Problem Solving with Instrumental Swallow Evaluations & Management

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Learning Objectives
- At culmination of the session participants will be able to:
  - Describe reasons for consideration of an instrumental swallow evaluation for infants & young children with neurologic impairments affecting swallowing
  - Incorporate information related to clinic/instrumental evaluation of swallowing with health status into decision making for management of infants & children with dysphagia

State of Art & Science for Evaluation of Infants & Children with Signs/Symptoms of Dysphagia

- Clinical feeding evaluation
- FEES (often when upper airway & swallowing concerns are noted)
- VFSS
  - Stand alone examination
  - Combined with esophageal manometry

Introduction
- Predictability: the only predictable aspect for infants & young children is unpredictability
- Systematic decision making is important, with individual variability always in mind
- Sensori-motor learning & neural plasticity: useful considerations for management plans
- What else?

Criteria for Instrumental Evaluation

- Risk for aspiration by history or observation
- Prior aspiration pneumonia
- Suspicion of pharyngeal/laryngeal problem on basis of etiology
- Gurgly voice quality
- Need to define oral, pharyngeal, & upper esophageal components for management

Instrumental Swallow Evaluations

- Videofluoroscopic Swallow Study (VFSS)
  - AKA – Modified Barium Swallow Study (MBS)
  - Rehabilitation Swallow Study
  - Cookie Swallow + other names
- Fiberoptic Endoscopic Evaluation of Swallowing (FEES) + Sensory Test (FEESST)
Flexible Endoscopic Evaluation of Swallowing (FEES)
- No radiation
- Bedside exam possible
  - Including NICU
  - Otolaryngologist & SLP
- Defines some aspects of pharyngeal physiology, not oral or esophageal
- Can evaluate handling of secretions
- Not time limited

FEES: Breastfeeding Infant
- Only instrumental exam with breastfeeding infant (ultrasound may be possible, no data)
- Most common findings (23 patients, 10 months & younger)
  - Functional swallow (12.5%)
  - Laryngeal penetration (83%)
  - Direct aspiration (50%)
Willette et al, 2016

FEES in NICU
- Safe alternative or supplement to VFSS, multidisciplinary team (Reynolds et al., 2016)
  - Can be used at bedside
  - Further research needed
- Detection of laryngeal penetration & aspiration (Suterwala et al., 2017)
  - Infants < 3 months old in NICU
  - 25 infants: FEES & VFSS
  - No complications, no significant differences

Videofluoroscopic Swallow Study (VFSS)
- Defines oral & pharyngeal phases
- Defines esophageal transit & basic motility
- Delineates aspiration related factors
  - Before, during, or after swallows
  - Texture specificity
  - Physiologic reasons for aspiration
  - Estimate of risk

What VFSS is NOT
- To rule out aspiration or determine if child aspirates with oral feeding (important finding but not reason for exam)
- Simulation of a real meal
- Evaluation of oral skills for bolus formation
- Chewing evaluation
- Esophageal function (only upper esophagus)
- Pass-Fail Examination

VFSS Aims
- Define anatomy & physiology of oropharyngeal swallow + upper esophageal
- Measure efficiency of swallow
- Define movement patterns of structures in oral cavity, pharynx, larynx, UES
- If aspiration occurs, determine when, why, & how much
VFSS Aims (continued)
- Examine intervention possibilities
  - Postural changes
  - Sensory enhancement
  - Maneuvers in children (not infants)
  - Diet modifications (texture changes)

Major Unanswered Question:
How much aspiration of what can a system tolerate before chronic lung disease becomes a problem?

Patient Considerations
- Diagnostic & management needs
  - Nature of swallow impairment
  - Determination of ability to feed safely
  - Development of management plan
- Ability or readiness to participate
  - Medical stability
  - Ability/willingness to cooperate
  - Age, cognitive, & developmental status

Preparation of Oral (PO) Feeders
- Hungry, but not starving
- Schedule close to feeding time if possible
- Normalize the situation as much as possible
  - Child’s own utensils
  - Video/music as needed
- GT + PO: same guidelines as for total PO, unless child gets slow, continuous tube feeds

Preparation of Tube Feeder: NPO
- Child should demonstrate some level of oral intake, at least for therapeutic “taste trials”
  - NG tube – remove in some instances, not all
  - Amount per bolus: 2 to 3 cc
  - Total of 10-15 cc preferred, but not necessary, for validity & reliability
- Medication schedules maintained, or in some cases, adjustments needed

Child’s “State”
- Typical feeding status desired (e.g., baseline health status)
- Increased risks for aspiration
  - Lethargy
  - Agitation (fussing & crying)
- Cooperative child: interpretation possible in reliable & valid ways
- Always remember: Just a brief window in time, not a typical meal
**VF Equipment & Procedures**
- 30 frames per second – real time, not pulsed
- Radiation exposure determined by radiologist
  - Need adequate clarity
  - Minimal radiation dose
  - Coning – avoid orbits of eyes – cannot eliminate the thyroid gland

**Radiation Dose with VFSS**
- ALARA concept applies to pediatrics
- Long term effects are of concern
  - Younger the child, greater the risk
  - More sensitive to radiation-induced cancer
- Decreasing fluoroscopic pulse rate cannot be used to decrease radiation dose
  - Would result in non-detection of supraglottic penetration & aspiration, especially on liquid

**Radiation Safety Considerations**
- Patient protection
  - Collimate x-ray field
  - Use magnification judiciously
  - Limit “fluoro-on” time (ex., 1-3 min) while maximizing information
  - Lead protection Guidelines
    - Pediatric Radiology – better not to use shield

**Radiation Safety Considerations**
- Personnel protection
  - Use shielding (e.g., lead apron, thyroid collar, lead gloves, protective glasses)
  - Radiation monitor badges
- Pregnant personnel (same as for patient)

**Important Considerations in High Risk Pediatric Patients**
- Radiologist or PA must be present
- Well formulated questions
- Lateral view standard, A-P selective
  - Enlarged tonsils?
  - Oral & pharyngeal asymmetry?
- Audio important part of record
- Fluoroscopy time shortest possible while obtaining needed information

**Feeding Supplies & Recipes**
- Readily available when caregivers are asked to bring food samples
- Textures & barium recipes need to be standardized
- Data lacking, especially in children
- Poor relationship between viscosity of dysphagia diet foods & swallow barium test feeds of different viscosities (Strowd et al., 2008)
Standardized Products

- Properties of prepackaged products
  - Standardized viscosities
  - Minimal coating
  - Uniform opacity
  - Pleasant taste & texture (not always from child’s perspective)
  - Time-efficient solutions
- Thin liquid, nectar, thin honey, honey, & pudding

Procedural Decisions

- No fixed order for presentations in pediatrics
- Preferable to start with thinnest liquid
  - Controlled bolus size to start, e.g., spoon before going to bottle or cup drinking
- Work toward thicker as needed
  - Not want residue in pharynx that may complicate interpretation with thinner later
- Exceptions: parents tell us that child will not accept any thing else if he gets liquid first

Reasons to Start with Thin Liquid

- If aspirated
  - More easily expectorated – but remember young infants & those with neurologic impairment are not likely to cough
  - Small amounts of thin liquid may be absorbed by “stable” lungs (more research needed – we don’t know how much, how long)
  - Cannot block the airway

Lateral View

- Encompassing
  - Lips anterior
  - Soft palate superior
  - Posterior pharyngeal wall posterior
  - Fifth to seventh cervical vertebrae inferior, varying with age of child
- Simultaneous view of oral, pharyngeal & upper esophagus before food is presented

Antero-Posterior (PA) View

- When asymmetry is known or suspected
- Unilateral vocal fold paralysis or paresis
- Tonsil related questions
- Other possibilities?
  - Keep in mind radiation exposure time
  - Importance of findings for management

VFSS Procedural Considerations

- Positioning/seating: typical & optimal
- Cooperative patient imperative for interpretation
- Caregivers included, findings reviewed
- Findings interpreted & used as part of total team approach: maximize safety
- Review in slow motion, frame-by-frame
Infant Procedure Considerations
- Readiness
- Position/posture
- Feeding supplies
- View(s)
- Presentation
- Adaptations “on line”
- Fluoroscopy time

Child Procedure Considerations
- Readiness
- Position/posture
- Feeding supplies
- View (lateral & PA)
- Feeding options
- Adaptations “on line”
- Fluoroscopy time

Findings by Phase of Swallow
- Bolus Formation
- Oral transit
- Pharyngeal initiation
- Pharyngeal phase
- Upper esophageal phase

What is the problem?
- Aspiration?
- Laryngeal penetration?
- Residue?
- Concerns re continued PO?
- Underlying etiologies?

On-Line Bolus Modifications
- Position/posture
  (chin tuck - not for infants)
- Bolus changes
  ◆ Texture & order of textures
  ◆ Temperature
  ◆ Taste
  ◆ Size of bolus

On-Line Bolus Modifications
- Utensils
  ◆ nipples
  ◆ spoons & cups
  ◆ syringe (with caution)
  ◆ Placement in oral cavity
  ◆ Rate of presentation
  ◆ Maneuvers
Bolus Formation Findings
- Loss of food or liquid out mouth, cannot hold food in anterior part of mouth
- Material in anterior sulcus
- Material in lateral sulcus
- Limited tongue movement
- Material pushed out with tongue
- Jaw grading inappropriate (reduced chew)
- >3 sucks per swallow (nipple feeding)
- Gag

Oral Phase/Transit Findings
- Searching tongue movements
- Forward tongue action to move bolus
- Material remains
  - In anterior sulcus
  - In lateral sulcus
  - On floor of mouth
  - On tongue
  - On hard palate

Oral Phase/Transit Findings
- Limited tongue movement (A-P)
- Passive movement over posterior tongue into pharynx along tongue base
- Tongue-palate contact incomplete
- Piecemeal (multiple swallows per bolus)
- Delayed oral transit (>3 seconds)
- Other?

Initiation of Pharyngeal Swallow
- Delayed swallow initiation/onset
  - Material in valleculae (not necessarily a delay – depends on timing)
- Material in pyriform sinuses (even if brief, it is a “delay”)
- Failure to initiate swallow

Pharyngeal Phase Swallow Findings
- Pharyngonasal backflow or reflux
- Penetration
  - To underside of superior epiglottis
  - To laryngeal vestibule/vocal folds
- Aspiration (below level of true vocal folds)
  - Response (or lack) to aspiration
  - Clearance of airway?

Pharyngeal Phase Swallow Findings
- Response to aspiration
  - Immediate spontaneous productive cough
  - Delayed nonproductive cough
  - No cough (silent)
  - Eliminated (ejected, expelled, squeezed out)
- Penetration-Aspiration Scale Score
  - Worst swallow? How many times each code?
**Pharyngeal Phase Swallow Findings**

- Post swallow residue location
  - Tongue base
  - Valleculae
  - Pyriform sinuses
  - Posterior pharyngeal wall
  - Clinging to tonsil tissue
  - Laryngeal vestibule/supraglottic space
- Residue cleared with next swallow
- Residue not cleared

**Pharyngeal Swallow Problems**

- Tongue base retraction reduced
  - Residue in valleculae
  - Tonsil tissue negative impact
- Pharyngeal contractions reduced
  - Residue in pyriform sinuses
- Pharyngeal motility reduced
- Vocal fold paralysis/paresis
- Reduced velopharyngeal closure
- Incoordination

**Esophageal Swallow Findings**

- Upper esophageal sphincter
  - Opening, e.g., reduced, incoordinated (often pharyngeal phase problem)
  - Prominence (e.g., CP bar)
- Bolus passage
  - Slow, interrupted
- Retrograde movement of contrast (better term than reflux in this instance)

**Aspiration Before Swallow: Causes?**

- Limited tongue action
- Limited mandibular movement
- Reduced tongue & soft palate approximation
- Delayed initiation/onset of pharyngeal swallow
  - Premature spillage – best term?
  - Material in valleculae & pyriform sinuses
- Pharyngeal dysmotility

**Aspiration Before Swallow**

- Most common with liquids
- Airway is open
- Neural control is voluntary

**Aspiration During Swallow: Causes?**

- Vocal fold paralysis/paresis
- Reduced laryngeal excursion/elevation
- Pharyngeal incoordination
- Pharyngonasal backflow/reflux or regurgitation may be seen
Aspiration During Swallow

- Neural control
  - Initiation under voluntary control
  - Involuntary control for completion

- Airway
  - Closes upon initiation of pharyngeal swallow
  - Multiple levels of airway protection common

Aspiration After Swallow

- Reduced tongue base retraction
  - Residue in valleculae
  - Penetration into laryngeal vestibule

- Reduced pharyngeal contraction/motility
  - Residue in pyriform sinuses

- Reduced hyolaryngeal excursion

- Cricopharyngeal dysfunction

- Pharyngonasal backflow may be noted

Aspiration After Swallow

- Neural Control
  - Involuntary for esophageal phase

- Airway
  - Open

- Precipitating factors with open airway
  - Pharyngeal residue spills into airway
  - Pharyngonasal refluxed material

Esophageal Dysphagia Diagnosis

- Dysphagia for solids > liquids, structural cause likely

- Dysphagia for solids & liquids similar, dysmotility likely cause

Interpretation of VFSS Findings

- SLP reviews with caregivers & therapists or others involved in care
  - Findings by phase of swallow per texture
  - Timing of laryngeal penetration/aspiration related to physiologic processes

- If review reveals a finding not anticipated or noted during exam, SLP contacts PA or radiologist to discuss or review together

- Important that reports are not discrepant

Review of Findings at CHW

- All exams are saved as permanent record
- SLP reviews in real time, slow motion, & frame-by-frame

- Radiologists & PAs also review after exam

- Call or page with questions
Problem Areas from VFSS
- Oral phase (bolus formation & transit)
- Initiating pharyngeal swallow
- Pharyngeal phase
- Esophageal phase (upper)
  - Esophagram or UGI may be needed to define esophageal function
  - Impedance, manometry, or pH probe

Report Outline
- Demographics (Name, MR#, DOB, age)
- Reason for referral
- Primary medical diagnoses/etiologies
- Medications
- Developmental status (if pertinent)
- Current feeding status
- Procedural information

Report Outline
- Findings
  - By phase
  - By texture
- Impression or Interpretation
  - Correlate findings with physiology
  - Prognosis
- Recommendations

Management Recommendations
- Route for nutrition/hydration
- Feeding suggestions
- Therapy recommendations
- Additional suggestions
- Plans for follow-up or re-evaluation

Recommendations After VFSS
- Changes in route of nutrition/hydration
- Nutrition guidelines
- Position & posture changes
- Alterations of food textures, temperatures
- Utensil changes
- Changes in feeding schedule & pacing
- Oral sensorimotor program with food
- Nonnutritive oral sensorimotor program

Principles for Repeat VFSS
- Same as for initial VFSS
- Information needed for
  - Definition of etiology or diagnosis
  - Guide for management decisions
- NOT some arbitrary time interval
- Child should be at baseline
Repeat VFSS: Primary Reasons
- Modification of current feeding routines anticipated
- Prior study lacks sufficient information for areas of concern
- Patient transfer & inadequate data

Instrumental Evaluation Summary
- Purpose & questions must be well defined
- Keep in mind: children with complex health & developmental issues may have many radiology studies throughout their lifetimes
- How will findings impact management decisions?
- A cooperative child is needed for reliable & valid interpretation of findings

Instrumental Evaluation Summary
- Remember: Study samples a brief window in time while the child is in an atypical eating situation
- Strive for development of noninvasive measures that can infer pharyngeal physiology so accurately that radiologic studies will not be needed. Children (& parents) will be happy……..

Summary Questions
- What are primary factors in determining decisions to feed orally with risks for aspiration?
- When do risks of strict NPO outweigh risks of occasional aspiration on liquid?
- What are implications of frequent deep penetration on VFSS?
- Who assumes responsibility for decisions to feed or not to feed?

Management Priorities
- Parents want her to eat & drink (by cup)
- Nutrition status has to be top priority
- Behavior issues make it difficult to work on skills
- Oral skills & swallowing safety must be improved for major behavior gains to occur
- What is the best plan?

VFSS Training Manual
- Arvedson, J. Interpretation of Videofluoroscopic Swallow Studies of Infants and Children
  - www.nss-nrs.com
  - Email for Joan: jcarved@aol.com, jarvedson@chw.org
**Therapeutic Approaches/Techniques**

**Pros & Cons – What do we need to know?**

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**Postural Control Evaluation**

- Muscle tone (hypotonia or hypertonia)
- Central alignment relates directly to oral sensorimotor system
  - Presence of primitive reflexes
  - Level of physical activity
  - Self oral stimulation
- Use of eye contact, head turning, & touch

**Principles of Management**

- Whole child approach
- Total oral feeding is not always the goal
- Nutrition & respiratory status critical
- GER managed optimally
- Changes in management needed with gains or regression

**Management Recommendations**

- Direct & indirect approaches for oral sensorimotor function
- Types of abnormal sensory responses need to be considered
- Oral sensorimotor treatment for anatomic structure problems

**Intervention Based on Developmental Skill Levels**

- Overall gross & fine motor skill levels
- Cognitive, language, communication
- Adjusted age for first year or two in case of prematurity
- Important that all involved with a child understand & respect the child

**Intervention Factors**

- Cognitive status
- Posture, movement, motor skills
- Muscle tone
- Medications
- Reflexes
- Cranial nerve findings
- Dysmorphology diagnosis
### Ongoing Monitoring for Potential Changes
- Airway status
- GI tract disease (e.g., GER)
- Clinical ongoing assessment
  - Postural/positional observations
  - Caregiver/child interactions
  - Oral sensorimotor feeding status
  - Observation of respiration

### Intervention for Dysfunctional Swallowing
- Dietary changes
- Position & posture
- Bolus placement in mouth
- Timing between bolus presentations
- Thermal sensitization - caution for infants & young children

### Bolus Formation (Oral-Motor Focus for Function of Structures)
- Jaw
- Lips
- Cheeks
- Tongue
- Palate

### Oral Phase Management
- Positioning
- Sensory aspects
- Presentation
- Texture
- Movement patterns

### Pharyngeal Phase Management
- Indirect oral sensorimotor treatment
  (e.g., improve tongue base propulsion)
- Position changes
- Textures changes

### Nutrition Support
- Boost calories in a variety of ways
- Special formulas or foods
- Cut back calories/volume
  - Close monitoring with tube feeds
  - Infants with cardiac conditions along
    with neurologic problems may be fluid restricted
Positioning & Seating

- Critical as underpinning to oral sensorimotor considerations
- Adaptations may be needed with
  - Hypotonia
  - Hypertonia
  - Growth
  - Regression

Therapeutic Techniques: Pros & Cons for Discussion

- Thickeners
- Oral sensorimotor therapy
- Electrical stimulation
- Escape extinction (part of ABA)

Thickening: Questions

- What effect might thickened feeds have on the GI tract?
  - Young infants may face risk of life-threatening condition (NEC)
  - Simply Thick banned by FDA for infants
- Some companies now marketing for ages 3 years & above

Thickeners: Questions

- What happens to timing & coordination with prolonged use of thickened liquid when no practice is given to work toward thinner liquid
- Thickened fluids & water absorption in rats & humans (adults) – no evidence that absorption rate of water from the gut was different (Sharpe et al, 2007, Dysphagia)

International Dysphagia Diet Standardisation Initiative (IDDSI)

- Working committee working to standardize terminology related to texture modification
- Trends with thicker liquids
  - Reduce risk of penetration-aspiration
  - Increase risk of post-swallow residue in pharynx
- Food texture: properties of hardness, cohesiveness & slipperiness are relevant

IDDSI Processes

- 10 international researchers collaborated to review articles: started 10,147 screened for relevance; 488 met inclusion criteria
- 36 articles contained specific info re oral processing or swallow behaviors for at least 2 liquid consistencies or food textures
- Steele, CM et al Dysphagia 2015
**CP: Risks with Thin Liquids**
- Cochrane review – no studies found to support or refute water for children with cerebral palsy (Weir & Chang, 2005)
- Are there safe thin liquids if intermittent minimal aspiration occurs? If so, what conditions?
- How can practice/experience be provided?

**Oral-Motor Exercises**
- Evidence in literature: very limited with mixed quality of reports
- Arvedson et al 2010: 16 studies of variable quality
  - Insufficient evidence to determine effects
  - Well-designed studies are needed

**Oral-Motor Exercises**
- Likely sensory involved as well
- Work only on bolus formation & bolus transit – hoping to facilitate pharyngeal function
- Farther off task they go, the greater difficulty to bring around to desired function
- Must be pleasurable & not stressful
- How much time to spend on OM vs use of food or liquid leading to functional feeding?

**Electrical Stimulation**
- Electrodes placed on surface of skin – not adjacent to muscles involved in swallowing
- Goal: Increase speed of pharyngeal initiation of swallow and improve strength of pharyngeal contractors
- One report: no more effective than usual care for primary dysphagia in children

**Escape Extinction**
- Reports in psychology literature
- Usually part of ABA therapy especially for children with autism
- Nonremoval of spoon is typical focus to increase acceptance & mouth clean
- Used with positive reinforcement often

**Escape Extinction: Questions**
- Non-psychologists carry out?
- Is non-removal of the spoon really negative reinforcement?
- Could this approach ever be perceived as “forced” feeding?
- Can negative reinforcement ever be considered positive to the child?
- For what types of children, is this useful?
What Else?

- What about sensory approaches (SOS)?
- Do children who play in food readily end of putting that food into the mouth?
- What other functional approaches can we use to facilitate improved oral skills along with hunger for children?
- Other ideas? How do we measure outcomes?

Intervention Summary

- Airway & nutrition highest priorities
- Often cannot depend on clinic observations alone with suspicion of pharyngeal problem
- Effort expenditure must be considered
  - Developmental skill levels critical
  - Functional techniques/processes

Neurologic Problems: Summary

- Children with neurologically based feeding and swallowing problems are COMPLEX
- Feeding/swallowing status changes over time
- Realistic goals are critical & must be established with parents & professionals working closely together with mutual respect & coordination/collaboration