Swallowing dysfunction in infants less than 1 year of age

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Received: 22 September 2000
Accepted: 2 February 2001

Abstract Background. Gastro-esophageal reflux (GER) occurs frequently in infants and children and is implicated as a trigger for reactive airways disease. While evaluating patients for GER by upper gastrointestinal studies (UGI), we frequently noticed laryngeal penetration or tracheal aspiration in infants < 1 year of age. We conducted this prospective study to assess the incidence of swallowing dysfunction in infants with vomiting or respiratory symptoms. Methods. Between February 1994 and August 1997, 1,003 UGI in infants < 1 year of age were performed by two experienced pediatric radiologists. Fluoroscopy of swallowing using an appropriate image intensifier was observed as part of the UGI in all patients. In addition to evaluating premature infants, former premature infants, and infants with underlying conditions such as bronchopulmonary dysplasia (BPD), congenital heart disease (CHD), esophageal atresia and/or tracheoesophageal fistula (EA), and neurologic disorders, we assessed swallowing in 472 full-term infants in the general population who had respiratory symptoms or suspected GER, but no other apparent abnormalities. Swallowing was not assessed in patients with congenital bowel obstruction. The presence of normal swallowing or swallowing dysfunction was recorded immediately following the study. Chest radiographs obtained on the same day as the UGI were evaluated in the study. Forty-four videotaped modified barium-swallow studies (MBSS) were obtained in 25 general-population infants and reviewed frame-by-frame to determine the length of time that barium could be visualized in the subglottic trachea. Results. The incidence of swallowing dysfunction is significant in premature and former premature infants, those with BPD, CHD, EA, various syndromes, and neurologic abnormality. In the general population of full-term infants referred for evaluation of vomiting or respiratory symptoms, 63 (13.4% of 472) had swallowing dysfunction. Forty-four had tracheal aspiration (TA) and 19 had laryngeal penetration (LP). Gastroesophageal reflux was found in 79.5% with TA and in 68.4% with LP. The MBSS confirmed swallowing dysfunction in all patients shown to have vocal cord penetration or tracheal aspiration by UGI. Conclusions. Careful evaluation of swallowing during an UGI can identify swallowing dysfunction in full-term infants who have respiratory problems, as well as in infants with an abnormality that predisposes the patient to aspiration. Episodes of tracheal aspiration may be fleeting and overlooked if swallowing is not assessed carefully. An MBSS can confirm the observation of swallowing dysfunction found during an UGI and assist in planning appropriate dietary therapy that minimizes the likelihood of tracheal aspiration during feeding.

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Introduction

Feeding difficulty resulting in tracheal aspiration commonly occurs in infants and children with neurologic disorders, history of prematurity, and esophageal atresia [1–4]. Vazquez and Buonomo reported that swallowing dysfunction is a common finding in full term infants less than 1 month of age [5]. Swallowing dysfunction and aspiration occur when laryngeal protection of the airway fails [6, 7]. The relationship between laryngeal dysfunction and gastroesophageal reflux is unclear; laryngeal stenosis or edema and laryngomalacia due to reflux of gastric acid have been implicated as possible causes of hoarseness and dysphagia [8–10].

The upper gastrointestinal study (UGI) is often performed to diagnose gastroesophageal reflux (GER), a common finding in infants and young children with respiratory disease. When swallowing is routinely evaluated as part of the UGI, it is possible to identify swallowing incoordination in infants who have respiratory problems. These patients may require additional evaluation with a modified barium swallow study (MBSS) that is designed to evaluate the extent of swallowing incoordination as well as to establish appropriate therapy.

In addition to evaluating patients with underlying disorders that predispose to aspiration, we studied 63 children with swallowing incoordination initially identified by UGI. None of these 63 patients had a neurological deficit, history of chronic illness such as bronchopulmonary dysplasia, or heart disease, in which signs of swallowing incoordination are common.

Swallowing dysfunction clearly includes tracheal aspiration, identified by finding barium below the level of the true cords. We have also included in our definition of swallowing dysfunction penetration of barium underneath the epiglottis and within the vocal cords since this observation often preceded finding deeper penetration below the cords during the UGI and MBSS in several patients.

Patients and methods

Between February 1994 and August 1997, 1,003 UGI studies in infants < 1 year of age were performed by two experienced fellowship-trained pediatric radiologists who are also Board-certified pediatricians. The patients were typical of a population referred by general pediatrics, neonatologists, and pediatric subspecialists for pediatric imaging to evaluate vomiting and respiratory problems. In addition to evaluating the esophagus, stomach, and proximal small intestine, we carefully observed swallowing using appropriate image magnification during fluoroscopy in 784 infants. Swallowing was not assessed in 219 patients with congenital bowel obstruction, esophageal dilatation, or recent esophageal surgery for esophageal atresia.

During the UGI, the patient was placed in the right lateral position and offered a barium meal in a bottle. As the patient drank the barium, swallowing was observed using continuous fluoroscopy (30 frames/s). In order to assess transitory and briskly occurring vocal cord penetration or tracheal aspiration in the small infant, a 9° or 6° image intensifier was typically employed during fluoroscopy. The following were noted during swallowing: the motion of the tongue, evidence of suck/swallow/breathing incoordination, nasopharyngeal reflux (NPR), episodes of penetration into the larynx, and/or aspiration below the level of the cords. Esophageal anatomy and motility, gastric emptying and the position of the ligament of Treitz were observed. If present, laryngomalacia and tracheomalacia were noted. Finally, GER was evaluated fluoroscopically. Generally, the entire study was completed in less than 4 min of intermittent fluoroscopy. When ordered, a chest radiograph was obtained and interpretation recorded on the same date as the UGI. A 24-h pH probe study was performed immediately following the UGI in 22 of the 63 patients.

One hundred seventy-nine MBSS were ordered by referring physicians and were performed in 126 patients, including 25 of the 63 general population patients. During the MBSS, the pediatric radiologist and speech pathologist performed lateral projection fluoroscopy of the upper airway with the patient placed in a semi-recumbent position. The study was videotaped. Neonates and infants were placed in a small tumble-form feeder with the torso elevated at least 45°; toddlers were positioned in a medium-tumble-form feeder seat and elevated approximately 90°. Different age-appropriate consistencies of food and liquids were offered to the child. These included thin barium (Enter-H; E-Z-EM, Westbury, N.Y.) mixed with thin and thick liquids (1 tablespoon of rice cereal per ounce of thin barium), and pureed food. A minimum of three swallows per type of liquid and semisolid food was observed, and the entire study was videotaped.

Results

Of the 1,003 UGI studies in infants < 1 year of age, 472 were performed in infants without an underlying disease (Table 1). Of those infants with conditions that predisposed the patient to swallowing dysfunction, the incidence of aspiration during swallowing ranged from 25 to 73% (Table 1). During the study period, of the 472 children from the general population, 63 (range, 1 day–12 months; mean, 5.69 months), with no history of prematurity, cardiac disease, neurological impairment, developmental delay or chronic illness were identified with swallowing dysfunction by UGI examination (13.4%). Of the 63 patients, 36 were male. The most common signs/symptoms in these 63 patients were wheezing (15), multiple respiratory infections or pneumonias (15), anemia (9), cough (8), and reactive airway disease (8) (Table 2). Chest radiograph findings in 48 of these 63 patients included perihilar peribronchial cuffing (22), normal (16), focal airspace opacity (11), and hyperinflation (6) (Table 3). Of the 63 patients, GER was demonstrated in 48 (76.2%) either by UGI or pH probe (Table 4). Of 44 studies that demonstrated tracheal aspiration, GER was noted in 35 (79.5%). Of 19 instances of cord penetration, GER was present in 13 (68.4%) (Table 4).