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

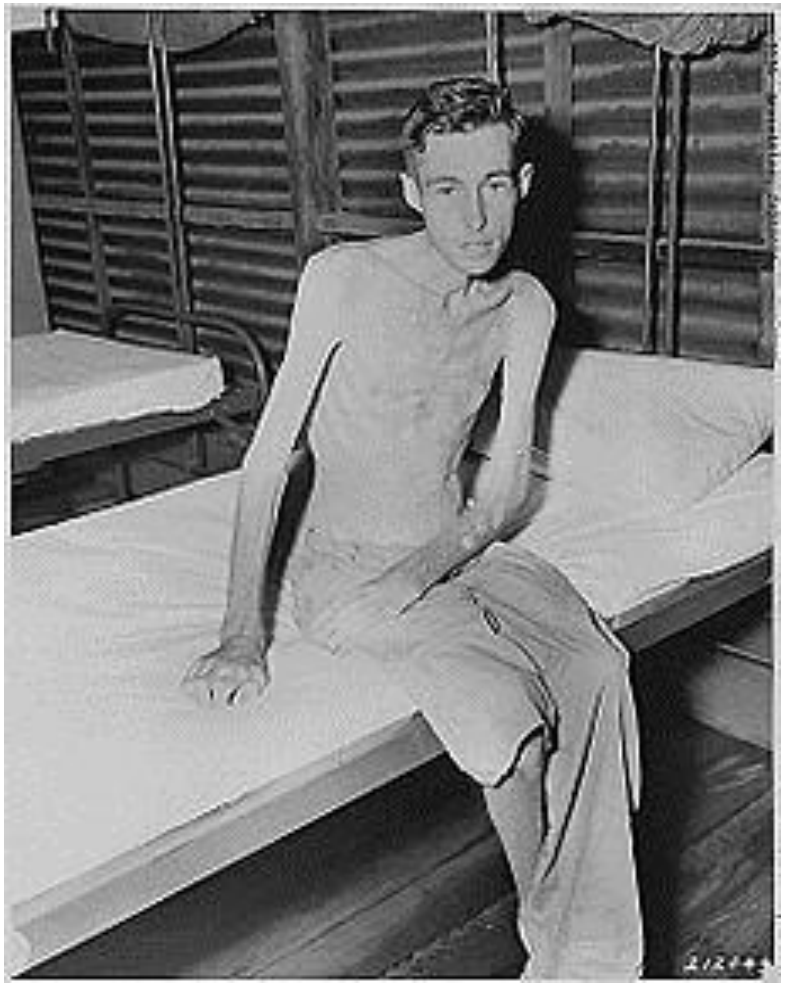
Negative Effects of Bed Rest

- 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]

1. Griffiths, R.D., et al. (1995). Effect of passive stretching on the wasting of muscle in the critically ill. *Nutrition*, 11:428.
2. de Jonghe, B., Lacherade, J.C., Sharshar, T., Outin, H. (2009) Intensive care unit-acquired weakness: risk factors and prevention. *Crit Care Med*, S309.

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."



Griffiths, Richard D., Jones, C. (1999). Recovery from intensive care. *BMJ*, 319:427.
Mirzakhani, H. et al. (2013) Muscle Weakness Predicts Pharyngeal Dysfunction and Symptomatic Aspiration in Long-term Ventilated Patients. *Anesthesiology,* 119:389.

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

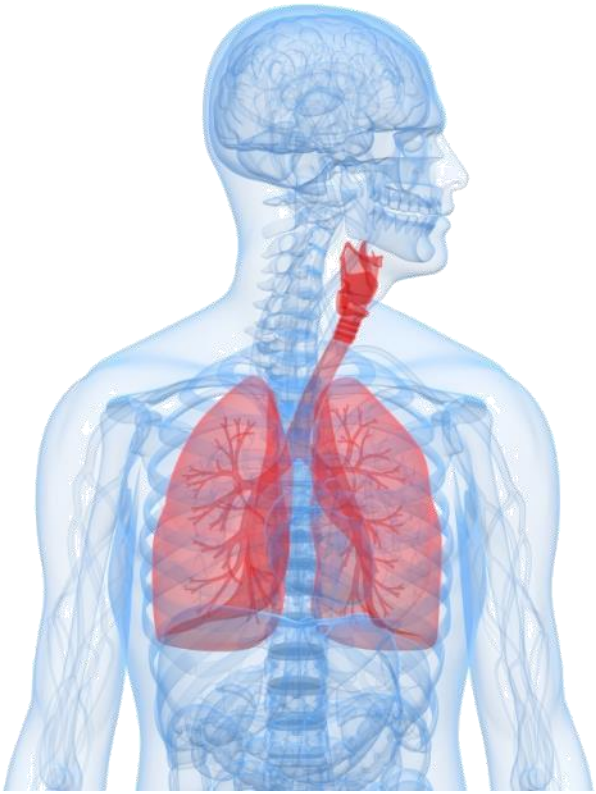
- Impaired exercise capacity and persistent weakness
- Suboptimal quality of life
- Enduring impairments and high costs of health care utilization

"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

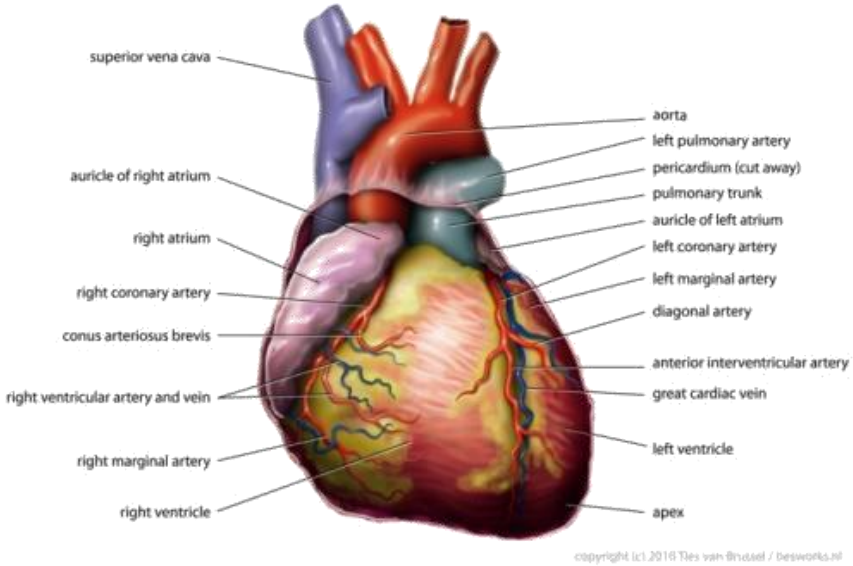
- Factors that disrupt oxygen transport
  - Fever
  - Disease
  - The healing process
  - Anxiety, stress and pain
  - #1 Factor: Lack of mobilization



Dean, E., Frownfelter, D. (2005) *Cardiovascular and Pulmonary Physical Therapy*, 4th Edition. St Louis, MO: Elsevier Mosby.

What Are The Positive Effects of Mobilization and Exercise?

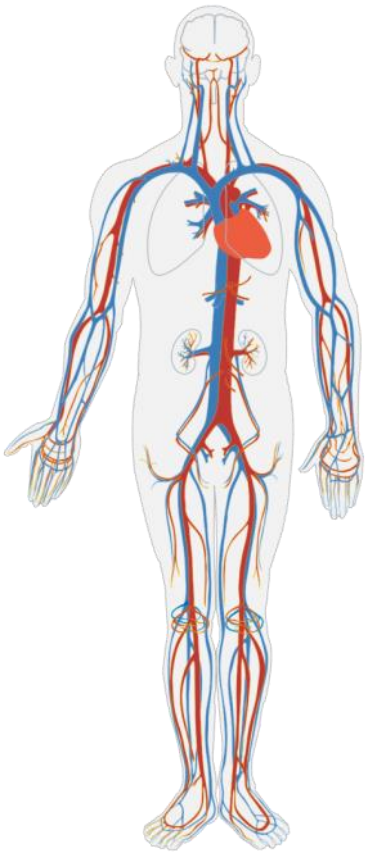
- Cardiac Effects
  - Increase venous return
  - Increase SV, HR, CO
  - Increase contractility
  - Increase coronary artery perfusion
  - Increase circulatory blood volume



- Frownfelter, D., Dean, E., (2006) Cardiovascular & Pulmonary Physical Therapy, 4th Edition

What Are The Positive Effects of Mobilization and Exercise?

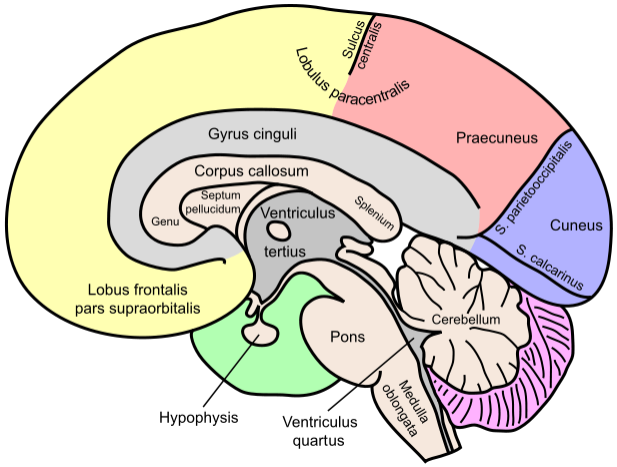
- Circulatory Effects
  - Increase peripheral blood flow and tissue oxygenation
  - Decrease venous stasis (emboli)
  - Increase pulmonary lymphatic blood flow and drainage (effusion)
  - Promote diuresis
  - Increase WBC production



- Frownfelter, D., Dean, E., (2006) Cardiovascular & Pulmonary Physical Therapy, 4th Edition

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



- Frownfelter, D., Dean, E., (2006) Cardiovascular & Pulmonary Physical Therapy, 4th Edition
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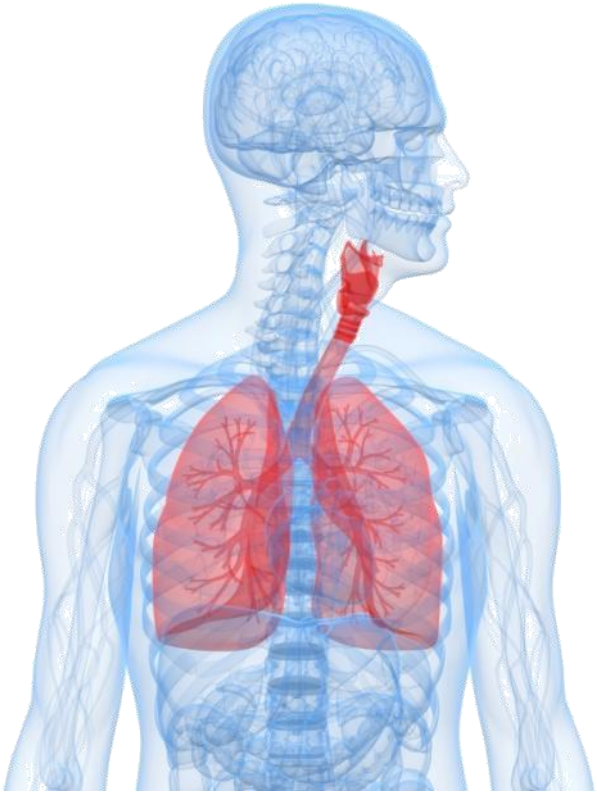
What Are The Positive Effects of Mobilization and Exercise?

- Metabolic Effects
  - Increase glucose metabolism – decrease insulin resistance
  - Speed drug metabolism/clearance
  - Increase immunity/less infection

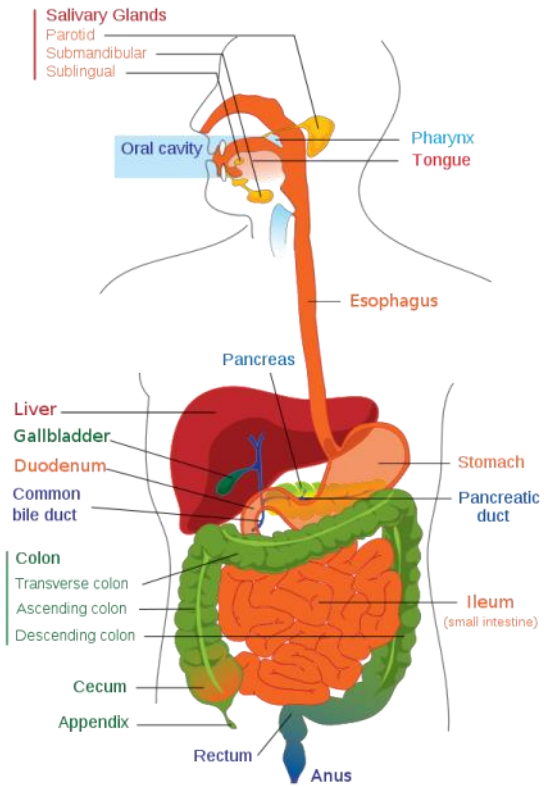
What Are The Positive Effects of Mobilization and Exercise?

- 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?

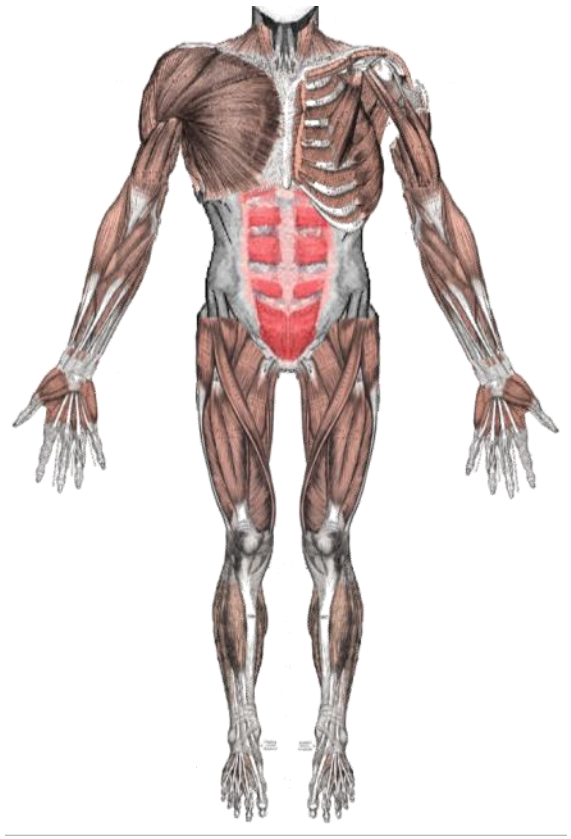
- Nutrition/Digestive Effects
  - Increase gut function
    - Absorption
    - Motility



- 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

AARC Clinical Practice Guideline
(2002) Pulmonary Rehabilitation. *Respiratory Care*, 37(5):617.

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

The EMST 150 – Handheld device for increasing expiratory muscle strength

Patient using the EMST 150

- Therapy to assist in lung expansion, coughing and airway clearance

  -Acapella

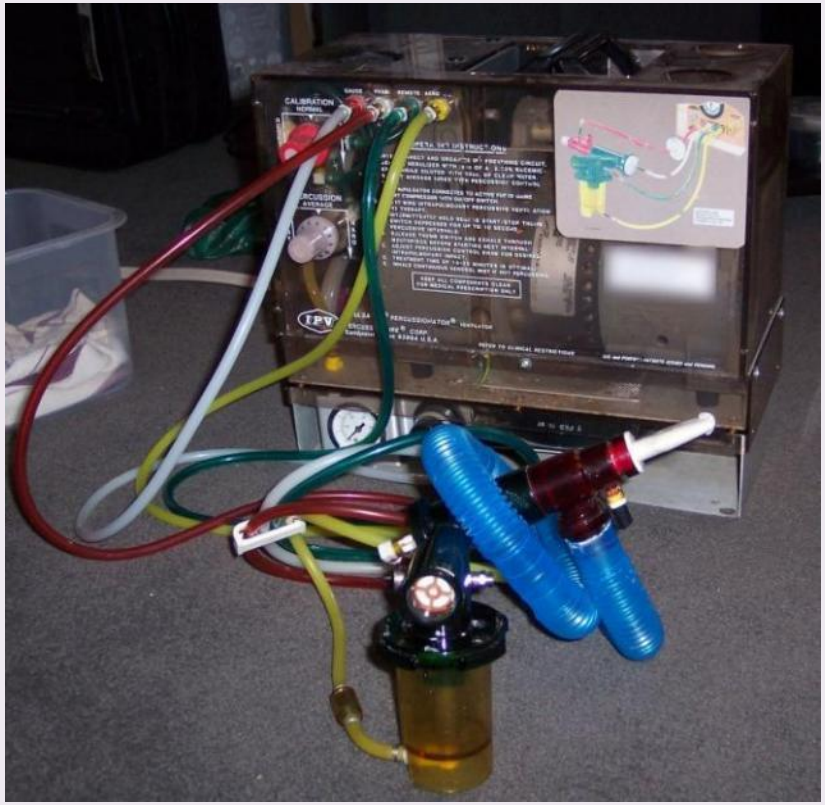
  -EZ Pap

  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/

Right: Source: English Wikipedia Originally uploaded by: en:User:ImmortalGoddezz Category:Pulmonology)

Alternative Airway Clearance Devices

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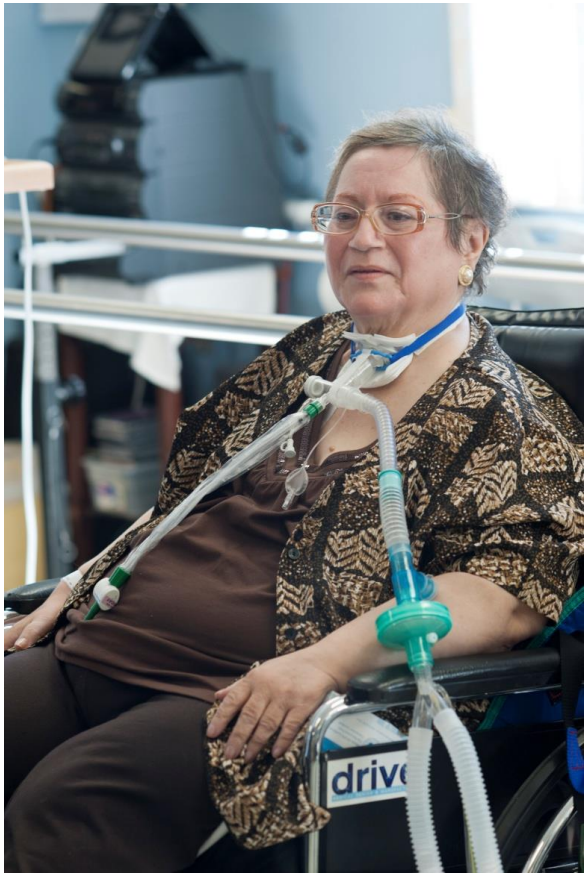
- Right: Source: English Wikipedia Originally uploaded by: en:User:ImmortalGoddezz Category:Pulmonology)

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



- Frownfelter,D. (2006) Cardiovascular & Pulmonary Physical Therapy, 4th Edition

Posture and Positioning Matter

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

- Frownfelter,D. (2006)Cardiovascular & Pulmonary Physical Therapy, 4th Edition

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

- Frownfelter,D.(2006)Cardiovascular & Pulmonary Physical Therapy, 4th Edition

Posture and Positioning Matter

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

- Massery, M. Chapter 39,(2006)Cardiovascular & Pulmonary Physical Therapy, 4th Edition

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."

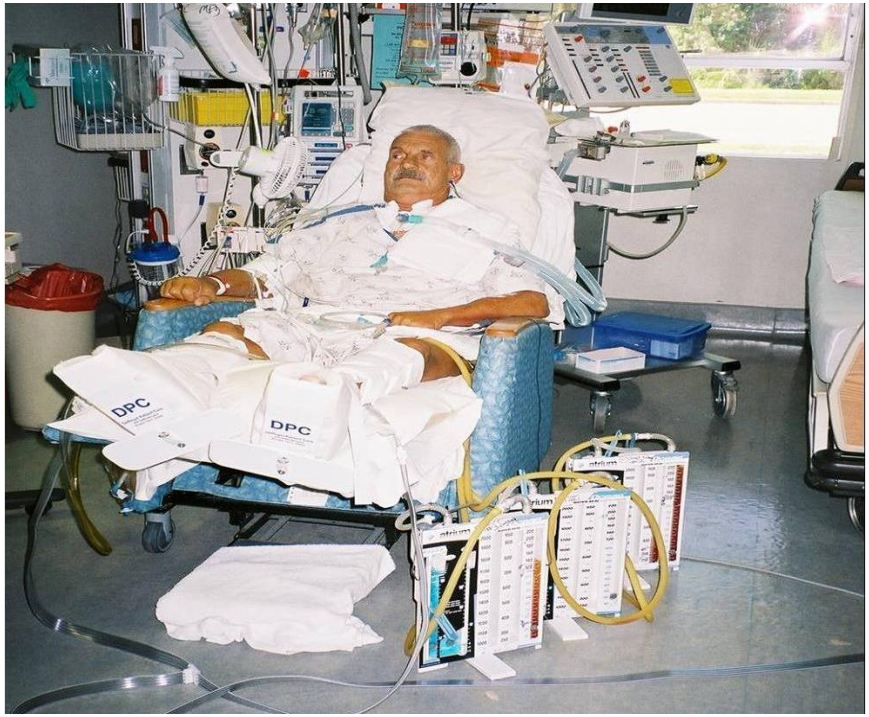
- Massery J Appl Physiol (1985). 2013

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
Morris et al. Am J Med Sci. 2011; 34(5):373
Needham et al. Arch Phys Med Rehab 2010; 91:536

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"

SAFETY
HERE
RT

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

- Yu, M. 2010. Tracheostomy patients on the ward: multiple benefits from a multidisciplinary team? *Critical Care*, 14:109T
- Muralidhar, K. 2008. Tracheostomy in ICU: An Insight into the Present Concepts. Indian Journal of Anaesthia. 52 (1): 28-37.
- Esteban, A. et al. 2000. How is mechanical ventilation employed in the intensive care unit? An international utilization review. American Journal of Respiratory Critical Care Medicine. 161:1450-1458
- Engoren, M. et. al. 2004. Hospital and Long-term Outcome after Tracheostomy for Respiratory Failure. Chest. 125:220-227.
- 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)
- Zilerberg, M. & Shorr, A. 2008. Prolonged acute mechanical ventilation and hospital bed utilization in 2020 in the United States: implications for budgets, plant and personnel planning*. BMC Health Services Research,* 8:242.

References For Cost

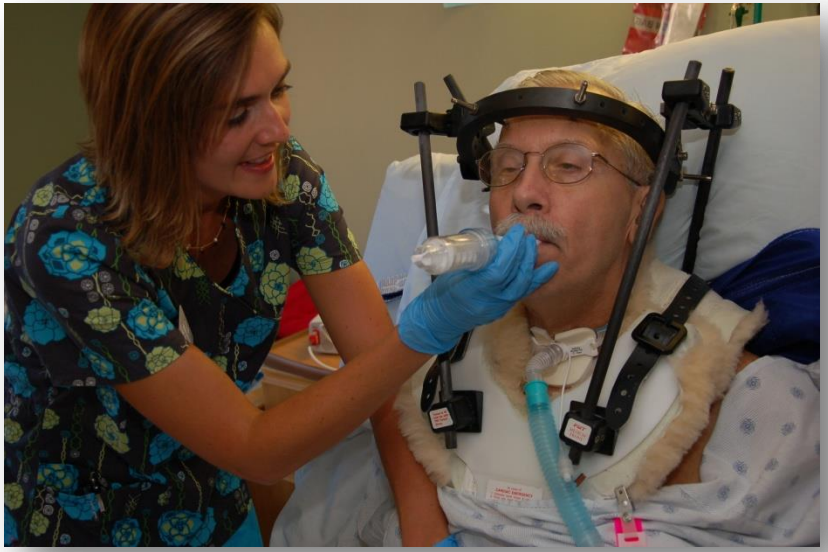
- Muralidhar, K. 2008. Tracheostomy in ICU: An Insight into the Present Concepts. Indian Journal of Anaesthesia. 52 (1): 28-37.
- Engoren, M. et. al. 2004. Hospital and Long-term Outcome after Tracheostomy for Respiratory Failure. Chest. 125:220-227.
- The Joint Commission. Advancing Effective Communication, Cultural Competence, and Patient-and Family-Centered Care: A Roadmap for Hospitals. Oakbrook Terrace, IL: The Joint Commission, 2010.
- Elpern, E., et al. (1994). Pulmonary Aspiration in Mechanically Ventilated Patients with Tracheostomies.Chest, 105:583-586.
- Dettelbach, M., et al. (1995). Effect of the Passy-Muir Valve on Aspiration in Patients with Tracheostomy.Head & Neck, 297-300.
- HCUP Nationwide Inpatients Sample (NIS), 2011. AGENCY FOR HEALTH CARERESEARCH & QUALITY (AHRQ).hcupnet.ahrq.gov
- Public Law 111-148, Patient Protection and Affordable Care Act 2010: Part III, Section 33025. March 2010. http://www.gpo.gov/fdsys/pkg/PLAW-111publ148/pdf/PLAW-111publ148.pdf
- 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

Kindred Hospital
Wyoming Valley

Debra Gurnari, RRT, and Cheryl Martin, MS, CCC-SLP
Kindred Hospital Wyoming Valley, Wilkes-Barre, PA

Introduction:

According to the 2003 Agency for Healthcare Research and Quality (AHRQ) data, cost and length of stay associated with the care of the trachestomized patient ranks 2nd in the nation, making this diagnosis one of the most expensive medical conditions to treat (1). 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% (2, 3). It is also well documented that earlier intervention by a multidisciplinary team improves various outcomes for tracheostomy patients (4-8). We hypothesized that intervention by a multidisciplinary team with the goal of early ambulation in the LTAC environment would improve weaning rates.

Objective:

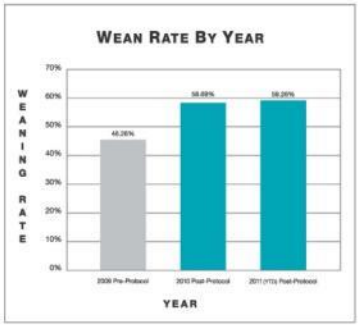
In 2010, the Respiratory Therapy and Rehabilitation Departments at Kindred Hospital - Wyoming Valley began early, collaborative assessment of all tracheostomized patients with the goal of ambulating patients as soon as possible after admission. We wanted to see if early intervention by a multidisciplinary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

Methods:

We decided to incorporate ambulation trials using the Passy-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 restore positive intra-thoracic pressure, which improves postural control, upper extremity force, bowel and bladder emptying, swallow and voicing (9). Inclusion criteria for a PMV are based on vital signs, medical stability, and swallow function. We evaluate patients with large amounts of secretions, when other places use that as exclusion criteria. Even traumatic brain injury patients are evaluated. Tracheostomy tubes are downsized as needed to allow ample expiratory airflow once the valve is placed. When patients are not immediately included in valve trials due to intolerance, they are re-assessed throughout their stay for changes in their condition and criteria. Due to their conditions, not all patients were candidates to ambulate at first. Some patients could only 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 when the PMV was used 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 Passy-Muir Valve, early ambulation of the tracheostomized patient, or the combination of the two.

Ventilator patient using the PMV® 007 in-line and ambulating

Respiratory Care and Rehabilitation Departments of Kindred Wyoming Valley

Passy-Muir® Valve assessment is performed as early in stay as possible

Ventilator patient ambulating in hallway

Combined efforts of departments for early ambulation

References:

1. Agency for Healthcare Research and Quality (2003) Fact Book #7: Procedures in US Hospitals.

2. Needham D, et al. (2010) Early physical medicine and rehabilitation for patients with acute respiratory failure: A quality improvement project. Arch Phys Med Rehab, Vol 91.

3. Morris PE, Goad A, Thompson C, et al. (2008) Early intensive care unit mobility therapy in the treatment of acute respiratory failure. Critical Care Medicine. 36(8):2238-43.

4. LeBlanc, et al. (2010) Outcome in tracheostomized patients with severe TBI following implementation of a specialized multidisciplinary tracheostomy team. Journal of Head and Trauma Rehabilitation. 25(5):362-5.

5. Tobin A & Santamaria J (2008) An intensivist-led tracheostomy review team is associated with shorter decannulation time and length of stay: A prospective cohort study. Critical Care. 12(2):R48.

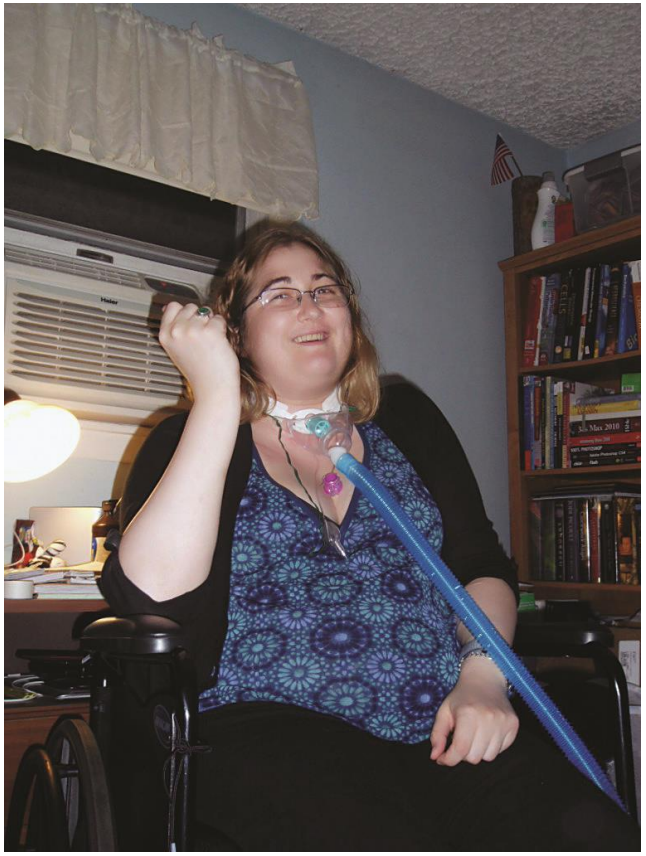
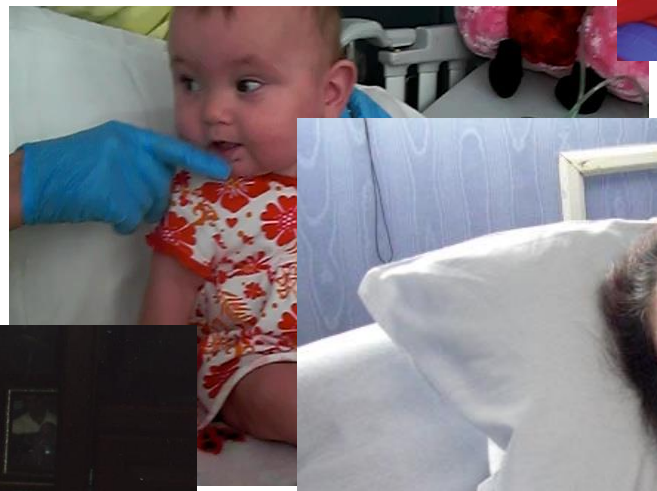
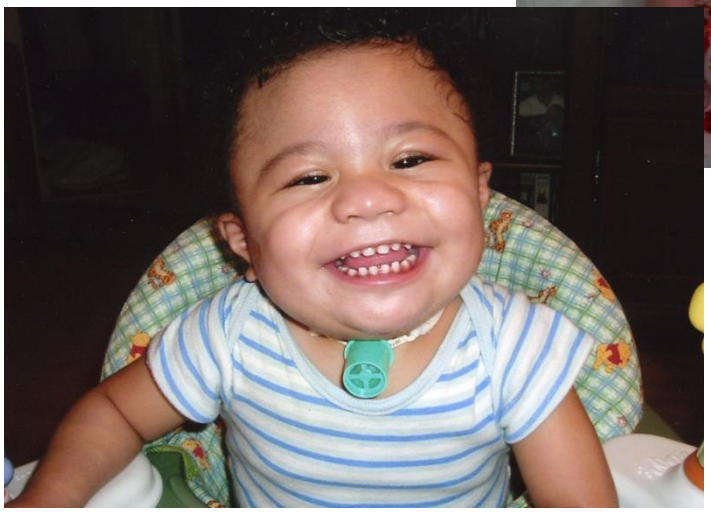
6. Windhorst C, Harth R, Wagoner C. (2009) Patients requiring tracheostomy and mechanical ventilation: A model for interdisciplinary decision making. The ASHA Leader, 14(1), 10-13.

7. Henneman E, Dracup K, Gantz T, Molayenne O and Cooper C. (2001) Effect of a collaboration weaning plan on patient outcome in the critical care setting. Critical Care Medicine. 29: 297-303.

8. Cohen I, Bari N, Strosberg M et al. (1991) Reduction of duration of cost of mechanical ventilation in an intensive care unit by use of a ventilatory management team. Critical Care Medicine. 19:1278-1283.

9. Massery M. (2010) "Breathing and upright posture: Simultaneous needs" as presented for the 28th International Seating Symposium, March 11-13, Vancouver, Canada.

Questions?



Thank You!!