Yes You Can! Early Intervention and Rehab
Walking While Ventilated
Principal Goals of Rehab

• Decrease:
  • Symptoms
  • Disability
  • Mortality

• Increase participation in physical and social activities

• Improve QOL
“If you do nothing, you will improve nothing.”

Lori Burkhead Morgan, PhD
Negative Effects of Bed Rest

• Disuse atrophy at the cellular level begins within 4 hours of bed rest - also impacts nerve conductivity

• Healthy adults, bed rest\(^1\)
  • Adversely affects all major organ systems by decreasing \(O_2\) transport
  • Strength declines 1% – 1.5% per day
  • Mood changes - functional and cognitive deficits persist for years
  • Loss of coordination, balance and work tolerance
  • Strength declines by 25% in 7 days\(^2\)

Disuse Atrophy

- Mechanical ventilation can cause atrophy, and injury of diaphragmatic muscle fibers
- “Patients in intensive care lose about 2% of muscle mass a day during their illness.”
- “Muscle weakness predicts pharyngeal dysfunction.”

Minimum Criteria for Initiating Early Mobilization

• M – Myocardial stability
  • No evidence of myocardial ischemia
  • Stable heart rate and rhythm

• O – Oxygenation
  • FIO2 < 60%
  • PEEP <= 10

• V – Vaso-pressors Minimal
  • No need for increased dose within 2 hours

• E – Engages to voice
  • Patient responds to verbal stimuli

• William D. Schweickert, MD. NALTHA 2013 Presentation
Perceived Complications of Mobilization

• Tenuous hemodynamic status
• Severe weakness
• Multiple central catheters
• Life support monitors
• Artificial airways
• Variable rehabilitation work practices
Early Activity: Feasible and Safe

• Prospective cohort study of 103 Ventilator patients >4 days
• Total of 1449 activity events in 103 patients
  • 16% sit on bedside
  • 31% sit in chair
  • 53% ambulation
  • 69% of survivors could ambulate > 100 ft at discharge

• Adverse events - < 1%
  • fall to knees,
  • feeding tube removal,
  • BP changes,
  • desaturation to <80%
  • **No extubations**

• Baily et al. CCM 2007; 35:139
Long-term Complications of Immobility

• Impaired exercise capacity and persistent weakness
• Suboptimal quality of life
• Enduring impairments and high costs of health care utilization
“The cardiopulmonary system affects and is affected by virtually every organ system in the body.”

- Dean, El, Cardiovascular and Pulmonary PT 4th Edition
The Cardiopulmonary System

- Factors that disrupt oxygen transport
  - Fever
  - Disease
  - The healing process
  - Anxiety, stress and pain
  - #1 Factor: Lack of mobilization

What Are The Positive Effects of Mobilization and Exercise?

• Cardiac Effects

• Increase venous return
• Increase SV, HR, CO
• Increase contractility
• Increase coronary artery perfusion
• Increase circulatory blood volume

What Are The Positive Effects of Mobilization and Exercise?

• Circulatory Effects
  
  • Increase peripheral blood flow and tissue oxygenation
  • Decrease venous stasis (emboli)
  • Increase pulmonary lymphatic blood flow and drainage (effusion)
  • Promote diuresis
  • Increase WBC production

What Are The Positive Effects of Mobilization and Exercise?

• **Neurologic Effects**
  - Increase arousal
  - Fewer sleep disturbances
  - Increase cerebral electric activity
  - Increase sympathetic stimulation
  - Increase postural reflexes

• By [NEUOtiker (Own work)](http://commons.wikimedia.org/wiki/File:Brain_anatomy.png) [GFDL (www.gnu.org/copyleft/fdl.html), CC-BY-SA-3.0 (www.creativecommons.org/licenses/by-sa/3.0/) or CC-BY-SA-2.5-2.0-1.0 (www.creativecommons.org/licenses/by-sa/2.5-2.0-1.0)], via Wikimedia Commons
What Are The Positive Effects of Mobilization and Exercise?

- **Metabolic Effects**
  - Increase glucose metabolism – decrease insulin resistance
  - Speed drug metabolism/clearance
  - Increase immunity/less infection
What Are The Positive Effects of Mobilization and Exercise?

• Pulmonary Effects
  • Increase volumes and capacities
  • Increase efficiency of respiratory mechanics
  • Enhance cough
  • Decrease thoracic blood volume
  • Increase Cst and decreased Raw
What Are The Positive Effects of Mobilization and Exercise?

- Nutrition/Digestive Effects
  - Increase gut function
    - Absorption
    - Motility

- By Mariana RuizLadyofHats, edited by Joaquim Alves Gaspar [Public domain], via Wikimedia Commons
What Are The Positive Effects of Mobilization and Exercise?

- Musculoskeletal Effects
  - Engage the diaphragm, chest wall muscles, larynx, abdominal muscles (accessory)
  - Engage skeletal muscles
  - Move bones and joints
  - Increase strength and endurance

By User:Mikael Häggström (Image:Gray190.png) [Public domain], via Wikimedia Commons
The Main Components of a Rehabilitation Program

• Exercise
• Breathing exercises and airway clearance
• Respiratory muscle training
• Education
• Psychosocial & behavioral interventions
• Nutritional assessment and intervention

Exercise Training

Rehab can begin in the bed:

• Bed rest exercises
• Moving in the bed for simple ADL’s
• Sitting up on side of bed to dangle
• Chair exercises
• Progress to standing
• Begin short walks
#1. Exercise Training

- “Air trapping with glottal control increases limb force production”

- Hayama 2002
#2 Breathing Techniques

- Pursed lip breathing
  - Coordinate breathing and activity
- Diaphragmatic breathing
- Lateral costal breathing
- Accessory muscle breathing
- Butterfly technique
- Glossopharyngeal breathing
- Abdominal binders
#3 Respiratory Muscle Training and Airway Clearance Devices

- Diaphragmatic and purse lip breathing:
  - EMST 150
  - Threshold PEP

- Therapy to assist in lung expansion, coughing and airway clearance
  - Acapella
  - EZ Pap
  - The Breather
Alternative Airway Clearance Techniques

• Chest physical therapy
• Percussion and postural drainage
• Manual hyperventilation, NaCl instillation
• Active cycle breathing
• Autogenic drainage
• Huffing
• Assistive coughing
  • Abdominal thrust, coastal phrenic assist, anterior chest compression assist, side lying counter rotation assist

• Mobilization and exercise!!
Alternative Airway Clearance Devices

Left: The Vest-Airway Clearance System http://www.thevest.com/
Alternative Airway Clearance Devices

- Left: The Vest-Airway Clearance System http://www.thevest.com/
Alternative Airway Clearance Devices
The #1 Airway Clearance Device Is....
Posture and Positioning Matt

• Benefits of an upright position are:
  • Maximize ventilation and perfusion
  • Improve cough and secretion clearance
  • Decrease $R_{aw}$
  • Increase $C_{st}$
  • Promote bladder and bowel function
  • Promote fluid shifts

Posture and Positioning Matter

- Daily tasks that require trunk control:
  - Breathing
  - Coughing
  - Eating
  - Talking
  - Moving
  - Bowel and bladder emptying

Upright Sitting Posture

- Important to prevent aspiration, clear lungs
- Use of abdominal binder and TED hose
- Use of pressure relieving cushion
- Use towel roles for posture support

Posture and Positioning Matter

- Primary Pressure Regulating Muscles
  - Intercostal (thoracic pressure)
  - **Diaphragm** (thoracic and abdominal pressure)
  - Back muscles (stabilize spine and ribcage)

Postural Stability Study Findings:

“Our findings suggest that balance strategies are likely to be disadvantaged if the ability to recruit glottal structures as part of dynamic postural control is compromised. This would be clinically meaningful for patients with a tracheostomy or damage/paralysis of the glottal structures.”

Advantages of Using The Passy-Muir® Valve

• Closing the respiratory system and regulating intrathoracic and intrabdominal pressures will:
  • Allow graded exhalation
  • Improve internal pressure support for posture
  • Improve upper extremity force/strength
  • Improve bowel and bladder emptying
  • Improve swallowing mechanics
  • Improve coughing/secretion management
  • Restore voicing
  • Restore physiologic PEEP
Role of Acute Care

- Establish medical stability
- Prevent further medical complications
- Prepare patient for transfer
Rehabilitation in the ICU – Cost Savings

• Johns Hopkins University Hospital MICU
  • Admit 900 patients per year
  • Dedicated rehabilitation team in ICU added $358,000
• First year results:
  • Reduced length of stay by 23%
  • Net savings – $818,000

Reported in Critical Care Medicine 2013
Dale Needham PhD, MD, Critical Care Specialist
Early Rehabilitation in the Johns Hopkins MICU
Outcomes: Early Exercise and Mobilization

- **Functional**
  - Earlier time out of bed
  - Earlier time walking
  - Independence at discharge
  - Greater walking distance
  - More likely discharge to home

- **Neurocognitive**
  - Shorter duration of delirium

- **Hospital Dependence**
  - Reduced ICU days
  - Reduced hospital stay
  - Reduced ventilator days
  - Fewer readmissions or deaths

Morris et al. CCM 2008; 36:2238
Role of Post Acute

• Prevent re-hospitalization
  • Patients are transferring to post-acute facilities earlier, and often while they are still critically ill
  • The patient population is elderly, with a broad spectrum of acute and chronic medical problems
• Wean the “unweanable”
Everyone’s Role

Wound prevention

- Keep skin clean and dry
- Reposition every 2 hours
- Use pressure relieving cushions
- Daily skin checks
Role of Rehab

• Teach adaptive strategies
• Maximize activity participation
• Enhance independence
• Train patient in directing care
• Caregiver training
Use Technology

• Control the environment
• Online bill paying
• Social networking
• Job skills
• Volunteer work
• Community participation
• School re-entry program
• Mobility – sip and puff wheelchair
Interdisciplinary Strategies That Support Rehabilitation

- SLP
  - Communication
  - Swallowing
- RN (quarterback)
  - Infection prevention
  - Skin integrity
- RRT
  - Weaning/decannulation
- PT/OT
  - Seating/activity tolerance
  - Mobility
- Dietary
  - Nutrition
Tracheostomy Teams

- Affordable Care Act
- Joint Commission
Financial Complications of Tracheostomy
The Impact on Costs

• **100,000**
  • Average number tracheostomies performed annually in the US

• **24%**
  • Percentage of tracheostomies performed on critically ill patients that require mechanical ventilation

• **29 days**
  • Average length of stay for a tracheostomized patient

• **$ 316,333**
  • Average amount of hospital charges associated with tracheostomy

• **$60 Billion**
  • Expected national bill in the year 2020 associated with prolonged mechanical ventilation
After Acute Care Expenses

• 11% of patients discharged to home
• 6% will be discharged to an LTAC
• 56% will be discharged to a SNF
• 14% will need some sort of home care

Survivors suffer from enduring impairments and continue to utilize costly health care
References for Cost

- 2009, Agency for Healthcare Research and Quality (AHRQ), HCUP-net National and regional estimates on hospital use for all patients from the HCUP Nationwide Inpatient Sample (NIS)
References For Cost


• HCUP Nationwide Inpatients Sample (NIS), 2011. AGENCY FOR HEALTH CARE RESEARCH & QUALITY (AHRQ). hcupnet.ahrq.gov


• Accessed April 3, 2013.
Multi-disciplinary Tracheostomy Teams

- Increase speaking valve use
- Improve decannulation time
- Reduce LOS
- Cut costs

Speed, L. et.al., 2012; Cameron, T. et.al., 2009, deMastral et.al., 2011
Therapy Interventions: Swallow and PEP
Respiratory Mobility
Early Collaboration of Respiratory and Rehabilitation Department Improves Ventilator Weaning Rates

Debra Gurnari, RRT, and Cheryl Martin, MS, CCC-SLP
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Introduction:
According to the 2002 Agency for Healthcare Research and Quality (AHRQ) data, cost and length of stay associated with the care of the tracheostomy patient ranks 2nd in the nation, making this diagnosis one of the most expensive medical conditions to treat. There is a well-known correlation between prolonged mechanical ventilation and increased length of stay, increased cost of care, and increased morbidity. It is well documented in the most recent literature that earlier ambulation in the critical care areas has decreased the length of stay in the ICU by as much as 30% [1-3]. It is also well documented that earlier intervention by a multidisciplinary team improves various outcomes for tracheostomy patients [4-6]. We hypothesized that intervention by a multidisciplinary team with the goal of early ambulation in the LTAC environment would improve weaning rates.

Objective:
In 2010, the Respiratory Therapy and Rehabilitation Departments at Kindred Hospital Wyoming Valley began early collaborative assessment of all tracheostomy patients with the goal of ambulating patients as soon as possible after admission. We wanted to see if early intervention by a multidisciplinary team working towards common goals would improve weaning rates.

Methods:
We decided to incorporate ambulation trials using the Passey-Muir Valve (PMV) on all patients who could tolerate the valve as early as possible – even those patients who required mechanical ventilation. This is an important aspect of our protocol, as the literature supports using a PMV to reduce positive intrathoracic pressure, which improves postural control, upper extremity function, bowel and bladder emptying, swallowing and voice (7). Inclusion criteria for a PMV are based on vital signs, medical stability, and swallowing function. We evaluate patients with large amounts of secretion, when other plans were used as an exclusion criteria. Even traumatic brain injury patients are evaluated. Tracheostomy tubes are downsized as needed to allow simple tracheostomy tube removal once the valve is placed. When patients are not immediately included in valve trials due to intolerance, they are reassessed throughout their stay for changes in their condition and criteria. Due to their condition, not all patients were candidates to ambulate at first. Some patients could tolerate a few steps inside their rooms initially but then progressed to hallway ambulation. As the patients’ exercise tolerance progressed, advanced gait training and pulmonary rehabilitation continued.

Results:
Early intervention by a multidisciplinary team to incorporate ambulation therapy, in conjunction with utilizing a PMV as soon as possible after admission, has improved our facility’s ventilator weaning rates by 13% over 1.5 years.

Conclusion:
We feel incorporating the PMV in conjunction with rehabilitation therapy improved the ambulation/weaning outcomes. Some side benefits we also noted were decreased anxiety, earlier advancement to oral diet, improved patient satisfaction, and increased management of heavy secretion loads.

Clinical Implications:
This prospective data has shown early collaboration and intervention with the Respiratory Care Practitioners and the Rehabilitation Staff improves weaning outcomes. Further research needs to be done to determine the most significant factor responsible for improved ventilator weaning: early use of the Passey-Muir Valve, early ambulation of the tracheostomy patient, or the combination of the two.

References:
Questions?
Thank You!!