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Swallowing Evaluations with the Pediatric Population: A Comparison to Standard Adult Protocols

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SWALLOWING EVALUATIONS WITH THE PEDIATRIC POPULATION: A COMPARISON TO STANDARD ADULT PROTOCOLS

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Introduction

The process of swallowing is sophisticated, involving neuromuscular and aerodigestive systems. The physiologic system involves four stages of swallowing: oral preparatory, oral, pharyngeal, and esophageal. Each phase is important for temporal coordination and duration of the swallowing process. When one or more of the phases is disrupted pediatric dysphagia may evolve.

Pediatric dysphagia is not a specific diagnosis; the term is used to describe a wide range of feeding and/or swallowing dysfunction in infants and children (Miller & Willging, 2003). Pediatric dysphagia has traditionally been classified in an organic/non-organic separation. However, within the past ten years pediatric dysphagia has been classified as interplay between biological and environmental factors (Miller & Willging, 2003). Thus, comprehensive classification systems of the causes of pediatric dysphagia include multiple categories, such as: structural abnormalities, neurologic conditions, cardiorespiratory issues, metabolic dysfunction, oral sensory, and behavioral issues (Miller & Willging, 2003). The speech language pathologist (SLP) will execute an important role in determining the etiological cause of dysphagia, as well as conducting the appropriate swallowing evaluation. This paper will discuss four types of swallowing evaluations and common etiologies of pediatric dysphagia to determine which evaluation is appropriate for the pediatric population based on diagnosis, in comparison to standard adult procedures.

Etiologies of pediatrics are addressed below to inform medical SLPs what populations are at risk for aspiration and how to determine warning signs, symptoms, or potential risks of pediatric dysphagia.

Etiology of Pediatric Dysphagia and/or Feeding Problems

Pediatric dysphagia and/or feeding problems evolve due to a multitude of factors. Etiology of a swallowing dysfunction or food refusal may be linked to upper digestive disorders such as gastroesophageal reflux (GERD), and eosinophilic esophagitis (EE). Other common etiologies are prematurity and craniofacial anomalies including cleft lip and/or palate. Psychosocial perceptions may develop and cause negative discernments about feeding which can lead to oral defensiveness, aberrant behavior, or malnutrition.

Gastroesophageal Reflux Disorder

Signs and symptoms of pediatric dysphagia may be primarily due to esophageal disorders (Miller, et al., 2003). Gastroesophageal reflux disorder (GERD) is considered a cause of feeding disorders in infants (Duca, Dantas, Rodrigues, & Sawamura, 2008). Infants' negative experiences with vomiting, regurgitation, dysphagia, and painful swallowing may cause the infant to withdraw or refuse meals. The relationship between laryngeal dysfunction (dysphagia) and GERD is unclear; laryngeal stenosis (narrowing) or edema (swelling) and laryngomalacia (i.e., softening of tissue above the true vocal folds) due to reflux of gastric acid have been implicated as a possible cause of hoarseness and dysphagia (Mercando-Deane, Burton, Harlow, Glover, Deane, Guill, & Hudson, 2001). When an infant diagnosed with GERD is evaluated with an upper gastrointestinal study (UGI), swallowing incoordination may be detected as well. These infants are referred to an SLP to conduct further testing of the swallowing sequence that includes a clinical bedside swallow evaluation (CBSE), modified barium swallow study (MBSS), fiberoptic endoscopic evaluation of swallowing (FEES), or fiberoptic endoscopic evaluation swallowing with sensory testing (FEESST).

Eosinophilic Esophagitis

Eosinophilic esophagitis (EE) is a chronic inflammatory disease characterized by dense esophageal eosinophilia (i.e., allergic reaction to increase of eosinophils) and esophageal symptoms such as dysphagia, food sticking, vomiting, and heartburn (Diniz, Putnum, & Towbin, 2012). Symptoms of EE can cause harmful effects to the infant obtaining oral nutrition which include food aversion or negative feeding experiences, as well as decreased motivation to feed. EE occurs with an incidence of up to 1:10,000 children per year (Diniz, Putnum, & Towbin, 2012). However, EE is not diagnosed until after the age of six months because in order to accurately diagnose EE, patients must have both the histological and clinical features of the disease.

Histologically, EE is characterized by an esophageal mucosal biopsy with more than 15 eosinophils per high-power field. Common clinical findings of EE are longitudinal furrowing (i.e., circles throughout the esophagus), edema (swelling), narrow esophagus, and esophageal rings (i.e., circles at the distal esophagus). Although none of these clinical findings is pathognomonic of EE, the presence of more than one of these findings is strongly suggestive of EE (Diniz, Putnum, & Towbin, 2012). Another way EE differs from GERD is by measuring the normal pH monitoring of the distal esophagus and the lack of response to high-dose proton pump inhibitors (Diniz, et al., 2012). SLPs in the medical setting require excellent knowledge and understanding of the distinction between EE and GERD, which can be determined through an extensive evaluation. To determine if the child experiences dysphagia, secondary to EE, the SLP can objectively test the pediatric patient with a clinical bedside swallow evaluation, MBSS, FEES, or FEESST.

Because a patient with EE has multiple esophageal problems, the SLP needs a view of the esophagus during the swallow trials to understand the extent the GI problems has on the patient's dysphagia. This may alert the SLP if the patient needs further evaluations with a gastroenterology (GI) specialist before the SLP can appropriately treat the patient's dysphagia.

Prematurity

Preterm births (i.e., infants born before 37 weeks gestation) compromise 10% of all births (Burkolow, McGrath, & Kaul, 2002). Premature infants have a difficult time coordinating and tolerating the various activities required for oral feeding (Prasse, & Kikano, 2009). Feeding difficulties may be reflective of the causes and perinatal complications of premature birth, as well as the direct and indirect consequences of the subsequent medical procedures and treatment experienced by the preterm infant (Burklow, McGrath, & Kaul, 2002). For example, if an infant receives perenteral feedings (through their veins) and/or enteral feedings (through a nasogastric or gastronomy tube), the lack of experience and missed oral feedings in the first few weeks of his/her life disrupts the natural coordination of the suck, swallow, and breathe sequence needed to obtain oral nutrition. According to Prasse & Kikano (2009) poor suckling occurs in premature infants because of lack of oral motor strength, immaturity, or lack of development altogether of the buccal pads (cheeks).

Preterm infants primarily have oral stage dysphagia. This is due to the lack of coordinating his/her suck rate with breathing. Other instances of preterm infants' dysphagia are related to bradycardia, which is a rapid increase in heart rate. Also, preterm infants fatigue early during feedings. When this occurs the patient's heart rate increases and may cause the infant to become stressed during the feeding. These instances sometimes referred to as "bradys" can be

detrimental to the fragile infant. It is the role of the SLP to determine the safest swallowing evaluation to utilize for obtaining the most objective information in the shortest amount of time.

SLPs conduct a clinical evaluation of the premature infant to determine if it is safe to begin oral feeding in order to protect the patient from adopting adverse or negative preconceptions with feeding. If the SLP's clinical observation is not justified to determine a safe feeding environment, the client will participate in an instrumental swallow study before oral feedings begin. The earliest an infant can participate in an instrumental feeding evaluation is between 34-36 weeks gestational age. At this time the infant's oral structures, respiration, and cardiac rhythm have fully developed. If the infant is evaluated before the structures have fully developed the patient will not be a safe candidate for oral feedings because of lack of coordination.

Cleft Lip and/or Palate

For infants born with an isolated cleft lip and/ or palate, it is the cleft or opening in the oral cavity that is primarily responsible for the feeding problem (Glass & Wolf, 1999). These infants do not sustain adequate negative pressure throughout an oral feeding and may fatigue earlier in the feeding. Patients with a cleft lip and/or palate require different equipment and positions while feeding. A Haberman feeder is a bottle developed for infants with a cleft lip and/or palate. It has a one-way valve for adequate fluid delivery by compression alone, which compensates for the infant's poor ability to create suction while feeding. The SLP may use Haberman feeder bottle during an evaluation to determine if the infant would benefit from this type of bottle.

Another important component to consider before an evaluation is positioning. Infants with an isolated cleft palate are not able to keep food and secretions from entering the nasal

cavity, which is in close proximity to the eustachian tubes. This leads to a high incidence of chronic otitis media in children with clefts (Glass & Wolf, 1999). Upright positioning during feeding can utilize gravity to channel food through the hypopharynx and away from the eustachian tubes and nasopharynx.

Non-Instrumental Evaluations

Evaluation of swallowing is available in two gross distinctions: instrumental or non-instrumental. A non-instrumental evaluation, called a clinical bedside swallow evaluation (CBSE), consists of the SLP, the patient, and the caregiver. It usually occurs in a natural environment, such as the patient's home, but it can also be conducted in a clinic or a hospital. The SLP observes the patient drinking four different consistencies of liquids, including pudding, honey, nectar, and thin liquid. The patient is presented trials of each consistency to inform the SLP what liquid consistency a child may tolerate without signs or symptoms of aspiration. The SLP must then present diet trials of a regular solid food. SLPs may use preferred food items with children to make them feel more comfortable during the evaluation. Prior to and during the evaluation the SLP collects a case history from caregivers. Observation of the child eating and parent report is a general foundation for the SLP to comprehend the child's swallowing behavior. Non-instrumental evaluations require an SLP to recognize signs and symptoms of pediatric dysphagia through observation and examination of the patient.

A physical examination is important to assess the child's nutritional status, growth, and identify anatomical structures. An SLP will conduct an oral motor examination prior to oral intake to assess the patient's labial, lingual, and velar function. Caregiver report can be one of the most advantageous resources for the SLP during the initial non-instrumental evaluation. Collecting medical history, developmental milestones, and feeding history from the caregiver

may lead to pertinent information that warns the SLP about the signs or symptoms the patient is experiencing. Children and infants rely on their parents or physicians to be alert to the signs and symptoms of their swallowing problems (Prasse & Kikano, 2009). Significant signs of pediatric dysphagia include the child having little interest in eating or feeding, straining or extension of muscles during feedings, extensive time required to feed, spilling of food or liquid out of the mouth, emesis (vomiting), coughing and gagging during feeding, challenges with breathing/ stridor when feeding, and failure to thrive (Prasse, et al., 2009). If the SLP observes any of these signs, an instrumental evaluation is warranted to objectively diagnose a child.

Instrumental Evaluations

An instrumental evaluation is conducted to establish the child's swallowing sequence. Instrumental evaluations are a standardized method used to obtain a view inside the clients' oral cavity and upper digestive system. An evaluation may be completed in the clinical setting, an office, accompanied by a radiologist, or at the patient's bedside. The SLP will choose the type of instrumental evaluation based on the patient's age, behavior, medical status, stamina and stability. The three types of instrumental swallowing evaluations that are primarily used to evaluate adults include: MBSS, FEES, and FEESST. Each evaluation may be conducted with the pediatric population; however the standard protocols are primarily used with the adult population.

To determine what factors may contribute to differences between each evaluation used with both populations, the following discussion is to inform professionals about accommodations needed to safely evaluate the pediatric population with evaluations intended for adult populations. Pertinent factors about conducting an instrumental swallowing evaluation, as well as common similarities and differences have been identified to inform the reader which evaluation may benefit the pediatric population. The first evaluation defined is the modified barium swallow

study, followed by the fiberoptic endoscopic evaluation of swallowing, and last the fiberoptic endoscopic evaluation of swallowing with sensory testing.

Modified Barium Swallow Study

Videofluoroscopic analysis of the swallow, also called a modified barium swallow study (MBSS), remains the gold standard of objective swallowing assessment following the clinical feeding evaluation for confirmation of airway protection adequacy during swallowing (Miller et al., 2003). The procedure lasts approximately one to five minutes. However, Aviv (2000) implies there are limitations to the procedure such as cost, time constraint, and an accurate and safe diagnosis. The clinical limitations that may breach the outcomes of the evaluation include the client's age, behavior, cognition, and weight.

Procedure

The MBSS is completed in a radiology suite. A radiologist, radiology technician, and an SLP complete the evaluation. Radiologists are referred to as the gatekeepers. A gatekeeper can be defined as a person who is positioned between an organization and the individuals who wish to utilize the resources within that organization (Knechtges & Carlos, 2007). Use of a radiologist team and an SLP during the swallowing evaluation are considerable to verify the fitting services of obtaining a fluoroscopic view of the patient's swallowing anatomy and physiology. The SLP is responsible for referring the patient by writing a recommendation to the primary physician, who orders the test, and the radiologist approves and/or defers the test for the patient. The radiologist team, who controls the videofluoroscopic view, and the SLP, who determines when the evaluation is completed and which consistencies to present, together observe the patient's swallowing sequence and then write a report based on the results. However, the cost of the radiology team and the SLP together is higher, than an evaluation that can be conducted solely

by an SLP. According to Knechtges & Carlos (2007), it is more expensive for a patient to be seen in an imaging office because of physician ownership of equipment and cost of staff. Alternatively, the hospital is less expensive option for the patient, but three professionals are still involved in the patient's evaluation.

Each MBSS is set-up prior to the patient's arrival. The four liquid consistencies, pudding, honey, nectar, and thin liquid, are mixed with barium. Each consistency is presented to the patient via the SLP or the radiologist technician. If the patient is at high risk for aspiration the SLP may begin with a thicker consistency, such as honey-thick. However, some hospitals begin all evaluations with thin-liquid trials. This is due to time constraint, patient fatigue, and/or pharyngeal residue that may accumulate in the valleculae or pyriform sinuses after consecutive trials. Each trial is observed on a television placed above the patient. The SLP watches the patient swallow in real time, while objectively determining which consistency to present next to the patient. Based on patient performance the SLP will announce when enough trials have been viewed in order to determine an objective diagnosis. The procedure is short-term lasting only a few minutes, but the set-up and transportation may be a challenge for certain patients.

Outcomes

Long-term effects of radiation are increasingly acknowledged, especially in children, as exposure to radiation has adverse effects that are age-dependent (i.e. the younger the child, the greater the radiation risk) (Weir et al., 2007). Logemann (1993), recommended a maximum exposure time of two minutes for children regardless of age and number of food and fluids trials. However, body mass index (BMI), weight, and height are factors that attribute to the maximum exposure of radiation. The recommended radiation exposure dose limit for adults is 3,000 millirem (mrem) to any tissue during a 13-week period and 5,000 mrem annually, according to

the NIH radiation safety guideline. Kim, Choi, & Kim, (2013) stated in their study the mean effective dose was 0.09-3.20 mrem. With this mean effective dose, more than 40 MBSS annually would be needed to exceed the annual radiation exposure limit of the NIH guideline (Kim, Choi, & Kim, 2013). However, because pediatrics BMI, weight, and height differ drastically from an adult, the results cannot be interpreted with the pediatric population. Additionally, Kim, Choi, & Kim, (2013) stated the radiation dose used in their MBSS was much lower than that of a routine chest computed tomography (CT) performed in previous studies. Therefore the assumption is possible that a child or adult may be exposed to more radiation during a different procedure other than the MBSS.

Children are more sensitive to radiation-induced cancer than adults and are also vulnerable to the effects of radiation on development with reported consequences including leukemia, breast cancer and developmental delay (Weir, McMahon, Long, Bunch, Pandeya, Coakley, & Chang, 2007). It is vital that SLPs are aware of the significant side effects of radiation within the pediatric population. When the SLP conducts the case history, it is important to ask the caregivers if his/her child has ever been exposed to radiation. This information is valuable to the SLP when choosing an instrumental evaluation.

SLPs evaluating the pediatric population want to consider the adverse effects a MBSS may cause. Therefore, it is important for the SLP to minimize the screening time with all populations to reduce the risk of radiation exposure to the patient. Other instrumental evaluations will be considered if the patient requires further testing. A safer, yet more intrusive type of instrumental evaluation is the fiberoptic endoscopic evaluation of swallowing (FEES).

Fiberoptic Endoscopic Evaluation of Swallowing

Prior to the use of FEES, MBSS was the primary evaluation used in diagnosing and treating swallowing disorders. However, within the past 15 years, FEES was developed as an adjunct to the MBSS and introduced to SLPs for use in examining the swallowing apparatus from a superior view. FEES is portable, allowing SLPs to conduct a swallowing evaluation at nearly any location comfortable for the patient. FEES can be considered a safer type of evaluation because the patient does not have to leave his/her facility, does not get radiation exposure, and is able to participate more frequently in the evaluation. FEES, however, does have complications, such as epistaxis (nosebleed) and gagging, that may interfere with conducting an accurate evaluation to determine a proper diagnosis.

Procedure

FEES is a flexible endoscope that is passed along the floor of the nasal cavity through the velopharyngeal port into the pharynx. The clinician superiorly visualizes the anatomy of the nasopharynx, tongue base, hypopharynx, larynx, and vocal folds (Aviv, Murry, Cohen, Zschommler, & Gartner, 2005). The procedure requires approximately 10 to 20 minutes of active assessment. Placement of the endoscope transnasally may be uncomfortable for some patients. Aviv, Murry, Cohen, Zschommler, & Gartner (2005) conducted 1,340 examinations of the FEESST and asked the participants to rate their level of comfort. Of the 1,340 participants in the study, 1,128 participants were able to rate their level of comfort; 60.2% rated the examination as either not uncomfortable (41.4%) or mildly uncomfortable (9.6%) (Aviv, Murry, Cohen, Zschommler, & Gartner (2005).

However, FEES potential risks associated with endoscopy include gagging, laryngospasm (involuntary spasm of the larynx), vasovagal syncope (fainting), topical anesthetic adverse reactions, and epistaxis (nosebleed) (Hiss & Postma, (2003). Langmore, Pelletier, &

Nelson surveyed SLPs trained in the FEES and who administer it independently. Of the 6,000 FEES examinations reported, there were 2 incidents of laryngospasm, 4 vasovagal episodes, and 20 cases of epistaxes (Hiss & Postma, 2003). A previous study reported that of 500 consecutive FEESST procedures, there were no incidents of laryngospasm or vasovagal responses and there were only three patients with epistaxis (Aviv, Kaplan, Thomson, Spitzer, Diamond, & Close 2000).

FEES provides information about the handling of food or liquids before, during, and after the act of swallowing (Willging & Thompson, 2005).The SLP observes two positions during the evaluation, pre-swallow and post-swallow. The pre-swallow position is when the tip of the endoscope is between the soft palate and the tip of the epiglottis where the entire larynx and both pyriform sinuses are visualized. This view assesses premature spillage and a delay in the initiation of the swallow. Premature spillage can be observed before the initiation of the swallow and is scored based on the travel of the bolus to the vallecula or pyriform sinuses before a swallow is initiated. The post-swallow position allows the visualization of the swallowing apparatus after the swallow trial is complete. The endoscope passes inferiorly into the larynx so that the subglottis is visualized. This allows optimum detection of laryngeal penetration and aspiration (Hiss & Postma 2003). After visualization of the trachea, the SLP pulls the endoscope back to the pre-swallow position to allow for appropriate laryngeal elevation with phonation and further swallows.

Outcomes

Although the FEES has multiple attributes that seem appealing, most clients would rather conduct the MBSS. The primary reason FEES are conducted over an MBSS is due to patient's strength and weight. The FEES is an overall safer approach to evaluate swallowing, but the

patient may not be comfortable with a flexible scope traveling down his/her nose. The time FEES takes also decreases the benefits of the procedure. The time needed to conduct the FEES is twice as long the MBSS. The SLP has to take extra time to gather the equipment, set up the materials, and have a nurse or another SLP feed the patient during the procedure. The certified SLP who conducts FEES is responsible for placing the scope and holding it stable for the best superior view. The other disadvantage of the scope is fogging. During the evaluation the scope lens may get fogged by secretions or residue. This can force the SLP to pull the scope out to de-fog the lens and then re-insert the scope. Inserting the scope is the most uncomfortable time throughout the procedure.

One of the shortcomings with FEES and MBSS is that these diagnostic tests primarily analyze the motor component of swallowing, but only indirectly analyze the sensory component (Aviv, 2000). A patient with unrecognized sensory deficits in the laryngopharynx can lead to dysphagia and aspiration, or silent aspiration. The idea is that the patient who cannot sense residue or fluid in their laryngopharynx will not initiate the proper reflexes needed to clear airway residue from entering the larynx and the tracheobronchial tree. Aviv, et al., (2005), developed a method of sensory discrimination testing as an adjunct to the FEES examination.

Fiberoptic Endoscopic Evaluation of Swallowing with Sensory Testing

Fiberoptic endoscopic evaluation of swallowing with sensory testing (FEESST) was originally developed as a psychophysical test (Willging & Thompson, 2005).

A simple, reliable method of laryngopharyngeal sensory discrimination testing that is performed at the same time, and with essentially the same equipment as the traditional FEES examination, is the FEESST.

Procedure

The procedure is completed by an air pulse stimulus of mechanoreceptors within the larynx during the FEESST. Stimulation of these receptors sends afferent information along the superior laryngeal nerve (SLN) to the brainstem for integration (Willging, et al., 2005). Involuntary efferent impulses travel along the vagus nerve to adduct the vocal cords and initiate a swallow response (Willging, et al., 2005). Laryngopharyngeal sensory capacity is determined by elicitation of the laryngeal adductor reflux (LAR), a sensory-motor reflex (Aviv, 2000). This gives the professional a comprehensive motor and sensory assessment of swallowing at the patient's bedside or in the office.

The patient may identify the sensation in the larynx in the area of the aryepiglottic folds by making a facial grimace or change in posture. Indication of sensation from the FEESST is important for the protection of the upper airway from aspirations of saliva and food materials (Willging, et al., 2005).

Comparison of Pediatric and Adult Evaluations

Swallowing evaluations in pediatrics and adults are conducted because of medical history, predisposed etiologies, or current issues that provide the caregiver or significant other with signs of distress with feeding and/or swallowing. The following is a comparison of the standard adult protocol for instrumental and non-instrumental swallow evaluations to the pediatric population.

Pediatric MBSS has been adapted from adult studies to incorporate both diagnostic and treatment/management components while taking into account the developmental continuum (e.g., neuromotor, cognitive and behavior development) and techniques unique to the feeding styles of individual children (Weir, McMahon, Long, Bunch, Pandeya, Coakley, & Chang, 2007).

However, FEES(ST) has been adapted to use as a swallowing evaluation with the pediatric population, especially those at risk for silent aspiration.

Pediatric MBSS Procedure

During the MBSS the patient is seated in a tumbler chair with a secure belt in an upright position. The seat is flush against the fluoroscopy table with the patient positioned laterally behind the fluoroscopy table. For infants (0-1year), the SLP may lay the patient on the horizontal on the fluoroscopy table to obtain a view of the infant in different feeding positions. If the patient is over one year, food and drink preferences may be obtained prior to the evaluation and mixed with a powder or liquid form of barium. If the patient is under one year, the SLP only uses liquid consistency trials with different types of nipples. The nipples used during the evaluation are cross cut, standard flow, medium flow, slow flow, and for certain cases, such as a cleft lip and/or palate, a Haberman feeder. The barium mixture is then fed orally to the patient, by the SLP or the radiology technician. A lateral view of the swallow is watched, in real-time, on a small screen. The SLP continues the MBSS according to response and observation on the first trial.

Pediatric patients who are fragile and do not have high stamina for feedings may get tired easily during a MBSS. The SLP has to ensure the patient has adequate strength to receive the liquid and/or diet trials presented. The SLP also has to determine if the patient is stable to leave their hospital room or home without causing stress on the patient. If the patient is on oxygen, his/her levels must remain between 90 and 100 throughout the evaluation or the patient may experience brain anoxia. Another concern to consider is episodes of bradycardia (increased heart rate) while feeding. All of these factors must be considered before it is safe for the patient to continue the evaluation.

Adult MBSS Procedure

During the MBS with an adult patient, he/she is seated in a lateral position, flush against the upright fluoroscopy table, and given different liquid and diet consistencies. Each trial of food presented consists of pudding, honey, nectar, thin, mechanical soft, and regular solid consistency mixed with barium. Patients with a history of strokes have been shown to experience fatigue of the pharyngeal phase of swallowing as they progress through a meal (Aviv, 2000). This factor may affect the time the SLP has with the patient during a video fluoroscopy evaluation. The limited time during the procedure may also be attributed to previous amounts of radiation exposure. If the client's history reflects multiple fluoroscopy examinations or radiation exposure, the time allotment for the procedure may be reduced.

Adult or geriatric patients may have the same issues stated above that pediatric patients endure. However, a newer reason SLPs are not able to conduct a MBSS on adults is due to obesity. Obese adults are too large to fit into the small space between the fluoroscopic table and the x-ray machine where the patient sits or stands. If a patient enters the small space and his/her shoulders shrug superiorly towards his/her ears, the shoulder will impede the view of his/her swallowing mechanisms which will not allow an objective view. SLPs do have an alternative to objectively evaluate the swallow using instrumentation. The FEES(ST) is used in place of the MBSS when warranted.

Pediatric FEES Procedure

The pediatric procedure is accomplished with the infant sitting in the caregivers lap. The SLP mixes a preferred food item with a colorant, which must exclude blue dye #1 due to its potential toxic effects in children (Willging & Thompson, 2005). Due to potential side effects with dye in the food, an SLP may use vanilla pudding as an alternative. Vanilla pudding residue

is easily identified in the oral-pharyngeal area. This decreases chances the patient may have adverse effects to any dye used for the evaluation and increases the overall safety of procedure. After the swallowing sequence occurs, the SLP examines the patient's hypopharynx to identify pooling of secretions or residue. Subsequent trials of different liquid and diet consistencies are obtained.

Adult FEES Procedure

The adult procedure is accomplished in the most comfortable setting for the patient. A patient may be in a long-term facility, a nursing home, or in acute care in a hospital. Because the FEES is portable it is viable to bring the test to the patient. The portability reduces patients wait time for transportation to and from the procedure, as well as reduces accidents of patients who are at risk of falling. The patients can safely stay in their hospital beds during the FEES procedure which allows the patient to stay calm and relaxed throughout the procedure. Patients who are administered FEES in their rooms may also have their loved ones present. Due to the exposure of radiation risks with the MBSS the patient is the only one in the radiology suite. With FEES, the patient's family can safely sit in the room during the procedure and allow the patient to feel secure. The family can also watch the television screen and view their loved one's swallow in accordance with the SLP.

Pediatric FEESST Procedure

The FEESST procedure is similar to the FEES in regards to patient's seating and positioning. However, the fiberoptic endoscope used during the FEESST was developed by Pentax Precision Instruments with an internal channel standardized for the delivery of discrete, calibrated air pulses (Willging, et al., 2003). The endoscope can provide an air pulse of 50 ms in duration. The SLP controls the intensity and has an operating range of 2 to 10 mm Hg, varying in

increments of 0.1 mm Hg. The SLP will discretely decrease the amount of mechanoreceptors provided throughout the evaluation to determine the patient's sensory threshold. Normal thresholds are considered less than 4 mm Hg of air pressure (Willging et al., 2003). Moderate sensory deficit is elevated between 4.0 and 6.0 mm Hg and severe deficits is considered above 6.0 mm Hg (Willging et al., 2003).

Behavioral indicators of sensation are important for the SLP to recognize in the pediatric population because of inability to verbalize when he or she encounters the air pulse. Willging, et al., (2003), report adequate levels of cooperation can be obtained in nearly all pediatrics requiring FEESST. Willging, et al., (2003) states 7% of participants had anatomic anomalies that precluded the passage of the endoscopes or behavioral problems such as excessive gagging or crying that make the sensory test unreliable. Willging et al., (2003) goes on to state that FEESST can be performed safely in children and adults.

Adult FEESST Procedures

Adults who undergo the FEESST usually have decreased sensation that has resulted from a stroke. According to Willging, et al., (2003) in adults, FEESST has centered on stroke patients. Sensory threshold's correlate with aspiration risks and the greater the threshold the greater the risk for aspiration (Willging, et al., 2003). The stimulus required to elicit the LAR increases from 2.0 to 2.2 to 2.7 mm Hg as one ages from 20 to 40 to greater than 60 years (Willging, et al., 2003). Although these numbers are still within a normal range it is an indicator as to why dysphagia becomes more prevalent with age.

Similarities Between the Swallowing Evaluations

Each procedure is used to measure the pathology and severity of dysphagia of different populations. The primary instrumental evaluations MBSS, FEES, and FEESST are used to

diagnose swallowing disorders and used for dietary management in adults and pediatrics. Each of the instrumental evaluations is conducted outside a patient's home in either a clinic or hospital setting. However the non-instrumental evaluation may be conducted at the patient's home or in the outpatient center. Each of the instrumental evaluations also has associated health risks such as laryngeal stenosis or radiation exposure.

Many of the same signs and symptoms of dysphagia may be identified with both instrumental and non-instrumental evaluations. Epiglottic inversion, penetration, aspiration, residue from the bolus, laryngeal elevation, and mastication are all observed with the non-instrumental and instrumental evaluations. During the non-instrumental evaluation overt signs of aspiration and penetration are subjectively noted by the patient coughing or clearing their throat. During the instrumental evaluation the patient's swallowing anatomy is objectively viewed to confirm the signs noted during the non-instrumental evaluation. Each of the evaluations can identify the patient's laryngeal movement. During the instrumental the clinician objectively observes the hyoid bone elevation, which can be subjectively viewed during the non-instrumental. Each of these signs are important factors that help the SLP determine if the patient has dysphagia.

Differences Between the Swallowing Evaluations

A major difference between the adults and pediatrics MBSS evaluation is the amount of time the SLP is allowed during the evaluation. According to the article by Weir, et al., (2007), Lefton-Grief et al., (2000) reported a screening time of "approximately 1 minute"; Newman et al., (1991) documented screening times of 1–2 min for infants who were bottle fed only; Griggs et al., (1989) reported a range of 2.07– 8.12 min for children with multiple disabilities; and Jolley et al., (1995) reported that studies can range from 30 s to 5 min with an average MBSS study

lasting approximately 2.5–3.5 min (Weir, et al., (2007). Overall, it is crucial that the SLP has the competence to conduct the evaluation in a timely manner, as well as adequately view the swallowing sequence. The SLP has less time with a pediatric patient not only due to safety factors, but also because of behavioral issues.

Pediatric patients may not participate and comply during the evaluation. This is one major component the SLP may take advantage of during an adult evaluation. An adult has motivation to participate in the evaluation because he or she knows it will aid in a safe swallow and better quality of life. However, a child may not have the cognitive capacities to understand why a stranger is feeding him/her. A patient who has multiple disorders or esophageal disorders may not want to swallow because of negative experiences with feeding. Careful consideration must also be given to other factors including feeder-child interaction, concurrent medical diagnoses, environmental factors, and the findings of other disciplines involved in the care of the child (Miller, 2009). All these factors will affect the evaluation procedure and possibly the outcomes of the study.

The non-instrumental and instrumental evaluations differ in the way the clinician views the swallowing anatomy. This difference can be pertinent in determining the type of evaluation to use with a pediatric or adult patient. During the FEES(ST) evaluation the patient's swallow is viewed superiorly, which allows the clinician to observe the vocal folds and identify adequate vocal fold closure. During the MBSS the patient's swallow is viewed laterally, which allows the clinician to view all four of the swallowing phases. Because the patient's seated in a lateral position during the MBSS the clinician does not get a view of vocal fold closure, however the clinician does observe if the patient penetrates or aspirates.

The clinician is not the only person responsible during the evaluation procedure with the pediatric population. The pediatric population experiencing a swallowing problem usually has dysphagia secondary to other disorders. The clinician will need team support to determine readiness for a patient to be evaluated.

Team Approach

The pediatric population with an extensive medical history requires management of their disorders through a team approach. The pediatric client needs multiple professionals to determine the best outcomes for successful development. Pediatric dysphagia clients are evaluated and treated by a multidisciplinary team. Professionals involved in the evaluation process include the otolaryngologist, gastroenterologist, registered dietician, occupational therapist, behavioral psychologist, audiologist, and speech and language pathologist. Each discipline may recommend specific diagnostic tests and/or management options (Miller, et al., 2003). The team approach also provides consistency in regard to the communication given to caretakers, family members, and the patient regarding the plan of care (Miller, et al., 2003).

SLPs are the primary provider for the swallowing treatment. SLPs need to develop an established relationship with the other professionals involved with the child. This enables the SLP to feel safe to communicate noted changes in behavior or structures. Communication between the disciplines not only helps each professional, but will substantially help the child receiving services, by aiding the SLP in determining the safest type of evaluation based on a holistic approach to evaluating the child.

The SLP does not want to conduct an evaluation too early on a child who is in respiratory distress, or may need another reconstruction surgery to his/her palate. This is why the team

approach is important in the pediatric population to aid the SLP in appropriately evaluating the child for the best possible services.

Discussion

Epidemiologic data regarding the incidence and prevalence of symptoms of dysphagia in regard to specific diagnoses in the pediatric population is not well developed, perhaps because evaluation protocols are not standardized and definitions of what constitutes degree of impairment differ among professionals (Miller, et al., 2003). SLPs need to conduct accurate diagnostic procedures to ensure that a child experiencing difficulty swallowing is properly evaluated. Stated below are the recommended swallowing evaluations based on patient's diagnosis.

According to Arvedson (2008) of the available instrumental assessments, the MBSS continues to be the most widely utilized to assess dynamic swallowing in the pediatric population. Weir, McMahon, Long, Bunch, Pandeya, Coakley, & Chang (2007) concur with Arvedson (2008) that the MBSS is arguably the most utilized tool for assessing swallowing disorders and oropharyngeal aspiration in children.

Clinical Bedside Evaluation Candidates

Clinical beside evaluations (CBSEs) are the primary evaluations used before any instrumental evaluation is conducted. The SLP needs to understand the child from a holistic perspective before conducting a procedure that may cause potential harm, such as radiation exposure or nosebleeds. All pediatric candidates should first have a CBSE to determine which of the instrumental evaluations would be most appropriate for the patient, based on the diagnosis, stamina, and swallowing concerns.

The recommended swallowing evaluation for the pediatric client with EE is initially a non-instrumental evaluation, the clinical bedside swallow evaluation. Due to the child's negative discernments with feeding, the clinician can create an environment during the CBSE that will allow the clinician to observe the child during a meal.

The recommended swallow evaluation for a preterm infant is a clinical bedside swallow evaluation. During this time the SLP can monitor the patient's heart rate, help the infant pace his/her sucking and breathing rate, and try various positions to reduce the stress that feeding may cause the infant.

Modified Barium Swallow Candidates

A patient with GERD can be properly evaluated with all three evaluations; however, due to the patients' reflux, an MBSS is the primary choice for testing. The MBSS can determine the patient's swallowing coordination with the opening of the upper esophageal sphincter (UES). This will allow the SLP to determine if the patient has a delayed initiation of the swallow or weak laryngeal elevation.

The recommended evaluation for a patient with a cleft lip and/or palate is the MBSS because it allows the SLP to objectively view the patient's swallowing coordination to determine which stage of swallowing is interrupted. The common signs of dysphagia in pediatrics with cleft lip and/or palate, such as nasopharynx regurgitation and insufficient velopharyngeal closure, can be observed during the MBSS. The observation of these signs during a feeding gives the SLP an adequate picture of how often it occurs, how much liquid is entering the nasopharynx, and the amount of open space between the velum and the nasopharynx.

Infants born premature will require swallowing evaluations to determine readiness for oral feedings. Evaluations may be conducted through clinical observation, behavioral

observation, and instrumental procedures. All three measures used systematically can alert the clinician about swallowing dysfunction, as well as inform the clinician about physiological development. According to Mercado-Deane, Burton, Harlow, Glover, Deane, Guill, & Hudson (2001), a UGI study completed on infants less than one year presented suck/swallow/breathing incoordination, nasopharyngeal reflux, episodes of penetration into the larynx, and aspiration below the vocal folds. In addition to the UGI evaluation, a MBS, FEES, or FEESST may be administered to evaluate the extent of swallowing incoordination and also establish a treatment plan.

FEES Candidates

Pediatric patients are candidates for the FEES examination. However due to the placement of the endoscope, the appropriate amount of time needed, and the side effects such as epistaxis, FEES is not a primary choice for pediatric patients. The reason a FEES may be conducted with a pediatric patient is to obtain a superior view of the swallow in a natural setting, but if the FEES is conducted the SLP most likely will use the adjunct sensory test (FEESST).

FEESST Candidates

The FEESST is the secondary choice for the patient with GERD, however the primary choice for the patient with EE because it can determine the patient's sensation threshold. If the patient has severe GERD the patient's vocal fold sensation may decrease due to harsh effects of reflux in the esophagus and up to the level of the vocal folds. According to Willging et al., (2003), patients with moderate laryngomalacia, which is a common side effect of EE, exhibit elevations of the LAR threshold to the moderate impairment level (median 5.2 mm Hg). This implies that patients with moderate to severe GERD and EE may experience decreased sensation due to the effects of laryngomalacia, which increases his/her risk for aspiration.

Outcomes of Evaluations used with Pediatrics and Adults

In 2000, Leder and Karas reported 100% agreement between FEES and MBS on the parameters of penetration and aspiration in children. In their study 30 pediatric patients were assessed to evaluate the clinical use of FEES. Seven patients were randomly assigned to both FEES and MBSS, while the remaining 23 were assigned solely to FEES. The authors demonstrated that FEES provided specific data regarding feeding recommendations and dysphagia management (Hiss, et al., 2003). FEES is as sensitive as the MBSS on standard swallowing parameters, but also suggests that penetration and aspiration are more frequently identified with FEES.

Unfortunately, the above study did not state the participant's disorders. This information is pertinent for determining which evaluation appropriately diagnoses pediatrics with dysphagia. The previous information is important for determining signs and symptoms of aspiration, but it does not indicate the importance of choosing a type of evaluation based on patient's medical history.

Pediatrics and adults are both administered the MBSS. Adults are able to tolerate more radiation exposure and higher doses of barium than pediatrics, who can only tolerate minimal exposure and low doses of barium. Pediatric and adult swallowing evaluations have multiple commonalities that determine the outcomes; however there are many differences with the procedure of the test.

Conclusion

Pediatric dysphagia encompasses feeding and swallowing. A child who presents feeding aversion may not show signs or symptoms of dysphagia. Dysphagia disrupts the swallow sequence, which then can cause a feeding problem. Overall, it is important for the SLP to

understand that both feeding and swallowing play an integral part within in each other. Feeding may be separated from swallowing problems, but one usually affects the other.

SLPs have multiple ways to evaluate the pediatric client's swallowing behavior and swallowing sequence. The most common way to evaluate swallowing is through instrumentation using a MBSS or FEES(ST). However, the MBSS has many implications the SLP needs to consider, such as limited time during the evaluation and lack of cooperation from the client. FEES(ST) can be supplemented in place of MBSS, but it also has factors that contribute to lack of understanding of the child's swallowing, such as the limited view of the swallowing anatomy.

SLPs that use a team approach will have a better understanding of the holistic child and the appropriate time to refer to other professionals. Other professionals involved will aid the SLP in treating the child's swallowing problems, as well as his/her other disorders. Together the team can improve the quality of life for the child.

Evaluation of swallowing problems within the pediatric population is complicated. It cannot occur in one setting with one clinician. Evaluation involves the caregiver, multiple professionals, and cooperation from the child. It is important that the SLP is well educated in the procedure, side effects, and expected outcomes. SLP competence in evaluating swallowing in the pediatric population is a big task, but it is worth giving the child the life he or she deserves.

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Swallowing Evaluations used with the Pediatric Population: A Comparison to Standard Adult Protocols

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