Disclosures

- Katie Walsh, Tyler Johnson and Nikki Hill all receive a salary from Ann & Robert H. Lurie Children's Hospital of Chicago.
- They no non-financial disclosures to report.

Objectives

- **Objective 1:** Therapists will be able to identify 3 scenarios in which thickening may be indicated.

- **Objective 2:** Therapists will be able to describe the difference between a Videofluoroscopic Swallow Study (VFSS) and a Fiberoptic Endoscopic Evaluation of Swallowing (FEES) exam.

- **Objective 3:** Therapists will be able to describe why variations in recipes for thickened liquids may take place.

Thickening in Pediatrics: Why

- Kids to continue feeding orally; enjoy feeding orally; be safe feeding orally
- Thickening liquids is one strategy used to help achieve these goals when patients demonstrate aspiration, laryngeal penetration, and/or reflux

Thickened liquids

- Viscosity→ "the quality or state of being viscous : a sticky or glutinous consistency... the property of resistance to flow in any material with fluid properties" (Merriam-Webster)
Oral Phase
- Bolus formation with tongue and cheek muscles
- Soft palate in a lowered position to help contain liquid bolus
- Tongue elevation and posterior propulsion of bolus
- Elevation of velum

Pharyngeal Phase
- Elevation of velum to seal off nasopharynx
- Pharyngeal constriction to push bolus down through pharynx
- Laryngeal closure
  - Pause in breathing
  - Epiglottis covers glottis moving bolus laterally
  - Aryepiglottic folds move anterior and medial to cover glottis
  - Vocal folds adduct
- Opening of UES

Esophageal Phase
- Resting tonic contraction of cricopharyngeus is inhibited allowing bolus to pass into esophagus
- Peristalsis carries to bolus to the stomach
- LES relaxes to allow bolus to enter stomach
Aspiration
• Aspiration: “the passage of foreign materials below the level of the true vocal folds” (Arvedson & Brodsky, 2002, p. 471)
• Consequences of aspiration: obstruction, pneumonia, chemical tracheo-bronchitis, stenosis
• Tutor and Gosa (2012, p. 323): “Histologic findings of aspiration include degeneration of bronchiolar epithelium, pulmonary edema and hemorrhage, focal atelectasis, exudation of fibrin, and acute inflammatory cell infiltrate.”
• Wheezing, chronic cough, atelectasis, bronchiolitis obliterans (Colombo & Halberg, 2000).

Why thickened liquids with aspiration?
• Thickening liquids is a common practice in both the pediatric and adult dysphagia populations when other strategies, such as changing the method of introduction (e.g. straw, cup), are unsuccessful in increasing the safety of the swallow.
• It’s been shown to work!
• Adil et al. (2015): Aspiration identified with normal UA anatomy; most kids showed resolution of aspiration within a year.

How thickened liquids work
• Adult dysphagia with thickened liquids:
  – increased oral and pharyngeal transit times
  – increased duration of tongue base contact to the posterior pharyngeal wall
  – changes in UES opening
  – (Bisch, et al., 1994; Steele, 2005; Lazarus et al., 1993).
• Increased sensory information (i.e., larger bolus volume, increased viscosity) appeared to decrease pharyngeal delay time in patients with neurologic impairments (Bisch et al., 1994).

How thickened liquids work
• Goldfield et al. (2013) looked at pre-term infants and the impact of Level 2 (Nectar Thick) Liquids in comparison to Level 0 (Thin) Liquids.
• This study found that pharyngeal transit time was longer with nectar thick liquids, which may have allowed for available sensory info to be utilized to modulate coordination of swallowing.
• Variability of tongue-soft palate coordination decreased with successive swallows of nectar thick- not the case with thin liquids.
Thickened liquids and Aspiration

(Arvedson & Brodsky, 2002)

• Before the swallow → reduced bolus control/passive leakage of material, delay in swallow initiation
• During the swallow → ineffective laryngeal closure, reduced coordination of timing of laryngeal closure, anatomic difference
• After the swallow → residue due to reduced pharyngeal constriction, change in pressure gradient (e.g., incomplete closure of VP port), UES dysfunction

Laryngeal penetration

• Laryngeal penetration → “material enters the laryngeal inlet but does not extend below the level of the vocal cords” (Duncan et al., 2019, p. 218)
• Patients who demonstrated only transient penetration (no treatment) did end up having both pulmonary and gastrointestinal hospitalizations (Duncan et al., 2019).
• When looking specifically at hospitalization rates, no difference was found between children identified to aspirate and children identified to only penetrate on their swallow study (McSweeney et al., 2016).

Reflux

• AAP defines gastroesophageal reflux (GER) “as the passage of gastric contents into the esophagus... is generally associated with transient relaxations of the lower esophageal sphincter independent of swallowing” (Lightdale & Gremse, 2013).
• GERD → includes other troublesome symptoms, both esophageal and extraesophageal: poor weight gain, vomiting, wheezing, arching during feeds, etc.
• Food aversion may develop due to stimulus-response association of eating with pain.

Thickening in Pediatrics: Why

(Duncan et al., 2019)

- 55% (n=75/137) received feeding intervention
- 77% (n=114/148) resolved thickening
- 36% (n=50/141) change in flow rate
- 13% (n=18/137) no feeding intervention

Reflux: Thickening

• AAP recognizes thickening formula with rice cereal or switching to commercially thickened formula as a “reasonable management strategy” for GER/GERD in full term infants
• Increasing the weight and ‘stickiness’ of the liquid may help to keep it down in the stomach (Kwok et al., 2017)
• In a systematic review of randomized controlled trials, thickened formulas, as compared to regular formulas, increased the percentage of infants with no regurgitation (Horvath et al., 2008).
  – No definitive data to show one thickening agent was more effective than another
Reflux: Thickening

- Chao and Vandenplas (2007) prospectively looked at 2-6 month old infants who presented with regurgitation/vomiting at least 3x/day and implemented two interventions (i.e., thickening, positional therapy) over 8 weeks.
- After 4 weeks, incidence of regurgitation decreased significantly in both groups.
- However, after 8 weeks, cereal-thickened formula was statistically more effective in decreasing the incidence of regurgitation/vomiting:
  - Fewer infants with positive reflux episodes on scintigram.
  - But mild prolongation of gastric emptying.
  - Increased caloric intake led to increased weight gain.

Reflux: Thickening

- Chao and Vandenplas (2007): effects of cornstarch thickened formula versus 25% strengthened regular formula on regurgitation, gastric emptying, weight gain.
- After one and two months of intervention, infants who received AR showed reduced frequency of regurgitation/vomiting, as compared to those on the strengthened formula.
- Cornstarch thickened formula showed statistically significant improvements:
  - Associated clinical symptoms (e.g., irritability, cough, choking, crying at night).
  - Tolerated amount of feeding.
  - Weight gain (increased mean ingested volume).

Thickening liquids in Pediatrics: Food for thought

- "Least restrictive diet" depends on how you look at it:
  - To promote respiratory health?
  - Variety of food/liquid?
  - Volume of PO intake?
- Goals of care:
  - Safe, functional mode of intake.
  - Palliative.
- Family values, resources (e.g., time, money).

Instrumental Exams

The purpose of an instrumental exam is to further evaluate the anatomy and physiology of swallow function. A definitive diagnosis of dysphagia can only be evaluated with an instrumental assessment (Tutor & Gosa, 2012).
Normal Clinical Exam

Aspiration  Laryngeal Penetration  Normal Exam

(Duncan, Mitchell, Larson, & Rosen, 2018).

Presenting Signs and Symptoms do not Predict Aspiration Risk in Children.
Duncan, Mitchell, Larson, & Rosen, 2018

<table>
<thead>
<tr>
<th>Symptoms of Aspiration</th>
<th>Diagnosis Specific</th>
</tr>
</thead>
<tbody>
<tr>
<td>Signs of Aspiration</td>
<td></td>
</tr>
<tr>
<td>When to consider an instrumental exam</td>
<td></td>
</tr>
<tr>
<td>Evaluate Progress</td>
<td></td>
</tr>
<tr>
<td>When no progress has been made</td>
<td></td>
</tr>
<tr>
<td>They have practiced!</td>
<td></td>
</tr>
</tbody>
</table>

When no progress has been made, Evaluate Progress. They have practiced!

Symptoms of Aspiration: VFSS, FEES

VFSS
- Structural differences
- Esophageal concerns
- Age
- Difficulty calming
- Sensory feeding disorders

FEES
- Airway concerns
- Sensory feeding disorders
- Frequent reassessment

Breastfeeding
Positioning
Secretion management

Videofluoroscopic Swallow Study: VFSS
Fiberoptic Endoscopic Evaluation of Swallow

Sometimes, we need both exams...

Thickening: How to Implement

IDDSI

• The International Dysphagia Diet Standardization Initiative (IDDSI) committee was formed by volunteer professionals from around the world
• Objective was to develop standardized terminology and definitions for both thickened liquids and modified solids that can be used across ages, cultures, and settings

(Cichero et al., 2013; Cichero et al., 2016; Lam, Stanschus, Zaman, & Cichero, 2017)

www.iddsi.org

IDDSI

• The IDDSI Framework classifies and labels food and drinks within a continuum of 8 levels ranging from 0-7.
• Liquids or drinks are represented by levels 0-3 while solids fall into levels 4-7.

IDDSI Flow Test: “drip testing”
IDDSI: So, what did we learn?

- Prior to IDDSI implementation
  - Thin, Thin-Nectar, Nectar, Syrup, and Honey
- Many previous assumptions about “thickened liquids” were found to be incorrect.
  - “Thin-Nectar” barium
  - “Thicker” liquids:
    - Pediasure
    - Enfamil AR
    - Jumex “nectar” drinks
    - Whole milk

Test Results: Barium

- Using the IDDSI flow test, it’s important to establish accurate baselines.
  - Level 0 (Thin Liquid): 60 mL Varibar Thin Liquid
  - Level 1 (Thin-Nectar Thick Liquid): 15 mL Varibar Thin Liquid + 45 mL Varibar Nectar
  - Level 2 (Nectar Thick Liquid): 60 mL Varibar Nectar
  - Level 2.5 (Syrup Thick Liquid): 30 mL Varibar Nectar + 30 mL Varibar Thin Honey
  - Level 3 (Honey thick liquid): 60 mL Varibar Thin Honey
  - Level 4 (Pureed Solid): Varibar Pudding

Test Results: Formulas

- Ready to Feed formulas are a Level 0
  - Similac 19 kcal
  - Similac Neosure 22kcal
  - Enfamil Infant 20 kcal
  - Enfamil Neuprol 20 kcal
  - Enfamil EnfaCare 23kcal
  - Enfamil 24kcal
  - Enfamil AR 20kcal

- Most infant formula made from powder is a Level 0
  - Note: Increased caloric density (even 27kcal/oz) and temperature did not increase IDDSI consistency level.

Test Results: Enfamil AR

- Ready to feed Enfamil AR 20 kcal is a Level 0
- Enfamil AR 20 kcal prepared from powder and served immediately is Level 0
- Enfamil AR 20 kcal can be a Level 1: Must be prepared from powder needs to rest for at least 30 minutes prior to serving
  - Note: Both cold and cold to warm formula was Level 1
- Note: Similac Spit-Up did NOT achieve a Level 1 thickness over time

Test Results: Supplements

- Level 0 (Thin Liquid)
  - Pediasure 1.0 (cold or room temperature)
- Level 1 (Thin Nectar Thick Liquid)
  - Pediasure 1.5 (cold)
  - Pediasure Peptide 1.5 (cold or room temperature)
  - Ripple (cold)
  - COMPLEAT (room temperature or cold)
- Level 2 (Nectar Thick Liquid)
  - Pediasure Harvest (room temperature or cold)
  - Boost Very High Calorie Vanilla (room temperature)
- Level 2.5 (Syrup Thick Liquid)
  - Boost Very High Calorie Vanilla (cold)
- Level 3 (Honey Thick Liquid)
  - Real Food Blends: Salmon, oats, squash (room temperature)

Test Results: Naturally Thick Liquids

- Smoothies can vary in consistency
  - Level 1: Bolthouse Farms – Mango, Green Goodness, and C-boost (cold)
  - Level 2.5: Bolthouse Farms – Strawberry Banana (cold or room temp)
- Drinkable yogurts ranged from Level 1 to Level 2.5 depending on flavor and brand
Infant Cereal
- Can be used to thicken infant formula or cow’s milk
  - Does not work for water or juice
  - Breast milk thickened with infant cereal thins out over time (Gibbons & Davidson, 2018)
  - May not be accepted by older children

- Considerations: Types of cereal (rice, oatmeal, multigrain, barley, quinoa)
  - Oatmeal cereal alone is not effective at maintaining thickness
  - Rice cereal can lead to stooling issues (Mascarenhas et al., 2005)
  - Medical/Nutritional considerations
    - Gluten, Carbs, Complex gut history
      - Arsenic concerns with rice cereal (Carignan et al., 2016)

Infant Cereal
- Considerations: Brands of cereal (Earth’s Best, Gerber, Beechnut, Happy Baby, Plum Organics)
  - Can vary in size of grains
  - Crushing vs uncrushed

- Considerations: Manner of measuring
  - Measuring spoons (tsp) vs med cups (ml)
  - Level?
  - Packed?
  - If crushed, how fine? (Would it be better to go by weight?)
  - Mixing varying volumes (difficulty with 15-30mL trial volumes)
  - Mixing varying caloric densities (e.g., 27kcal/oz)

Infant Cereal
- Cereal settles to the bottom over time

Commercial Thickeners
- Be aware of the thickening agent(s).

<table>
<thead>
<tr>
<th>Product</th>
<th>Ingredients</th>
</tr>
</thead>
<tbody>
<tr>
<td>SimplyThick</td>
<td>Xanthan Gum</td>
</tr>
<tr>
<td>Gelmix</td>
<td>Organic Tapioca Maltodextrin, Organic Carob Bean Gum, Calcium Carbonate</td>
</tr>
<tr>
<td>Purathick</td>
<td>Organic Tapioca Maltodextrin, Organic Tara Gum, Calcium Carbonate</td>
</tr>
<tr>
<td>Thick-It</td>
<td>Modified Food Starch and Maltodextrin</td>
</tr>
<tr>
<td>Thick It</td>
<td>Modified corn starch</td>
</tr>
</tbody>
</table>

Commercial Thickeners: Considerations
- Recommended ages
  - Gelmix: Recommended for corrected age of 42+ weeks, at least 6lbs (www.healthierthickening.com 2020)
  - Purathick: Recommended above age 1 and not for use with breast milk (www.healthierthickening.com 2020)
  - Thick-It: (recently updated) “Products should not be used by infants under 2 years old and should only be used by children under the age of 12 in consultation with a physician.” (www.thickit.com, 2020)
  - SimplyThick EasyMix: “Do not use in infants or children under 12 years of age without consulting a healthcare professional.” (www.simplythick.com 2020)

- Defer to each product’s recommendations for when to use
- Exceptions may be considered in collaboration with MD & RD
Commercial Thickeners: Additional Considerations

• Gum based thickeners tend to more stable over time
• Starch based thickeners tend to thicken over time and tend to be thicker at colder temperature
• It is important to consider the nutrient and caloric impact that the use of thickeners may have on thickening liquids (McCallum, 2011)
  – Collaborate with your nutrition team!
• Each thickener is made of different ingredients that will interact with beverages in different ways

Used with permission from Simply Thick

Thickening with Purees
Recipes will vary based on the thickness of your base puree
• Pudding and milk
  – Level 3: 4 oz pudding to 4 oz milk
• Gerber banana puree
  – Level 3: 4 oz Gerber banana to 4 oz liquid
• Gerber apple puree
  – Level 3: 3 oz Gerber apple to 1 oz liquid
• Yogurt and milk
  – Variations depending on the type of yogurt used
  – Watch out for chunks of fruit
• Consider the nutritional displacement when using purees

Specialty Diets: Ketogenic Diet
• High fat, low carbohydrate diet often used for seizure management when medication has proven ineffective (Kossoff et al., 2018)
• Xanthan gum, Guar gum
  – Recommend using blender bottle or blender to ensure product is fully dissolved
  – Homemade thickening gel
• SimplyThick EasyMix

Used with permission from Simply Thick
Specialty Diets:
Food allergies or intolerances

- Soy Formulas (Similac Isomil, Enfamil Prosobee, Gerber Good Start Soy)
- Partially Hydrolyzed Formulas (Enfamil Gentlease, Enfamil Reguline, Similac Total Comfort, Gerber Good Start Gentle, Gerber Good Start Soothe)
- Extensively-Hydrolyzed Formulas (Alimentum, Nutramigen)
- Amino Acid-Based Formulas (Neocate, EleCare)

- How will these varied formulas interact with your thickening agent?
  - Test it! 😊

- Some infant cereals have soy or gluten – read labels!

Specialty Diets:
Other Considerations

- Kosher
  - GelMix, PuraThick, Thick It, Simply Thick, Thicken Up
  - Cereals and purees – do your research

- Halal
  - GelMix, PuraThick, Simply Thick, Thicken Up
  - Cereals and purees – do your research

- Vegan
  - GelMix, PuraThick, Thick It, Simply Thick
  - Infant cereals and fruit/veggie purees

- Gluten Free
  - GelMix, PuraThick, Thick It, Simply Thick, Thicken Up
  - Rice cereal (*may be risk for cross-contamination)

Specialty Diets:
Other Considerations

- Gelmix and probiotics: “Heat can damage the probiotic. Since heating the liquid is required to mix with Gelmix, it is not recommended to use ready to feed formulas that contain a probiotic. For powder formulas, Gelmix can be mixed with warm water to thicken, then allowed to cool down before mixing in the powder formula.”
  (www.healthierthickening.com 2020)

Things to Consider When Thickening

- Juicy Fruits
  - Consider purees
  - Less juicy options

- Soups
  - Instant mashed potato flakes
  - Immersion blender
  - Flour/Corn starch
  - Okra

- Secretions
  - A patient who aspirates liquids may also be aspirating their secretions.
  - Oral stimulation, oral care routines, and PO intake can all increase secretion production.
  - Keep this in mind as you treat your patients, and exercise caution as necessary.
Things to Consider When Thickening

- Texture of ingredients
  - cereal grains, pulp, lumps/chunks
- Temperature
- Time
  - starch-based commercial thickeners
  - cereal for thickening
  - cereal in breast milk
- Thickening infant formula is highly variable (may vary day-to-day, or from one feed to next)
  - water temperature
  - amount of formula used
  - who is preparing the bottle
  - how much air/bubbles in the formula

Questions?

References


References


