SWALLOWING DISORDERS IN INFANTS AND TODDLERS: TESTING AND TREATMENT

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Disclosure

In the past 12 months, I have had no relevant financial relationships with the manufacturer(s) of any commercial product(s) and/or provider(s) of commercial services discussed in this CME activity.

Objectives

- Recognize swallowing problems in normal and medically-complex infants and toddlers
- Understand the instrumental diagnosis of dysphagia
- Comprehend the role non-physician colleagues provide to the diagnosis and treatment of dysphagia
- Be empowered to synthesize and execute plans for infants and children with swallowing disorders
SWALLOWING AND DYSPHAGIA

Normal progression of feeding skill acquisition:

<table>
<thead>
<tr>
<th>Skill</th>
<th>Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breast / Bottle only</td>
<td>0-4 mos</td>
</tr>
<tr>
<td>Smooth puree by spoon</td>
<td>4-6 mos</td>
</tr>
<tr>
<td>Soft chewables and cup</td>
<td>6-8 mos</td>
</tr>
<tr>
<td>Mashed table food</td>
<td>8-12 mos</td>
</tr>
<tr>
<td>Chopped table food</td>
<td>12-18 mos</td>
</tr>
</tbody>
</table>

Development of Swallowing and Feeding: Prenatal through First Year of Life

Infant Anatomy

- Tongue fills mouth
- Edentulous
- Small mandible relative to maxilla
- No definite oropharynx
- 1/3 of adult size
- Narrow vertical epiglottis
Transitional Anatomy

- Oral cavity enlarging
- Dentulous
- Lengthening mandible
- Elongating pharynx
- Descending larynx
- Widening epiglottis

Adult Anatomy

- Tongue rests on floor
- Dentulous
- Larger mandible relative to maxilla
- Present oropharynx
- Flat, wide epiglottis

Oral Stage

- Oral manipulation of food
- Timing depends on consistency
- First posterior movement of bolus by tongue
- Voluntary
- Airway open
Onset of Pharyngeal Swallow

- Bolus passes anterior faucial arch to valleculae
- Elevation and retraction of velum (soft palate)
- Elevation and anterior movement of hyoid and larynx
- Closure of larynx
- Opening of CP juncture

Pharyngeal Stage

- Pharyngeal transit time: 1 sec or less
- No hesitation of bolus
- Clearance of pharynx post-swallow
- Return of larynx to rest position in individual swallows
- Resume respiration

Swallowing → Airway → Upper GI Tract
### Oral Phase:

<table>
<thead>
<tr>
<th>Afferent</th>
<th>Touch</th>
<th>Taste</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trigeminal (V)</td>
<td>Oral cavity, anterior 2/3 of tongue</td>
<td>None</td>
</tr>
<tr>
<td>Facial (VII)</td>
<td>None</td>
<td>Anterior 2/3 of tongue</td>
</tr>
<tr>
<td>Glossopharyngeal (IX)</td>
<td>Posterior 1/3 of tongue</td>
<td>Posterior 1/3 of tongue</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Efferent</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Trigeminal (V)</td>
<td>Muscles of mastication</td>
<td></td>
</tr>
<tr>
<td>Facial (VII)</td>
<td>Lips and face</td>
<td></td>
</tr>
<tr>
<td>Vagus (X)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hypoglossal (XII)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C1 &amp; C2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Pharyngeal Phase:

<table>
<thead>
<tr>
<th>Afferent</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Glossopharyngeal (IX)</td>
<td>Pharynx</td>
<td></td>
</tr>
<tr>
<td>Vagus (X)</td>
<td>Larynx and Esophagus</td>
<td></td>
</tr>
<tr>
<td>Trigeminal (V)</td>
<td></td>
<td>Tensor veli palatini</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Efferent</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Trigeminal (V)</td>
<td>Palate, pharynx, larynx</td>
<td></td>
</tr>
<tr>
<td>Facial (VII)</td>
<td>Hyoid and laryngeal movement</td>
<td></td>
</tr>
<tr>
<td>C1 &amp; C2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### DIAGNOSIS

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Dysphagia

- Def: difficulty in swallowing
- A symptom, not a disease
- Indicates an underlying problem
  - Neurologic
  - Muscular
  - Anatomic
- Generally, physicians not trained in assessment

Assessment of dysphagia:

- Clinical assessment
- Instrumental assessment
  - Videofluoroscopic swallow study (VSS)
  - Fiber-optic endoscopic evaluation of swallow (FEES)
  - Scintigraphy (milk scan / spit scan)
  - High-resolution manometry
- Assessment for sequelae of aspiration
  - CT Scan
  - Bronchoscopy
- Assessment for CNS anatomic pathology
  - Brain MRI

Clinical Evaluation of Swallow

- Prospective evaluation of 75 children*
  - Age range 0-14 years, mean 2 years
  - Clinical evaluation (compared to VSS):
    - 92% sensitivity for detection of fluid aspiration
    - 33% sensitivity for detection of solid aspiration
  - No radiation or instrumentation
  - Cannot detect silent aspiration

*DeMatteo et al., Dev Med Child Neurology, 47, 2005
**Videofluoroscopic Swallow Study**

- Thought to be “gold standard”
- **Unlike other gold standards:**
  - Variability in procedure
  - Variability in interpretation of procedure
  - Aspiration may be only measure with high inter-rater reliability
- Effective in predicting development of pneumonia relative to degree of swallowing dysfunction

O’Donoghue and Bagnall, Folia Phoniatr Logop, 51, 1999

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**VSS – systematic assessment**

**Oral phase components**
- Lip closure
- Tongue control during bolus hold
- Bolus transport / lingual motion
- Oral residue: amount
- Oral residue: location

**Pharyngeal phase components**
- Initiation of pharyngeal swallow
- Soft palate elevation
- Laryngeal elevation
- Anterior hyoid excursion
- Epiglottic movement
- Laryngeal vestibular closure: height of swallow
- Pharyngeal stripping wave
- Pharyngeal contraction
- Pharyngoesophageal segment

**Esophageal phase components**
- Esophageal clearance in upright position
- Penetration / Aspiration
  - Thin liquid (sipper cup)
  - Thin liquid (medicine cup, bottle, syringe)
  - Puree (spoon)
  - Dissolvable finger foods

**Therapeutic interventions**

Assessment criteria at Duke
No chewing

Absent oral phase (1)

Absent oral phase (2)
Fiberoptic endoscopic evaluation of swallow (FEES)

- Similar to VSS in detecting aspiration
- May be best when:
  - Pharyngeal or laryngeal abnormality is suspected
  - Tracheotomy or ETT in place
  - Difficulty managing secretions
  - Assessment of sensation is important
- Cannot evaluate oral phase of swallow
- May add sensory testing

Residue

Paralyzed vocal fold

Videos courtesy of David Brown, MD

How reliable are flexible laryngoscopic findings?

- 52 adults with no history of ENT abnormalities or problems with GERD
- Flexible and rigid laryngoscopy
- Blind review by three reviewers
  - Abnormalities in 93% by flexible laryngoscopy
  - Abnormalities in 83% by rigid laryngoscopy
- Limited concordance in findings among evaluators
- Findings on laryngoscopy may be non-specific
- Appearance differs according to instrument
- Inter-observer variability

Milstein et al. Laryngoscope. 115, 2005
Posterior Laryngeal Cleft

Subglottic Stenosis

What about the future?

- High-resolution manometry (HRM) for speech-language pathologists
- Technological extension of manofluorography
- Ongoing pediatric research
  - Natalie Rommel
  - Tahir Omari
    - Review in JPGN, 2011
- Detailed physiologic analysis
- No assessment of the oral phase

Knigge et al, Dysphagia, 2014

Knigge et al, JPGN, 2011

Knigge et al, JOP, 2014
Allows demonstration of physiologic changes from mechanical maneuvers.

Knigge et al, Dysphagia, 2014
Therapists

- Skill-based therapists
  - Speech-language pathologists
  - Occupational therapists
  - Speech therapists
- Behavior-based therapists
  - Pediatric psychologists
  - Social workers
  - Technicians

Caveat emptor…

- Unlike North American medical education, there are no broadly accepted standards that delineate educational experience for skill therapists
- Competency with infant/toddler dysphagia gathered individually by interested individuals
- Look for:
  - Techniques (work within scope of practice)
  - Training
  - Reputation with complex and non-complex patients
  - Experience in working with physicians

Dysphagia
- 611 publications since 2005
- 29 relevant to infant populations (4.7%)

What about sensory problems?

- AAP position statement from 2012
- “…Because there is no universally accepted framework for diagnosis, sensory processing disorder generally should not be diagnosed.”

- Regardless of any sensory problems, any therapy should involve actual feeding
- Behavioral interventions are still very effective

Pediatrics, 2012
Silverman AH, NCP, 2010
PUTTING IT ALL TOGETHER

- Failure to gain weight?
  - Consider causes other than insufficient calories (maldigestion, malabsorption, ↑ demands)
  - Caloric supplementation
  - Structure meals
  - Augmentation of appetite

Failure to gain weight?

- Vomiting / GERD?
  - Acid suppression
  - Formula / diet changes
  - UGI series
  - Consider non-GI causes
  - EGD with biopsies
  - pH/Impedance testing

Vomiting / GERD?

- Dysphagia / aspiration?
  - ENT / SLP evaluation
  - Instrumental assessment
  - Appropriate feeding interventions
  - Pulmonary evaluation

Dysphagia / aspiration?

- Inability to control?
  - Concerns with pulmonary health?

Inability to control?

- Tube Feeding (NG / GT)
  - Ongoing vomiting or reflux with / without aspiration and / or lung disease?

Tube Feeding (NG / GT)

- Intestinal feeding
  - Fundoplication

Intestinal feeding

No adequate trials exist upon which to form evidence-based conclusions:

- No evidence to document pulmonary effects of allowing OR restricting drinking water in children who aspirate thin liquids.


Aspiration, alone, is not a reason to stop oral feeding; progression of lung disease is.

Ongoing vomiting or reflux with / without aspiration and / or lung disease?

Intestinal feeding

Fundoplication
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- ENT / SLP evaluation
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- Appropriate feeding interventions
- Pulmonary evaluation

Concerns with pulmonary health?
- Therapy skills, behaviors
  - Intestinal feeding
  - Fundoplication

Ongoing vomiting or reflux with / without aspiration and / or lung disease?
Conclusions

- Swallowing function in young children reflects anatomic and neurodevelopmental maturation
- Medically-complex children are at increased risk of dysphagia
- Among the multiple modalities for the assessment of dysphagia, VSS is the current standard
- Therapists expert at the management of infant dysphagia are rare – be nice to them
- Management of infant dysphagia requires multidisciplinary care with good communication among care providers