WVSHA Annual Conference, Bridgeport, WV; April 2016

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Disclosure

• University of Pittsburgh (salary)
• WVSHA honorarium
• NIH RO-1 (25% effort)
• No products
• Lots of biases favoring my patients

Treatment
Some Common Interventions...

- They are designed for this...
- Intended consequences

- **But they also do this**...
- Unintended consequences
  - Sometimes good...
  - Sometimes not so good...

Some Common Interventions... compensate...

- 1. Head rotation posture* - divert bolus
  - Directs bolus to opposite side of pharynx
  - Compensate for unilateral noncompliance

- **BUT IT ALSO:**
  - Increases UESO diameter (rotation to either side in normals)
  - Reduces UES pressure (either side, normals)
  - Increased intrabolus pressure
  - Reduces contralateral pyriform sinus pressure**

*Logemann et al (1989); **Takasaki et al., 2012
Some Common Interventions... compensate...

• 2. Chin-down posture* - reduce aspiration
  • Patients with aspiration due to "pharyngeal delay"
  • 50% did not aspirate with CDP (OR = 0.5)
  • Continued aspirators: pyriform sinus residue aspirated
  • Valleculae widened
  • Anterior bolus position (phar. delay, oral containment) →
  • BUT IT ALSO:
  • Reduces intrabolus hypopharyngeal pressure**
  • Contraindicated in patient with weak constrictors

*Shanahan et al. (1993); **Bulow et al (2002)

Oral containment vs. delay?

• Pharyngeal delay
  • Abnormally long pause between volitional oral transit of an organized bolus and onset of hyolaryngeal excursion
• Oral containment impairment
  • Loss of posterior bolus containment (tongue & soft palate); unorganized material enters pharynx before hyolaryngeal excursion

Impaired oral containment
Pharyngeal Delay
Some Common Interventions... compensate...

3. Increase duration of UES opening*
   - Mendelsohn Maneuver
     - maintains prolonged HLE
   - BUT IT ALSO:
     - is difficult to teach, difficult to perform
   - SEMG biofeedback training improves treatment effect* **

*Logemann et al (1990); **Coyle (2008)

4. Self-protection of airway
   - Supraglottic swallow (SGS)
     - Closes airway before swallow
   - “super SGS”
   - “effortful” vocal fold closure + tilts arytenoids
   - Earlier/longer UES relaxation and HLE* **

*Bulow et al (2002); **Ohmae et al., 1996;
Some Common Interventions... compensate...

BUT IT ALSO:
• Does the work of 3 other interventions
  • Increased intrabolus pressure*
  • Increase UES Opening and laryngeal closure*
  • Reduced oral residue*
• And can be Dangerous!!!
  • Produces arrhythmia in certain patients**

*Bulow et al (2002); **Chaudhuri et al. (2001)

Swallow respiratory coordination

• Healthy swallows followed by exhalation
• Disordered swallows followed by inhalation
• Training patients to coordinate breathing and swallowing?

Gross et al, 2009; Leslie et al, 2002a,b; Leslie et al, 2005

Some Common Interventions... compensate...

• 5. Tongue holding/tether
  • Bulge in PPW during swallowing
  • Inhibits tongue motion
  • Increases oral residue in normals
• BUT IT ALSO:
  • Is not intended for use by patients when swallowing!

Fujiu & Logemann (1996)
• And when we combine maneuvers we treat multiple problems
• ...but we need evidence that each is appropriate for the impairment

What about texture modification and Water?

Diet modification
• Should be the last compensatory method evaluated in testing
  • Logemann, 1993
• Issues:
  • What does texture modification do for patient?
  • Is patient amenable to modification?
  • Will patient eat the prescribed diet
    • Malnutrition, dehydration
Thickened liquids

• Reduces aspiration of thin liquids
  • Kuhlemeier et al., 2001; Logemann et al., 2008
• Swallow apnea later/longer with thick liquids
  • Hiss et al., 2004; Butler et al., 2004
• More effort needed to clear thick
  • Nicosia et al., 2001

Water

• Intake of water: ~2300 mL per day
  • 2100 mL through intake
  • 200 mL synthesized by body (CHO metabolism)
• Variations in water intake
  • Climate, habits, physical activity

Thickened liquids

• Patients do not like thick liquids
  • Garcia, 2005: prepackaged vs. mixed
    • Prepackaged better: Whelan, 2001
• Great variability in thick liquids
  • Prepackaged & mixed: UW/VA Swallowing Research Lab, 1999
  • Prepackaged: Garcia, et al., 2005; Steele, 2005
Do thickened liquids cause dehydration?

Thickened liquids

- Hydration and thick liquids
  - Sharpe et al., 2007
    - >95% water absorbed from thick mixtures
    - No difference between water, thick water

- Hydration and thick liquids
  - Reduced fluid intake when thick prescribed
    - Whelan, 2001: 24 stroke patients
    - Mean fluid intake = 455 mL/day

Do thick liquids reduce aspiration and pneumonia?

- Protocol 201 (Logemann et al., 2007; Robbins et al., 2008)
- Problem: Thin liquid aspiration
- Chin Down Posture vs. Thick liquids
  - Nectar, honey
- Parkinson’s disease, dementia, both
- Part 1: liquid aspiration prevention
- Part 2: pneumonia incidence
PART 1:
Do thick liquids or chin-down posture prevent aspiration?

<table>
<thead>
<tr>
<th></th>
<th>Thin liquid</th>
<th>Thin liquid-chin-down</th>
<th>Nectar</th>
<th>Honey</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aspiration</td>
<td>100%</td>
<td>68%</td>
<td>63%</td>
<td>53%</td>
</tr>
<tr>
<td>Preference</td>
<td>1st</td>
<td>2nd</td>
<td>3rd</td>
<td>last</td>
</tr>
</tbody>
</table>

PART 2:
In liquid aspirators, which has lowest pneumonia incidence: Thin/CDP? Nectar? Honey?
3 month randomized study

Pneumonia incidence: 11% (52/515 patients)

<table>
<thead>
<tr>
<th>Pneumonia</th>
<th>CDP/Thin</th>
<th>All Thick Liquid</th>
<th>Nectar</th>
<th>Honey</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aspirated in Part 1 (36)</td>
<td>6 (17%)</td>
<td>4 (11%)</td>
<td>3 (8%)</td>
<td>4 (11%)</td>
</tr>
<tr>
<td>Aspirated all 3 in Part 1 (42)</td>
<td>18 (43%)</td>
<td>24 (57%)</td>
<td>10 (24%)</td>
<td>14 (33%)</td>
</tr>
</tbody>
</table>

Evidence Summary for using Free Water Protocols

“Free Water” Protocols
“Free Water Protocol” Principles

• Rationale of protocol per developers:
  • 1. Need for hydration – self evident
  • 2. Poor compliance with thick liquids
  • We have reviewed that data
  • 3. Safety of water aspiration
  • One study published before 2008!!!

Evidence: one study before 2008

• Garon et al., 1997
  • 20 aspiration-documented CVA patients
    • Aspirated liquid only on VFSS
    • Randomized to free water or no free water
  • Results
    • No patient in either group developed pneumonia
    • No dehydration, complications
  • "Much less water than expected" by investigators ("we were surprised...")

Water Protocol Evidence

• Becker, et al., 2008
  • 26 patients randomly assigned
  • Results
    • Pneumonia: 1 patient in each group
    • UTI: 2 patients in each group
    • Independent patients consumed significantly less fluid than dependent patients (p<.01), regardless of group
Recent Evidence

- Karagiannis et al. (2011)
  - Significant increase in lung complications (6/42) vs. controls (0/34)
- Carlaw et al. (2011)
  - No complications in either group
  - More fluid intake in “protocol” patients

NMES

- “This preliminary meta-analysis revealed a small but significant summary effect size for transcutaneous NMES for swallowing. Because of the small number of studies and low methodological grading for these studies, caution should be taken in interpreting this finding. These results support the need for more rigorous research in this area.”
  - Small = clinically insignificant
  - Low grading = invalid results

Carnaby-Mann & Crary, 2007

Using the /k/ phoneme

<table>
<thead>
<tr>
<th>Task</th>
<th>Percent of Swallow activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>2.79 %</td>
</tr>
<tr>
<td>Ab</td>
<td>5.06 %</td>
</tr>
<tr>
<td>Sack tube</td>
<td>6.79 %</td>
</tr>
<tr>
<td>Key</td>
<td>7.11 %</td>
</tr>
<tr>
<td>Prry</td>
<td>7.50 %</td>
</tr>
<tr>
<td>Valsalva</td>
<td>8.98 %</td>
</tr>
<tr>
<td>Suckle</td>
<td>8.98 %</td>
</tr>
<tr>
<td>Laugh</td>
<td>12.27 %</td>
</tr>
<tr>
<td>Palato</td>
<td>14.95 %</td>
</tr>
<tr>
<td>Modified Valsalva</td>
<td>20.00 %</td>
</tr>
<tr>
<td>Hawk</td>
<td>23.66 %</td>
</tr>
<tr>
<td>Cog</td>
<td>62.12 %</td>
</tr>
<tr>
<td>Swallow</td>
<td>100.00 %</td>
</tr>
</tbody>
</table>

“Hawk”, modified valsalva produced “20% of muscle activity seen during swallow.”
**Tongue Press exercise**

- Reduced oropharyngeal residue (overall $p = .01 - .02$)
- Improved PA scores (3mL, 10mL liquid) - 4 weeks: $p = .02$, 8 weeks: $p = .005$
- Increased isometric pressure
  - Anterior 4-8 wk: ($p = .001$); posterior ($p = .01, .001$)
- Increased swallowing pressure
  - All consistencies/volumes at 4, 8 weeks.

**Restorative Methods**

- Exercise
  - Resistive expiratory exercise
    - Increase force of expiratory effort

Sapienza et al.
WVSHA 2016 Convention, J. Coyle, PhD, Treatment

04/06/2016

- Sham (7) vs Real (11)
- No significant difference in any biomechanical measures
- 11 real exercise pts. Pre-Post Real Exercise
  - AP UESO, anterior laryngeal excursion (ALE), all significantly increased from own baseline

• Head lift exercise

**Jaw Opening Exercise**

Significant increases (p<.05):
- Vertical hyoid motion
- UES opening diameter,
- Pharyngeal transit duration
Near significant (p=.05)
- anterior hyoid motion


http://dx.doi.org/10.1016/j.apmr.2012.04.025

McNeill program

- “Exercise based intervention specific to swallow activity”
- Swallow hard in a single swallow
- Systematic increase bolus volume, consistency as eating rate increased
- Homework (eating what was used in treatment)
- Record keeping at home
- Significantly higher diet levels (n=9)

*Crary et al., 2012 (above); Carnaby-Mann et al., 2010 (N=8); Lan et al. (2012) (N=8)
Facilitative Methods

- Thermal Tactile Stimulation
  - Thought to stimulate afferent pathways *
  - No evidence supports sustained effects
    - High dosage over long term produced momentarily quicker onset of HLE (reduced DST)**
- Taste-sour bolus (50% lemon juice/barium)
  - Reduced aspiration in neuro patients***
  - Reduced DST in stroke patients***


Facilitative Methods

- Interest in manipulating other sensory modalities
  - Taste, vibratory sense, electrical stimulation (?)
- Can the brain be rewired in adults?
  - Emerging evidence that “something” is happening upstream
    - MEG, EEG (record the effects), MRI
    - TCMS (stimulate motor effects)
    - Direct current stimulation
    - Exercise
- Implantable intramuscular ES

Jayasekeran et al., 2010, 2011; Pelletier & Lawless, 2003; Malandraki et al., 2011

What is plasticity?

- Alteration in the outcome

Motor learning theory?

- Mass practice
  - Dosage, intensity, progressive resistance + (other increments)
- Task specificity
- Neural adaptation
Stimulation of the brain?!?!?!

- Transcranial stimulation
- Magnetic fields
- Direct current
- Peripheral (pharyngeal)

Hype & enthusiasm

Evidence. What is Evidence?

There is no evidence that parachutes prevent injury or death

Smith et al., 2003
"... significant inverse relationship between pirates and global temperature."
Tactic 1

Tactic 2

Tactic 3

Improved Health, Reduced Risk

Long-term

Goals

New

Evidence!

STG

Prior Evidence!

How to decide?

Evaluating the evidence

• PEDro

1. Stability criteria were specified
2. Subjects were randomly allocated to groups in a crossover study, subjects were randomly allocated to an order in which treatments were received
3. Allocation was concealed
4. The groups were similar at baseline reporting for most important prognostic indicators
5. There was blinding of all subjects
6. There was blinding of all therapists who administered the therapy
7. There was blinding of all assessors who measured at least one key outcome
8. Measures of at least one key outcome were obtained on more than 85% of participants in the groups receiving the intervention
9. All subjects for whom outcome measures were available received the treatment as intended by the investigators
10. The results of between-group statistical comparisons are reported for at least one key outcome
11. The study provides both group results and measures of variability for at least one key outcome

Figure 1. The Physiotherapy Evidence Database scale was developed to facilitate analysis of research trial design and evidence-based clinical practice guidelines.
Summary

- Treatment is guided by accurate diagnosis
- Strategies are guided by many factors
- Tactics are scaffolded to make a strategy
- Evidence is essential
  - Generate your own evidence!
  - Evidence consumers are the customers!

Questions?

Thank you
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