VIDEOFLUOROSCOPIC SWALLOW STUDIES: LOOKING BEYOND ASPIRATION

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VIDEOFLUOROSCOPIC SWALLOW STUDIES

➤ VFS or VFSS for short

➤ Previously known as an OPM (Oral Pharyngeal Motility Study) at Children’s Mercy (CMH)

➤ Modified Barium Swallow Study

➤ It is “video x-ray” of the patient’s swallow
REFERRALS

➤ Clinical signs of aspiration
  ➤ coughing
  ➤ choking
  ➤ frequent respiratory infections
    ➤ Pneumonia, Bronchiolitis vs. RSV
  ➤ wet breath or vocal sounds with feedings
➤ Poor weight gain
➤ Limited interest in oral feedings
A WORD OF CAUTION RE: CLINICAL SIGNS OF ASPIRATION

- Clinical signs and symptoms of oropharyngeal aspiration and dysphagia in children (Weir et al. 2009)
- 150 children
  - median age = 16 months; range 2 weeks - 247 weeks (nearly 3 years)
  - 106 (71%) had a neurological impairment
- Findings
  - Cough, wet voice and wet breathing were most significantly associated with aspiration on thin liquids
    - These markers were NOT associated with aspiration on purees
  - No markers were associated with isolated laryngeal penetration or post-swallow residue on purees
  - Post swallow residue on thin liquids was associated with coughing
Clinical signs and symptoms of oropharyngeal aspiration and dysphagia in children (Weir et al. 2009)

Findings (continued)

- Infants were more likely to have wet voice on thin liquids
- Older children who aspirated were more likely to demonstrate wet breathing with thin liquids and purees
- Isolated laryngeal penetration or post-swallow residue = no clinical markers regardless of consistency or age group
- Neurological impairment = strong correlation between wet voice and breathing and aspiration on thin liquids
- Non-neurological group = wet voice was associated with aspiration
REFERRALS

➤ A VFSS is not the best assessment for:

➤ Limited oral intake
  ➤ Ideally patient is accepting at least 1 oz. orally

➤ Chewing concerns
  ➤ Multidimensional process but VFSS typically only offers a lateral view
  ➤ Best assessed clinically

➤ Barium allergy
  ➤ Rare
PREPARATION FOR THE STUDY

➤ Requires a physician order

➤ Patient preparation:
   ➤ Nothing to eat or drink for 2-3 hours prior to the study
     ➤ goal = hungry and willing to accept barium
     ➤ patient should be hungry but not “hangry”
   ➤ No metal on clothing from the waist up
   ➤ No siblings in the radiology suite
   ➤ Bring familiar bottles, cups, utensils, preferred food
   ➤ Items for a typical feeding after the study
   ➤ Ideally caregiver will be present for the study
SET UP FOR THE PROCEDURE

➤ Goal is to replicate a typical feeding as much as possible
  ➤ Positioning
    ➤ Upright
    ➤ Reclined
    ➤ Side-lying
  ➤ Bottle/cup
  ➤ Utensils
  ➤ Feeder techniques
➤ Most patients benefit from a clinical feeding evaluation prior to a VFS
SET UP FOR THE PROCEDURE
PROCEDURE

➤ Typically start with thin liquids

➤ prefer to use patient’s current bottle or cup

➤ may evaluate swallow after a fatigue period (i.e. the patient continues to drink the barium but there is no fluoroscopy for a period of time (typically 30-60 seconds)

➤ Implement compensatory strategies before increasing viscosity of the liquid

➤ Typically progress from thin to nectar to honey to honey plus

➤ this pattern varies depending on observations
COMPENSATORY STRATEGIES

➤ Ideally, we want to try all other options before thickening liquids.

➤ Positioning
  ➤ Elevated side-lying
  ➤ More upright
  ➤ Slightly reclined

➤ Flow rate
  ➤ Slower flowing nipple
  ➤ Sippy cup vs. open cup
  ➤ Straw
  ➤ Use with caution
COMPENSATORY STRATEGIES

➤ Techniques
  ➤ Pacing
  ➤ Chin tuck
  ➤ Multiple swallows
  ➤ Chin/jaw support

➤ Consistency of liquids
  ➤ Thin
  ➤ Nectar
  ➤ Honey
  ➤ Spoon Thick
    ➤ typically requires supplemental non-oral feedings due to dehydration concerns
COMPENSATORY STRATEGIES

➤ Information from the feeding therapist is very helpful
  ➤ Helpful strategies
    ➤ Positioning
    ➤ Pacing
    ➤ Bolus presentation
  ➤ Challenging liquids/foods
  ➤ Current treatment plan
➤ Clinical feeding plan prior to the VFSS
BARIUM

➤ Basic Element
  ➤ On the periodic table
➤ “White when it goes in and white when it comes out”
➤ Can be mildly constipating but typically intake during a VFSS is limited
➤ Slightly chalking
➤ Can flavor it
  ➤ Kool-Aid packets
➤ Avoid products that would alter the consistency
We use Varibar Barium at CMH

- Thin
- Nectar
- Thin Honey
  - this corresponds to the standard “honey” recipe for most thickening agents
- Honey
- Pudding
At Children’s Mercy, we use the following consistencies clinically:

- Thin
  - Water, milk, breastmilk
- Nectar
  - 3 teaspoons of Thick & Easy per 4 oz. of liquid
- Syrup (this is typically called honey consistency)
  - 4 1/2 teaspoons of Thick & Easy per 4 oz. of liquid
- Honey (this is typically called spoon thick)
  - 5 1/2 teaspoons of Thick & Easy per 4 oz. of liquid
LIQUID CONSISTENCIES

➤ Currently working on standardizing recipes and identifying the best thickening agents

➤ Would like our recipes to match the viscosity of the Varibar Barium products we use during swallow studies

➤ Visualization is a very inaccurate way to assess viscosity

➤ Improve education and compliance with thickening recommendations
OPTIMAL SAMPLING RATE

➤ ASHA recommends a national standard of 30 frames per second
➤ We currently use 15 fps at Children’s Mercy
➤ SLPs are working with radiology to change this practice
➤ Bonilha, et. al. 2013
➤ scores from MBSImp and Penetration-Aspiration Scale varied between pulse rates
➤ Cohen 2009
➤ The full depth of laryngeal penetration was visible on only 1 frame for 70% of the studies
THREE PHASES OF SWALLOWING

➤ Oral phase
➤ Pharyngeal phase
➤ Esophageal phase

➤ At CMH, a swallow study is used to evaluate the first 2 phases
ORAL PHASE

➤ During a swallow study, we are evaluating the following areas:
  ➤ Lip seal
    ➤ Bottling
    ➤ Cup drinking
    ➤ Spoon feeding
    ➤ Oral containment of the bolus
  ➤ Tongue movement
    ➤ Tongue base retraction
    ➤ Tongue pumping, fasciculations
ORAL PHASE

➤ Bolus control
  ➤ Is the bolus split, pocketed

➤ Chewing
  ➤ A swallow study is not typically the best evaluation of chewing concerns (recommend a clinical feeding evaluation)

➤ Lingual-palatal seal
  ➤ Prevents the bolus from entering the pharynx too soon

➤ Piecemeal deglutition
  ➤ Bolus is divided into smaller parts before swallowing
ORAL PHASE

➤ Residue after the swallow

➤ Bolus size
  ➤ Too big
  ➤ Too small
  ➤ Inefficient extraction

➤ Pacing
  ➤ Difficulty coordinating suck-swallow-breathe pattern
  ➤ Consecutive swallows
  ➤ Controlled pattern
PHARYNGEAL PHASE

➤ Trigger of the swallow response
  ➤ Lots of opinions on this topic
➤ Pooling/filling in the valleculae and pyriforms
  ➤ Associated with poor oral containment and a delayed swallow
  ➤ Acceptable pooling varies by age
➤ Epiglottic inversion
  ➤ Simplified version of airway protection:
    ➤ Epiglottis inverts (“caps the larynx”)
    ➤ Aryepiglottic folds tighten (purse-like strings)
    ➤ Vocal folds adduct (close)
PHARYNGEAL PHASE

- Hyo-laryngeal elevation
  - The larynx moves up and forward during the swallow to initiate airway protection
  - Decreased elevation may contribute to reduced epiglottic inversion, laryngeal penetration, aspiration, cricopharyngeal dysfunction, and residue after the swallow
  - Cricopharyngeal dysfunction may cause reduced hyo-laryngeal elevation

- Nasopharyngeal reflux
  - Part of the bolus enters the nasal cavity
  - Somewhat acceptable in neonates
  - Common in infants with unrepaired cleft palate
PHARYNGEAL PHASE

- Pharyngeal peristalsis
  - Pharyngeal weakness will result in residue
    - Increases risk for aspiration
  - Uncoordinated
    - May divide the bolus
    - May contribute to nasopharyngeal reflux
- Laryngeal penetration
- Aspiration
- Residue after the swallow
  - Location of residue can provide cues about swallowing difficulties
PHARYNGEAL PHASE

➤ Cricopharyngeal/upper esophageal sphincter function
  ➤ Does the bolus easily pass into the esophagus?
  ➤ May be caused by reduced hyo-laryngeal elevation but may also be limiting hyo-laryngeal elevation (tethering effect)

➤ Signs of a tracheoesophageal fistula
  ➤ Barium in the airway without aspiration
LARYNGEAL PENETRATION

➤ Food or liquid enters the laryngeal vestibule but does not go below the vocal folds

➤ Severity:
  ➤ Amount of barium
    ➤ Trace, slight, moderate, entire bolus
  ➤ Level of penetration
    ➤ Upper 1/3 of the laryngeal vestibule
    ➤ Upper 2/3
    ➤ Deep = touches or nearly touches the vocal folds
      ➤ Not a safe feeding plan
      ➤ Will often stop testing that consistency during a VFS to minimize radiation exposure

➤ Residue in laryngeal vestibule
LARYNGEAL PENETRATION

  ➤ 165 pediatric patients with a wide range of diagnoses
    ➤ 58 had neither laryngeal penetration or aspiration
    ➤ 59 had laryngeal penetration
    ➤ 48 had tracheobronchial aspiration
  ➤ “Children with laryngeal penetration on videofluoroscopic swallowing study had significantly more pneumonia than patients with neither penetration nor aspiration.”
    ➤ 2 pneumonias compared to 0
  ➤ Increased risk for pneumonia and aspiration for patients with glottic abnormalities (ex. laryngeal cleft)
  ➤ Associated syndromes did not appear to impact risk for pneumonia or aspiration
LARYNGEAL PENETRATION

➤ Friedman, B., et al. 2000
➤ 60% of the 125 children in the study demonstrated laryngeal penetration
  ➤ 31% = deep laryngeal penetration
➤ 85% of these children eventually aspirated during the study

➤ Why are these studies important?
  ➤ Laryngeal penetration is not benign
  ➤ Minimize radiation exposure
  ➤ deep laryngeal penetration is not a safe plan so we can move to the next strategy or consistency faster vs. waiting to witness aspiration
**ASPIRATION**

➤ Food or liquid passes through the vocal folds and into the sub-glottic space

➤ Types

➤ Silent (no cough)

➤ very common in the pediatric population

➤ Can be very hard to detect silent aspiration clinically – VFSS is the gold standard

➤ Aspiration with a cough

➤ Aspiration with a delayed cough
ASPIRATION

➤ Timing of the aspiration event
➤ Before the swallow
  ➤ suggests a delayed or absent swallow
➤ During
  ➤ suggests incomplete vocal fold closure, reduced hyo-laryngeal elevation, laryngeal cleft
➤ After
  ➤ often due to residue
ASPIRATION

➤ Amount of barium aspirated
  ➤ Trace, minimal…
➤ Was the patient able to clear the barium from the airway?
  ➤ Effective cough
  ➤ Cue to cough or spontaneous
➤ Other signs of aspiration
  ➤ Watery eyes
  ➤ Stopped the feeding
  ➤ Wet breath or vocal sounds
PENETRATION–ASPIRATION SCALE


1 = Material does not enter the airway

2 = Material enters the airway, remains above the vocal folds, and is not ejected from the airway

3 = Material enters the airway, remains above the vocal folds, and is not ejected from the airway

4 = Material enters the airway, contacts the vocal folds, and is ejected from the airway

5 = Material enters with airway, passes below the vocal folds, and is not ejected from the airway

6 = Material enters the airway, passes below the vocal folds, and is ejected into the larynx or out of the airway

7 = Material enters the airway, passes below the vocal folds, and is not ejected from the trachea despite effort

8 = Material enters the airway, passes below the vocal folds, and no effort is made to eject
MBSImP™

➤ Martin-Harris, B. et al. 2008
➤ Modified Barium Swallow Impairment Profile (MBSImP)
➤ A standardized approach to instruction, assessment, and reporting of physiologic swallowing impairment
➤ Evidence based
➤ Assesses 17 components of swallowing
➤ SLPs become a “Registered MBSImP Clinician” upon successful completion of the MBSImP Online Training and Reliability Testing
➤ Pediatric protocol is being developed
Findings

- Safe swallow for ...
- Aspiration/penetration
  - note consistencies
- Possible reason for dysphagia concerns

Diagnosis

- Oral dysphagia
- Pharyngeal dysphagia
- Oral-pharyngeal dysphagia

Support for diagnosis
Recommendations

- Feeding plan
  - liquid consistency recommended
    - recipe
    - recommended thickening agent
  - solids
  - will require physician approval for thickening

Therapy

- ideally will include recommendations for therapy goals/activities
➤ Recommendations (continued)

➤ Referrals
  ➤ ENT
  ➤ GI

➤ Repeat swallow study
  ➤ recommend limiting studies as much as possible
    ➤ Approximately every 6-12 months
    ➤ Change in swallow
  ➤ Change in medical status
  ➤ Clinical feeding evaluation prior to a repeat study
FEES VS. VFSS
FEES

- Flexible Endoscopic Evaluation of Swallowing (FEES)
- A flexible endoscope is used to evaluate the pharyngeal phase of the swallow
- At Children’s Mercy, ENT typically places the scope
- Use green dye for contrast
- Multiple positioning options including:
  - Caregiver's lap
  - Exam chair
  - Wheelchair
FEES

Candidates for FEES include:

- Suspect structural issues are impacting swallow safety
- Assessing secretion management
  - typically done with children who are not oral eaters
- Only instrumental assessment to further evaluate breastfeeding
- Special positioning needs
- Unable to tolerate a VFSS
FEES

Pros:

➤ No radiation exposure
  ➤ Study time is limited only by patient’s tolerance/willingness to participate
➤ Able to use the patient’s preferred foods
  ➤ Breastfeeding
  ➤ No need to alter taste or texture with barium
  ➤ Green dye is optional
➤ Able to view saliva swallows
➤ More flexible seating/positioning
Pros (continued):

- Excellent view of pharyngeal anatomy
  - Base of tongue
  - Epiglottis
  - Vocal folds
  - Arytenoid cartilage
- Able to view asymmetry
  - Unilateral pooling
FEES

Cons:

➤ “White out” during the swallow

➤ Challenging to identify aspiration
  ➤ looking for signs of the aspirated bolus between or below the vocal folds

➤ Blocks the nasal airway
  ➤ May impact bottle and breastfeeding
  ➤ Nasogastric tubes

➤ May be uncomfortable

➤ Pharyngeal phase only
  ➤ unable to assess tongue movement or other elements of the oral phase
VFSS

Pros:

➤ Gold standard for identification of laryngeal penetration and aspiration

➤ Able to track the bolus through the oral and pharyngeal phases as well as esophageal phase

➤ May be able to see possible signs of a TE fistula and/or laryngeal cleft

➤ further work-up may be necessary to fully evaluate these concerns
VFSS

Cons:

➤ Radiation exposure
➤ Must use barium
➤ Unable to clearly evaluate structures
  ➤ vocal folds
➤ More challenging to identify asymmetries
  ➤ At CMH, we typically only complete a lateral view to minimize radiation exposure
  ➤ Anterior posture view
CASE STUDIES & VIDEOS
REFERENCES


QUESTIONS?
THANK YOU!

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