

ment, or would they have to have something more in terms of poor antibody response?

Dr. Polmar. That is a very good question. The issues are as follows. If you have a patient with a credible subclass deficiency (G2, G3) with or without selective antibody deficiency (such as pneumococcal polysaccharide, unresponsiveness), the patient would be maintained on prophylactic antibiotics. If the patient does not respond to prophylactic antibiotics, we would attempt a trial of intravenous γ -globulin.

Dr. Fireman. This type of discussion that we are having regarding subclass deficiency refers mainly to younger children. When you get past the age of 4 or 5 years, I think your approach would not be quite the same.

Dr. Polmar. The number of older patients who have normal immunoglobulins and have defect in functional antibody is very, very small.

Dr. Rachelefsky. I think Dr. Fireman is trying to make a very important point, and that is that the interpretation of the laboratory data and the functional defect in the patient must be interpreted differently in the younger child versus the child over 6 years of age. Immune abnormalities may resolve in the younger child but may be permanent in the older child.

Dr. Fireman. If you have the young child and you see a response to a single antigen type, I feel comfortable with that. If you have an 8-year-old who has a response to just one, then I don't feel comfortable.

Dr. Rachelefsky. If you can't control their infection and they have an immunologic defect (i.e., an antibody deficiency) and you have nothing else to offer that patient, I believe that a trial of γ -globulin therapy is valid.

The role of allergy in sinusitis in children

Clifton T. Furukawa, MD *Seattle, Wash.*

Allergic rhinitis and sinusitis are independently common disorders. Studies document the presence of both disorders in the same patient 25% to 70% of the time. Because this is above the prevalence of allergic rhinitis in the general population, the literature supports that allergy is an important associated factor in sinusitis. Younger children appear to be even more at risk of sinusitis, perhaps because of small anatomic structures, more frequent viral infections, and more exposure to indoor allergens and irritants. Immunodeficiency appears to play an independent role in resistant, severe sinusitis. (J ALLERGY CLIN IMMUNOL 1992;90:515-7.)

Key words: Allergy, sinusitis

Even at birth children may develop sinusitis, in this case by bacteria pushed into the ethmoid sinuses during vaginal delivery. By 6 months of age most children are sitting, and most are walking by age 1 year. This places the maxillary ostia in a superior position so that gravity now works against the mucous flow around and out of the sinuses. The channels of the osteomeatal complex are long and thin and may be easily obstructed with the smaller anatomic structures of very young children.

PREDISPOSING FACTORS

Five factors have been implicated as predisposing to sinusitis: (1) *Anatomic*, including adenoidal hypertrophy, deviated septum, foreign bodies, immotile cilia, polyps, and tumors; (2) *trauma*, including barotrauma (e.g., diving) and dental procedures; (3) *diseases*, including allergic rhinitis, bronchiectasis, cystic fibrosis, immunodeficiency, and respiratory infections; (4) *drug abuse*, including overuse of topical decongestants; and (5) *irritants*, including tobacco smoke, chlorine, and air pollution.

The most commonly associated factors are by far upper respiratory tract infections and allergy. Both of these conditions cause mucosal swelling and affect mucous secretions and perhaps ciliary function. Therefore it is not surprising that an association exists. Yet it is equally clear that respiratory tract infections and allergy do not cause bacterial sinusitis per se.

From Northwest Asthma and Allergy Center, Seattle, Wash.

Reprint requests: Clifton T. Furukawa, MD, 4540 Sand Point Way N.E., Suite 200, Seattle, WA 98105.

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ACUTE VERSUS CHRONIC SINUSITIS

With the current status of knowledge, it is probably worthwhile to separately conceptualize acute from recurrent from chronic sinusitis. Although these may only represent different severities and consequently differing extent of anatomic involvement, the role of allergy and immunodeficiency may be different in sinusitis that does versus that which does not respond to intensive medical and even surgical therapy.

SIMILARITY OF ALLERGY AND SINUSITIS

Initial studies by allergists focused on the similarities between sinus disease and allergic disorders. Typical findings were that persistent cough, chronic rhinorrhea, fatigue, and irritability were not specific for either. We noted that in 91 such children, sinusitis was the correct diagnosis for 64 (70%); most had resolution with the use of antibiotics, antihistamine-decongestants, and vasoconstrictor nasal spray.¹ Of interest was the paucity of eosinophils present on nasal smear examination. There was an increased likelihood that eosinophils were present after therapy. Therefore we initially thought that allergy and sinusitis were separate entities, common only because of common symptoms. It should be noted that these cases were predominantly previously unrecognized cases of sinusitis, chronic only because they were not adequately treated. Seventy similar children were evaluated at another center²; sinusitis was found in 37 of 70 children (53%). Again the presence of neutrophils and the low numbers of eosinophils present on nasal smear were predictive of sinusitis. Those children with severe radiographic abnormalities tended to be younger (mean age, 6.5 years vs 9.2 years for the unaffected group). This suggests that smaller sinus structures or more frequent viral respiratory tract infections affecting younger children predispose to sinusitis.

STUDIES OF THE RELATIONSHIP BETWEEN ALLERGY AND SINUSITIS

Later studies have focused more directly on the question of a relationship between allergy and sinusitis. One study evaluated 224 Army recruits with acute sinusitis and compared them with 103 recruits suffering from acoustic trauma from firearm shooting.³ Although the reported allergic symptoms (75/224 vs 24/103) were not significantly different, skin tests revealed a significant ($p < 0.05$) increase in allergy in the sinusitis group (56 to 70/224) versus the control group (17/103). This study suggests a minimum of a 25% likelihood of allergy in young adults, which is a half to a third of that reported by allergists. This 25% figure is notably higher than the control group

(16%) and the general allergy prevalence in the Finnish population (19%). The incidence of acute sinusitis was lowest in the summer months, but allergic patients were not only grass allergic but also tree pollen and cat and dog allergic. During the birch pollen season, sinusitis was more frequent among those allergic to birch pollen, but this was not statistically significant.

In another study, an allergy practice examined 90 children with chronic sinusitis and found that 51% also had positive allergy skin tests.⁴ Interestingly, 57% had asthma, which seemed related to the sinus disease. Immunodeficiency was uncommon; three children had low IgG2 and abnormal antibody response to pneumococcal vaccine polyvalent (Pneumovax) or *Haemophilus influenzae* vaccination.

A somewhat different way to consider the relationship between allergy and sinusitis is to analyze the frequency of recurrent, acute sinusitis. We⁵ retrospectively reviewed patients in two studies of antibiotics in which the number of radiographically documented episodes of sinusitis in the year before entrance to the study was determined. Those patients with positive prick skin tests to common inhalants were considered "allergic," and those with negative test results were "not allergic." As would be expected with an allergy practice, of the 92 patients 85 were skin test positive and 7 were skin test negative. Most were children, ages 6 to 16 years, with 14 adults participating. As a group, those patients with allergies sustained 1.09 more sinus infections ($p = 0.012$). This study suggests that allergy may be associated with more frequent bouts of appropriately treated sinusitis than in similar sinusitis-prone persons.

RELATIONSHIP OF ALLERGY OR IMMUNODEFICIENCY TO EXTENT OR SEVERITY OF SINUSITIS

One hundred consecutively seen children, ages 7 months to 14 years, suspected of having sinusitis participated in a university outpatient study; 96% had radiographic confirmation of sinusitis. Within this group, 38 patients had allergy or asthma, and 5 patients were "immunologically deficient." Because the report focused on the importance of sinus x-ray films, only a comment without further details was made about these immunodeficient patients. This study noted that those patients with allergic rhinitis or asthma "had more severe and widespread involvement of the paranasal sinuses" and those with immunologic deficiencies "without exception, had severe, extensive and intractable pansinusitis."⁶

We looked for allergy and immunodeficiency in 61 children, ages 2 to 13 years, with chronic sinusitis

refractory to prolonged medical therapy.⁷ Positive allergy prick tests were found in 22 children, strongly positive intradermal tests in an additional 13 children, and elevated serum IgE in an additional 2. Thus 22 of 61 children were clearly allergic, and 37 of 61 were probably allergic. Immunodeficiency (low IgG or subtypes, vaccine hyporesponsiveness) was noted for 34 of 61. About half of the allergic group were also deficient in their immunologic tests. This is about the same percentage as those with immunity tests suggesting deficiency compared with the total number studied. Thus is the most severe group of patients with sinusitis, both allergy and immunodeficiency appear independently common.

NONINFECTIOUS ALLERGIC SINUSITIS

A separate entity, "allergic sinusitis," was suggested by Slavin et al.⁸ after hyperemia and increased metabolic activity were found in the paranasal sinuses of three patients after ragweed challenge test with the use of single-photon emission computerized tomography. However, the results of these radiographs were normal.

Using a population already susceptible to sinusitis, another study that used allergen nasal challenge actually demonstrated radiographic changes induced by allergens.⁹ It should be noted that adult patients with chronic maxillary sinus were selected, although most (34/37) only had slight (<3 mm) mucosal thickening or challenge. Twenty-nine of the 37 patients had positive allergen challenge compared with none of 8 patients with eczema who served as the control group. Radiographic changes with increased mucosal edema or opacification were noted 78% of the time for those patients with positive challenges and 16% of the time for those with negative challenges. These radiographic changes resolved in 24 to 48 hours. The authors propose a hypersensitivity mechanism initiated by antigen-antibody interaction that resulted in edema, obstruction, and mucous gas accumulation within the sinuses, with subsequent mucous membrane thickening, decreased aeration, increased fluid level, and soft tissue mass.

CONCLUSIONS

These studies support a minimum concordance of allergy and sinusitis of 25%, with maximum concordance of 70%. This is clearly above the general prevalence of allergy and supports the general impression that allergy is an important associated and probably predisposing factor in sinusitis. Furthermore, the younger the child, the more susceptible he or she is,

which is perhaps related to size of the anatomic structure, frequency of viral respiratory tract infections, or intensity to exposure to indoor allergens or irritants. Immunodeficiency disorders also seem to play a role in sinusitis, particularly in patients who are resistant to intensive and prolonged therapy.

That allergy can cause the radiographic changes and some of the symptoms of sinusitis appears credible; the study used allergen challenge and follow-up radiographs. Further studies are necessary to better define the mechanism involved and the role of antiallergic therapy in the treatment of sinusitis.

There also remains much to be desired in the definition of what is acute or chronic sinusitis, because several studies noted that sinusitis was newly diagnosed in a high proportion of patients with long-term symptoms. Furthermore, more intensive and prolonged medical therapy was able to resolve these "chronic" cases.

The relevance of the relationship between allergy and sinusitis still needs further examination. Is it a good or bad prognostic indicator for a person with sinusitis to also be allergic? Does the presence of neutrophils on the nasal smear represent late cellular reaction after the eosinophilia of an allergic reaction? We need more studies in which the clinical and radiographic features of sinusitis are brought on by an experimental protocol rather than the uncontrolled, after-the-fact studies of populations affected by the end-stage disease we call "sinusitis."

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