Swallow Function: Passy-Muir® Valve Use for Evaluation & Rehabilitation
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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
- Physiology of Swallow
- Aspiration Risks
- Tracheostomy Tubes and Swallow
- The Passy-Muir® Valves
- Benefits of the Passy-Muir Valves
- Troubleshooting and Treatment Planning

Physiology of Swallow
- The Aerodigestive Tract Is a Shared System
  - Respiratory system shares a common functional space with the digestive tract and the vocal tract.
  - The trachea is a dynamic structure
  - We never fully exhale (i.e. physiological PEEP)
  - The Upper-Aerodigestive Tract Is a Valving System
  - Beginning at the lips and ending at the UES, the valves are always permitting or preventing airflow, food, or liquids to go from one direction to another.
- Consensus
  - High incidence of disordered swallowing following intubation, tracheostomy, and mechanical ventilation
- Oral Preparatory and Oral Stage Swallowing
  - Readiness to accept the bolus, including level of alertness.
  - Positioning, dentition, and medications.
  - Valving system: lip closure, lingual propulsion, velopharyngeal closure.
- Pharyngeal Stage of Swallowing
  - Hyo-laryngeal anterior motion provides some airway protection and opens UES sphincter
  - Bolus pressure widens opening of UES
  - Closure of the laryngeal valving system.
- Respiratory Pause
  - In healthy adults there is a respiratory “pause” during the swallow, with swallowing occurring most often in mid-expiration
There is evidence that swallows occurring at lower lung volumes such as exhalation to inhalation transition are more likely to result in aspiration.

**Esophageal Phase of Swallowing**
- Readiness to accept the bolus, including level of alertness.
- Positioning, dentition, and medications.
- Valving system: lip closure, lingual propulsion, velopharyngeal closure.
- Reflexive phase transports the bolus via peristaltic wave.

**Aspiration Risks**

**Effects of Tracheostomy on Normal Swallowing Function**
- Tracheostomy is often preceded by endotracheal tube intubation. (oral or nasal)

**Well Documented Complications Associated with Endotracheal Tubes**
- Mucosal injury
- Blunting of glottic reflexes
- Allows free passage (aspiration) of oral-pharyngeal secretions into the upper airway with a heightened risk for Ventilator Associated Pneumonia (VAP)

**Aspiration Pneumonia Is an Opportunistic Infection**
- Something must be aspirated.
- Aspirate must contain a respiratory pathogen.
- Must be able to overwhelm patient’s normal defense/immune system.

**Additional Identified Risk Factors Predisposing Patients to Aspiration Include:**
- Witnessed aspiration secondary to emesis or reflux.
- Supine position and coma.
- Enteral nutrition and presence of a nasogastric tube.
- Multiple intubations or self-extubation.

**Aspiration**
- Incidence of aspiration in patients with tracheostomy is estimated to be in the range of 50-83% (includes “silent aspiration”)
- Is this a causal relationship?
- Other factors cited to contribute: intubation and underlying critical illness

**Additional Identified Risk Factors Predisposing Patients to Aspiration Include:**
- COPD, age > 60 years, and acute respiratory distress syndrome
- Prior exposure to antibiotics which predispose the patient to colonization of the upper aerodigestive tract.
- Infection control lapses, including hand washing and non-sterile tracheal suctioning

**Ventilator Associated Pneumonia (VAP)**
- Defined as nosocomial (hospital acquired) pneumonia occurring in patients after 48 hours of mechanical ventilation via endotracheal tube or tracheostomy tube.
Oral-pharyngeal secretions colonized with bacteria bypass the cuff on the ET tube or tracheostomy tube and pass into the lower respiratory tract.

Factors Related to Dysphagia Which May Influence Cost of Care for Tracheostomized Patients:
- Pulmonary complications from aspiration, use of antibiotics, reduced weaning, and prolonged ICU/hospital stay.
- Late onset aspiration due to undiagnosed laryngeal injury or impairment.
- Depression and reduced patient participation in care, reduced quality of life and impaired communication and loss of control over decision making.

Tracheostomy Tubes and Swallow
- Early Tracheostomy (7-10 days) May:
  - Reduce incidence of VAP and further injury to the larynx caused by the ET tube.
  - Improve patient comfort including possibility for oral communication and oral diet and requirement for less sedation
  - Improve oral hygiene
  - Improve secretion management (pulmonary toilet)

Indications for Tracheostomy
- Upper airway obstruction
- Pulmonary toilet
- Mechanical ventilation

A Tracheostomy Alters Physiological Function of Upper AeroDigestive Tract
- Aphonia
- Reduced ability to expectorate secretions
- Reduced sense of taste and smell
- Reduced physiological PEEP
- Reduced ability to expectorate secretions

Tracheostomy Effect on Swallowing:
- Scar tissue formation from the tracheotomy procedure may affix the trachea to overlying tissues and the larynx may not move freely
- If the tube is too large for the patient's trachea, patient may feel discomfort and may compensate with reduced laryngeal excursion
- "Many physicians conceive of a tracheostomy as a solution to long term aspiration, but in reality, it may increase the problem rather than solve it." Nash, 1998

The Cuff on the Tracheostomy Tube Is Indicated During Mechanical Ventilation
- The cuff is designed to create a "closed" system, so the volume of air delivered to the lungs is not lost due to an upper airway leak.
- The cuff may reduce the impact of aspiration, but cannot prevent aspiration, it sits below the level of the true vocal folds.
Aspiration of Liquid or Food Around the Tracheostomy Tube Cuff Has Been Well Documented

- The tracheal lumen is not static during respiration.
- Aspiration around the tracheal cuff may be due to the leak caused by tracheal dilation during inspiration, and/or due to secretions which pool above the cuff.
- The cuff may create a reservoir for pooled or stagnate secretions to colonize and eventually enter the lower respiratory tract.

Cuff Mismanagement Has Been Associated with:

- Damage to the tracheal mucosa
- Tracheal stenosis
- Granulation formation
- Tracheal erosion
- Tracheoesophageal fistula
- Tracheal dilation

Mismanagement of Cuff Pressures

- Distention caused by the cuffed tracheostomy tube against the esophagus may cause liquids to overflow the UES and fall into the trachea.
- Refluxed tube feedings or gastric contents may also enter the airway via the same mechanism.

Tracheostomy Tube Effect on Swallowing

- Impaired oral-pharyngeal pressure
- Impaired hyolaryngeal elevation/excursion
- Impaired glottic closure
- Reduced subglottic pressures and reduced sensation..
- Muscle disuse atrophy

Effect of Mechanical Ventilation on Swallowing:

- Ventilator modes with a pre-set breath may push air at a time the patient is trying to maintain airway closure for a swallow.
- If the cuff is deflated, without a Passy-Muir® valve, a translaryngeal leak may occur on inspiration and expiration.

Evaluation and Rehabilitation of Swallowing in the Tracheostomized Patient

- "All tracheostomy patients should be referred for speech therapy prior to surgical placement of the tracheostomy or soon thereafter." Respiratory Care, April 2005.

Passy-Muir® Valve and Swallowing

- Placing the Passy-Muir valve before your swallowing assessment may enhance your patient’s swallowing performance

Benefits of a Passy-Muir® Valve Include:

- Re-connects the upper and lower airway and normalizes the aerodigestive tract and prevents disuse atrophy.

The Passy-Muir® Valves
Passy-Muir® Valves
- The biased-closed position, “no-leak” design of the Passy-Muir valve was invented by David Muir.
- Since the early 1990’s numerous independent research studies have further described its benefits, including improved swallowing function.

Improved Swallowing and the Passy-Muir® Valve
- The valve is “biased closed”—closes at the end of inspiration.
- Remains completely closed during exhalation.
- Patient does not exhale against the valve diaphragm to close.
- Secretions are not exhaled into the valve.

Criteria for use of the Passy-Muir® Valve
- Cognitive status: awake and responsive and able to follow simple instructions
- Medically stable (individually decided)
- Able to tolerate cuff deflation
- non-negotiable

Improved Swallowing and the Passy-Muir® Valve Bedside Exam:
- Chart review, to include: indication for tracheostomy, size of tube, and goals for de-cannulation.
- A full bedside swallow exam (BSE).
- Diagnostic use of the Passy-Muir valve may help in assessment of airway patency, laryngeal sensitivity and function.

Benefits of the Passy-Muir® Valve

Improved Swallowing and the Passy-Muir® Valve Trial and Placement:
- If indicated, suction patient pre- and post slow cuff deflation, and provide oral suction.
- May use digital occlusion to assess for upper airway patency.
- Assess vocal quality, throat clear, cough, response to secretions.
- Bolus test swallow

Passy-Muir® Valve Trial and Placement Additional Assessment Tools:
- Monitor and record baseline vital signs.
- Pulse oximetry
- Blue dye testing
- Cervical auscultation

Improved Swallowing and the Passy-Muir® Valve
- Once in place, the Passy-Muir valve allows you to further assess the patient with instrumental assessment (VFSS or FEES)

Improved Airflow and the Passy-Muir® Valve:
- Patient will still inspire through the tracheostomy, but exhale through the glottis and upper airway.

Improved Swallowing and the Passy-Muir® Valve Functions Restored: Peep
- Facilitates end-expiratory pressure (PEEP) which increases alveolar surface area
Physiologic PEEP is instrumental in gas exchange across blood/gas barrier.

- Improved Swallowing and the Passy-Muir® Valve Functions Restored: Sensitivity
  - Improved Laryngeal and Pharyngeal Sensitivity
  - Improved Glottic Function: Ability to cough and expectorate and react to material threatening entrance to the airway.

- Improved Swallowing and the Passy-Muir® Valve Functions Restored:
  - Restoration of Subglottic Pressure: Improved duration of vocal fold closure during swallow.
  - “No-Leak” design: mimics a closed pharyngeal system, allowing improved reciprocity between respiration and swallowing.
  - “Early placement of the Passy-Muir valve may provide “physical therapy” to the upper airway, helping to reduce effect of muscle atrophy, and improve pharyngeal and laryngeal swallowing function.” Burkhead, 2007

- Early Placement of the Passy-Muir® Valve
  - Allow patients to communicate orally and actively participate in healthcare decision making

Swallowing and Passy-Muir® Troubleshooting and Treatment Planning

- Cuff Up or Down?
  - Our pulmonologist directs the nurses to feed the patient with the cuff up.
  - A clinician asks:
    - Q: How do we educate them about the risks/benefits to cuff deflation?
    - Review the role of the cuff during mechanical ventilation.
    - Request a trial of cuff deflation and Passy-Muir® valve use to restore more normal physiology.
    - Perform an instrumental exam, and document findings under both conditions.

- Swallowing Treatment Short Term Goals:
  - Patient will tolerate cuff deflation and Passy-Muir® valve placement during supervised trials with speech pathology (30 min), twice daily.
  - Patient will have functional voice, laryngeal responses (cough, throat clear) when using Passy-Muir valve, 75%
  - Patient will expectorate pulmonary secretions when using the Passy-Muir valve with reduced need for tracheal suctioning, 80%
  - Patient will participate in bedside bolus trials, demonstrating prompt and efficient swallow, and without signs/symptoms of aspiration, 80%

- Work of Breathing
  - Our pulmonologist will not let us use the Passy-Muir® valve with our patients during weaning from mechanical ventilation, stating that: “the valve will increase the work of breathing”
  - A clinician asks:
    - Q: How do I convince him otherwise?
Work of breathing is multifactoral.
Patients may actually benefit from “exercising” the respiratory and upper airway musculature.
Careful monitoring of the patient by respiratory and speech.

- **Swallowing Treatment Short Term Goals:**
  o Patient will tolerate cuff deflation and Passy-Muir® valve placement during t-piece trials, 30 minutes, bid, with maintenance of baseline vital signs, 80%
  o Patient will participate in respiratory support exercises (diaphragmatic breathing), 10-15 min. while using the Passy-Muir valve.
  o Patient will participate in bedside swallow exam while using Passy-Muir valve.
  o Patient will tolerate ice chip trials, while wearing the Passy-Muir valve, and without signs/symptoms of aspiration, 80%.

- **Dysphonia–Dysphagia Despite Passy-Muir® Valve Use**
  o I have placed the Passy-Muir valve on my patient, and she tolerates it well, but she only has whispered voice, and we still document aspiration of thin liquids on a VFSS.
  o A clinician asks:
  o Q: Should I continue to use the Passy-Muir valve?
  o What do you observe?
  o s/s of dysphonia and reduced airway protection.
  o What do you request?
  o Intubation history.
  o ENT consult.
  o What do you do?
  o Vocal function/laryngeal strengthening exercises.

- **Swallowing Treatment Short Term Goals:**
  o Patient will tolerate Passy-Muir® valve placement 30-90 minutes daily with no decline in baseline vital signs, 80%
  o Patient will utilize Passy-Muir valve and participate in vocal function exercise to increase vocal fold adduction for voice as measured by audible phonation attempts, 45%
  o Patient will utilize Passy-Muir valve while participating in laryngeal strengthening exercises for improved airway protection during swallowing, 90%
  o Patient will utilize Passy-Muir valve to maximize benefit of employing compensatory swallowing strategies, with reduced episodes of aspiration for liquid trials, 80%

- **Educate and Document**
  o If you didn’t document it, you didn’t do it.
  o Utilize the instructions and labels that come packaged with the Passy-Muir® valve.
  o Develop multidisciplinary policies and procedures for best outcomes.
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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