Neurosurgical Management of Bipolaris-Specific Skull Base Allergic Fungal Sinusitis: Diagnostic Criteria and Outcome

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Skull base allergic fungal sinusitis is a rare but important neurosurgical entity that can be mistaken for a skull base tumor during preoperative assessment. Due to the significantly variable clinical presentation of and preoperative evaluation for this disease, clinicians are often surprised when the diagnosis becomes apparent during surgery or thereafter. However, SBAFS must be differentiated from malignancy and invasive fungal disease because this allergic disease does not require aggressive, complete resection or potentially toxic antifungal medications. We report six cases of SBAFS to illustrate the neurosurgical management of this rare disease.

Key Words: allergic fungal sinusitis, Bipolaris, skull base

Abbreviations Used: AFS, allergic fungal sinusitis; CT, computed tomography; GMS, Gomori methenamine silver; MR, magnetic resonance; SBAFS, skull base allergic fungal sinusitis

Over the past decade, the incidence of fungal infections has increased dramatically. Fungal paranasal sinus disease, a large component of fungal infections, is common and is defined by the host and the host's response to the fungus. Invasive fungal sinusitis occurs in immunocompromised hosts and can manifest as acute, fulminant, and life-threatening or as a more manageable chronic/granulomatous indolent form. However, the hallmark of invasive disease is the presence of large amounts of the fungal element in the associated pathology without immune containment.

In contrast, noninvasive fungal sinusitis occurs in immunocompetent individuals. It exists in two forms, both characterized by the host's response to the fungal agent. With the first, mycetoma, the host's immune response is inadequate and the fungal agent proliferates as an encapsulated mass. The second, AFS, the subject of this report, occurs when the host provides an overly exuberant immune response to the antigens of the fungus.

Skull base allergic fungal sinusitis, a term first introduced by Kinsella et al., denotes the specific condition in which AFS extends intracranially. Ten to 20% of patients with AFS have an intracranial extension. Once SBAFS is encountered, neurosurgical intervention is required. Because of their variable presentation and rarity, these lesions are seldom expected preoperatively. Consequently, SBAFS is often mistaken for a malignancy, and patients may receive overly aggressive therapy. Because SBAFS is noninvasive, surgical debulkment is standard therapy; radical resection or toxic med-
ical regimens are unnecessary. We present six patients with Bipolaris-specific SBAFS to highlight the neurosurgical management of this rare clinical entity.

Clinical Materials and Methods

Bipolaris-Specific SBAFS

The records of six patients (3 men, 3 women; mean age, 34 years; age-range, 19 to 75 years) who underwent resection with pathologic verification of AFS and culture-proven Bipolaris from January 1989 to August 2004 were analyzed retrospectively. The criteria for pathologic verification were allergic mucin-containing eosinophils, Charcot-Leyden crystals, cellular debris, and sparse hyphae. To evaluate the invasive nature of this disease, all cases of Bipolaris-specific AFS were identified by querying our microbiology database from January 1998 to August 2004.

Most patients became symptomatic with visual complaints or headache of gradually increasing intensity (Table 1). On examination, the most frequent sign was ocular defect. All patients had a history of atopy, including polyps and at least one other indicator of atopy.

Bipolaris-Specific AFS

Between January 1998 and August 2004, 28 cases of culture-proven Bipolaris-specific AFS were treated at our institution. There were 20 men and 8 women (mean age, 30 years; range, 13 to 80 years). Three patients had an intracranial extension consistent with SBAFS (invasion rate, 10.7%). Of these 28 cases, only 1 had fungal elements identified on a KOH preparation. Eleven had concomitant positive cultures for bacterial isolate.

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Results

Radiology

Bipolaris-specific SBAFS lesions were isointense on T1-weighted MR images and T2-weighted MR images lacked lesional or perilesional hyperintensity, suggesting no inflammation. All but one lesion was isointense to brain parenchyma; the exception was hypointense (Table 2). Four cases showed intense uptake on gadolinium-enhanced MR imaging, and another lesion was considered ring enhancing. There was no gadolinium enhancement in the remaining case. In all cases CT showed increased attenuation and bony destruction with expansion of its associated sinus or sella without evidence of hyperostosis. The location of the pituitary in relation to the tumor varied across the cases.

Treatment

Five cases consisted of a primary sphenoidal extension and were treated through a transsphenoidal approach (Table 1). A tumor that originated from the frontal sinus and extended into the anterior cranial fossa was approached through a bicornal craniotomy. In all cases a coincident positive culture of bacterial isolate (nasopharyngeal flora) was also treated (Table 1). Postoperatively, one patient was diagnosed with aseptic meningitis.
meningitis. The resulting transient recurrent sixth cranial nerve palsy resolved with treatment. Whether this complication was related to surgery is unclear. After surgical decompression neurologic symptoms resolved in all cases (range of follow-up, 2 months to 15 years). All patients received postoperative steroids from 2 weeks to 4 months. Three patients also received 2 weeks of antifungal therapy. There were no recurrences.

Illustrative Case

Patient History

A 31-year-old African-American man was transferred from an outside hospital with the radiographic diagnosis of a skull base tumor for further evaluation. The patient reported an 8-month history of headache and progressive loss of vision. The headache consisted of constant throbbing frontal pain. It gradually progressed from low-grade pain to an intensity of 10 on a 1 to 10 scale. Photophobia was present, but there was no evidence of nausea, vomiting, transient visual scotoma, or flashing lights. With the right eye, the patient could only see shadows. Vision in his left eye was beginning to blur. His history included evidence of significant atopy, nasal polyposis, chronic sinusitis with eight previous sinus surgeries, and childhood asthma.

Physical Examination

On neurologic examination the patient was alert and oriented. His right pupil was nonreactive to light; his left pupil was miotic but briskly reactive. Vision was full to confrontation in the left eye. Extraocular movements were intact bilaterally; however, gaze was dysconjugate. Evaluation of pituitary function was unremarkable.

Radiological Examination

Noncontrast head CT showed a hypodense mass occupying the sphenoid sinus and sella (Fig. 1). The bony confines were expanded, and multiple calcified foci were present within the lesion without evidence of hyperostosis or perilesional edema. On T1- and T2-weighted MR images, the lesion was isointense relative to brain parenchyma (Fig. 2). Gadolinium-enhanced MR images showed a large, avidly enhancing lesion with its isocenter in the sphenoid sinus. It extended to the planum sphenoidale inferiorly and abutted the clivus posteriorly. Furthermore, there was evidence of an intracranial extension into the anterior cranial fossa beneath the frontal lobes. Moreover, involvement of the optic nerve suggested chiasmopathy and involvement of the perichiasmal segment (Fig. 3).

Treatment

The patient began steroid therapy and his vision subsequently improved. He then underwent frameless stereotactic transnasal-transsphenoidal debulking of the lesion. A firm white mass intermingled with fibrous tissue, which had eroded the planum sphenoidale and anterior and basal sellar floors, was encountered. Its adherence to the sellar diaphragm and frontal fossa dura made its removal difficult. An intraoperative frozen-section biopsy was consistent with an inflammatory process. The lesion was debulked without complication.

Histopathology

Hematoxylin and eosin staining revealed inflammatory infiltrate without dysplasia. Sparse fungal elements with the rare yeast were present on Fontana and GMS stains. By Day 10, intraoperative cultures were positive for Bipolaris.

Outcome

The patient recovered on steroid therapy without complications. At discharge his visual function had normalized, and his headaches had improved significantly.

<table>
<thead>
<tr>
<th>Case</th>
<th>MRI T1</th>
<th>MRI T2</th>
<th>Gadolinium Uptake</th>
<th>Attenuation</th>
<th>CT Bone Destruction</th>
<th>Pituitary Location</th>
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<tbody>
<tr>
<td>1</td>
<td>Isointense</td>
<td>Isointense</td>
<td>Intense</td>
<td>Increased</td>
<td>+</td>
<td>Posterior</td>
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<td>2</td>
<td>Isointense</td>
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<td>Intense</td>
<td>Increased</td>
<td>+</td>
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<td>3</td>
<td>Isointense</td>
<td>Isointense</td>
<td>Ring enhancing</td>
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<td>+</td>
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<tr>
<td>4</td>
<td>Isointense</td>
<td>Isointense</td>
<td>Intense</td>
<td>Increased</td>
<td>+</td>
<td>Anterior</td>
</tr>
<tr>
<td>5</td>
<td>Isointense</td>
<td>Isointense</td>
<td>No uptake</td>
<td>Increased</td>
<td>+</td>
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</tr>
<tr>
<td>6</td>
<td>Isointense</td>
<td>Hypointense</td>
<td>Intense</td>
<td>Increased</td>
<td>+</td>
<td>None</td>
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1 Relative to brain parenchyma. 2 Relative to mass and sella.

Table 2. Bipolaris SBAFS Imaging Characteristics
Discussion

Natural History

AFS accounts for 7% of all fungal sinus disease. Dematiaceous fungi, most prominently Bipolaris, account for 81% of AFS. The remaining cases are primarily caused by Aspergillus. Bipolaris is found in dust and soil and on plants. Many cases of Bipolaris occur in hot, arid climates with mild winters such as the southern United States and Middle East.10,17,24,25

AFS caused by Aspergillus and fungal agents of the dematiaceous family, Bipolaris, represent different entities. Many Aspergillus-associated cases of AFS have been associated with immunodeficiency such as chemotherapy for acute lymphoblastic leukemia, renal failure, or long-standing diabetes. Therefore, we excluded such cases. However, all cases reviewed and all cases reported as Bipolaris SBAFS fit the atopic pattern of young, immunocompetent patients, suggesting that this group is homogeneous. Patients with aspergillosis AFS may have elements of invasive disease and should not be considered to have AFS.19

The mean age of patients with AFS ranges between 21 to 26 years. Our patients, however, averaged 30 to 34 years old.4,14 There was no difference in the incidence of SBAFS patients by gender, but the 2:1 male-to-female ratio in our AFS population is consistent with published reports.14 All had nasal polyps with at least one other atopic finding, which is also consistent with previous reports. None of our patients had stigmata of immunoincompetency. Many patients with SBAFS have proptosis or visual defects.5,22,28 Five of our six surgical patients had an ocular defect. Almost 11% of the 28 AFS patients we treated had an intracranial extension, a finding consistent with the literature.13

In addition to those proposed by Kinsella et al.,10 we support the following criteria for the diagnosis of Bipolaris SBAFS (Table 3). (1) Evidence of intracranial extension by radiographic, surgical, or pathologic means must be present. (2) Histopathologically, the lesion must be consistent with AFS. Aspergillus should be excluded. (3) Finally, many reports suggest that species such as Drechslera and others are separate microbial agents, but this is not the case.
Curvularia, Bucchulium, Drechslera, and Helminthosporium are obsolete synonyms of Bipolaris. Cochliobolus is also a teleomorph. Therefore, all of these microbes should be reported as Bipolaris.

Diagnostic Imaging

The most remarkable aspect of SBAFS is the consistency with which findings on preoperative imaging are considered to be a malignancy, as occurred in our patient. Preoperative radiographic diagnoses often include chordoma, meningioma, chondrosarcoma, and head-and-neck squamous cell carcinoma. Such misdiagnoses can result in an overly aggressive surgical and/or medical intervention. However, reported imaging characteristics are relatively uniform. In early case reports, sinus expansion was uniformly noted on CT. As in our patient, bony erosion with residual bony spiculation without hyperostosis has been reported in all cases of SBAFS.

The finding of a hyperattenuating lesion (45–60 Hounsfield units) is also uniform. Sinus expansion and bony destruction may be related to pressure atrophy, and hyperattenuation may be related to the high residual content of metallic ions in the lesion. Moreover, these lesions appear as areas of diminished signal intensity on both T1- and T2-weighted MR images. As in our patient, the lesions often enhance with the administration of gadolinium. CT evidence of a lesion extending from a paranasal sinus associated with bony expansion, erosion, and hyperattenuation should prompt suspicion of an SBAFS. When this diagnosis is doubtful, MR imaging can be useful. The lesion should appear iso- to hypointense on both T1- and T2-weighted MR imaging. Transnasal sampling under CT guidance is possible.

Treatment

Because the pathophysiology of AFS is of an allergic nature and the disease is noninvasive, complete removal is unnecessary. The goals of surgery should be to provide tissue for pathologic verification (via intraoperative frozen sec-

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The prognosis of SBAFS is good. After adequate surgical debidement and aeration of the sinuses, complete neurologic resolution can be expected, as in our 6 cases. Close follow-up care is important. CT, MR imaging, or both are adequate for following SBAFS. The long-term use of topical steroids controls relapses, and systemic steroids may be warranted for a recurrence.

Conclusions

Although Bipolaris SBAFS associated with a skull base extension is rare, this diagnosis should be considered when a paranasal sinus mass is present in a young atopic patient. CT findings of a hyperattenuating mass extending from the paranasal sinuses with bony erosion and isointense to hypointense lesions on T1- and T2-weighted MR images are consistent with Bipolaris SBAFS. These findings should raise suspicions of this entity in patients living in hot, arid climates. Definitive treatment consists of conservative surgical debulkment with aeration of the sinuses and postoperative use of corticosteroids. Postoperatively, antifungal medications are not required and complete neurologic recovery can be expected.
References

22. Roth M: Should oral steroids be the primary treatment for allergic fungal sinusitis? *Ear Nose Throat J* 73:526-530, 1994