Gastroesophageal Reflux Contributing to Chronic Sinus Disease in Children

A Prospective Analysis

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Objective: To explore the possible role of gastroesophageal reflux (GER) in children with chronic sinus disease (CSD).

Design: A descriptive prevalence study of the frequency of GER and nasopharyngeal reflux in children with CSD.

Setting: Pediatric otolaryngology and gastroenterology outpatient clinics of a regional medical center.

Patients and Other Participants: Consecutive children aged 2 to 18 years referred for evaluation of CSD from December 1, 1996, through April 30, 1998.

Interventions: Participants underwent 24-hour monitoring with dual pH probes, and participants (or their parents) completed questionnaires before treatment and at specific intervals after treatment.

Main Outcome Measures: Prevalence of GER and nasopharyngeal reflux in children with CSD, and the response of sinusitis to treatment in those diagnosed with GER.

Results: Nineteen (63%) of 30 patients demonstrated esophageal reflux, which is well above the expected prevalence of GER in the healthy general population. Six (32%) of these 19 patients demonstrated nasopharyngeal reflux. Fifteen (79%) of 19 patients improved after treatment for GER.

Conclusions: The children in this population had a prevalence of GER that was significantly higher than expected. Furthermore, most children with GER demonstrated improvement of sinus disease after treatment of GER. We recommend that children with CSD refractory to aggressive medical management be evaluated for GER and, if GER is present, be treated accordingly, before sinus surgery is considered.


Gastroesophageal reflux (GER) has been implicated as a contributing factor in the pathogenesis of many pulmonary and otolaryngological disorders. Gastroesophageal reflux has been associated with reactive airway disease, otalgia, stridor, pharyngitis, laryngitis, cricopharyngeal spasm, chronic cough, rhinitis, contact ulcerations, pneumonia, and others.1-6 Historically, most associations have focused on laryngeal and lower airway disease. More recently, however, attention has been directed toward relationships between GER and upper airway disease. Contencin and Narcy1 demonstrated a relationship between reflux into the nasopharynx and chronic rhinopharyngitis. Conley et al7 demonstrated the association of GER with certain upper airway obstructive disorders. Implication in these disorders has fostered speculation that GER plays a role in other upper airway maladies such as chronic sinus disease (CSD). If GER were shown to play a significant contributory role in CSD, it might change the way these children are evaluated and treated. Treatment of GER in children with medically refractory CSD might reduce disease burden, improve quality of life, avoid prolonged antibiotic therapy, and obviate the need for sinus surgery. Because of the potential risks associated with sinus surgery, which is rarely curative, and unknown effects on facial growth and development, the consensus is that all medical treatment options should be exhausted before considering elective sinus surgery in children.

The most popular method and criterion standard for evaluating GER has been the esophageal pH probe, but some investigators have placed probes in other locations (eg, pharynx, proximal esophagus) to further evaluate possible associations with upper airway disease.3,8,9
PATIENTS AND METHODS

The study protocol was reviewed by the Institutional Research Review Board at Geisinger Medical Center, Danville, Pa, and approved. The study sample consisted of 30 consecutive children referred to the Geisinger Medical Center Department of Otolaryngology for evaluation of CSD from December 1, 1996, through April 30, 1998. Patients younger than 2 years or older than 18 years were not enrolled in the study. A certain amount of GER is considered normal in infants, but beyond 12 months of age the amount of physiologic reflux approximates that of adults.\(^4\)\(^5\) A conservative plan to ensure that marked GER did not represent normal development was to exclude children younger than 2 years. Control subjects were not used because of ethical constraints (ie, invasive procedure on a well child).

The initial evaluation and treatment of referred patients included taking a history, performing an otolaryngological examination, and instituting maximal medical management. Medical treatment included no less than 3 weeks of broad-spectrum antibiotic therapy and intranasal saline and steroid sprays. Attempts were also made to correct environmental irritant exposures such as passive tobacco smoke. Patients with persistent sinus symptoms despite aggressive medical management underwent computed tomography (CT) scans of the sinuses. Those patients with evidence of sinus disease on results of CT scan who met the following criteria for CSD were asked to participate in the study: (1) 3 months or more of multiple clinical sinus symptoms; (2) failure of medical management of CSD, including a minimum 3-week course of broad-spectrum antibiotic therapy and adjuvant measures; and (3) evidence of sinus disease on results of CT scan, after maximal medical management. Patients with previously diagnosed GER were not excluded. Informed consent was obtained on enrollment from the parents or legal guardian, and assent was obtained from children of appropriate age.

Thirty-eight patients were asked to participate in the research study. Two patients (or their parents) declined participation. (One of these had been empirically treated for GER by the primary care physician, with resolution of symptoms.) Thirty-six agreed to participate in the research study; however, 6 of these patients failed to keep scheduled appointments or were unable to be scheduled for pH probe. Therefore, 30 patients underwent evaluation for gastroesophageal and nasopharyngeal reflux by means of dual pH probes. Patients and/or parents were asked at enrollment to complete a questionnaire with subjective and objective measures of sinus disease symptoms and the significance of those symptoms. Questionnaires addressed the presence of major and minor symptoms, frequency of antibiotic therapy, frequency of physician office visits, and number of school days missed (when applicable). Patients were then referred to the Department of Pediatric Gastroenterology and Nutrition, Geisinger Medical Center, for examination and the placement of 24-hour dual pH probes.

Dual pH probe monitoring was performed with the use of 2 portable pH measuring units (Mark II Digitrapper; Synectics Medical, Shoreview, Minn). All electrodes were calibrated in buffer solution with a pH of 7.0. If patients were taking acid-inhibiting medications or prokinetic agents, they were instructed to discontinue these at least 48 hours before the pH probe study. Patients were instructed to have a liquid breakfast before 8 AM. Patients then reported to the Department of Pediatric Gastroenterology and Nutrition, approximately 10 AM. An external lead, intended to serve as a reference electrode, was attached to the chest. Flexible pH probes (Synectics Medical) were passed through the nose and taped into position. One probe was placed approximately 3 cm above the lower esophageal sphincter and the other was placed in the nasopharynx. Chest and lateral neck x-ray films were obtained to confirm proper probe position, and probes were adjusted if necessary. Patients spent the night at home or in a hotel adjacent to the hospital and returned the following morning for probe removal. They were instructed to pursue their normal activities and had no meal restrictions. Probes remained in position approximately 24 hours. The pH probe results were recorded separately for each probe. A reflux episode was defined as whenever pH was less than 4.0. We recorded the number of reflux episodes, the percentage of time that pH was less than 4.0 (the most reliable measure recorded), the length of the longest episode, and the number of episodes lasting longer than 5 minutes.

In the absence of control subjects, we compared our data with existing normative data. Kaufman\(^4\) reviewed normative data from several studies and combined the GER values for healthy patients. Thresholds for GER were defined though there is a certain degree of “physiologic” reflux in the lower esophagus, reflux into the nasopharynx is unusual in most patients.\(^7\)\(^8\) It is possible that reflux to higher anatomic levels contributes to more proximal airway disease. We therefore proposed that dual pH probes be used, with one probe in the nasopharynx and the other in the distal esophagus, for evaluation of possible gastroesophageal and nasopharyngeal reflux in children with CSD.

RESULTS

Twenty-two male and 8 female patients participated in the study (average age, 7.7 years). Most patients were probed and treated for GER during the “viral season,” suggesting that favorable treatment responses were not the result of a reduced frequency of contracted viral upper respiratory tract infections.

All children exhibited multiple symptoms of sinusitis, with 5 or 6 symptoms being reported by most parents. Those symptoms most commonly reported were cough (in 30 patients [100%]), nasal obstruction (in 27 [90%]), irritability or changes in behavior (in 27 [90%]), sore throat (in 24 [80%]), and postnasal drainage (in 24 [80%]). Other symptoms included fatigue or lethargy (in 23 patients [77%]), headache (in 23 [77%]), purulent nasal drainage (in 19 [63%]), fever (in 18 [60%]), hoarseness (in 18 [60%]), halitosis (in 18 [60%]), and vomiting of mucus (in 16 [53%]). In addition, 21 patients (70%) reported a history of asthma and 16 (76%) of these reported that the asthma was exacerbated by sinus infections. Eighteen patients (60%) were found to have previously undergone tonsillectomy and adenoidectomy or adenoidectomy alone.

Data from the pH probes are listed in the Table and presented in the Figure. Of the 30 patients undergoing dual pH probe, 19 (63%) were found to have pathologic
Esophageal reflux, indicating a prevalence of GER that was clinically significant and much higher than a 5% prevalence anticipated in the general population. Six (32%) of these 19 also had reflux into the nasopharynx. Eleven (37%) of 30 patients did not have significant esophageal reflux, but 1 (9%) of the 11 had nasopharyngeal reflux. This patient was treated for GER without a favorable response and subsequently underwent endoscopic sinus surgery, with improvement of CSD.

Fifteen (79%) of the 19 patients with reflux were improved to parental satisfaction after treatment for GER (data not shown). One patient was treated for GER but CSD symptoms remained unchanged. Another patient would not comply with treatment and CSD symptoms remained unchanged. Follow-up information was not available for a single patient. One child was not treated initially for GER and CSD symptoms remained unchanged; this patient is currently undergoing treatment for GER. Five (45%) of 11 patients not identified as having GER improved to parental satisfaction after maximal medical management of CSD.

We found that the percentage of time with pH less than 4.0 detected by the nasopharyngeal pH probe did not correlate with that detected by the esophageal probe. However, many patients with proven GER had brief drops in nasopharyngeal pH below 4.0 associated concurrently with symptoms such as cough. This occurred in patients with and without a significant total percentage of time with nasopharyngeal pH less than 4.0.

There has been an increased understanding of the meaning of CSD in children. The cause of CSD is multifactorial and includes viral infections, host immunologic status, allergy, anatomic configuration of the sinuses, and...
environmental irritants. Routine evaluation for CSD usually includes a complete otolaryngological examination, allergy tests, an immune system survey, and a CT scan of the sinuses. A biopsy of the mucosa to assess motility of the cilia and a sweat chloride test to evaluate for cystic fibrosis are sometimes indicated. Medical treatment typically includes antibiotics, nasal saline and steroid sprays, and environmental controls. Oral antihistamines can be helpful when there is known allergic disease. Decongestants are best reserved for short-term therapy, as they may thicken nasal secretions and negatively affect ciliary clearance. Current surgical management consists of an adenoidectomy or endoscopic sinus surgery for those children with exceptional disease burden and quality-of-life issues.

Although GER has been implicated in many aero-digestive disorders, its possible association with sinusitis has been a matter of controversy and debate. To date, there has been a paucity of literature directly addressing this issue. Barbero11 provided several illustrative cases of patients with medically refractory CSD that improved after GER treatment. Bothwell and colleagues12 found that the number of children with CSD requiring sinus surgery was dramatically reduced after treatment for GER.

The child with sinusitis and comorbid asthma is at particular risk for GER, since a strikingly increased prevalence of GER has been demonstrated in asthmatic patients.13 Reasons for this prevalence include an increased negative intrathoracic pressure relative to intra-abdominal pressure. Furthermore, some medications used to treat asthma may relax the lower esophageal sphincter and/or cause hypersecretion of gastric acid. Our study supports this association, since 15 (71%) of our 21 patients with CSD and comorbid asthma had GER. In contrast, GER was diagnosed in 4 (44%) of 9 patients without asthma.

The pathophysiological characteristics of GER in CSD are unknown. The most popular theory is that nasopharyngeal reflux has a direct effect on mucosa, initiating an inflammatory response with edema and impaired mucociliary clearance. These events culminate in obstruction of the sinus ostia and resulting infection. Such gastro-nasopharyngeal reflux has been demonstrated in children. Contencin and Narcy3 described a difference in the duration and degree of pH reduction in the nasopharynx of children with GER and rhinopharyngitis compared with controls. Our study also supports this theory, since 6 (32%) of 19 patients with GER had nasopharyngeal reflux. Five (26%) of 19 had nasopharyngeal reflux greater than 1.5% of the time. Other patients without a significant total percentage of time with nasopharyngeal pH less than 4.0 had brief drops in pH be-
low 4.0 associated with coughing paroxysms. An alternative theory of pathogenesis proposes the existence of a reflex response such as has been described with GER and pulmonary disease. Such an esophagosal or esophagonasopharyngeal reflex that causes sinonasal mucosa to respond to esophageal irritation has not been demonstrated.

Evaluation of a child for suspected GER should include a detailed history and clinical examination, which may be unrevealing, as GER can be “silent” with nonspecific clinical manifestations. Children usually do not localize symptoms of GER and, therefore, seldom complain of heartburn, sour eructations, or regurgitation. Frequent nausea and diminished appetite might be reported, but are nonspecific and can be related to prolonged antibiotic therapy and other medications. Newborns and infants may reflux up to 10% of the time. It has been demonstrated, and is widely accepted in the pediatric gastroenterology community, that the amount of physiologic reflux in children older than 1 year is comparable to the adult level of 4%. Extraesophageal gastric reflux to the levels of the hypopharynx and nasopharynx has been demonstrated in children with laryngeal and pulmonary abnormalities as well as choanal atresia. Normative data for healthy children are lacking. For the purposes of our study, any nasopharyngeal reflux was considered abnormal and potentially contributory in the pathogenesis of sinusitis.

Evaluation by means of 24-hour pH probe has been described as highly sensitive and specific for GER and is considered by many to be the criterion standard. We found evaluation by means of pH probe to be safe and well tolerated; there was no associated morbidity in our patients. Monitoring was performed with a portable unit on an outpatient basis, which allowed essentially normal patterns of diet and activity.

Treatment for GER consists of behavioral and dietary modifications, acid-reducing and prokinetic medications, and possibly surgery (Nissen fundoplication) if GER is severe and medically refractory. Pediatric gastroenterologists at our institution have found that 2 months is a reasonable minimum duration to assess the impact of GER treatment.

Our data clearly show that this population of children with CSD demonstrated a prevalence of GER that was higher than expected. Moreover, treatment of GER resulted in improvement of sinus symptoms for most patients. If one accepts the concept of a possible contributory role of GER in the pathogenesis of sinusitis for even some patients, then it is warranted to evaluate for GER in any child with CSD unresponsive to aggressive medical management or previous sinus surgery. Treatment of identified GER will not affect the disease process of all children, and endoscopic sinus surgery may be justified for selected patients. Conceptually, continuation of GER management, despite the decision to operate, would seem reasonable and might favorably affect healing by reducing granulation and scar formation. Treatment of identified GER, even in the absence of associated nasopharyngeal reflux, resulted in clinical improvement of sinusitis for most of these patients. Consequently, esophageal pH probe alone is probably sufficient as a basis for determining treatment.

The use of esophageal and nasopharyngeal pH probes to evaluate children with CSD for GER in our study re-
revealed a prevalence of GER that was significantly higher than expected. Many children with GER were not demonstrated to have nasopharyngeal reflux; however, medical treatment of identified GER with or without associated nasopharyngeal reflux resulted in clinical improvement of sinusitis for most patients. Therefore, esophageal pH probe alone is probably sufficient as a basis for determining treatment. We recommend that children with CSD refractory to aggressive medical management be evaluated for GER and, if GER is present, be treated accordingly before sinus surgery is contemplated.

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