Pediatric Ventilator Application
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David A. Muir
• 23 year-old ventilator dependent quadriplegic due to Muscular Dystrophy
• Developed PMV with help of his father
• David passed away in August 1990

Course Outline
• Review Benefits of the Passy-Muir® Valve
• Identify Proper Pt and Assess Candidacy for In-Line Valve Placement
• Understand Common Ventilator Setting Changes and Safe Alarm Practice
• Step Through Case Studies and Learn By Examples

• The Passy-Muir® Tracheostomy & Ventilator Swallowing and Speaking Valve
• Physiologic Benefits of Passy-Muir® valve
  o Restores Voice/Communication
  o Improves Swallowing
  o Restores Physiologic PEEP
  o Improves Secretion Management
  o Improves Oxygenation
  o Promotes Weaning and Decannulation
  o May Decrease Risk of Aspiration
  o Improves Smell & Taste

PASSY-MUIR® VALVE Assessment and Placement
“Set Yourself and your Patient up for Success!”
• Patient Selection
  o Cognitive status-awake, responsive
  o Pick a happy time of day
  o Medically Stable
  o Able to Manage Secretions orally
  o Swallow Status/Risk for Aspiration
• Play, Play, Play!
  o Best in a play-like environment (bubbles, singing, whistles, etc.)
  o Best in an environment of trust, very perceptive
  o Easily distracted, use this to your advantage!
  o Enjoy lots of positive feedback, a sense of accomplishment
• Placement Guidelines
  o Peer education – team approach!
  o Body position and posture- semi-Fowler’s
Position of head and neck
- Tube Position is Important!
- Cuffs Versus Non-Cuffed Airways
  - Pediatric artificial airways are typically cuffless
  - If a cuff is present, 100% deflation is mandatory prior to Passy-Muir® valve placement
- Leak Speech/Ventilator Patient
  - Cuff deflation to allow airflow via upper airway during inspiration
  - Some loss of ventilation—adjust to compensate
  - Can vocalize during inspiration –
  - Why is this not optimal?
- Ventilators That are Passy-Muir Valve Compatible
- Ventilator Criteria Suggestions
  - Patient on <.60 FiO2
  - PEEP requirements of <15cm H2O
  - PIP less than 40cm H2O
- Assessment Criteria
  - Observe pre-Passy-Muir® valve PIP
  - Observe pre-Passy-Muir valve exhaled Vt
  - If cuffed, achieve cuff deflation – slowly over 1-2 minutes – assess volume loss
  - Listen for tracheal BS and assess leak
- Assessment Criteria
  - Determine if leak is present:
    - Patient can exhale around the properly sized trach tube
    - Airway above the cuff must be patent
    - Direct visualization to evaluate/assess Passy-Muir® valve candidacy in pediatric patients
- Assessment Criteria
  - 100% Cuff Deflation is mandatory!
  - Patient Must Be Able to Exhale Past the Tracheostomy Tube and Through Upper Airway
  - Assess Air Leak/Decreased Ventilation ??
  - Compensate with Ventilator Changes
- Cuff Inflated-Closed Circuit
- Cuff Deflated-Open Circuit
- Passy-Muir® Valve In-line
- Ventilator Adjustments
- Ventilator Assessment and Adjustments
  - PEEP On/Off
  - Consider turning PEEP down by ½ as a starting point
- Ventilator Assessment and Adjustments
  - Pressure versus Flow Trigger
  - Make sure vent is not auto-cycling
- Ventilator Assessment and Adjustments
  - Volume Compensation During Cuff Deflation
    - Increase Vt in small increments to achieve pre-cuff deflation pressures (PIP)
  - Pressure Assessment and Adjustments
    - Pressure Compensation During Cuff Deflation
      - Seldom increase PC (sometimes decrease) in small increments to achieve audible voice and adequate ventilation
  - Pressure Support
    - Use Exp % Sensitivity, Inspiratory Cycle Off to Time Limit PS Breath, or Set I-time
  - Pressure Control
    - Set I-Time
  - Alarm Assessment and Adjustments
    - Use Low Pressure Alarm as Disconnect/Indirect Low Exhaled Vt Alarm (set above 10 cm H20 and best if set 5-10 cm below PIP)
    - Set High Pressure Limit Appropriately (set 10-15 cm H2O above PIP)
  - Ventilator Assessment and Adjustments
    - Consider NIPPV Mode
- Recapping
  - Adjust PEEP
  - Slow cuff deflation
  - Monitor pressure/volume loss
  - Place Passy-Muir® valve
  - Compensate for volume/pressure loss
  - Time limit PS breaths
  - Set alarms appropriately
- Humidification
  - Use with Heat/Moisture Exchanger (HME) is Ineffective
  - Use with Heated Humidified Systems
  - Remove Passy-Muir® valve for medicated treatment
- Ventilator Connections
- Let’s Pick a Patient
- Team Approach
- Patient from Peoria Eating
- Step Through the Process
  - Age appropriate education for patient and family
  - Educate staff
  - Place warning labels provided
  - Position body and neck/trach
  - Note PIP and inhaled and exhaled Vt
  - Pulmonary Toilet - oral care
  - If present, SLOW cuff deflation
- Re-assess airflow - Vt and PIP

- Patient Assessment
  - Oxygenation
  - Vital Signs
  - Breath Sounds
  - Color
  - WOB - abdominals
  - Patient Responsiveness
  - Assess for back pressure (PSSH sound)

- Distress...Signs and Symptoms
  - Increased RR, HR
  - Anxiety and fear
  - Restlessness
  - Increased irritability
  - Stridor
  - Grunting (infants)
  - Retractions
  - Nasal flaring
  - Head bobbing
  - Sniffing position
  - Decreased BS during auscultation
  - Decreased chest movement
  - Decreased LOC
  - Decreased PaO2 (SaO2)
  - Increased PaCO2
  - Paleness or cyanosis
  - Decreased perfusion/mottling
  - Bradycardia/hypotensin
  - (this is a late sign)

- Case Study #1 – 15 mo old BPD
  - Pressure Ventilating

- Vent Settings
  - SIMV 12
  - PC 18cm
  - PEEP 8cm
  - PIP 26cm
  - FiO2 .24
  - PS 12 cm

- Step Through the Process
  - Age appropriate education for pt and family
  - Educate staff
  - Place warning labels provided
  - Position body and neck/trach
  - Note PIP and inhaled and exhaled Vt
Pulmonary Toilet – oral care

If present, SLOW cuff deflation

Re-assess airflow – Vt and PIP

**Passy-Muir® Valve Placement Assessment**
- PC set at 18cm (we did not change it)
- PEEP decreased to 4cm
- Place Passy-Muir valve
- PIP now 22cm (not fluctuating)
- Pt has great cough! (closed glottis)
- Pt may begin to make sounds
- Successful??? YES!!!

**Patient from Peoria on Vent**

**What if….Troubleshooting**

- EXAMPLE:
  - Let’s say with each breath the PIP climbed 3-6 cm at a time. Pt begins to have increased abdominal WOB. Pressure limit alarms.
  - What is wrong?
    - You are not sure, so you remove the circuit and hear a “hiss” sound come from the trach.
  - What is this telling you?

**Case Study #2 Volume ventilation**

**Servo i**
- Vent Settings: SIMV 10
  - Vt 250 cc (PIP 28 cm)
  - PEEP 8 cm
  - FiO2 24%
  - PS 15 cm
  - Servo i when in ICU
- Trach X 2 weeks w #5.0 ped tube

**Step Through the Process**
- Educate pt and staff
- Place warning labels
- Position body and neck/trach
- 1/2 PEEP
- Note PIP and exhaled Vt
- Pulmonary Toilet – oral care
- SLOW cuff deflation
- Re-assess airflow – Vt and PIP changes

**Cuff Deflation Assessment**
- Exhaled Vt is now 175cc (was 250)
- PIP is now 23cm (was 28 cm)
- Pt has poor cough
- Pt is not making any sounds
- Would you place a Passy-Muir valve®?
Valve is Not Placed In-Line
  o Why not?
  o What are your recommendations?

Trach tube #4 Shiley
  o You changed to # 4.0 Peds tube and your assessment is now:
    o Exhaled Vt 80cc (was 250)
    o PIP is now 8 cm (was 28)
    o Pt is coughing
    o Pt is verbalizing, but seems to be able to produce speech on inspiration and expiration – cont flow in circuit???
    o What 2 things should you troubleshoot?

Troubleshooting
  o Is the PEEP cont. flow? (½ ?)
  o Can you time limit PS on your ventilator?
    - Inspiratory Cycle off – Servo I (up to 70%)
    - Exp % Sensitivity on other vents
    - Set an inspiratory time for PS breath
  o Consider NIV mode

Add An External Low Pressure Alarm
  o Safety back up systems to alert practitioners to disconnects and low pressures are MANDATORY if you eliminate low volume alarms!

Add An External Low Pressure Alarm
  o Connect tubing to the back of this particular external low pressure alarm box

Add An External Low Pressure Alarm
  o Now this external low pressure alarm should also be set above 10cmH2O, and preferably 5-10cm below PIP

Toby Tracheasaurus

Care, Cleaning and Lifetime of the Passy-Muir® Speaking Valves
  o Average lifetime of 2 months

Educational Opportunities
WEBINARS or SELF STUDY COURSES
Application of Passy-Muir® Swallowing and Speaking Valves
Interdisciplinary Tracheostomy Team: Where Do I Start?
Ventilator Basics for the Non-RT
Ventilator Application of the Passy-Muir Valve
Pediatric Tracheostomy and Use of the Passy-Muir Valve
Pediatric Ventilator Application of Passy-Muir Valve
Swallow Function: Passy-Muir Valve Use for Evaluation & Rehabilitation

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