The Role of the Passy Muir® Valve in the Pulmonary Management of the Patient with a Spinal Cord Injury

Rebecca Willis BA, LRCP, CRT-NPS and Diane Ulmer OTR/L
Madonna Rehabilitation Hospital
Lincoln, Nebraska

Objectives

1. Summarize the pulmonary impairments associated with a spinal cord injury (SCI)
2. Describe the physiological and psychological impact of the inclusion of the Passy Muir closed system one-way valve in the pulmonary management of the patient with a SCI
3. Discuss the role of the Passy-Muir® Valve in accessing voice-activated technology, life-skills training and community resources for the individual with a spinal cord injury

What are the Facts?

- According to the National Spinal Cord Injury Statistical Center (NSCISC) there are approximately 12,000 new spinal cord injuries (SCI) each year in the United States.
- In 2007 there was an estimated 255,702 persons in the U.S. living with a SCI.
Respiratory diseases are the #1 cause of death in SCI persons.
Respiratory diseases are the 3rd most common source of re-hospitalization.
Complications of the respiratory system prolong acute care length of stay and delay progression to rehab.

**Anatomy of a Spinal Cord Injury**

*SCI can be divided into three groups depending on the location of the injury:*
- High Tetraplegia are cervical spine injuries between vertebra C1-C4.
- Low Tetraplegia are cervical spine injuries between vertebra C5-C8
- Paraplegia are typically vertebra injuries of thoracic, lumbar or sacrum
Primary Pulmonary Impairments

- Decreased lung volume
- Decreased chest excursion
- Decreased cough strength
- Impaired breathing patterns

The Muscles of Respiration

Diaphragm
- Primary respiratory muscle providing ⅔ to ⅔ of tidal volume
- Innervation at C3-C5
- Completely separates the thoracic and abdominal cavities to regulate pressures
- Receives support from pelvic floor and vocal folds

Intercostals

Innervated at T1-T12
- Stabilizes rib cage during inhalation
- Concentric contraction for inspiration
- Eccentric contraction for exhalation
Abdominals

Innervation at T6-L1
• Provide support for the trunk
• Provide positive pressure for the diaphragm
• Provide necessary intra-thoracic pressure

Respiratory Muscles | Function | SCI Injury/Effect
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Diaphragm | Main muscle of respiration | Injury above C5 may require mechanical ventilation
Intercostals | Used in coughing and deep breathing | Injury above T8 will reduce muscle strength
Abdominals | Assist with cough | Injury above T12 will reduce muscle strength
Atelectasis

- Collapse of lung tissue/alveoli
- Left Lower Lobe more common than Right
- Requires rigorous secretion management
- Re-expansion of the affected lung tissue
  - Deep breathing and coughing

Cough

Phases of a cough

- Inspiratory phase
- Hold phase (closed glottis)
- Force phase
- Expulsion phase

High thoracic pressures are needed to generate the requisite cough expiratory flow and velocity

Muscles used during cough:

- The abdominals, intercostals and diaphragm; abdominal and intercostals tighten and diaphragm relaxes.
Trunk control, breathing and internal functions are dependent on the ability of the body to generate, maintain and regulate pressure in the thoracic and abdominal cavities.

Our Body’s Closed System

- Trunk includes abdominal cavity and thoracic cavity, separated by diaphragm
- Vocal folds at the top, pelvic floor at the bottom
- Diaphragm regulates the pressure

Breach in the closed system

- Tracheostomy
- Abdominal paralysis/weakness
- Intercostal paralysis/weakness
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**SCI Protocol**

- Initial Eval
  - Level of injury
  - Additional risk factors

- Initial Assessment
  - Inspiratory Capacity (IC)
  - Peak Expiratory Flow (PEF)

**Shane**

- 30 y/o
- C5-C6 injury
- Weaned from vent

**Interdisciplinary Care Plan**

- Flow sheet used by interdisciplinary team
- Record objective data
- Monitor and trend respiratory status
- Measure progress
- Early identification of possible decline
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Clinical Interventions

- Breath stacking
- Diaphragmatic breathing
- Expiratory trainer
- Incentive spirometry
- Pectoral stretch
- Vibratory PEP
- Sniffing

Positioning Strategy

- Shoulder abduction and external rotation
- Pectoralis stretch
- Positioning for chest expansion
- Shoulder preparation for functional training
- "iron cross" technique in bed/mat table

Phone Use

- Motivation to use Passy-Muir Valve
- Distraction from initial anxiety
- Increase patient independence and privacy
- Decrease burden of care on nursing staff
- Volunteer opportunity
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Phone setup

- Voice activated phone with added switch for opening line
- Blue tooth technology with switch adaptation to open and close line and use voice activation to make calls.

Assistive Technology

- Voice Activated Remote
- Voice Recognition Software
- Integrated Phone & PDA's

Computer Access

- Training in breath support, timing, phonation
- Online bill paying, grocery shopping, Christmas shopping, social networking
- Job skills, volunteer work, community participation
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Community Reentry
- Communication is key to self advocacy
- Self image
- Ordering at a café

Quality of Life
- Patient testimony
- Directing care to multiple caregivers and healthcare professionals

Summary of Impact of Passy-Muir Valve™
- Physiological
  - Cough strength
  - Secretion management
  - Reduced risk of aspiration
- Psychological
  - Communication
  - Assistive technology
  - Quality of life
Passy-Muir® Valve and the Diaphragm Pacer Patient

- Patients with intact phrenic nerve/ dependent on mechanical ventilation, e.g. persons with a high spinal cord injury
- NeuRx DPS™ directly stimulates the diaphragm, restoring negative pressure breathing

Eating and swallowing are complex neuromuscular activities
- Disconnect in communication = breathing and swallowing function independently
- Need to establish coordination
- Eat, drink and sleep with Passy Muir Valve™ to maintain patent airway

Larry
- 58 y/o
- C2 injury in 2006
- DPS in 2009
Thank you!

Questions…