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Medical Position Paper

A Medical Position Statement of the North American Society for Pediatric Gastroenterology and Nutrition

Indications for Pediatric Esophageal Manometry

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Recently the American Gastroenterological Association published a medical position statement on the clinical use of esophageal manometry (1), accompanied by a technical review (2). These documents are a comprehensive description of basic esophageal physiology and manometry, technical aspects and limitations of manometric recordings, and the clinical applications of esophageal manometry in the adult patient. Because the approach to the child with esophageal disorders is different, the North American Society for Pediatric Gastroenterology and Nutrition has prepared the following medical position statement.

ESOPHAGEAL PHYSIOLOGY IN CHILDREN

Swallowing is a complex process initiated by the voluntary ingestion of food and followed by the involuntary or automatic actions of the oropharynx and the esophagus. The esophageal phase of the swallow involves the transport of the food bolus into the stomach. The three structural components of the esophagus are the upper esophageal sphincter (UES), the esophageal body, and the lower esophageal sphincter (LES) (3).

The UES, defined as an area of increased pressure between the pharynx and the esophageal body, is present by at least 32 weeks gestation and is functional at birth (4). However, swallowing coordination may be poor in the first week of life and in premature infants <1500 g (4–6). Structurally, the UES is ~0.5–1 cm long at birth and increases in length to ~3 cm in the adult (3). In general, the UES corresponds to the cricopharyngeus muscle, the inferior pharyngeal constrictor, and the muscle of the proximal esophagus. Surgical myotomy of the cricopharyngeus does not abolish UES tone (7–9). Because of axial movement of the UES, its precise pressure measurement requires a special sleeve catheter; with such a catheter UES pressure ranges between 18 and 44 cm H_2O (7). UES location can be determined by side-port catheters for the purpose of placing proximal esophageal pH electrodes.

The esophageal body is composed of striated muscle in the upper one-third and smooth muscle in the distal two-thirds. Three types of esophageal contractions occur: primary, secondary, and tertiary (3). Primary peristalsis begins after swallowing, in coordination with pharyngeal contraction and UES and LES relaxation. Secondary peristalsis occurs secondary to intraluminal distention, usually by the food bolus. This function is important in esophageal clearance of material such as refluxed gastric contents. Tertiary contractions consist of random, spontaneous contractions that have no peristaltic function. Pressures within the esophageal body vary with respiration. The velocity of esophageal contractions is typically from 2 to 5 cm per second but is slower during the first week of life, ranging from 0.8 to 2 cm per second.[3]

The LES is the high-pressure zone between the esophageal body and the stomach. Like the UES, its length increases with age, from 1 cm in the newborn to 2–4 cm in the adult (10,11). LES pressure also varies with age, ranging from 7 mm Hg in a premature infant of 27 weeks gestation to 18 mm Hg at term and from 10 to 45 mm Hg in the adult (1,12).

CLINICAL CONSIDERATIONS

Typical manifestations of abnormal esophageal function in the child are eating difficulties, pain, or

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regurgitation. Since the esophagus is composed of both striated and smooth muscle, abnormalities of esophageal motility can involve either muscle type or both. Disorders of esophageal function can be either primary or secondary to systemic disease.

The symptoms and signs that most commonly suggest a disorder of swallowing or esophageal function in children are dysphagia (including food refusal, abnormally slow eating, persistent drooling, and posturing during swallow) (13), chest pain or odynophagia, recurrent aspiration, and recurrent food impaction.

Achalasia and chronic intestinal pseudo-obstruction are the most common primary esophageal motility disorders in children, but both occur infrequently. Diffuse esophageal spasm and nutcracker esophagus occur rarely. Esophageal motility may also be abnormal secondary to reflux esophagitis and tracheo-esophageal fistula, although esophageal manometry has little or no role in the evaluation of these disorders.

Pharyngeal and cricopharyngeal motor dysfunction may be of several origins, which may be classified as follows: (a) corticobulbar disorders, such as palsies, Arnold-Chiari malformation, stroke, tumor, trauma, and multiple sclerosis; (b) neuropathic disorders, such as diabetes, tetanus, lead poisoning, rabies, and drug reactions (e.g., nitrazepam); (c) motor end plate disease, such as myasthenia gravis and botulism; (d) myopathic disorders, such as muscular dystrophy, collagen vascular diseases, hyperthyroidism and hypothyroidism; and (e) autonomic disorders, such as familial dysautonomia.

Measurement of esophageal contraction allows differentiation of some of these disorders. Generally, esophageal manometry is performed after a radiographic contrast study or upper endoscopy of the esophagus has excluded structural or other causes of esophageal dysfunction. It can be performed to evaluate nonstructural abnormalities of the esophagus, such as achalasia; disorders of connective tissue, such as scleroderma; and chronic intestinal pseudo-obstruction or to determine the location of the sphincters for esophageal pH monitoring (14–16).

TECHNICAL CONSIDERATIONS

Esophageal manometry is performed differently in children than in adults because of the differences in size of the esophagus, cooperation by the patient, and neurologic and developmental maturation. These differences require special equipment as well as technical expertise to perform the study, handle the patient, and properly interpret the findings.

Two types of catheter are available: water-perfused and solid-state. When water-perfused catheters are used in small infants, fewer recording ports are utilized to reduce the diameter of the catheter, which is typically 6–10 French (2–3 mm). Such a small catheter size must be accounted for in the amplitude and duration of waves. Solid-state catheters offer several advantages in the pediatric patient, such as a more rapid response rate, maintenance of transducer and lumen relationship in the upright position, and lack of spontaneous stimulation of swallows by water. However, cost, fragility, and inflexibility are significant disadvantages that preclude routine usage.

The spacing of the sensing ports depends on the size of the patient. The interval between perfusion ports or transducers may need to be as close as 1–3 cm apart to accommodate the shorter esophagus in infants. For precise pressure measurements, the low-compliance perfusion system must be adapted to children. During perfusion in infants and small children, the perfusion rate may need to be slower because of the size of the esophagus, the fluid tolerance of infants, and the potential for aspiration. Care must be exercised to compensate for the slower flow rate by decreasing the system compliance. While such precise accounting of compliance and flow rate is required for research, it is not necessary for most clinical purposes.

Esophageal manometry is best performed without sedation. In many children, however, sedation is necessary. Midazolam and chloral hydrate have been shown to be effective with minimal or no influence on pressure measurements (17,18). A natural reflex swallow may be induced in young infants and neurologically abnormal children by gently blowing in the child's face (Santmyer swallow) (19).

At least the distal sensing site should be advanced into the stomach initially (20–23). The single most difficult technical aspect of esophageal manometry in children is cooperation. Physicians performing manometry in children must have great patience. The patient's cooperation can, however, be improved by the use of age-appropriate relaxation techniques. For example, infants relax with swaddling and use of a pacifier. Toddlers are comforted by having a favorite blanket or toy. School-age children benefit from being allowed to handle and examine equipment before the procedure. Adolescents benefit from a thorough review of what to expect before the procedure. Recording artifacts are common in the pediatric patient and occur more commonly than in adults. Specific behaviors (e.g., crying or squirming) should be noted on the tracing itself to allow proper interpretation upon completion of the study.

RECOMMENDATIONS

The following recommendations were prepared with the critique and endorsement of the Subcommittee on Endoscopy and Procedures, the approval of the Patient Care Committee, review by the NASPGN membership at large, and the authorization of the Executive Council of NASPGN. These recommendations are subject to change of the basis of periodic review of subsequent research.

1. Esophageal manometry can be useful to evaluate symptoms or signs of esophageal dysfunction, such as dysphagia, odynophagia, chest pain, aspiration, and recurrent food impaction.

2. Contrast radiography and/or endoscopy of the esophagus is generally performed prior to manometry.

3. Esophageal manometry can be useful to diagnose motility disorders of the esophagus such as achalasia as well as to detect esophageal manifestations of disorders of connective tissue (such as scleroderma) and chronic intestinal pseudo-obstruction.

4. Esophageal manometry can be useful to locate the upper and lower esophageal sphincters for esophageal pH monitoring.

5. Esophageal manometry is generally not useful in the diagnosis or medical management of gastroesophageal reflux disease or structural lesions of the esophagus.

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