia Protocol
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Overview

For microlaryngoscopy and laryngeal surgery several methods can be used to ventilate the patient during surgery. A common way at UWMC is to use a jet ventilation technique using a Hunsaker Mon-Jet tube with an Acutronic AMS-1000 High Frequency Jet Ventilator or Acutronic Monsoon Universal Jet Ventilator. This protocol gives guidance for using this device and these ventilators. In all cases these cases the anesthesia team is sharing the airway with the otolaryngologists so having a standard approach is important.

Setting up Equipment

Equipment covered in protocol

- Acutronic AMS-1000 High Frequency Jet Ventilator *(see photos on page 7)*
- Acutronic Monsoon Universal Jet Ventilator *(see photos on page 8)*

The Acutronics are electrically powered, pneumatically driven jet ventilators capable of delivering…

Frequency	10 to 150 breaths per minute
Tidal Volume	0 to 1990 mL
Peak Inspiratory Pressure	0 to 99 cm H2O
Mean airway Pressures	0 to 99 cm H2O

Indications for Use of Equipment

- Bronchosopy and larygoscopy procedures
- Management of large pulmonary air leaks such as bronchopleural fistulas
- Management of one lung ventilation during single lung transplant procedure

Preoperative Check of the Equipment

You must familiarize yourself with the Hunsaker tube and the ventilators. The tube is approximately 30 cm long and has two lumens. The distal lumen is the jet lumen through which the gas for ventilation passes. The proximal lumen is a detection lumen that the ventilator measures the airway pressure through. This is a safety feature of the Hunsaker tube and minimizes the risk of barotrauma. The end of the tube has a green plastic cage that keeps the jet centered in the trachea to minimize any chance of the jet being up against the wall of the trachea and dissecting through the mucosa causing a pneumomediastinum or pneumothorax. The tube itself is made of fluroplastic that is extremely resistant to combustion. (See the package insert for details of use with the laser and airway fire hazard; Possible link to XOMED site).

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Recommended Initial Settings

High Frequency jet Ventilation (100-150 jet pulses per minute)

Frequency:	100
Inspiration Time:	30%
EEP Set Limit	20 cm H2O
Peak Set Limit	50 cm H2O
Driving Pressure	20-30 PSI

Low Frequency Jet Ventilation (10-90 jet pulses per minute)

Frequency:	10-90
Inspiration Time:	10-30%
EEP Set Limit	20 cm H2O
Peak Set Limit	50-60 cm H2O
Driving Pressure	20-40 PSI

Acutronic AMS-1000 High Frequency Jet Ventilator

Front Panel Controls

- **Manual Inspiration Switch:** Provides jet inspiration for the period of time the switch is depressed.

- **Mode Switch:** Three Position Selector Switch

  Manual: Inspiration initiated with manual inspiration switch.
  Stop: Ventilator activated but jet control, alarms, and display disabled.
  Automatic: Normal Ventilator Operation

Driving Pressure Control Knob: Adjusts jet drive pressure from 0 to 60 PSI: Sets the Tidal Volume (VT) delivered with each breath. NOTE: Driving Pressure sets the TV. Higher pressures may be required at lower frequencies to maintain adequate minute ventilation (L/M).

Front Panel Displays

1) User set **Frequency** (jet pulses per minute)
2) User set **Inspiration** (Percent of total cycle time spent in inspiration)
3) User set **Driving Pressure** in Pounds per Square Inch (PSI)
4) Liters per Minute (**L/M**) (ventilator output only)
5) Tidal Volume in mL (**MLTV**) (ventilator output only)
6) Measured **PEEP** in cm H2O
7) Measured **Peak Inspiratory Pressure** in cm H2O
8) **EEP Set Limit** (high limit for PEEP)
9) **Peak Set Limit** (high PIP limit)

Acutronic Monsoon Universal Jet Ventilator

Front Panel Controls

- Alarm reset button
- **Mode Selector:** Manual / automatic
  Manual: Inspiration initiated by pressing manual/automatic button
  Auto: normal ventilator operation
- **Start/Stop button**
  Stop: Ventilator activated but jet control, alarms, and display disabled
- **α-Dial knob:** menu dial/parameter setting
- **FiO2 dial:**: Set % oxygen required
- **Pressure dial:** set driving pressure

Front Connectors (from left to right)

- **Airway pressure connector**
- **Jet tube connector**
- **Auxiliary gas output connector** (not used for our purposes)

Front Display Panel

- Airway pressure diagram
  1) user set **frequency** (CPM) – jet pulses per minute
  2) user set **inspiration time** - % of total cycle time spent in inspiration
  3) user set **FiO2**
  4) user set **driving pressure** (PSI)
  5) **Continuous auxiliary gas flow** thro' separate outlet (lpm) – not used by us
  6) Intermittent measurement of the **pause pressure** (PP) thro' the jet line
  7) Humidification - not used by us
  8) Measured values of:
     - **Peak pressure** – high PIP limit
     - **Mean pressure**
     - **End expiratory pressure** – set limit
     - **Pause pressure**
  9) **Tidal volume** (ml)
  10) **Minute volume**(l/min)

Important Alarms on both Ventilators

EEP Set Limits: Sets high PEEP limit. **If the PEEP in the jet tube at the end of expiration is higher than the set limit, the ventilator will discontinue operation until the pressure falls below 20 cm H2O**. The alarm will automatically reset when the pressure falls below 20 cm H2O.

Peak Pressure Set Limit: Inspiration will stop when the pressure limit is reached.

Patient Disconnect: **This alarm only operates when the airway pressure is monitored by a separate airway pressure line from the jet endotracheal tube. If PetCO2 is being measured though this line, pressures are not monitored and the disconnect line is not functional**.

Power failure: When there is no electrical power, the alarm is audible and the Power On lamp will flash.

Warning

1) 1. The Acutronic jet ventilator is an "open ventilation system". It has no exhalation valve. Therefore, the expiratory pathway around the outside of the jet endotracheal tube cannot be obstructed and must be maintained open.

2) 2. Extending the length of the patient connecting tubing with tubing of any kind may cause the ventilator to malfunction.

Procedure

Preoperative Preparation

- Prior to the procedure obtain the Hunsaker tube and one of the ventilators.
- Make sure that the operating room you choose to use has an anesthesia machine capable of delivering O2/Air mixtures.
- Plug in electrical cord. Attach O2 and Air lines to wall outlets.

Acutronic AMS-1000 High Frequency Jet Ventilator

- Set FiO_2 blender on side of ventilator to 1.0
- Place the RED mode switch to "stop" position
- Press GREEN ON/OFF button on BACK of ventilator
- Adjust driving pressure with driving pressure dial
- For manual operation, place RED "mode" Switch to MANUAL
- For automatic operation, place the RED "mode" Switch to AUTO position
- Set frequency, EEP (PEEP) limit, set PEAK AWP limit
- Test ventilator function prior to use with a **test lung**

Acutronic Monsoon Universal Jet Ventilator (see photos 2)

- Set FiO2 on front of ventilator to 1.0
- Press GREEN ON/OFF button on BACK of ventilator
  Automatic calibration of the O2 occurs with the Acutronic Monsoon Universal Jet Ventilator
- Adjust driving pressure with driving pressure dial
- For manual operation, press "Auto/Man" button so green LED lights up.
- For automatic operation, press "Auto/Man" button so yellow LED lights up and press "start/stop" button to start
- Set frequency, EEP (PEEP) limit, set PEAK AWP limit
- Test ventilator function prior to use with a **test lung**

Airway Exam

As with all ENT surgery a careful airway exam is vital. Communication with the surgeons to understand the airway lesion of interest is mandatory and a thorough understanding of the imaging studies and possible prior flexible airway exams is vital. It is also useful to review previous anesthesia records looking at ease of ventilation, grade of laryngoscopy and intubation.

Patient care

- Start IV in left hand or arm.
- Administer 10mg of Dexamethasone iv 30 minutes prior to the procedure. (NOT if viral papilloma)
- Administer iv antibiotics 30 minutes prior to the procedure but not more than 60 minutes prior. (Vancomycin can be given up to 120 minutes prior to procedure). Advise starting antibiotics just before leaving the holding area.
- Patient to the room and apply standard monitors unless there is a special indication for more invasive monitoring.
- Position patient on bed with right arm tucked.
- Table should have the support pedestal at the foot end to allow for more space for the surgeons feet.
- Place neuromuscular blockade monitor
- Place BIS Monitor
- Connect propofol & remifentanil infusions for maintenance of anesthesia to proximal port of iv line.
- IV Induction with appropriate drug. (Propofol 2-2.5 mg/kg)
- Ventilation with bag and mask unless reflux is an issue then consider airway protection with an endotracheal tube.
- Muscle relaxant (Succinylcholine 1-2 mg/kg or Vecuronium 0.05-0.1 mg/Kg)
- Intubate the patient with the Hunsaker tube using the stylet. Blind attempts should be avoided since jet ventilation to the esophagus could cause tissue damage, esophageal perforation and resultant mediastinitis. Pass the end of the tube 3 cm beyond the glottic opening and note the depth of the tube.
- Attach “Patient Connection” tubing to central lumen of the Hunsaker Mon-jet tube.
- Attach “Airway Pressure tubing to the side port of the Hunsaker Mon-jet tube.
- Place oral airway to allow the jet ventilation volume to escape.
- Start Ventilator
- Observe for chest excursions
- Listen for breath sounds for equal distribution of ventilation
- ETCO2 can be measured on an intermittent basis from the side port of the Hunsaker Mon-jet tube
- If the carbon dioxide laser is to be used lower FIO2 to .3 to reduce the chance of airway fires.
- Observe respiratory parameters on Front Display Panel
- Observe SpO2 and ETCO2 or draw a blood gas and make necessary adjustments in ventilation.
- Cooperate with the surgeon holding ventilation when a quiescent operative field is needed.
- At the end of the case spray the cords and trachea with 4% Lidocaine to minimize coughing and laryngospasm. (The surgeon may do this for you)
- If the airway was easy to manage with a bag and mask an oral airway could be place or an LMA positioned for the patient to resume spontaneous ventilation and emergence, An endotracheal tube could also be passed by the otolaryngologist for ventilation and emergence.

Notes

In laser cases, have a laser ETT in the room **unopened**, in case the Hunsaker tube needs to be exchanged.

References

1) Orloff LA, Parhizkar N, Ortiz E.. The Hunsaker Mon-Jet ventilation tube for microlaryngeal surgery. *ENT-Ear, Nose & Throat Journal. June 2002*

2) Brooker CR, Hunsaker DH, Zimmerman AA. A New Anesthetic System for Microlaryngeal Surgery, *Otolaryngology-Head and Neck Surgery. January 1998.*

3) Hogue CW, Bowdle TA et al. A Multicenter Evaluation of Total Intravenous Anesthesia with Remifentanil and Propofol for Elective Inpatient Surgery. *AnesthAnalg August 1996;83(2):279-285.*

Photos

Acutronic AMS-1000 High Frequency Jet Ventilator

Acutronic Monsoon Universal Jet Ventilator