Early Intervention for the Ventilated ICU Patient: Use it or Lose it!
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Disclosures
- Lori Burkhead Morgan, PhD, CCC-SLP
  - Disclosure: Financial - Received an honorarium from Passy-Muir Inc. for this presentation.
    - Nonfinancial - No relevant nonfinancial relationship exists.

Purpose of this talk
- Elucidate the impact of critical illness on the neuromuscular system and how this can impact swallowing & communication
- Identify rationale and simple interventions that can facilitate communication & swallowing

Identifying the problems

Major culprits in the ICU patient-alt
- Systemic inflammatory response syndrome
- Critical illness myopathy
- Critical illness polyneuropathy

Disclosures
- Passy-Muir, Inc. has developed and patented a licensed technology trademarked as the Passy-Muir® Tracheostomy and Ventilator Swallowing and Speaking Valve. This presentation will focus primarily on the biased-closed position Passy-Muir Valve and will include little to no information on other speaking valves.
**Systemic Inflammatory Response Syndrome (SIRS)**
- HR > 90 bpm
- Body temperature, 36 or >38°C
- WBC count, 4000 cells/mm³
- SIRS + infection = sepsis

**SIRS**
- Occurs in adults and children
- Up to 50% of ICU patients on vent have SIRS
- 50-70% of those patients develop diffuse myopathy and polyneuropathy

**SIRS**
- Results in
  - Muscle weakness
  - Difficulty weaning from the ventilator

**Critical Illness Myopathy (CIM) & Polyneuropathy (CIP)**
- Usually co-occurring
- Presents as ventilator weaning difficulty
- Seen in 25-63% of patients on vent >1 week
- Sensorimotor with motor predominance
- Limbs & respiratory muscle affected most
- Cranial nerves usually spared

**Critical Illness Myopathy (CIM)**
- Diffuse weakness
- Diagnosed with EMG studies & biopsy
- Type II muscle atrophy or undergo necrosis

**“Offenders” specifically impacting communication & swallowing**
- Deconditioning
- Endotracheal intubation
- Tracheostomy
- Ventilator dependency
Deconditioning Negatively Impacts Structure & Function

- Muscle atrophy
- Reduced force-generating capacity
- Lower endurance

Skeletal Muscle Composition

- Type I ▶ Slow-twitch, fatigue resistant
- Type II ▶ Fast-twitch, fatigable
  - Ila ▶ Adaptable, more efficient Type II fiber
  - IIb ▶ Best force generation, but inefficient
- Whole muscle contains blend with a predominance of one type

Oropharyngeal Muscle Composition

- Type II is predominant
- Type I, Ila, IIb and hybrid fibers
- Unique architecture
  - Regional differences in proportion & diameter of fibers
  - Complex arrangement

What about communication & swallowing in the ICU?

- Intubation
- Tracheostomy
- Ventilator dependency
- NPO

Endotracheal Intubation

- Bypasses use of upper airway
  - Disuse atrophy
  - Desensitization
- Trauma to mucosa, particularly larynx
- Cuff over inflation is common

Nasotracheal Intubation

- Because mouth is “available” patients are sometimes erroneously given ice chips, liquid, food, meds.
- Do not encourage mouthing to communicate
- Same complications as ETT
Granuloma

Subglottic Stenosis

Glottic & subglottic trauma

Post-Intubation Ulceration

What contributes to structural deficits?

- Prolonged intubation (>2 weeks)
- Can happen quickly, not just in long-term intubation
- Trauma due to movement/friction
**Incidence & Prevalence**

- Laryngotracheal injury in 95% (39/41) of previously intubated patients.¹
- Dysphagia as high as 56% (27/48), with nearly half those patients aspirating silently
  - Ajemian, Nirmul, Anderson, Zirlen, & Kwasnik (2001)²

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**What can you do to minimize intubation complication?**

- Don’t over-inflate cuff
- Secure tube to minimize movement
- Minimize patient movement
  - Education
  - Sedation as necessary
  - Discourage “mouthing”
- Convert to tracheostomy and Passy-Muir Valve placement sooner!

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**Airflow Changes with tracheostomy**

- Airflow bypasses upper airway
- Deflated cuff and/or fenestration can facilitate some upper airway airflow

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**Impact of Tracheostomy on Voice, Cough & Swallow**

- Larynx & upper airway are not involved in inspiration or expiration
  - Aphonia
  - Desensitization
  - No subglottic air pressure
  - Can disrupt swallow function
  - Higher likelihood for silent aspiration
  - Cannot cough to clear oropharynx or nasopharynx

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**What does research tell us about tracheostomy & swallowing?**

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**Tracheostomy negatively impacts swallowing & laryngeal function...**

**Trach occlusion to reduce/eliminate aspiration & impact swallow physiology...**


**Deconditioning**

- **PERIPHERAL**
  - Atrophy
    - Loss in cross sectional area
    - Decreased size
    - Force-generating capacity ("strength")
  - Fiber-type shift
    - More easily fatigued
  - Sarcopenia
    - Age-related reduction in muscle fibers
    - Preferentially affects Type II
- **CENTRAL**
  - Decreased neural activation ("drive")
  - Decrease in number of motor units
  - Remodeling of motor units

**"Vicious Loops" in Dysphagia?**

- Dysphagia - NPO
- Decreased swallow frequency
- Deconditioning
- Exacerbation of dysfunction

**But we CAN do something....**

**Conditioned:**

- Muscle-wasting, cachexia

**Deconditioning**

- Muscle atrophy & deconditioning
  - 4-6 wks bed rest (young, healthy) = ~40% decrease in strength
  - Ill & elderly even more susceptible

1. Bloomfield, 1997
**Conditioning**

- PERIPHERAL
  - Hypertrophy
    - Increased cross-sectional area
    - Increased force-generating capacity
  - Fiber type shift
    - Increased endurance
    6-12 wks.

- CENTRAL
  - Increased neural activation ("drive")
  - Increased number of motor units
    4-8 wks.

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**Plasticity**

- Cortical reorganization
- Blood flow changes
- Peripheral muscle changes

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**Now that we’ve identified the culprits and their impact on communication & swallowing what can we do about it?**

- Early intervention
- ROM and facilitation are precursors to rehabilitating functional movement.

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"Our patients are too sick"

- If you do nothing you will improve nothing.
- Function may only get worse as you “wait” for the patient to “get better.”
- Remember the concept of “vicious loops.”

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**Therapeutic Exercise: When, What, How?**

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**Lessons from Physical Therapy**

- Early intervention
- ROM and facilitation are precursors to rehabilitating functional movement.
Exercise: When?

- The sooner the better
  - Muscle atrophy & deconditioning
  - 4-6 weeks bedrest = ~40% decrease in strength¹
  - Ill & elderly even more susceptible²

First things first....

- Restore the system to the most “normal” condition as possible
- Passy-Muir Valve use (in-line ventilator use or trach alone)

Passy-Muir Valve

- Only valve FDA indicated for use on/off vent
- Only valve indicated in research to impact swallow as well as voice
- Original intent was to be used in-line with vent

Physiologic Impact of the Passy-Muir Valve

- Airflow
- Oxygenation
- Sensation
- Cough, secretion management
- Subglottic air pressure

Airflow Changes with Passy-Muir Valve

- Still inspire through tracheostomy
- Exhale through glottis & upper airway

Oxygenation with Passy-Muir Valve

- Facilitates end-expiratory pressure which increases alveolar surface area
  - Instrumental in gas exchange across blood/gas barrier
Changes in Sensation with Passy-Muir Valve

- Airflow over mucosa promotes sensation
  - Glottis
    - Voicing
    - Protective cough
  - Pharynx
    - Clear secretions
    - Swallowing
  - Mouth
    - Taste
    - Swallowing
  - Nasal Passages
    - Clear secretions
    - Smell

Changes in Cough with Passy-Muir Valve

- Cough
  - Improved sensitivity to cough in response to noxious stimuli (secretions, aspirate)
  - More forceful due to subglottic air pressure
  - Now able to clear oropharyngeal secretions with cough

Changes in Secretion Management with the Passy-Muir Valve

- With more forceful, effective cough, less suctioning may be required
- Sensing/clearing secretions in upper airway
- Able to blow nose

Passy-Muir a “SPEAKING” Valve and so much more!

- Unique design mimics a “more normal” system and physiology
  - Voicing
  - Pulmonary functions
  - Swallowing

Restoration of Subglottic Air Pressure with the Passy-Muir Valve

- Important for voice production, cough, and swallow.

Exercise: What?

- Expiratory muscle strength training (EMST)\(^1\)
  - Patients exhale against > 80% MEP
  - Suprahyoid complex activation, similar to swallow
  - May also increase strength of protective cough

\(^1\)Sapienza 2004; Kim & Sapienza, 2005
**EMST**

- Provides resistive strength training to intercostals as well as suprahyoids
- 5 sets of 5 breaths, 3-5x per day, 3-5 days per week
- Progressively increase weekly as necessary to insure pt is exhaling against >60% of maximal expiratory pressure/effort
- Monitor vitals
- Use caution in patients with increased intracranial pressure
- Other precautions-see manufacturer warnings

**MD order required**

- Both Passy-Muir Valves and EMST devices are prescription devices, requiring MD orders
- A Speech Pathologist and/or Respiratory therapist will evaluate appropriateness of use and prescribe usage protocol

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**Sampling of Other Treatment Tools**

**Thank you for your attention.**

**Presenter**

- Lori Burkhead-Morgan, PhD, CCC-SLP

Questions can be directed to Julie Kobak at jkobak@passy-muir.com

**Additional Educational Opportunities**

- Self-study webinars available on demand
  - Getting Started
  - Ventilator Application
  - Swallowing
  - Pediatric
  - Special Populations
- Live group webinars
  - [www.passy-muir.com](http://www.passy-muir.com)
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