The prevalence and effect of asthma on adults with chronic rhinosinusitis

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Abstract
We conducted a retrospective review of 145 consecutively presenting adults treated for chronic rhinosinusitis (CRS) in a tertiary care institution. Our goals were to determine (1) the prevalence of asthma in these patients, (2) the prevalence of specific CRS symptoms in both asthmatic and nonasthmatic patients, and (3) the frequency of surgical treatment for CRS in patients with and without asthma. We found that asthma was present in 23.4% of CRS patients, a much higher rate than the 5% prevalence of asthma in the general adult population. Patients with asthma had a significantly higher prevalence of nasal polyps (47 vs. 22%; \( p = 0.004 \)), olfactory dysfunction (26 vs. 6%; \( p = 0.001 \)), and nasal congestion (85 vs. 60%; \( p = 0.027 \)) than did those without asthma. Patients without asthma had a significantly higher prevalence of headache (72 vs. 53%; \( p = 0.037 \)) and rhinorrhea (58 vs. 38%; \( p = 0.047 \)). The prevalence of postnasal drip and environmental allergies in the two groups was similar. Although the difference between the proportions of patients with and without asthma who required primary sinus surgery was not statistically significant (76 vs. 64%; \( p = 0.175 \)), patients with asthma did require significantly more revision sinus procedures overall (mean: 2.9 vs. 1.5; \( p = 0.003 \)).

Introduction
The association between asthma and chronic rhinosinusitis (CRS) has long been established. Although the exact nature of this relationship has not yet been elucidated, molecular research is focusing on the notion that asthma and CRS likely represent upper- and lower-airway manifestations of the same mucosal inflammation.\(^1\) Such an association may indicate that the ciliated, pseudostratified, columnar respiratory epithelia that line the lungs, nose, and sinuses may share a common pathophysiology.\(^2\)

In general, sinusitis in patients with asthma tends to be more severe and refractory to conventional medical management than it is in patients without asthma.\(^3\) In this article, we describe the results of our study of the prevalence of asthma in CRS patients, the prevalence of specific CRS symptoms in patients with and without asthma, and differences between the two groups with respect to the need for sinus surgery.

Patients and methods
We retrospectively reviewed the charts of 145 consecutively presenting eligible patients—64 men and 81 women, aged 18 to 83 years (mean: 46.1)—who had been diagnosed with CRS at the Medical College of Georgia’s rhinology clinic from January through September 2003. Data were compiled by a manual chart review, and a database was created to record each patient’s demographic information, the presence or absence of asthma, and the presence or absence of six specific signs and symptoms: nasal polyps, olfactory dysfunction (anosmia/hyposmia), nasal congestion, headache, rhinorrhea, and postnasal drip. Other variables evaluated included the presence of environmental allergies (based on history, medication use, and physical examination findings) and the need for surgical management.

Patients were designated as asthmatic if (1) they had a history of asthma, (2) if they had a history of positive pulmonary function test results, and/or (3) if they were taking an asthma medication at the time of presentation. Before patients were considered for surgery, they underwent medical therapy with intranasal steroids, saline nasal sprays and irrigations, high-dose guaifenesin, and/or appropriate antibiotic therapy when indicated. The diagnosis of sinusitis was based on criteria set forth by the Task Force on Rhinosinusitis.\(^4\)

Patients with cystic fibrosis, immunodeficiency disorders, a history of facial trauma, or a neoplastic process were not eligible for this study. The study was approved by our institutional review board.

Results
Of the 145 patients with CRS, 34 (23.4%) were being treated concurrently for asthma and 111 (76.6%) were not.
The patients with asthma had a significantly higher prevalence of nasal polyps (47 vs. 22%; \( p = 0.004 \)), olfactory dysfunction (26 vs. 6%; \( p = 0.001 \)), and nasal congestion (85 vs. 60%; \( p = 0.027 \)) (figure 1). The patients without asthma had a higher prevalence of headache (72 vs. 53%; \( p = 0.037 \)) and rhinorrhea (58 vs. 38%; \( p = 0.047 \)).

The prevalence of postnasal drip was similar in the two groups (29% for those with asthma and 31% for those without; \( p = 0.892 \)).

The prevalence of environmental allergies was similar in the two groups. Although the difference between the proportions of patients with and without asthma who required primary sinus surgery was not statistically significant (76 vs. 64%; \( p = 0.175 \)), individual patients with asthma did require significantly more revision sinus procedures overall (mean: 2.9 vs. 1.5; \( p = 0.003 \)) (figure 2).

Discussion

Multiple theories have been proposed to explain the association between asthma and CRS.

According to one early theory, sinus material is aspirated into the lower airways, where it irritates the epithelium and exacerbates the asthma.\(^5\) However, Bardin et al argued that this seeding effect is a very unlikely cause of asthma; they administered experimental radionuclide to the sinuses of patients with sinusitis and asthma and found no evidence that the radionuclide was aspirated into the lungs.\(^6\)

According to another theory, which involves a proposed sinonosal-bronchial reflex, the bronchoconstriction that asthmatic patients experience is caused by CRS-induced vagal stimulation.\(^7\) Support for this mechanism is provided by the fact that many patients with asthma report an increase in asthma symptoms during acute episodes of CRS.\(^7\) Similarly, several studies have demonstrated an increase in lower-airway resistance following the placement of an allergic or irritant stimulus in the nose.\(^8-11\)

Much current investigation is focusing on the search for a precipitating factor in the respiratory epithelium of patients with asthma that produces severe and refractory CRS. On computed tomography (CT), 74 to 90% of adults with asthma have some degree of mucosal hyperplasia in the epithelium of the paranasal sinuses.\(^12-14\) Although the CRS in these patients is often asymptomatic, this abnormality suggests that CRS and asthma may be, as mentioned, upper- and lower-airway manifestations of a shared pathophysiology.\(^1\)

In patients with both asthma and CRS, respiratory epithelial cells produce a range of cytokines that could affect the recruitment and activation of inflammatory leukocytes.\(^15\) The resultant increase in inflammatory mediators leads to increased vascular permeability, mucus hypersecretion, ciliary impairment, and mucosal edema, which can obstruct the sinus ostia and create an optimal environment for bacterial overgrowth. An infection of the sinuses then leads to the systemic release of inflammatory cytokines, which mediate bronchoconstriction and pulmonary inflammation.\(^16\) In our study, 23.4% of patients treated for CRS were diagnosed with and actively treated for asthma, a rate that is much higher than the 5% asthma prevalence in the general adult population.\(^1\)

Several inflammatory mediators have been studied with regard to their dual role in asthma and sinusitis. They include histamine, thromboxane, interleukin (IL) 3, IL-4, IL-5, IL-13, eotaxin, and granulocyte-macrophage colony-stimulating factor.\(^17-19\) Steinke et al explored the role of cysteinyl leukotrienes produced by eosinophils, mast cells, basophils, and monocytes in asthma and CRS.\(^2\) Cysteinyl leukotrienes increase bronchoconstriction, cause mucus hypersecretion with goblet-cell hyperplasia, impair ciliary activity, increase vascular permeability, and lead to edema.\(^20-22\) More important, these molecules elicit the proliferation of myofibroblasts and collagen deposition.\(^23\) Borrish suggested that leukotriene-induced myofibroblast proliferation and collagen deposition may result in chronic remodeling of the upper airway, an effect similar to the long-term changes seen in patients with asthma.\(^23\) Our data provide further evidence to support the link between asthma and CRS.

In 2003, Perry and Kountakis\(^24\) reported higher levels of olfactory dysfunction in CRS patients with asthma, a finding that was confirmed in the present study. The exact mechanism for this disturbance remains unknown. Early
Theories were based on the assumption that hyposmia in CRS is caused by obstruction of airflow, which prevented odorants from reaching the olfactory cleft. However, subsequent research has suggested that olfactory dysfunction cannot be completely explained by obstruction alone. While obstruction certainly plays a role, patients with CRS and hyposmia frequently report no nasal congestion.

Sinonasal inflammation and edema may actually upset the delicate balance between ionic concentrations and osmotic pressures in the olfactory epithelium that is necessary for signal transduction to occur. It is possible that this inflammatory response is actually amplified in patients with asthma, and that this amplification impairs the function of the respiratory epithelium to a greater extent than it does in patients without asthma.

Several studies have reported that patients with asthma, compared with those without, have more severe sinus disease by objective measures such as nasal endoscopy and CT and may have less favorable outcomes after sinus surgery. In our study, asthmatic patients were more likely to require revision surgery. This trend may be explained by chronic remodeling of the respiratory epithelium in these patients as a result of leukotriene release.

References