Can you walk and talk?
Integrating Speech Therapy and Physical Therapy

Julie Hoffman PT, DPT, CCS  Creighton University
Jen Luethje PT, DPT  Madonna Rehabilitation Specialty Hospital
Suzanne Schult PT, DPT Madonna Rehabilitation Specialty Hospital
Cheryl Wagoner MS, CCC-SLP BCS-S, CBIS Madonna Rehabilitation Specialty Hospital

Objectives
• Identify benefits of transdisciplinary collaboration between physical therapy and speech pathology for medically complex patients.
• Summarize key anatomical concepts related to the thorax and airways.
• Apply specific therapeutic interventions that impact mobility, vocalization, ventilation, respiration, and cough to medically complex patients.
• Describe how the mechanics of breathing, postural control and glottic stability are inter-dependent components of normal movement.

Current Medical Trends
• Number of patients requiring mechanical ventilation increasing 50% per decade 1
• 5x increase in number of long-term ventilator patients vs. number of hospital admissions 2
• Chronic vent dependency compromises 5-10% of ICU patients, consuming 50% of resources 1
• Cost for the mechanically ventilated patient is increasing at a rate of 50% per decade 1

So why co-treat with Speech?
• Benefits of transdisciplinary approach: our experience
  - Earlier ventilator weaning and decannulation
  - Improve functional outcomes
  - Decrease length of stay
  - Decrease cost of medical care

Current Medical Trends
• Vocal fold dysfunction associated with cardiothoracic procedures
  - Studies demonstrate correlation up to 1.9% (over looked complication) 3
• Cognitive decline associated with CABG
  - Nearly 75% of patient’s at discharge 4
  - 75% of patient’s following CABG experience encephalopathy 5

Financial Disclosure
• Non-financial – No relevant financial relationship exists
• Associate Professor in the Physical Therapy Department at Creighton University
• Physical Therapist at Madonna Rehabilitation Specialty Hospital
• Speech Pathologist at Madonna Rehabilitation Specialty Hospital
  – Clinical Consultant for Passy-Muir
Our Background

Lincoln campus

Omaha campus

Madonna Rehabilitation Hospital is a Catholic organization that exists to provide medical and rehabilitation services to children and adults with physical disabilities throughout the nation and to create and share improved methods to reduce disability through research in rehabilitation science and engineering.

Our Background

Lincoln campus

Omaha campus

Madonna Facts

• Top 1% nationally for patient complexity

• Top 1.2% nationally for preventing re-hospitalizations to acute care post discharge

• Discharge: 44.95% to community compared to weighted national average of 42.75%

Madonna Outcome Numbers

• 65.3% of all patients admitted on a ventilator (regardless of weaning expectations at the time of admission) are weaned

• Average ventilator wean rate is 14 days

• Hospital Acquired Pneumonia 1.57 per 1000 vent days (goal is below 4/1000 vent days)

Therapy gym in Lincoln

Types of Collaboration

• Interprofessional
  – Term used in academia
  – “Showcasing different yet mutually reinforcing roles and expertise”

• Multidisciplinary
  – Professionals working independently towards goals specific to their discipline

• Interdisciplinary
  – Professionals working with common goal and decision-making process, by sharing professional responsibilities

Types of Collaboration Cont.

• Transdisciplinary
  – Implies the boundaries of each profession become blurred

  – “Characterized by a deliberate exchange of knowledge, skills, and expertise that transcend traditional boundaries”
Transdisciplinary approach results in:

- Improved consistency of interventions
- Increased frequency and practice with various therapeutic approaches
- Neuroplastic Effect
  - Increased repetition as a result of multiple team members knowledge and utilization

Benefits specific to Physical and Speech Therapy collaboration

– Improved awareness of upper airway anatomy and physiology on PTs behalf allows for:
  - improved positioning for patient communication and swallowing
  - increased postural stability for communication with gait activities

Putting it into practice

- Speech Pathologist and Positioning?
  - Respiration & posture are linked!
- Every muscle originating or inserting on the trunk is a respiratory AND a postural muscle

Key anatomical concepts related to the thorax and airways

“Triad of normal breathing”

- Key points:
  - These muscle groups working in concert necessary for normal, efficient breathing.
  - Weakness in any/all groups, leads to abnormal and/or inefficient breathing
  - Vocalization is accomplished when the diaphragm/abs/intercostals work eccentrically

Diaphragm

- Innervation – phrenic nerve, C3-C5
- Major muscle of passive ventilation
- Important role in pressure regulation - completely separates thoracic and abdominal cavities
Key Points – Diaphragm plays multiple roles

- Serves as the primary muscle of ventilation
- Provides ~75% of effort for tidal volume (at rest)
- Very efficient
- Provides postural support/control
- Respiration impacts venous return

Key Points – Intercostals

- Innervation – T1-T12
- Primary Role - stabilizes rib cage during inspiration
- Expands lower chest laterally and superiorly; upper chest anteriorly and superiorly

Key Points

- Important in forceful exhalation (e.g. coughing)
- Stabilizes rib cage during inspiration

Key Points – Abdominals

- Innervation T6-L1
- External obliques and rectus - stabilize rib cage
- Internal obliques – pulls inferior border of ribs downward
- Tranverse abdominus - Provides positive pressure support for diaphragm

Key Points

- Intact abdominals necessary to provide positive pressure for proper diaphragmatic movement (Provides stability for central tendon of the diaphragm)
- Assist in forceful exhalation (cough, huff maneuver)
- Essential for normal function: ventilation, cough, bowel movements

Every muscle attaching to bony thorax impacts ventilation and function

- Paraspinals, Pectoral muscles, Serratus anterior, Scalenes, Sternoceledomastoid, Trapezius
- Provide support even with quiet breathing
- Must be considered with thorough examination and evaluation
- Accessory muscle use in breathing = high energy cost
Healthy mucociliary escalator important for airway health

Functions:
1) Protect lower airway
2) prevent accumulation of mucus in airway
- Gel layer – traps foreign material
- Sol layer – cilia beat and propel mucus upward and outward
- Mucus protects epithelium by insulating/humidifying

Upper airway

- Passage by which air enters, leaves lungs
- Extends from the nares or mouth to and including the larynx
- Valving system to maintain pressure
- Sensory receptors

Normal FEES

Symmetrical TVF
Complete glottic closure
Glottic closure with cough

Open versus Closed system

- Effects of open/faulty upper airway system on:
  - Respiration
    - Cough
  - Voice
  - Swallowing
  - Postural control
  - GI/bowel elimination

Transdisciplinary Patient Management

- Collaboration throughout the full course of patient management
  - Admission
  - Initial Evaluation
  - Rehabilitation process
  - Discharge Planning
  - Discharge evaluation

Patient Evaluation:
A transdisciplinary collaboration/Who’s role is it?

- Observation
  - Breathing pattern efficiency (at rest, in various positions, with activity)
  - Work of Breathing
  - Posture
  - Vocal intensity and quality
- Vital sign response
  - How is BP, HR, Spo2, RR, RPE, RPD impacted by position or intervention?
- Informal pulmonary function measurement (VT, VC)
  - Incentive spirometer, timed vowel sound, syllables/breath
- Mobility - Sitting, Standing, Transfers, Ambulation
  - Dual Tasks
  - Not just ability to accomplish task, but the quality of movement
Patient Evaluation:
A transdisciplinary collaboration/Who’s role is it?
- Chest wall excursion
- Airway clearance
  - Auscultation
  - Peak flow meter to measure cough flow rate
  - Secretion management
- Cardiorespiratory fitness
  - Timed standing, ambulation, formal testing
- Comprehension & Expression
- Vocal quality/Speech intelligibility
- Cognition
- Swallowing

So, who does what? It depends...
- Medically Complex patients
  - High acuity
  - Poor activity tolerance
  - Vent dependent
- Communication or cognitively impaired patients
- Mobility impaired patients
  - Physically dependent vs. ambulatory
- Minimally responsive patients

Important of Early Intervention
- Studies indicate up to 16% knee extensor isometric strength loss in older adults with 5 days bed rest \(^{18}\)
  - 4% lean mass loss
- Muscle protein breakdown begins as soon as 5 days bed rest \(^{18}\)
- Results in better functional outcomes and shorter duration of delirium \(^{19}\)

Transdisciplinary interventions addressing cardiopulmonary impairments
- Positioning
- Postural re-education
- Muscle facilitation
- Muscle strengthening
- Airway clearance
- Ventilatory strategies
Sue

- Diagnosis: NSTEMI; CABG x 2; respiratory failure; pancreatitis; sepsis; Stage V sacral pressure ulcer; watershed CVA, tracheostomy, bilateral heel pressure ulcers
- Acute Care stay: 52 days
  - Return to Acute Care for FLAP
- LTACH stay: 21 days
- Acute Care stay: 3 days
- LTACH stay: 57 days
- Discharge Destination: Home

Evaluations

Physical Therapy
- 35% FiO2 via Trach-mask (PMV not in place)
- MMF: grossly 2/5
- Foot drop on the left
- Sensation: impaired distal to knees
- Balance:
  - Static sitting: minimal assistance
  - Dynamic sitting: maximum assistance
- Transfers:
  - Squat pivot: Max A x 2
  - Bed Mobility: Max A x 2
- Observations:
  - Posture: kyphosis
  - Breathing Pattern: upper chest, accessory muscles
  - Cough: weak, non productive
- Vital Sign Response: orthostatic hypotension, increased RPD with mobility

Speech Therapy
- HRA via 6 DCT trach
- Auditory Comprehension deficits:
  - 3-step commands 66%
  - Tracking complex conversation
- Verbal Expressive Deficits:
  - Word finding, verbal organization, delayed response
- Cognitive Communication:
  - Reports memory concerns
- Motor Speech
  - PMV assessment, harsh/hoarse voice, sustains /a/ 3 seconds, accessory muscle use ~ shoulder elevation for respiration at rest, frequent aphonia @ single word level
- Dysphagia
  - NPO, G-tube, and FEES recommended

FEES

Goals of Transdisciplinary Treatment Approach

- Patient Goal:
  - Return home and go to church with family

- Therapy Goals:
  - Increase communication efficiency in a community setting
  - Increase ability to multi-task
Transdisciplinary Treatment Interventions

- Ambulation with respiratory muscle strengthening devices
- Neuro re-education with gait and breathing pattern facilitation
- Core and respiratory muscle strengthening
- Dual tasks: simultaneous cognitive and motor activities

Inspiratory and Expiratory Muscle Strengthening: Current Evidence

- N=69 ICU patients with failure to wean from vent diagnosis (Martin et al²)
- Intervention protocol: IMST
  - Prescription: 5x's/week with threshold PEP, 4 sets of 6-10 breaths/day
- Outcome Measures: vent weaning, MIP
- Results:
  - 25/35 IMST subjects weaned; 16/34 control group weaned
  - MIP significantly greater in weaning group vs. failure to wean group
- Conclusion: "IMST is a clinically practical and safe method to improve weaning"

Inspiratory and Expiratory Muscle Strengthening: Current Evidence

- Sprague: Case Report¹
- N=6 individuals with failure to wean diagnosis in ICU
- Intervention: threshold IMT
  - Prescription: 6-7x's/week with IST, 4 sets of 6-8 breaths/day
- Outcome Measures: vent weaning, MIP
- Results: All weaned within 9 to 28 days
  - Rapidly improved MIP with use of threshold PEP protocol
- Theory:
  1. Reverse disuse atrophy
  2. Altered neuromuscular dysfunction
  3. Improvements to breathing patterns

Ambulation with Respiratory Muscle Strengthening Devices
Neuro re-education with gait and breathing pattern facilitation

Core and respiratory muscle strengthening

Diaphragmatic Activation & Mechanical Stability of the Trunk: Current Evidence

- N = 34 healthy individuals in outpatient clinic (Bradley et al²⁰)
- Purpose: examine relationship btw BPD & Functional Mvmt
- Outcome Measures: Functional Movement Screen, BPD as measured by CO2
- Findings:
  - Resting CO2 significantly different btw diaphragmatic & thoracic breathers
    - (36.14 mmHg vs. 32.14 mmHg)
  - Diaphragmatic breathers outscore thoracic breathers in FMS
    - (15.63 vs 13.89; p= .006)
- Conclusion: A decrease in diaphragmatic excursion has negative consequences to postural stability and optimal respiration

Dual Tasking: Current Evidence

- N = 32 healthy individuals assessed in single and dual task situations (Plummer et al ²¹)
  - Tasks include: walking while texting
- Outcome measures: gait speed, texting speed
- Results: Gait deviations noted with dual tasking
  - Decreased gait velocity
  - Increased lateral deviation

Fran

- Diagnosis: Respiratory failure with need for ventilator support, decubitus ulcers to coccyx and T-spine, severe generalized weakness with paraplegia
  - PMHx: metastatic prostate cancer Stage IV
  - Acute Care stay: 12 days
  - LTACH stay: 19 days

Evaluations

<table>
<thead>
<tr>
<th>Physical Therapy</th>
</tr>
</thead>
<tbody>
<tr>
<td>PMV not in place</td>
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<tr>
<td>MAFT O/S Bilaterally</td>
</tr>
<tr>
<td>Sensation: absent bilaterally distal to knees</td>
</tr>
<tr>
<td>Skin: stage IV coccyx wound</td>
</tr>
<tr>
<td>Balance</td>
</tr>
<tr>
<td>Static sitting: dependent</td>
</tr>
<tr>
<td>Transfers</td>
</tr>
<tr>
<td>- Dependent via use of hoyer lift</td>
</tr>
<tr>
<td>- Bed Mobility: Max A x 2</td>
</tr>
<tr>
<td>Observations</td>
</tr>
<tr>
<td>- Posture: rounded shoulders, forward head, kyphosis</td>
</tr>
<tr>
<td>- Breathing Pattern: accessory muscles, upper chest</td>
</tr>
<tr>
<td>- Cough: absent</td>
</tr>
<tr>
<td>- Vital Sign Response: decreased SpO2, elevated heart rate and respiratory rate with all movement</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Speech Therapy</th>
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</thead>
<tbody>
<tr>
<td>Decreased alertness and attention</td>
</tr>
<tr>
<td>Auditory Comprehension deficits:</td>
</tr>
<tr>
<td>- 1-step commands 100%</td>
</tr>
<tr>
<td>- 2-step commands 50%</td>
</tr>
<tr>
<td>Limited communication attempts</td>
</tr>
<tr>
<td>PMV assessment: tolerates 2 minute trial, however continues to desaturate with 100% oxygen boost</td>
</tr>
<tr>
<td>Dysphagia</td>
</tr>
<tr>
<td>NPO, G-tube, and FEES recommended</td>
</tr>
</tbody>
</table>
Goals of Transdisciplinary Treatment Approach

- Patient/Family Goals:
  - Communicate a message to a future grandchild
  - Increased comfort

- Therapy Goals:
  - Increased arousal
  - Improved secretion management & clearance

Transdisciplinary Treatment Interventions

- Positioning for arousal and communication
- Positional changes for secretion clearance and vocalization

Initial Positioning

Wheelchair Modifications

Supported sitting in wheelchair

Positioning for arousal and communication

Positional changes for secretion clearance and vocalization
Positioning and Improved Arousal: Current Evidence

• Systematic Review (Ambrosino et al.²³)
• Goal of review: identify rehabilitation components and techniques used in ICU setting
• Conclusions:
  – Benefits of early mobilization:
    1. Reduced rate of respiratory tract infection & pneumonia
    2. Reduced duration of intubation
  – Benefits of Prone positioning:
    1. Gains in oxygenation
    2. Improved ventilation and perfusion

Steve

• Diagnosis: Respiratory failure (requiring vent at night), Pacemaker placement; CVA; significant anemia with severe debility
• PMHx: metastatic prostate cancer Stage IV
  – Acute Care stay: 12 days
  – LTACH stay: 30 days
  – Discharge destination: SNF

Evaluations

<table>
<thead>
<tr>
<th>Physical Therapy</th>
<th>Speech Therapy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vent Settings: Trach Mask (CPAP mode at night, 30% FiO2)</td>
<td>Motor Speech:</td>
</tr>
<tr>
<td>Trach: DCT size 8</td>
<td>– PMV assessment: tolerates 2 minutes before increased work of breathing and audible back pressure, aphonic</td>
</tr>
</tbody>
</table>

• MMT: No formal assessment due to decreased alertness (≥ 3/5 left LE grossly)
• Motor Control: Flaccid right lower extremity
• Skin: stage IV coccyx wound
• Balance:
  – Static sitting dependent
• Transfer:
  – Dependent via use of Hoyer lift
  – Supine to and from sid lying dependent
• Observations:
  – Posture: rounded shoulders, forward head
  – Breathing Pattern: upper chest
  – Cough: weak, non productive
• Vital Sign Response: increased respiratory rate, increased O2 Sat, increased P/D

Steve’s FEES

• Motor Speech:
  – PMV assessment: tolerates 2 minutes before increased work of breathing and audible back pressure, aphonic
• Dysphagia: NPO, NJ tube, and FEES recommended
• Extubated 2x prior to having trach placed
• Decreased attention and alertness
• Initial evaluation limited due to low hemoglobin

Goals of Transdisciplinary Treatment Approach

• Goal:
  – Patient’s goal was to eat a cheeseburger

• Therapy Goals:
  – Improve swallowing using appropriate positioning
  – Improving voice quality with movement

Transdisciplinary Treatment Techniques

• Dynamic balance with vocalization
• Core and vocal-fold strengthening
• Lower extremity and respiratory strengthening
Core and vocal-fold strengthening

Glottal Closure Effect on Postural Stability: Current Evidence

- N= 12 healthy individuals (Massery et al. 2013 *)
- Method: participants on foot plate, perturbations under 7 different airway conditions
- Outcome Measures: GRF, Horizontal linear displacement of thorax, IAP
- Results: tasks requiring open glottis were associated with greater thoracic displacement
- Conclusions:
  - airway closure plays a role in postural stability

Penni

- Diagnosis: Heart transplant with severe debility requiring mechanical ventilation
- PMHx: Hodgkin’s lymphoma w/ radiation treatment- resulting in paralyzed right hemidiaphragm (seen on CXR)
  - Acute Care stay: 42 days
  - LTACH stay: 47 days
  - Discharge Destination: Home

Goals of Transdisciplinary Treatment Approach

- Patient Goal:
  - return to laying in bed
- Therapy Goals:
  - Increase communication efficiency in a functional setting
  - Increase functional positional tolerance
  - Increase ability to multi-task
  - Decrease anxiety

Transdisciplinary Treatment Interventions

- Neuromuscular re-education in semi-recumbent position for vocalization
- Neuromuscular re-education in side-lying position for breathing pattern facilitation
- Cognition and gait training

Initial Evaluation

<table>
<thead>
<tr>
<th>Vent Settings: A/C mode, 30% FiO2</th>
<th>Trach: 6 Shiley</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Therapy</td>
<td>Speech Therapy</td>
</tr>
<tr>
<td>MMT: R LE 3+, L LE 2+</td>
<td>Unable to tolerate PMV with audible backpressure</td>
</tr>
<tr>
<td>Balance:</td>
<td>Communicates via mouthing and writing with dry erase board</td>
</tr>
<tr>
<td>- Static sitting: HOA to Mod A</td>
<td>Cues required for orientation</td>
</tr>
<tr>
<td>- Dynamic Sitting: Mod/Max</td>
<td>Modified barium swallow completed at acute hospital; no aspiration on study</td>
</tr>
<tr>
<td>- Static Standing: Max to Dep.</td>
<td>Penetration with thin liquids</td>
</tr>
<tr>
<td>Observations:</td>
<td>Weak base of tongue retraction and decreased laryngeal elevation</td>
</tr>
<tr>
<td>- Posture: rounded shoulders</td>
<td>Admitted NPO with NG tube</td>
</tr>
<tr>
<td>- Breathing pattern: upper chest; diminished left diaphragm, accessory muscles</td>
<td></td>
</tr>
<tr>
<td>- Cough: weak</td>
<td></td>
</tr>
<tr>
<td>Vital Sign Response: increased respiratory rate</td>
<td></td>
</tr>
</tbody>
</table>
Questions?

References

1. Sprague S, Hopkins P. Use of inspiratory strength training to wean six patients who were ventilator-dependent. Physical Therapy. 2003;83:171-181.

References continued


References continued


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**Contact Info**

Creighton University
- Julie Hoffman PT, DPT, CCS
  - JulieHoffman@creighton.edu

Madonna Rehabilitation Specialty Hospital
- Jen Luethje PT, DPT
  - jluethje@madonna.org
- Suzanne Schult PT, DPT
  - sschult@madonna.org
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