Dysphagia Evaluation
In the Neonate Clinical Pathway
Dysphagia Evaluation in the Neonate
Clinical Pathway

Table of Contents

1. Rationale
2. Background / Published Data and Levels of Evidence
3. Clinical Management
4. Summary
5. Pathway / Algorithm
6. Glossary
7. References
8. Outcome Measures
9. Appendix
10. Clinical Pathways Team Information

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This pathway is intended as a guide for physicians, physician assistants, nurse practitioners and other healthcare providers. It should be adapted to the care of specific patient based on the patient’s individualized circumstances and the practitioner’s professional judgment.
Rationale

The pathophysiology of dysphagia is multi-factorial which makes determining the etiology difficult. Our current diagnostic capacity at JHACH are limited and do not elucidate aberrations in the pharyngeal and esophageal reflexes that could be contributing to dysphagia. The gold standard for diagnosing esophageal dysmotility in pediatrics is high resolution manometry. This CPG represents our unit consensus and will provide guidance on when high resolution esophageal manometry may be indicated.

Background / Published Data and Levels of Evidence

A. Prevalence and the Economic Burden of Dysphagia in Neonates
   1. While the exact prevalence of feeding problems in neonates is unknown (Jadcherla, 2016), NICUs are replete with convalescing neonates classified as “feeder growers” learning how to safely orally feed. It has been approximated that 10.5% premature infants born < 37 weeks gestation have dysphagia (Motion, 2001). This number is increased to 24.5% for very low birth weight infants (Motion, 2001). A recent NICHD study showed 7.3% of extremely low birthweight infants had a gastrostomy tube placement prior to being discharged from the NICU (Warren, 2019).
   2. The financial and psychosocial impact of gastrostomy tube placement on the family unit as well as the healthcare system cannot be overemphasized. Aside from the stigma associated with gastrotomy tube, the time commitment for frequent doctors’ visits for G-tube maintenance and management of complications and the financial burden is quite costly. Management of the gastrostomy tube costs $46,875 for the first year alone (Jadcherla, 2012) and adds up to $180,000 in 5 years (Gulati, 2020).

B. Risk Factors for Dysphagia
   1. The American Academy of Pediatrics criteria for discharge includes safe oral feeding abilities to meet metabolic and nutritional demands for adequate growth (AAP, 2008). While premature infants are at risk for dysphagia, even those born significantly premature have been shown to achieve successful oral feeding abilities by 36-38 weeks corrected gestational age (CGA) (Jadcherla, 2010 (feeding milestones)).
   2. The risk factors for dysphagia are multi-factorial and can occur and extend throughout the gastrointestinal tract often compounded by prematurity, anatomical and congenital malformations, infectious and inflammatory states, neurological injury,
and cardiopulmonary pathologies which affect the intricate interplay between the cranial nerves, afferent/efferent neurons, central pattern generator, somatosensory and neuromuscular pathways (Jadcherla 2012, 2016). The presentation is often non-specific and frequently can be similar across different pathologies.

C. Diagnostic Techniques for Dysphagia

1. As with any diagnostic approach, dysphagia evaluation must begin with a careful review of the history and physical exam (Jadcherla, 2012). Integration of diagnostic technologies, addressing parental and medical team concerns via an interdisciplinary team approach to diagnosis and management has been shown to decrease need for gastrostomy tube by up to 41% in infants who were being considered for a Gtube placement.

2. Utility of diagnostic techniques can be limited by availability of the specific technology, technical expertise for application of such technology and associated side effects (such as radiation exposure) (Jadcherla, 2012). In the last decade significant advances in diagnostic techniques have been made available to the
neonatal population, some of which can be done at the bedside without radiation exposure. pH impedance technology has allowed us to define the type of refluxate as well as to identify the acidic/alkaline nature of the refluxate and the extent of the height of the reflux into the esophagus. This has better defined which GERD can be managed with acid suppression medications, resulting in the decrease of inappropriate utilization of PPIs and H2 blockers (Shakeel, 2019).

The diagnosis of dysphagia can be broken down into bite-size pieces based on anatomic areas affected (8. Jadcherla, 2012; 9. Rapazzo, 2018 from Peds Dysphagia) using different diagnostic approaches. These modalities, however, have limitations.

1. **Upper Gastrointestinal Fluoroscopy** can be utilized to evaluate the anatomy of the GI tract, from the esophagus through the intestines
2. **Video-Fluoroscopic Swallow Study/ Oropharyngeal Motility Study (OPMS):** With the use of radiation, OPMS defines the anatomy of the proximal aerodigestive tract and can identify safe bolus transfer from the oropharynx to the esophagus. It can differentiate between anterograde aspiration (food falls below the true vocal cords), laryngeal penetration (food enters vestibule or airway entrance but does not fall below the true vocal cords), or the presence of safe swallow mechanisms with associated airway protection. This study requires access to the fluoroscopy suite, skilled Speech Language Pathologists (SLP) and radiologist. The technique is limited by radiation exposure and the infant’s ability to take enough fluid to diagnose the problem.
3. **pH probe:** allows for detection of acid reflux in the distal esophagus. It cannot detect non-acid reflux or the extent of proximal acid reflux exposure
4. **pH-multichannel Intraluminal Impedance:** determine the type of refluxate as well as to identify the acidic/alkaline nature of the refluxate and the extent of the height of the reflux in the esophagus
5. **Basal and adaptive pharyngo-esophageal manometry:** evaluates pharyngoesophageal peristaltic reflexes without radiation exposure at the crib side. This requires high resolution manometry equipment, technical support and expertise to perform and interpret the pharyngo-esophageal reflexes.

D. **High Resolution Manometry**
1. Water perfusion and high resolution manometry has been utilized as a diagnostic tool in adults with dysphagia for several decades (Chicago Classification). In fact, high resolution manometry is now the gold standard for diagnosing esophageal dysmotility in adults and pediatrics (David, 2020).
2. Esophageal manometry is safe, feasible, and well tolerated in neonates (Jensen, 2015; Rommel 2011). Vital sign instability nor esophageal perforations during the studies have not been reported.
   i. The safety profile is extended to neonates as early as 31 weeks PMA (Jadcherla, 2015; Rommel 2011; Rayyan 2019; Rayyan 2020)
   ii. Chicago Classification parameters can be easily identified in the neonatal population and esophageal motility disorders can be characterized (Jensen, 2014, Davidson, 2020).
iii. Esophageal manometry (both water perfusion and high resolution) have been instrumental in elucidating pharyngeal and esophageal motility reflexes in premature infant as well their maturation of these reflexes (Jadcherla and Rommel, 2011), bronchopulmonary dysplasia (Rayyan, 2020), congenital heart disease (Malkar, 2015), Infant of Diabetic Mother (Malkar, 2019), Congenital diaphragmatic hernia (Rayyan, 2019), opioid exposed infants in utero (Hart, 2019), hypoxic ischemic encephalopathy and neurologic injuries (Hill, 2013; Jensen, 2013).

3. The novel addition of provocative pharyngo-esophageal manometry techniques in neonates has become available and has facilitated identification of aerodigestive pathophysiology at the bedside ((Jadcherla, 2005, 2006, 2012; Gupta, 2009, Jensen, 2017). It's safety and feasibility has been noted in the literature since the early 2000s. By utilizing graded volumes of liquid and air infusions into the pharynx and esophagus via infusion ports, manometric techniques safely identified patients with safe swallow mechanisms through evaluation of the basal and adaptive deglutition reflexes within the pharynx, esophagus, and upper and lower esophageal sphincters. Oral feeding challenge with concurrent manometry evaluation at the bedside also allows real time evaluation of the oro-motor reflex and how the pharynx and esophagus responded anterograde fluid bolus. (Jadcherla, 2012; Jadcherla 2003, 2005, 2006; Gupta, 2009; Jensen, 2017)

4. Manometry predictors for feeding success have been identified using pharyngoesophageal manometry (Jadcherla, 2003, 2005, 2006; 2012; Gupta, 2009) by identifying the presence of:
   i. primary peristalsis (PP): swallow originates in the pharynx with UES relaxation, anterograde esophageal propagation, and LES relaxation
   ii. secondary peristalsis: esophageal peristalsis in response to mid-esophageal relaxation without pharyngeal contraction, but there is an UES contractile reflex
   iii. Normal pharyngeal manometry study is defined as: >80% peristaltic response to graded pharyngeal infusions.
   iv. Oral feeding challenge success is defined by 10-15 ml EBM or formula intake demonstrating nutritive sucking followed by swallowing, primary peristalsis and LES relaxation with appropriate deglutition apnea and no symptoms.

When each of these manometric criteria were evaluated in infants with dysphagia who ultimately achieved oral feeding success vs. oral feeding failure, the findings were as follows:

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Feeding success, N = 51</th>
<th>Feeding failure, N = 49</th>
<th>P</th>
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<tbody>
<tr>
<td>Peristaltic responses to esophageal infusion, %</td>
<td>71.10 ± 14.1</td>
<td>65.3 ± 18.5</td>
<td>0.04</td>
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<tr>
<td>Primary peristalsis induced by esophageal infusion, %</td>
<td>49.8 ± 25.5</td>
<td>32.8 ± 22.9</td>
<td>0.0008</td>
</tr>
<tr>
<td>Secondary peristalsis induced by esophageal infusion, %</td>
<td>50.9 ± 25.5</td>
<td>64.4 ± 24.2</td>
<td>0.009</td>
</tr>
<tr>
<td>Normal pharyngeal manometry, %</td>
<td>59.6</td>
<td>22.2</td>
<td>0.0003</td>
</tr>
<tr>
<td>Oral feeding challenge success, %</td>
<td>60.9</td>
<td>29.8</td>
<td>0.003</td>
</tr>
<tr>
<td>Suck-swallow-breath-esophageal swallow sequence, %</td>
<td>63.8</td>
<td>31.9</td>
<td>0.002</td>
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</table>

Data are presented as mean±SD or percentage. See manometric data analysis section for definition of characteristics.
Using logistic regression models, Jadcherla et al (2012) demonstrated that demonstrating the following manometric findings were had significant adjusted odds ratio for oral feeding success with \( P < 0.04 \):

<table>
<thead>
<tr>
<th>Manometric Findings</th>
<th>Adjusted Odds Ratio</th>
</tr>
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<tbody>
<tr>
<td>Oral Feeding Challenge</td>
<td>3.75*</td>
</tr>
<tr>
<td>Normal Pharyngeal Manometry</td>
<td>5.63*</td>
</tr>
<tr>
<td>Primary Peristalsis induced by esophageal infusion</td>
<td>156.88*</td>
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</table>

Figure 2. Pharyngoesophageal manometry of a successful orally feeding infant. (Jadcherla, 2012)
Figure 2. Water perfusion pharyngoesophageal manometry of infant with oral feeding failure. (Jadcherla, 2012)

Figure 3. High Resolution Manometry of infant demonstrating the normal pharyngeal manometry with PRS and successful oral feeding challenge (Gulati, 2020)

Of these, the presence PP from pharyngeal and esophageal provocation along with oral feeding challenge success are the highest predictor of independent oral feeding success. On the contrary, absence of PP, failed oral feeding challenge or absence of suck-swallow breath coordination are less likely to be responsive to oral feeding approaches.

E. Oral feeding failure management
1. In efforts to facilitate adequate nutrition for growth and development and meet criteria for discharge, gastrostomy tubes are sometimes unavoidable and necessary (
Jadcherla, 2016). However, the timing of when to pursue gastrotomy tube placement is unknown.

i. In evaluating the impact of gastrostomy tube placement on neurodevelopmental outcomes, Jadcherla et al (2017, Feeding and Necroed) showed that Gtube placement before 49 weeks CGA was associated with reduced adjusted odds ratio (OR) for cognitive delay (OR 0.16; 95% CI 0.05-0.74; P=0.02), communication delay (OR 0.2; 95% CI 0.06-0.72; P=0.01), and motor delay (OR 0.2; 95% CI 0.04-0.63; P=0.01).

ii. In converse, Jadcherla et al (2017) also showed that with each passing week beyond 49 weeks CGA in which a Gtube was placed is associated with increased multivariable adjusted odds for cognitive delay (OR 1.2; 95% CI 1.1-1.3, P=0.01), communication delay (OR 1.2; 95% CI 1-1.3, P=0.02) and motor delay (OR 1.2; 95% CI 1.1-1.3, P=0.01).

2. The establishment of targeted pathophysiological-based oral feeding therapy by 43 weeks CGA is associated with oral feeding success at discharge. Jadcherla et al recommends evaluation with manometry by 42 weeks gestation (Jadcherla, 2012) to help establish those targeted therapies in a timely manner.

i. Prior to manometry study evaluation, if concerns for anatomic malformations as well as aerodigestive pathologies involving the upper airways (obstruction) and oro-pharynx (aspiration, penetration) are present, they must be ruled out by ENT airway evaluation and OPMS study.

ii. If concern for GERD, pH impedance study must be done per GERD CPG.

Clinical Management

Primary prevention of neonatal dysphagia is preferred. Infant Driven Feeding or cue-based feeding has been helpful in standardizing oral feeding initiation and progression based primarily on an infant’s current physiologic state, thereby decreasing subjective biases of the provider. Please refer to Infant Driven Feeding Guideline oral feeding initiation and progression.

In spite of early feeding strategies to prevent dysphagia, it is not always avoidable. Per our IDF Guideline, infants who are demonstrating IDF Readiness Score ≥ 3 at 35 weeks CGA need SLP consult. After a very thorough review of the past medical history and well as an in-depth physical exam, the following approach recommended:
1. Oro-pharyngo-upper esophageal phase of swallowing. Determine the presence/absence of anatomical issues. First step in evaluation is to determine the presence/absence of anatomical issues. ENT evaluation may be warranted for any airway safety concerns. If there are concerns with the oro-pharyngo-upper esophageal phase of swallowing such as aspiration or penetration, an OPMS maybe ordered if the patient is at least 38 weeks CGA. In order to maximize the diagnostic capacity of the OPMS, infant must be requiring no more 2 LPM of respiratory support and able to take at least 15 ml of expressed breast milk or formula orally.

2. Concern for GERD: Please refer to the GERD CPG if concern for pathologic reflux.

3. If concern for delayed gastric emptying: obtain gastric emptying study and/or UGI

4. Intestinal anatomic concerns: Upper GI with Small Bowel follow through is indicated

Adapted from Jadcherla, 2012

If all of the above have been pursued (as clinically indicated) and there is no definable pathology causing the dysphagia, a High-Resolution Manometry study maybe pursued to evaluate the pharyngeal and esophageal reflexes if the baby is at least 40 weeks PMA, on 2 LPM or less of respiratory support and is able to take a minimum of 10-15 ml orally.
Algorithm for High Resolution Manometry Evaluation

If you have clinical concerns for:
- Airway and oropharyngeal anatomical anomalies
- Aspiration or penetration
- GERD
- Lower GI tract anatomical anomalies
Have you ruled them out?

Infant is 39 weeks CGA?
On <2 LPM?
Able to take 10 to 15 ml of feeds

YES

NO

Discuss with Feeding Enhancement Team: Order High Resolution Manometry

NO

Contact Feeding Enhancement Team

YES

High Resolution Manometry Study at 40-42 weeks CGA

Manometric predictors of Oral Feeding Success:

i. Primary peristalsis
ii. Secondary peristalsis
iii. Normal pharyngeal manometry
iv. Oral feeding challenge success
Schematic for High Resolution Manometry

Water Perfusion Manometry

High Resolution Manometry

Esophageal Pressure Topography
References


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Shakeel F, Crews J, Jensen P, et al. Decreasing inappropriate use of antireflux medications by standardizing gastroesophageal reflux disease management in the NICU. Pediatric Quality and Safety 2021; 6(2)e 394


Hill C, Jadcherla S. Esophageal mechanosensitive mechanisms are impaired in neonates with hypoxic ischemic encephalopathy. Journal of Pediatrics 2013; 162(5): 976-982


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<thead>
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<th>Clinical Pathway Team</th>
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<td>Dysphagia Evaluation Clinical Pathway</td>
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