

Allergic Fungal Sinusitis: A Review with Four Illustrated Cases

Marc F. Goldstein, M.D.*, Eliot H. Dunsky, M.D.*, Donald J. Dvorin, M.D.*, and Raymond W. Lesser, M.D.**

ABSTRACT

Although paranasal fungal sinusitis is rare, an increased number of Aspergillus and non-Aspergillus related cases of allergic fungal sinusitis have been described since its first report in 1983. The histopathologic findings necessary for a definitive diagnosis rest upon the detection of scattered fungal elements in a matrix of allergic mucin. The clinical spectrum and treatment of allergic fungal sinusitis are detailed within four illustrated case reports. Sinus surgery, followed by meticulous post-surgical care by an allergy and otolaryngology team using oral corticosteroids, and followed by maintenance intranasal steroids and nasal airway irrigations in conjunction with allergy immunotherapy, has resulted in excellent clinical outcomes. (Am J Rhinology 8, 1: 13-18, 1994)

The clinical spectrum of paranasal sinus fungal disease can be classified into four distinct clinicopathologic forms: 1) chronic indolent sinusitis, 2) invasive sinusitis, 3) mycetoma, and 4) allergic fungal sinusitis.¹ The syndrome of allergic fungal sinusitis caused by *Aspergillus* was first described by Katzenstein et al. in 1983.^{2,3} Since then, similar cases caused either by *Aspergillus* species or by non-*Aspergillus* fungal organisms have been described in the literature. The latter include *Curvularia*, *Alternaria*, *Bipolaris*, *Drechslera*, *Exserohilum*, *Chrysosporium*, and *Rhizomucor*.⁴ Cases of al-

lergic fungal sinusitis often share clinical, radiologic, and pathologic features. These features consist of symptomatic multi-sinus disease with or without nasal polyps, radiographically opacified paranasal sinuses, and histopathologic evidence of scattered fungal elements in inspissated allergic mucin. Allergic mucin is a distinct laminated-appearing mucinous material containing eosinophils and other inflammatory cells and cellular debris, including Charcot-Leyden crystals and sloughed respiratory epithelium. Another distinguishing histopathologic finding is that the hyphal elements do not penetrate the mucosa, submucosa, vasculature, and/or bone, thus characterizing the non-invasive nature of this disorder.

Despite common clinicopathologic and radiographic features, we have seen a broad spectrum of clinical presentations of allergic fungal sinusitis. In addition, only limited long-term follow-up studies of patients diagnosed with allergic fungal sinusitis have been published to date.⁵ We have observed a variety of treatment responses in our cases of allergic fungal sinusitis which may reflect differences in treatment modalities and follow-up care. We are therefore reporting four cases of allergic fungal sinusitis, each with follow-up of greater than 12 months. The following case reports illustrate both the common and unique clinical features of allergic fungal sinusitis, some diagnostic dilemmas encountered with chronic refractory sinusitis, complications, and the heterogeneity of treatment responses.

CASE PRESENTATIONS

1. Patient D.S.

D.S., a 39-year-old white male, presented with a 3-month history of progressive nasal and ocular symptoms as well as intermittent sinus headaches. No

From the Allergy and Immunology Service, Departments of Medicine and Pediatrics, and the Department of Otolaryngology**, Hahnemann University School of Medicine, Philadelphia, Pennsylvania*

Send reprint requests to Marc F. Goldstein, M. D., The Asthma Center, Allergic Disease Associates, The Professional Arts Building, Suite 300, 205 N. Broad St., Philadelphia, PA 19107

previous history of aspirin hypersensitivity, glucose intolerance, nasal polyp disease, sinus disease, food intolerances, antecedent upper respiratory allergies, or sinusitis was identified. The patient had rare episodes of transient wheezing as an adult. There was a history of cigarette smoking, but no history of illicit drug use. His environmental history was unremarkable. Initial evaluation included allergy skin testing which revealed marked reactivity to common aeroallergens and molds. Specific mold hypersensitivity was found to the following species: *Alternaria*, *Aspergillus*, *Helminthosporium*, *Hormodendrum*, and *Penicillium*. Sinus x-rays performed in May, 1990 revealed left ethmoiditis and left maxillary opacification. D.S. was treated with antibiotics with good clinical results, and the patient began allergy immunotherapy which included mold extracts. Follow-up radiographs were not performed.

In September, 1990, D.S. presented with progressive left facial pain associated with acute onset of left ptosis. Intranasal examination revealed new onset nasal polyposis. A paranasal sinus CT scan showed evidence of left maxillary ethmoid and sphenoid disease with a heterogeneous density and erosion of the left medial orbital wall. The patient was admitted with a presumptive diagnosis of neoplastic sinus lesion with orbital extension. Accordingly, a left external frontoethmoidectomy, a Caldwell-Luc procedure, and nasal endoscopic surgery were performed. As the periorbital tissue was elevated via the external ethmoid approach, a large amount of gray-green material was encountered. Similar material was also removed from the frontal and maxillary sinuses. Polypoid material was also subsequently removed from the middle-meatus and anterior ethmoids. Histopathology of the sinus contents revealed allergic mucin with septate hyphal elements. Hyphal elements were found only in the mucosa. The morphologic examination of the hyphal elements suggested *Aspergillus*. No neoplasm, vasculitis, or infectious processes were found. Postoperatively, the patient was treated with a four-week course of 30 mg of daily prednisone and liberal nasal lavage. The postoperative course was uneventful with complete resolution of symptoms.

D.S. has continued to receive allergy immunotherapy which includes the mold *Aspergillus fumigatus*, as well as maintenance intranasal steroids, saline irrigations, and intermittent oral decongestants. Follow-up paranasal sinus CT scans have shown complete radiographic clearing. Follow-up laboratory studies have been normal except for mild peripheral eosinophilia (400 cells/mm³). Clinically, the patient has required one short burst of daily oral corticosteroids for recurrence of nasal polyps and infrequent antibiotics for clinically diagnosed acute bacterial sinusitis.

Comment: This case illustrates allergic fungal sinusitis

presenting with acute ophthalmologic and sinus symptoms, facial deformity, and an abnormal paranasal sinus CT scan with bony erosions. The acute and expansive nature of this process mimicked a neoplastic disorder. Unlike most cases of allergic fungal sinusitis, a history of chronic recurrent sinusitis and sinus surgery or nasal polyposis was absent. Sinus surgery and oral corticosteroids were successful in achieving a remission. Supportive maintenance therapy including allergy immunotherapy (with mold extract containing *Aspergillus fumigatus*), nasal steroids, nasal saline irrigations, and oral decongestants has played a significant role in this patient's excellent long-term outcome. Theoretical concerns of immune complex mediated disease resulting from fungal immunotherapy have not been clinically or serologically evident. There has been no symptomatic or physical evidence of synovitis or vasculitis. Surveillance assays for circulatory immune complexes and complement activation over the 3-year post-operative period have been negative.

2. Patient V.G.

V.G. is a 34-year-old black female with a multi-year history since adolescence of recurrent sinusitis and seasonal allergic rhinitis which had not been well-controlled with previous medical therapy or sinus surgery. The patient was diagnosed with allergic fungal sinusitis in 1984 after presenting with pansinusitis, proptosis, and visual disturbances (previously reported).¹ A CT scan of the paranasal sinuses showed evidence of sphenoiditis and orbital bone erosion on the left. A traditional ethmoidectomy was performed. She did well post-operatively and was placed on a 2-month course of 30 mg of daily prednisone. V.G. was followed in an allergy clinic for medical therapy for one year post-operatively, but was then lost to follow-up for several years. After an 8-year period of untreated symptomatic upper respiratory allergies, V.G. presented in January 1992 complaining of several months of sinus pressure, loss of sense of smell and taste, post nasal drip, passage of brownish plugs from her left nasal passage, and new onset of a nonproductive cough. Examination revealed recrudescence of nasal polyp disease. Serologic evaluation revealed a normal total IgE level, and negative IgE and IgG antibodies against *Aspergillus fumigatus*. Peripheral eosinophilia was not noted. Rhinoscopic examination confirmed nasal polyposis, allergic rhinitis, and post surgical changes. Pulmonary function tests indicated the presence of reversible obstructive airways disease. Skin testing in 1992 as well as in 1984 indicated aeroallergen hypersensitivity, including marked reactivity to the molds *Alternaria*, *Aspergillus*, *Helminthosporium*, *Hormodendrum*, and *Penicillium*. Pathologic evaluation of an expelled nasal plug in May, 1992 identified allergic mucin without evidence of hyphal elements.

This was regarded as evidence of recrudescence of allergic fungal sinusitis. The patient improved symptomatically with a 4-week course of 20 mg of daily prednisone, saline nasal irrigations, and anti-asthma medications. Ophthalmologic and ENT consultation were unremarkable except for the presence of nasal polyps. Following oral corticosteroids, V.G.'s symptoms have been controlled without additional surgery using maintenance nasal corticosteroids and saline irrigations, inhaled bronchodilators, and inhaled corticosteroids. Follow-up paranasal sinus MRI in December, 1992 showed no mass or mucosal lesions in the paranasal sinus. Minimal post-contrast enhancement of the mucus membranes was seen.

Comment: The case represents a classic presentation of allergic fungal sinusitis with a multi-year history of allergic rhinitis and sinus disease in an atopic individual with nasal polyps. Relapse with nasal polyps and allergic fungal sinusitis reappeared 8 years after the initial diagnosis during a time when V.G. was not under medical care. Of note is the development of bronchial asthma without evidence of allergic bronchopulmonary mycosis in the context of recurrent allergic fungal sinusitis. Use of daily oral corticosteroids with additional local nasal care led to symptomatic improvement and spared the patient from further surgical intervention. Follow-up MRI showed no evidence of recurrent disease after oral corticosteroids.

3. Patient L.K.

This is a 26 year old white female presenting in January, 1991, with a 5-year history of chronic nasal congestion, tenacious purulent nasal discharge, post nasal drip, anosmia, and chronic sinus pressure headaches (previously reported).⁴ The patient had no history of nasal plug discharge, asthma, aspirin hypersensitivity, cigarette or marijuana smoking, or passive smoke exposure. Previous unsuccessful therapies included use of antihistamines and decongestants, intranasal steroids, frequent treatment with antibiotics and nasal polypectomy. At the time of initial evaluation, L.K. was found to have nasal polyp disease, allergic changes in the nasal airway, and skin test reactivity to perennial and seasonal aeroallergens and molds including *Rhizopus*. Peripheral eosinophilia was present but the total IgE level was normal. There was no evidence of any underlying immunodeficiencies or glucose intolerance. Paranasal sinus CT scan revealed chronic sinusitis without bony erosions. The patient underwent sinus surgery. The maxillary sinus was found to have a large amount of thick green mucoid material. A portion of the medial wall of the maxillary sinus was found to be eroded by a mass within the sinus. The ethmoid sinuses contained a moderate amount of polypoid mucosa, but none of the greenish mucoid material was found. His-

topathologic evaluation of the maxillary sinus contents revealed allergic mucin and isolated hyphal elements without evidence of mucosal bony or vascular invasion by hyphal forms. *Rhizomucor* was identified on fungal culture. Postoperatively, L.K. received a 4-week course of 30 mg daily prednisone and had marked symptomatic improvement. The patient has been maintained on allergy immunotherapy containing aeroallergens but no mold, as well as antihistamines, oral decongestants, nasal steroids, and nasal saline irrigation. L.K. has required additional endoscopic sinus surgery for recrudescence of nasal polyposis but there has been no histologic evidence of allergic mucin, nor has there been radiographic evidence of sinusitis. No asthmatic symptoms have occurred. Peripheral eosinophilia diminished from a preoperative high level of 2,922 cells/mm to a post-treatment level of 410 cells/mm. A concomitant decrease in specific anti-*Rhizomucor* IgG from 7.5 U/ml to a level of less than 3.4 U/ml was observed during the course of treatment.

Comment: This atopic patient had a typical presentation of allergic fungal sinusitis with nasal polyp disease, peripheral eosinophilia and refractory nasal and sinus symptoms despite previous medical and surgical therapy. Despite paranasal sinus CT scan findings to the contrary, bony erosion due to the inflammatory mass and the nature of allergic fungal sinusitis was seen at the time of surgery. Allergy immunotherapy (which did not include molds), saline nasal irrigation, topical nasal corticosteroids, antihistamine, oral decongestants, and revision endoscopic sinus surgery have kept L.K. clinically comfortable. Recurrent polyp disease was not associated with any serologic, radiographic, or histologic evidence of allergic fungal sinusitis.

4. Patient M.H.

This is a 54 year old female Panamanian immigrant who had a 7-year history of chronic sinus disease and had previously undergone two surgical sinus procedures for symptomatic sinusitis. M.H. presented in May, 1992, with symptoms of sinus pressure headaches, infraorbital puffiness, anosmia, nasal congestion, post nasal drip, and frequent throat clearing. She had two previous episodes of "bronchitis" associated with wheezing. The patient has a history of nasal polyp disease. There was no history of aspirin hypersensitivity, immunodeficiency, or glucose intolerance.

Initial evaluation revealed the presence of nasal polyps. M.H. had an immediate reaction and a 6-hour late phase reaction to *Aspergillus* and immediate reactions to *Fusarium*, *Helminthosporium*, *Hormodendrum* molds, and ragweed pollen. Bilateral maxillary sinusitis was seen on radiographic studies without bony erosive changes. The patient underwent functional endoscopic sinus surgery in June, 1992, and was found to have a

thick mucoid mass in her right maxillary sinus. Histopathologically, allergic mucin was identified containing scattered fungal elements. However, a fungal culture was negative. Preoperative total IgE level was normal and peripheral eosinophilia was not noted. *Aspergillus* precipitans were unremarkable. Postoperatively, the patient responded to a six-week course of 30 mg of daily prednisone, oral decongestants, and nasal irrigations. Over a 2-year span since her endoscopic sinus surgery, M.H. has required three limited bursts of oral corticosteroids for severe sinus headaches and nasal congestion without concurrent pathological CT changes of the paranasal sinuses. M.H. declined allergy immunotherapy.

Comment: Highlights of this case include a history of an older atopic individual with prior nasal polyp disease and a history of sinus surgery that developed allergic fungal sinusitis. The patient has improved clinically after sinus surgery and initial oral corticosteroid therapy, with maintenance nasal corticosteroids and oral decongestants, but has not been on allergy immunotherapy. She continues to suffer intermittently from breakthrough upper respiratory allergic symptoms and sinus pain requiring bursts of oral corticosteroids. Despite clinical follow-up and maintenance therapies, M.H. has experienced a greater than average number of post-surgical sinus problems. These episodes have been treated symptomatically with antibiotics and/or prednisone therapy. She has not, however, developed any signs of recurrent allergic fungal sinusitis.

DISCUSSION

Allergists and otolaryngologists have developed a special interest in allergic fungal sinusitis due to its refractory nature and because of its predilection for immunocompetent atopic individuals. Demographic and clinical characteristics of 42 cases of allergic *Aspergillus* sinusitis and a similarly sized group of cases of allergic non-*Aspergillus* fungal sinusitis have been previously reported (Table 1).⁴ In summary, most cases of

allergic fungal sinusitis appear to occur in young adults with a mean age of 27 years, with equal distribution between males and females. An antecedent history of chronic symptomatic rhinosinusitis and unsuccessful treatment of chronic sinusitis with or without polyps is common. Atopic disease has been reported in 1/3 of these cases defined either by positive immediate hypersensitivity skin tests, elevated serum total IgE levels, and/or histories suggestive of allergic rhinitis. Those patients tested have shown positive immediate hypersensitivity skin test responses to the putative fungus. The incidence of asthma has been reported in about 32% of cases, whereas allergic bronchopulmonary mycosis has rarely developed in established cases of allergic fungal sinusitis. Two-thirds of allergic fungal sinusitis cases have had a history of nasal polyposis. Paranasal sinusitis is seen on CT scan studies in all patients with concomitant bony changes seen in approximately 25% of these patients.

PRESENTATION AND DIAGNOSIS

The cases we have described are similar to previously reported cases of allergic fungal sinusitis, having occurred in immunocompetent individuals without underlying systemic disorders or prior treatment with systemic immunosuppressive therapy or radiotherapy. The history in 3 out of 4 of our cases (Cases 2, 3, 4) was with chronic sinusitis refractory to medical and/or surgical treatment. Case 1 was unique in that a prior history of chronic sinus disease or sinus surgery was absent. Surgical alteration of paranasal sinus anatomy therefore need not be a prerequisite for the development of allergic fungal sinusitis.

Some patients with allergic fungal sinusitis (Cases 1 and 2) present with acute central nervous system and/or ophthalmologic complications with bony changes seen on paranasal sinus CT scan. Often a presumptive diagnosis of malignancy is made (Cases 1 and 2) with such clinical findings. However, a variety of presenting central nervous system and/or ophthalmologic findings mimicking a neoplasm have been reported in allergic fungal sinusitis including visual defects, proptosis, exophthalmos, telecanthus, symptoms of intracranial extension, epiphora, and diplopia.⁴ Therefore, ophthalmologists and otolaryngologists must consider allergic fungal sinusitis in their differential diagnosis of patients presenting for surgery with these central nervous system and ophthalmologic findings, even in those individuals without prior histories of sinusitis.

In the four cases we described, all patients had an underlying allergic diathesis confirmed by positive immediate hypersensitivity skin tests. Elevated serum total IgE levels, fungal antibodies, and peripheral eosinophilia were identified in three of the four patients (Case 4 had no preoperative serologic evaluation) prior to definitive diagnosis and treatment. In general, consist-

TABLE I

Characteristics of Allergic Fungal Sinusitis

Mean age: 27
1:1 female:male ratio
chronic antecedent symptomatic rhinosinusitis
positive immediate skin test response to putative fungus
atopic background in 1/3 cases
asthma in 1/3 cases
polyp disease in 2/3 cases
bony changes on CT in 1/4 of cases

ent findings in total and/or specific IgE levels, total eosinophil counts, and/or fungal precipitans at the time of diagnosis or in follow-up have been lacking.⁴ Our cases support the general lack of specificity of serologic findings as markers of recrudescence disease activity after allergic fungal sinusitis has been successfully treated. However, a presumptive diagnostic suspicion of allergic fungal sinusitis may be strengthened with knowledge of these markers.

All of our cases of allergic fungal sinusitis presented with routine x-ray and/or CT scan finding of sinusitis. In the literature, up to 25% of presenting CT scans show bony displacement and/or erosions with intracavity areas of high attenuation.^{4,6} As reported by Zinreich et al., magnetic resonance imaging may have some added diagnostic advantage (hypointense T₂ weighted signals of sinus content) compared to CT scans.⁶ Post-surgical magnetic resonance imaging may also be superior to CT scan in distinguishing surgical changes in the sinuses from inflammatory changes secondary to fungal or bacterial sinusitis.

The confirmation of allergic fungal sinusitis in our patients, as well as those reported in the literature, was based on the histologic evidence of the presence of allergic mucin and evidence of non-invasive fungal pathology either by hematoxylin-eosin stains or specific fungal stains (Gomori methenamine-silver or Fontana-Masson stains). Fungal cultures are not always helpful in identification of the specific fungus involved, since they are often not positive. Only in a single case (Case 3) in our series did we identify a specific fungus by culture technique. Exclusion of invasive fungal disease by appropriate histopathologic evaluation is essential for the correct diagnosis of allergic fungal sinusitis which will result in the selection of the most effective therapy.⁴

TREATMENT AND MANAGEMENT

The optimal therapy for allergic fungal sinusitis beyond surgical debridement with restoration of mucociliary drainage and sinus ventilation has not been prospectively studied. However, what is impressive about our cases of allergic fungal sinusitis and those reported by others is the dramatic and immediate response to sinus surgical debridement concomitant with postoperative use of oral corticosteroids. The technique of functional endoscopic sinus surgery utilized in three of four of our cases has proved to be as successful as that of traditional sinus surgery.^{7,8} The length and amount of treatment with daily oral corticosteroids in the cases presented varied based on symptoms, body weight, and clinical response. However, corticosteroid treatment usually lasted from 4–8 weeks at doses ranging between 0.5–2 mg/kg of prednisone per day.

Close follow-up for recurrent symptoms secondary to recrudescence allergic fungal sinusitis, nasal polyposis,

bacterial sinusitis, and/or upper respiratory allergies is essential for successful treatment. This requires routine follow-up care with endoscopy, CT scans or MRI of the sinuses, fungal stain, and culture of any expelled nasal plugs/casts/tissue removed during surgery. The value of serology including total serum IgE, peripheral eosinophil counts, and specific anti-fungal antibodies in patients with established allergic fungal sinusitis is uncertain. In individual cases, serology may offer limited correlation with disease activity (Case 3).

One patient (Case 2) had a relapse of allergic fungal sinusitis. This occurred in a patient who was lost for long-term follow-up care only to return when symptoms became intolerable. Lack of aggressive follow-up and maintenance therapy may put patients at risk for recurrence of upper respiratory disease, including allergic fungal sinusitis (Case 2). We believe that meticulous maintenance care with intranasal steroids, saline nasal irrigation, oral decongestants and mucoevacuants, allergy immunotherapy, and appropriate use of revision endoscopic surgery/polypectomy have been key ingredients in our treatment successes.

As with all allergic respiratory disease, maneuvers to reduce environmental antigen exposure is an important therapeutic consideration in eliminating allergen-induced inflammation; therefore, reducing exposure to indoor mold sources and limiting unnecessary outdoor exposure during the season of high concentrations of mold spore may be helpful. In our experience, use of immunotherapy has been correlated with the best treatment outcomes (Cases 1 and 3). Of note, immunotherapy with an extract containing antigens of the causative fungal aeroallergen was used in Case 1 without any clinical or serological evidence of treatment induced immune-complex induced disease. We have used mold immunotherapy in other patients with allergic fungal sinusitis with similar success. We believe immunotherapy is an important therapeutic measure in conjunction with adjuvant medical therapy, including nasal steroids to prevent allergic inflammation that may promote recrudescence allergic fungal sinusitis.

Particular attention must also be directed at diagnosing and treating recurrent nasal polyposis. In our experience, we have seen that aggressive treatment after diagnosis with oral corticosteroids and/or surgery has led to symptomatic relief. Recurrence of nasal polyps, when aggressively treated, has not been correlated with recurrent allergic fungal sinusitis.

SUMMARY

In summary, allergic fungal sinusitis is a clinicopathologic disorder that needs to be considered in patients with chronic refractory sinusitis, particularly in those with nasal polyp disease and an atopic background. Acute clinical presentations without a prior history of sinusitis may also occur. For some, a pre-

operative suspicion of allergic fungal sinusitis may be based on the history and presence of immediate hypersensitivity responses to fungal antigens, elevated total serum IgE level, elevated serum levels of specific IgG and IgE directed against fungal antigens, and peripheral eosinophilia. Radiographic findings include evidence of sinusitis with or without bony changes. Acute presentations with central nervous system or ophthalmologic complications should include allergic fungal sinusitis as part of the differential diagnosis.

The clinical diagnosis must be confirmed by demonstrating the typical histopathologic features of allergic fungal sinusitis from the sinus contents and supported by the identification of fungal elements by fungal stains and/or species identification through fungal culture. At the time of surgery, it is essential that specimens be specifically stained and cultured for fungus and that the pathologist be alerted to evaluate histologic specimens for allergic mucin. This is particularly true if the otolaryngologist removes a thick "goosey" peanut butter-like material from the sinuses. Although the definitive diagnosis of allergic fungal sinusitis rests on pathologic and microbiologic findings, some specimens of allergic mucin may not demonstrate fungal elements on hematoxylin-eosin stain or even on Gomori methenamine-silver stain.^{4,9} It is unclear whether these cases are true allergic fungal sinusitis or a *forme fruste* of allergic fungal sinusitis analogous to the association of mucoid impaction of the lung with allergic bronchopulmonary mycosis. Fungal culture of allergic mucin is important for establishing the speciation of pathogenic fungi. However, as in some of the cases presented, culture may be negative.

The optimal acute therapy for allergic fungal sinusitis requires surgical debridement and sinus ventilation. Oral corticosteroids with postoperative rigorous local care and periodic debridement of tissue enhances ventilation and prevents unnecessary scarring of surgically established openings. During long-term treatment, patients need to be evaluated and treated for recurrent polyp disease and bacterial and/or fungal sinusitis. Careful routine follow-up examinations including

periodic fiberoptic endoscopic exam, paranasal CT or MRI scans, and culture of plugs or sinus material from additional sinus surgery are warranted. Although generally poor for bone resolution, MRI may be a superior image modality to CT in evaluation of recurrent allergic fungal sinusitis.⁶ Serologic evaluations are generally not useful but may benefit selected cases. We have found that use of intranasal steroids and irrigations, oral mucocoevacuants and decongestants, and allergy immunotherapy have been helpful in the long term reduction of allergic inflammation. Specific antifungal antimicrobial therapy is not required. The development of lower airways disease including asthma and/or allergic bronchopulmonary mycosis must be anticipated, especially in those patients with relapsing disease. We have found that the collaborative efforts and care of the Allergist and Otolaryngologist have afforded patients the best opportunity of avoiding recurrent disease and/or complications.

REFERENCES

1. Goldstein MF, Atkins PC, Cogen FC, Kornstein MJ, Levine RS, Zweiman B. Allergic *Aspergillus* sinusitis. *J Allergy Clin Immunol* 76:515-524, 1985.
2. Katzenstein A-LA, Sale SR, Greenberger PA. Allergic *Aspergillus* sinusitis: a newly recognized form of sinusitis. *J Allergy Clin Immunol* 72:89-93, 1983.
3. Katzenstein A-LA, Sale SR, Greenberger PA. Allergic *Aspergillus* sinusitis: a newly recognized form of sinusitis. *Am J Surg Pathol* 7:439-443, 1983.
4. Goldstein MF, Dvorin DJ, Dunsky EH, Lesser RW, Heuman PJ, Loose JH. Allergy grand rounds: allergic *Rhizomucor* sinusitis. *J Allergy Clin Immunol* 90:394-404, 1992.
5. Waxman JE, Spector JG, Sale SR, Katzenstein A-LA. Allergic *Aspergillus* sinusitis: concepts in diagnosis and treatment of a new clinical entity. *Laryngoscope* 97:261-266, 1987.
6. Zinreich SJ. Imaging of chronic sinusitis in adults: x-ray, computed tomography and magnetic resonance imaging. *J Allergy Clin Immunol* 90:445-451, 1992.
7. Manning SG, Schaefer SD, Close LG. Culture-positive allergic fungal sinusitis. *Arch Otolaryngol Head Neck Surg* 117:174-178, 1991.
8. Scheer L, Shutz G. Allergic fungal sinusitis due to *Chyrosporium* species [Abstract]. *Ann Allergy* 68:1185, 1992.
9. Allphin AL, Strauss M, Abdul-Karim FW. Allergic fungal sinusitis: problems in diagnosis and treatment. *Laryngoscope* 101:815-820, 1991. □

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.