

Allergic *Bipolaris* sinusitis: Clinical and immunopathologic characteristics

David S. Gourley, MD, MAJ, USAF, Bonnie A. Whisman, MS,
Neil L. Jorgensen, MD, CAPT, USAF, Michael E. Martin, MD, COL, USAF,
and Michael J. Reid, MD, CAPT, USN* Lackland Air Force Base, San Antonio,
Texas

Allergic Aspergillus sinusitis was first reported in 1983. We present the first three cases of allergic fungal sinusitis caused by the black fungus Bipolaris spicifera. The patients were young, atopic, and immunocompetent. All three patients demonstrated pansinusitis with nasal polyps and underwent multiple surgical procedures. Pathologic features included a characteristic mucoid exudate containing eosinophils, Charcot-Leyden crystals, and fungal hyphae. In two cases there was bony erosion revealed by computed tomography scan but no histologic evidence of direct fungal invasion into the mucosa or bony trabeculae. Immunologic features, including total eosinophil count, total serum IgE, immediate and late-phase skin response to B. spicifera, serum precipitins, and specific IgE and IgG to B. spicifera, are described. B. spicifera is a previously unrecognized cause of allergic fungal sinusitis that may be an underdiagnosed disorder. This diagnosis should be considered in atopic patients with nasal polyps and pansinusitis unresponsive to conventional medical therapy. Diagnostic criteria include characteristic histologic allergic mucin, culture identification of fungus, positive immediate cutaneous reactivity to fungal extract, positive serum precipitins, and elevated specific IgE and IgG antibodies. (J ALLERGY CLIN IMMUNOL 1990;85:583-91.)

In 1981, Millar et al.¹ described five patients with chronic sinusitis caused by *Aspergillus fumigatus*. All patients had immediate cutaneous reactivity to *A. fumigatus*. The histologic appearance of the material recovered from the sinuses was noted to be similar to the expectorated plugs from patients with ABPA. Interestingly, one patient had preexisting ABPA. The

Abbreviations used

ABPA: Allergic bronchopulmonary aspergillosis
CT: Computed tomography

From the Allergy and Immunology Service, Department of Medicine and Department of Pathology, Wilford Hall United States Air Force Medical Center, Lackland Air Force Base, San Antonio, Texas.

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Reprint requests: David S. Gourley, MD, DGM/SGHMI, Travis AFB, CA 94535.

*Current address: Division of Allergy/Immunology, Department of Internal Medicine, Naval Hospital Oakland, Oakland, CA 94627-5000.

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authors proposed that a previously undescribed form of sinusitis called "allergic aspergillosis of the paranasal sinuses" existed.

Two years later, Katzenstein et al.² retrospectively reviewed 119 surgical specimens excised from the paranasal sinuses and found nine specimens that compared histologically to mucoid impaction of the bronchi observed in patients with ABPA. Seven of the nine specimens were noted to have fungal hyphae resembling *Aspergillus* species within them. Clinically, the patients described were young, seemingly immunocompetent, atopic, and often with a history of asthma, and all had nasal polyposis. Radiographically, there was opacification of multiple sinuses. Several patients underwent numerous surgical drainage procedures for recurrent sinusitis. In one patient there was sinus-wall bony erosion. Histologically, a distinct mucinous material, termed allergic mucin, containing eosinophils, Charcot-Leyden crystals, and fungal hyphae, was found in tissue resected from the sinuses. The name "allergic *Aspergillus* sinusitis" was proposed

In 1983, two cases of young, atopic, otherwise healthy patients with ethmoid masses were reported.³ Histologically, a mucinous material with a dense infiltration of eosinophils and fungal hyphae was described. The authors proposed the term "allergic periorbital mucopyocele" to describe this disorder.

The only case of non-*Aspergillus*-allergic fungal sinusitis was reported in 1986.⁴ A healthy, 21-year-old atopic subject with asthma, nasal polyps, and pansinusitis with sinus cultures growing *Curvularia lunata* was described. The patient had immediate and late-phase skin responses and serum precipitins against *C. lunata*. Histopathologic sections revealed characteristic allergic mucin.

Bipolaris spicifera is a well-known plant pathogen⁵ and an emerging pathogen in man.⁶ It has been demonstrated to cause a variety of diseases, including fatal, invasive infections.⁷ Interestingly, it has been often associated with sinus disease.⁶⁻⁹ We document the first three cases of allergic fungal sinusitis caused by *B. spicifera* and present evidence that it may be an underdiagnosed disorder.

MATERIAL AND METHODS

Preparation of *Bipolaris* extract

Source material of *B. spicifera* was isolated from the maxillary sinuses of case 1. Identification was confirmed by Dr. Michael Rinaldi, Director, Fungal Testing Laboratory, University of Texas Health Science Center, San Antonio, Texas. The material was subcultured for 4 weeks in stationary Erlenmeyer flasks with Czapek Dox synthetic broth media.¹⁰ *B. spicifera* mats were harvested by filtration, twice defatted with acetone, and air-dried. The defatted powder was extracted (1:10 wt/vol) at 4° C in 0.125 mol/L solution of ammonium bicarbonate, pH 8, overnight. The crude extract was filtered serially to 0.45 µm. Material for skin testing was diluted with equal volumes of glycerin. Material for in vitro analysis was dialyzed against distilled water for 24 hours and lyophilized.

Immunogenicity of the extract was demonstrated by immunizing five New Zealand white rabbits with the *Bipolaris* extract and raising high-titer antibodies, as demonstrated by immunoprecipitation techniques. Allergenicity was demonstrated by prick skin testing 680 consecutive patients referred for allergy evaluation. Forty patients (6%) had a positive immediate cutaneous reaction (>3 mm wheal with erythema). We also found agreement between skin test results and *Bipolaris*-specific IgE antibody levels by ELISA.

Skin testing

Patients were skin tested by the prick method on the volar surface of the forearm with glycerinated (1:20 wt/vol) *B. spicifera* extract along with histamine (2.75 mg/ml) and albumin saline with phenol (Hollister-Stier Laboratories, Spokane, Wash.) as diluent control. The diameter of wheal and erythema was recorded in millimeters at 15 minutes. The late-phase reaction was assessed by injecting 0.02 ml

of *B. spicifera* extract (1:200 wt/vol) intradermally on the volar surface of the forearm. At 6 hours, the average diameter of swelling was recorded by measuring the longest diameter and adding the diameter at 90 degrees and dividing by 2. Negative skin tests were obtained from nonatopic subjects used as control subjects.

The three patients were also prick skin tested to common aeroallergens, including white ash, American elm, mountain cedar, live oak, Bermuda grass, brome, ryegrass, timothy grass, burning bush, lamb's-quarter, pigweed, Russian thistle, cocklebur, *Franseria*, ragweed mix, as well as *Alternaria*, *Cladosporium*, *Helminthosporium*, *Epicoccum*, *Aspergillus* mix, *Penicillium*, *Fusarium*, *Pullularia*, and cat, dog, and *Dermatophagoides farinae*.

Serum IgE concentration

The total IgE content of serum samples was determined by PRIST (Pharmacia, Piscataway, N.J.) according to the manufacturer's instructions.

Precipitins

Precipitins were obtained with the double-gel diffusion technique according to the method of Ouchterlony¹¹ after fivefold concentration of serum. Serum precipitins of skin test positive patients without allergic fungal sinusitis were obtained as controls.

ELISA assay to detect IgE and IgG against *B. spicifera*

Serum samples were analyzed for IgE and IgG antibodies to *B. spicifera* by methods previously described.^{12, 13} For specific IgE, a reference serum was made by pooling three high-titer sera and arbitrarily assigning it 100 U. The transfer method was used to minimize the effect of competing IgG antibodies, and unknown sera were assayed at a 1:5 dilution with phosphate-buffered saline containing 20% fetal bovine serum (GIBCO Laboratories, Baltimore, Md.). The resulting value in arbitrary units was determined by interpolating from the reference curves. The specific IgG to *B. spicifera* was determined in a similar manner except that a single incubation ELISA was used.¹³ Ten patients were selected as atopic control subjects. Five of the control subjects had positive prick skin tests to *Bipolaris* extract, and chronic bacterial sinusitis was proved at surgery. The other five control subjects had positive prick skin tests to *Bipolaris* extract, but no clinical or radiographic evidence of sinusitis was found.

Statistical analysis

The significance of the difference between antibody levels of the subjects with allergic fungal sinusitis and control subjects was determined by parametric and nonparametric (Kruskal-Wallis) analysis of variance. Reported *p* values are two-tailed and derived from the nonparametric test.

Report of cases

Case 1. Case 1 was a 16-year-old white female adolescent raised in southern Texas with a history of extrinsic asthma

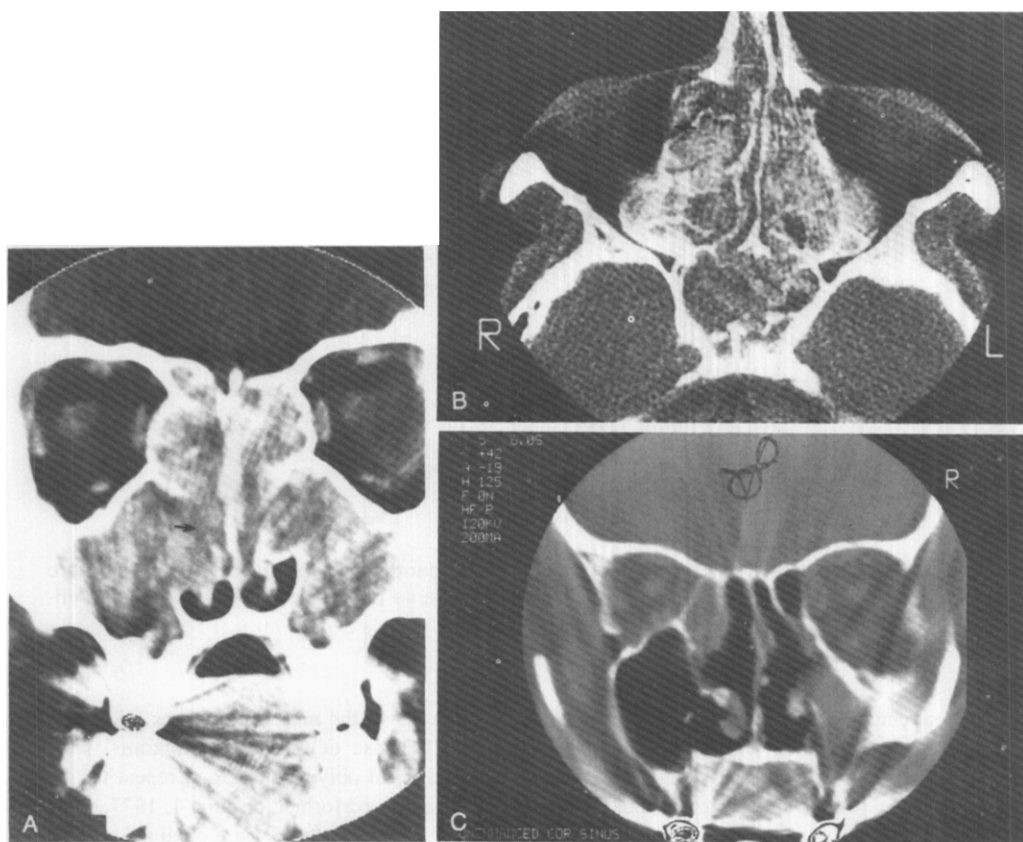


FIG. 1. **A**, Initial coronal sinus CT scan of case 1. The ethmoids and maxillaries are expanded with soft tissue density of increased attenuation. Note the destruction of the left medial wall of the maxillary sinus and portions of the middle turbinate (*arrow*). **B**, Initial horizontal sinus CT scan of case 2. The sphenoid and ethmoid sinuses are packed. Note the bony erosion of the right medial orbital wall (*arrow*). **C**, Recent coronal sinus CT scan of case 3. The ethmoid and maxillary sinuses are packed with soft tissue density of increased attenuation. No bony erosion was noted.

since the age of 6 years who began complaining of frontal headaches at age 10 years. She was receiving immunotherapy to common aeroallergens, including *Alternaria*, *Cladosporium*, *Penicillium*, and *Aspergillus* between 1976 and 1980. During the last 4 years, she required no chronic medication for asthma control, and her chest x-ray films were uniformly read as normal. Twelve months before admission, she began complaining of worsening headache and nasal obstruction. Six months before admission, she complained of uncontrolled tearing. In June 1987, observations at the ophthalmology clinic revealed telecanthus and bilateral nasal obstruction. She was referred to an otolaryngologist who noted laterally displaced medial canthi and nasal polyposis. Intranasal steroids were then prescribed. There was no previous history of aspirin sensitivity. Her initial coronal CT scan demonstrated all sinuses filled with soft tissue density material of increased attenuation (Fig. 1, A). The ethmoids appeared expanded with this material. Destruction of the left medial wall of the maxillary sinus and portions of the middle turbinate were noted. July 20, 1987, the patient underwent right external ethmoidectomy, sphen-

oidotomy, and right Caldwell-Luc procedures. Of interest was the thick peanut butter-like material that had to be scooped from the sinuses. *B. spicifera* was cultured from this material. Five weeks later, the patient underwent left external ethmoidectomy and left Caldwell-Luc procedures with similar findings. No antifungal therapy was prescribed, and 9 months after surgery, the patient was asymptomatic and doing well. Follow-up CT scan demonstrated no new disease.

Case 2. Case 2 was a 20-year-old white man raised in southern Texas. He had a history of seasonal allergic rhinitis and began having headache and sinusitis at age 7 years. He had received multiple courses of antibiotics for chronic sinusitis since 1972. He had never received immunotherapy, nor were systemic or intranasal steroids used. There was no history of aspirin sensitivity or asthma. At age 18 years, he was noted to have nasal polyps and pansinusitis that responded poorly to medical management. Seven days before scheduled elective surgical drainage, he developed an acute painful swelling of his left eyelid. Initial horizontal CT scan demonstrated all sinuses filled with soft tissue density ma-



FIG. 2. Culture isolates from the three patients were identified as *B. spicifera*. Note septate conidiophores and cylindrical conidia with three transverse pseudoseptae. (Original magnification $\times 900$.)

terial of increased attenuation and areas of bony erosion through the right maxillary posterior wall, the right frontal posterior wall, and the right medial orbital wall (Fig. 1, *B*). November 21, 1986, the patient underwent drainage of a left orbital subperiosteal abscess and trephination of the left frontal sinus. Cultures grew *Staphylococcus epidermis* and *B. spicifera*. Periorbital swelling resolved with cefoperazone, (intravenously,) during the next 14 days, and dicloxacillin was prescribed at discharge. Because of continued headaches, the patient underwent frontal sinus obliteration, right transfrontal partial ethmoidectomy, and left external sphenoethmoidectomy on December 18, 1986. Of interest was the thick, tenacious material in the involved sinuses. January 13, 1987, the patient underwent right external ethmoidectomy and bilateral Caldwell-Luc procedures, and again *B. spicifera* was isolated from the sinuses. Chest x-ray film was read as normal. No antifungal therapy was prescribed, and on follow-up evaluation 18 months later, the patient was asymptomatic and was doing well. A follow-up CT scan of the patient demonstrated no new disease.

Case 3. Case 3 was a healthy 40-year-old-white woman raised in southern Texas with a history of allergic rhinitis since the age of 9 years. She had been treated with immunotherapy to trees, grasses, weeds, and mold mix between 1973 and 1979. Her history of intermittent nasal congestion, headache, and nasal polyposis began in adolescence, at which time she underwent numerous nasal polypectomies. She had received two bursts of systemic corticosteroids of 4-week duration each and intranasal corticosteroids intermittently during the last 8 years. There was no history of aspirin sensitivity or asthma. June 28, 1974, she underwent bilateral nasal polypectomy, intranasal ethmoidectomy, and bilateral Caldwell-Luc procedures for pansinusitis. A thick, inspissated mucoid material was noted

bulging out of the maxillary sinuses. No bony erosion was noted. Because of recurrent symptoms, sphenoidectomy, bilateral nasal polypectomy, and repeat Caldwell-Luc procedures were performed on June 4, 1977, with similar findings. No fungal cultures were obtained at either procedure. She continued to have intermittent congestion and headache but refused further surgery. In October 1987, coronal CT scan demonstrated all sinuses filled with soft tissue density material of increased attenuation (Fig. 1, *C*). Maxillary sinus material obtained through patent nasal antral windows on three occasions was cultured and grew *B. spicifera*. No antifungal therapy was prescribed. Chest x-ray film was read as normal. She is presently scheduled for endoscopic surgical drainage.

RESULTS

Microbiology

Submitted fungal cultures from all three patients grew flat, spreading, velvety, gray to blackish-brown fungal colonies. The conidiophores were pale brown, septate, solitary, and repeatedly geniculate with the fertile area being restricted to the upper portion of the conidiophore. The conidia were pale brown with darkly pigmented, truncate hila. The conidia had three pseudoseptae and were straight, oblong to ellipsoidal, with rounded ends (Fig. 2). Isolates from all three patients were identified as *B. spicifera* and confirmed by Dr. Michael Rinaldi.

Histology

Submitted specimens from each of the three patients' sinuses demonstrated the inspissated material

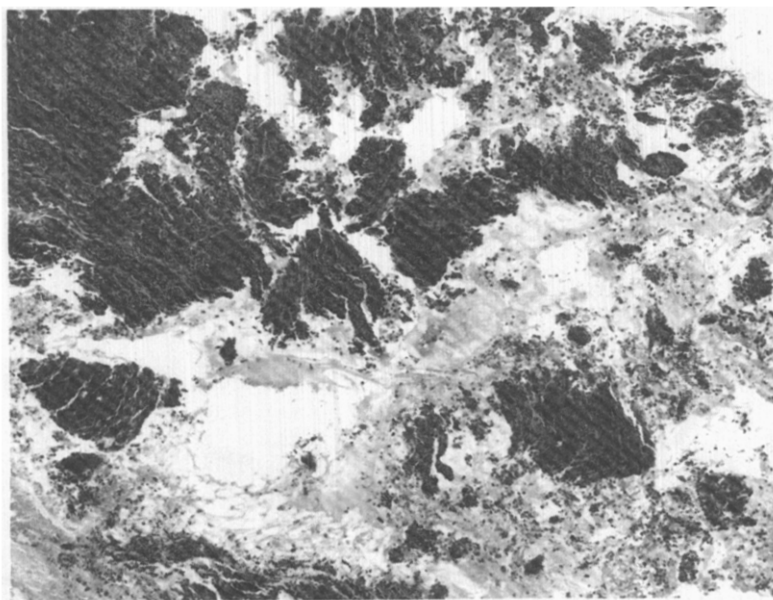


FIG. 3. Allergic mucin recovered from case 1. There is a pale, eosinophilic background containing predominantly eosinophils, cellular debris, and multiple Charcot-Leyden crystals. (Hematoxylin-eosin stain; original magnification $\times 75$.)

to have a pale eosinophilic to basophilic mucinous background containing predominantly eosinophils, sloughed respiratory epithelial cells, and cellular debris, including eosinophilic granules and multiple Charcot-Leyden crystals. There were islands of degenerated eosinophils with pyknotic nuclei and dispersed granules (Fig. 3). The Charcot-Leyden crystals varied in size from 2 to 60 μm and appeared pale orange with hematoxylin-eosin-stained sections. Their geometric shapes were characterized by a hexagon in crosssection and spindle shape with sharply pointed ends in longitudinal section. The solitary constituent of these crystals, lysophospholipase, stained remarkably well with a Brown-Brenn stain¹⁴ (Fig. 4). In all three patients, fungal hyphae were found within the allergic mucin by Grocott-Gomori methenamine-silver stain (Fig. 5). None of the three cases demonstrated evidence of tissue invasion into the mucosa or bony trabeculae.

Cutaneous reactivity and serologic findings

All cases had immediate cutaneous reactivity by prick skin test to multiple aeroallergens. Case 1 had >3 mm wheal reactions by prick testing to mountain cedar, oak, cocklebur, *Franseria*, *Alternaria*, *Cladosporium*, *Helminthosporium*, *Epicoccum*, and *Pulularia*. Case 2 had >3 mm wheal reactions by skin prick to white ash, American elm, smooth brome, ryegrass, and timothy grass, lamb's-quarter, pigweed, Russian thistle, cocklebur, *Franseria*, ragweed mix,

Alternaria, *Cladosporium*, *Helminthosporium*, *Epicoccum*, *Aspergillus*, *Penicillium*, *Fusarium*, and *D. farinae*. Case 3 had >3 mm wheal reactions by skin prick to mountain cedar, ragweed mix, and *D. Farinae*. All three cases had a >3 mm wheal with pseudopods and accompanying erythema by skin prick to *B. spicifera* extract. Cases 1 and 3 had cutaneous late-phase reactions as well as serum precipitin arcs to *B. spicifera* extract. Specific IgE and IgG values of each case are listed in Table 1. The mean concentrations of *B. spicifera*-specific IgE and IgG were 93 and 83 U/ml, respectively. The values for control subjects, skin test positive and sinusitis negative ($N = 5$), were 10 and 2 U/ml, respectively, whereas values for control subjects, skin test positive and with chronic nonfungal sinusitis ($N = 5$), were 8 and 4 U/ml, respectively. The specific IgE concentrations were not significantly different, but the specific IgG levels were significantly higher in the group with allergic fungal sinusitis compared to both control groups, $p < 0.05$. Total serum IgE was elevated in cases 1 and 3. The total eosinophil count was elevated in all three cases.

All three patients appeared immunocompetent. Evaluation of humoral and cellular immune function was performed by measuring quantitative immunoglobulins, IgG subclasses, isoagglutinins, rubella, polio, and tetanus titers, total hemolytic complement, absolute neutrophil and lymphocyte counts, and delayed hypersensitivity skin testing. All results



FIG. 4. Allergic mucin recovered from case 1. Charcot-Leyden crystals, stained dark red, vary in size from 2 to 60 μm . In cross-section they are hexagonal, and in longitudinal section, spindle shaped. (Brown-Brenn stain; original magnification $\times 700$.)

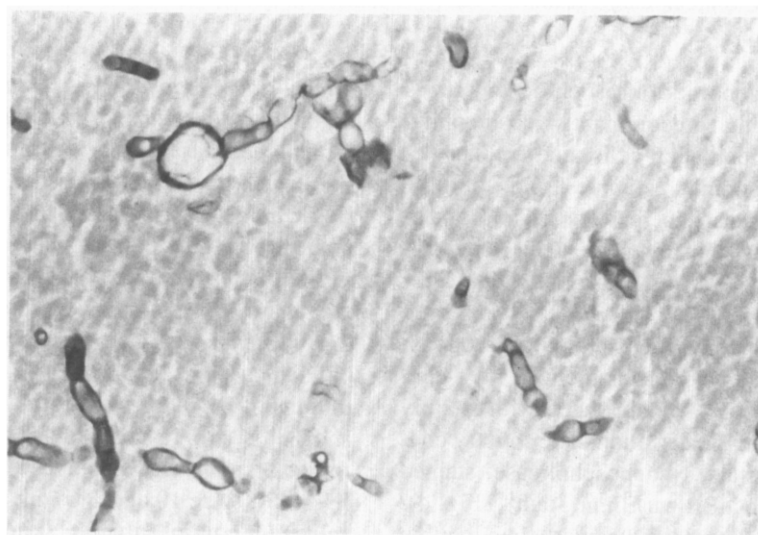


FIG. 5. Allergic mucin recovered from case 1. Septate hyphae can be observed within the mucoid matrix. (Grocott-Gomori methenamine-silver stain; original magnification $\times 700$.)

were normal. All three patients denied use of intranasal cocaine, marijuana, or prior systemic immunosuppressive therapy with the exception of case 3 who had received two courses of systemic corticosteroids (4 weeks each) during a 2-year period.

DISCUSSION

There are four forms of fungal sinusitis: mycetoma, invasive, indolent, and allergic.¹⁵ The first three forms differ both clinically and pathologically from allergic fungal sinusitis. Sinus mycetoma or "fungal ball" is

unilateral with no bony destruction and is resistant to conservative management. It is analogous to the bronchopulmonary mycetoma. Pathologically, there is a closely packed, tangled mass of fungal hyphae without allergic mucin. The invasive form can be slowly progressive or rapidly aggressive, especially in immunocompromised hosts. Initially, one sinus is involved with soft tissue necrosis, granulomatous reaction, and fibrosis that may progress to bony and soft tissue invasion with extensive bony destruction. Indolent fungal sinusitis is often first observed as a chronic uni-

TABLE I. Immunologic features

	Case 1	Case 2	Case 3
Total eosinophils (/mm ³)	528	352	405
Total serum IgE (IU/ml)	3310	245	762
Immediate prick skin test (wheal/flare mm)	10/38	11/42	13/37
Late-phase skin test (mm)	57	—	65
Serum precipitins	+	—	+
sIgE ELISA (U/ml)	250	19	11
sIgG ELISA (U/ml)	112	12	125

sIgE, *Bipolaris*-specific IgE; sIgG, *Bipolaris*-specific IgG.

TABLE II. Summary of *Bipolaris* spp sinusitis in immunocompetent patients

Age (yr)	Sex	Atopic	Polyps	No. of sinuses affected	Bony erosion	Medical RX after surgery	Recurrent sinus surgery	Organism	Where reported	Reference
10	M	?	No	3	No	None	Yes	<i>B. spicifera</i>	Okla.	8
12	F	?	No	3	No	None	No	<i>B. spicifera</i>	Okla.	8
36	M	Yes	Yes	3	No	None	Yes	<i>B. spicifera</i>	Okla.	8
19	F	Yes	Yes	All	Yes	Ampho B	Yes	<i>B. spicifera</i>	Tex.	7
15	M	?	Yes	All	Yes	Ampho B	Yes	<i>B. hawaiiensis</i>	So. Africa	24
28	M	Yes	Yes	4	Yes	Ampho B	Yes	<i>B. australiensis</i>	Colo.	25
32	M	?	Yes	All	Yes	Ampho B	Yes	<i>B. spicifera</i>	Ariz.	9
7	F	Yes	Yes	All	Yes	Ampho B	Yes	<i>B. spicifera</i>	So. Calif.	26
30	F	Yes	Yes	All	No	Ampho B	Yes	<i>B. spicifera</i>	Kan.	PC
21	F	?	Yes	2	Yes	None	No	<i>B. spicifera</i>	Ariz.	PC
12	F	?	Yes	All	Yes	Ampho B	No	<i>B. spicifera</i>	Ariz.	PC
40	F	Yes	Yes	All	No	None	Yes	<i>B. spicifera</i>	Tex.	PC
17	M	?	?	All	Yes	Ampho B	Yes	<i>B. spicifera</i>	Ark.	27
18	M	Yes	Yes	4	No	None	Yes	<i>B. spicifera</i>	Ark.	27
27	M	?	Yes	All	Yes	Ampho B	Yes	<i>B. species</i>	Hawaii	28
21	F	?	Yes	All	No	None	No	<i>B. spicifera</i>	S. C.	29
16	F	Yes	Yes	All	Yes	None	Yes	<i>B. spicifera</i>	Tex.	*
40	F	Yes	Yes	All	No	None	Yes	<i>B. spicifera</i>	Tex.	*
19	M	Yes	Yes	All	Yes	Ampho B	Yes	<i>B. spicifera</i>	Tex.	*

RX, Treatment; Ampho B, amphotericin B; PC, personal communication.

*Described in case report in this article.

lateral sinusitis in immunocompetent patients. The histopathology is usually that of chronic fibrosing granulomatous inflammation with multinucleated giant cells. Allergic fungal sinusitis occurs in atopic individuals, affects multiple sinuses, is chronic in nature, and demonstrates no histologic evidence of tissue invasion. Histologically, the inspissated mucoid material, termed allergic mucin,² is similar to material observed in mucoid impaction of bronchi in ABPA.¹⁶ It contains aggregates of inflammatory cells, most of which are eosinophils. The mucin and infiltrate often have a laminated appearance. Charcot-Leyden crystals are numerous, and special staining often discloses fungal hyphae. Studies in the literature of this distinctive clinicopathologic entity^{2, 4, 15, 17} appear to indicate that

there may be diverse causative agents similar to agents observed in allergic bronchopulmonary disease.¹⁸⁻²¹

B. spicifera is a dematiaceous hyphomycete that is commonly isolated from air, soil, and a wide variety of plants.⁵ It appears to be inciting human disease at an increasing rate⁶ with most cases reported in the southern portion of the United States. Because of its similar conidial appearance to *Helminthosporium* and *Drechslera*, it is difficult to speculate on the airborne geographic distribution of *Bipolaris* based on aeroallergen surveys.

Taxonomy and classification of *Bipolaris* has been confusing. During the mid-1930s, a fungus identified as a *Helminthosporium* species was demonstrated to be the cause of granulomatous nasal infections in cat-

tle.⁶ Since that time, numerous cases of infections caused by fungi identified as *Helminthosporium* and *Drechslera* have been reported in humans and animals. The names used for these fungi reflected the common practice by plant pathologists and mycologists of lumping together various unrelated species under the name *Helminthosporium*. Recently, some species of the genus *Helminthosporium* were segregated and reclassified as *Bipolaris* and *Drechslera*, based on conidial appearance and germination characteristics. Since the early 1980s, most mycologists have accepted *B. spicifera* as the appropriate term for *Brachycladium spiciferum*, *C. spicifera*, *D. spicifera*, and *H. spiciferum*.²²

Our three cases meet the clinical features expected for allergic fungal sinusitis.² The patients were relatively young at the onset of symptoms, atopic, with nasal polyps, and insidious presentations of pansinusitis. Bony erosion, without evidence of histologic fungal invasion, was noted in two patients. The etiology of the commonly observed bony erosion is poorly understood but may be related to pressure created by the expanding mass or to the effects of inflammatory mediators. However, this erosion is clearly not associated with tissue invasion by hyphae. Our tentative diagnostic characteristics of allergic *Bipolaris* sinusitis are listed below.

1. Atopic history and positive prick skin tests to aeroallergens
2. Pansinusitis, often with nasal polyposis, unresponsive to conventional medical therapy
3. Immediate cutaneous reactivity to *B. spicifera*
4. Isolation of *B. spicifera* from the sinuses
5. Typical histologic allergic mucin including eosinophils, Charcot-Leyden crystals, and fungal hyphae
6. Elevated total serum IgE
7. Serum precipitins to *B. spicifera*
8. Presence of high levels of specific IgE and IgG antibody to *B. spicifera*
9. Peripheral blood eosinophilia

Interestingly, specific IgG antibody to *B. spicifera* appears to be the most markedly elevated antibody in this disease with specific IgE also elevated, but to a lesser degree. We believe the relatively mild elevation of total IgE, absent late-phase skin response, and absent precipitins in case 2 were due to surgical removal of the antigen 12 months before evaluation.

The most common finding of sinusitis with CT scan is the presence of soft tissue masses of *decreased* density or *low* attenuation in the paranasal sinuses. In our three cases of allergic *Bipolaris* sinusitis, the CT scans revealed the contents of the paranasal sinuses

to have areas of *increased* density or *high* attenuation (Fig. 1). The soft tissue hyperdensity ranged from 100 to 125 Hounsfield units and was found to be secondary to surgically removed allergic mucin. Naul et al.²³ reported similar CT findings in two cases with chronic fungal sinusitis and inspissated mucus. Zinreich et al.²⁴ recently reported 19 patients with unspecified forms of fungal sinusitis, and all patients demonstrated focal or diffuse areas of increased attenuation in paranasal sinus soft tissue masses with CT scans. It remains to be determined whether this CT finding is characteristic for allergic fungal sinusitis or common to all forms of fungal sinusitis.

The prevalence of allergic *Bipolaris* sinusitis is not known. How this entity may be underdiagnosed in the community is exemplified by reviewing numerous articles describing fungal sinusitis caused by *B. spicifera* that have recently surfaced in the otolaryngology and infectious disease literature.^{7-9, 25-30} Sixteen cases of immunocompetent patients with *B. sinusitis*, along with the three cases of allergic *Bipolaris* sinusitis that are described in this article are listed in Table II. All patients are young, and most of the patients were documented as being atopic with nasal polyposis and pansinusitis. None of the cases were described as having histologic evidence of tissue or bone invasion despite eight patients being treated with systemic antifungal therapy after surgery. None of these 16 patients were tested for immediate cutaneous reactivity to *Bipolaris* extract, and histologic description of the surgical specimens did not rule out allergic mucin. We believe at least some of these patients have allergic *Bipolaris* sinusitis.

Summary

B. spicifera is a previously unrecognized cause of allergic fungal sinusitis. Allergic *Bipolaris* sinusitis may be a common form of fungal sinusitis, particularly in the southern region of the United States. Diagnosis of this disorder should be considered in any atopic patient with pansinusitis and nasal polyposis unresponsive to therapy. Since identification of the organism is essential in immunologic evaluation of this disease, fungal cultures and special histologic stains should be obtained at time of surgery in all suspected cases.

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