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Allergic fungal rhinosinusitis presenting with intracranial spread along large sphenoidal emissary foramen

Robert R. Lisac [a], Matthew Garber [a], Ayesha Mirza [a], Chetan C. Shah [a,b,c,d,*]

[a] University of Florida College of Medicine - Jacksonville, Jacksonville, FL, USA
[b] Nemours Children's Specialty Care - Jacksonville, Jacksonville, FL, USA
[c] Wolfson Children's Hospital, Jacksonville, FL, USA
[d] Mayo Clinic, Jacksonville, FL, USA

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Abstract

A 13-year-old girl was admitted for headache, right periorbital swelling and erythema. CT imaging demonstrated right orbital preseptal cellulitis, severe pansinusitis and suspected epidural abscess. Brain MRI and sinus CT confirmed an epidural abscess in the right middle cranial fossa and a second extra-cranial abscess in the right infratemporal fossa along with large right sphenoidal emissary foramen. Drainage from sinus surgery confirmed allergic fungal rhinosinusitis. She was treated with prednisone and voriconazole.

1. Introduction

Allergic fungal rhinosinusitis (AFRS) is a specific subtype of chronic rhinosinusitis first described in 1976 by Safirstein [1,2]. It is characterized by elevated immunoglobulin E (IgE), eosinophilic-rich mucin in the sinus cavities, and characteristic radiographic findings [3,4]. In AFRS, the paranasal sinuses become filled with thick, tenacious, highly viscous mucin, described as "peanut butter" and "axle grease." [5–7] This thick mucin obstructs the osteomeatal complexes and can lead to complications including ophthalmic, sinobronchial allergic mycosis, bony erosion, cavernous venous thrombosis, and otic involvement [8]. AFRS is relatively common affecting 1–3% of the United States population annually [9], while intracranial involvement is exceptionally rare. To date, there have been two reported cases of intracranial abscesses, but both patients had prior sinus surgery [10,11]. In this article, we present a third case of AFRS with an infratemporal fossa and an intracranial abscess in a 13-year-old female with ipsilateral larger sphenoidal emissary foramen. She presented with headache, right periorbital swelling and erythema. She was treated by endoscopic sinus surgery, prednisone and voriconazole.

2. Case

The patient is a 13-year-old girl with mild allergic rhinitis who presented to her pediatrician for right sided frontal headache for one week. She was treated with amoxicillin for a right acute otitis media. Over the next week, she also developed nausea, vomiting, and diarrhea and was taken to an emergency department (ED). ED treated her for a migraine and discharged. Her headache returned and she presented to the same ED three days later where a computed tomography (CT) scan of the head revealed sinusitis and a nasal polyp. She was referred to otolaryngology and while awaiting follow up, she developed right periorbital swelling and erythema, along with right sided facial numbness, prompting a third ED visit 3 days later, where a facial CT demonstrated mild right orbital preseptal cellulitis and severe pansinusitis with air-fluid levels. She was started on ceftriaxone and clindamycin and transferred to our tertiary pediatric care center for treatment of preseptal cellulitis. The patient was admitted to our institute on day 0, the day patient was transferred to us.

Admission physical examination findings on day 0 included pain to extraocular movement of the right eye, mild right sided periorbital swelling and erythema, right maxillary sinus tenderness, and right facial numbness. Visual acuity was normal and the remainder of the exam was unremarkable.

Admission laboratory findings on day 0 revealed a white blood cell count of 11,400 cells/uL (normal), 62.4% granulocytes (normal), 0.4% immature granulocytes (normal), 18.7% lymphocytes (normal), 15.1% monocytes (normal), 3.3% eosinophils (normal), and 0.1% basophils (normal), hemoglobin level of 14.2 g/dL (normal), and platelet count of 449,000 cells/uL (normal).

* Corresponding author. University of Florida College of Medicine - Jacksonville, Jacksonville, FL, USA.
E-mail address: chetan.shah@nemours.org (C.C. Shah).

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The patient's headache and evidence of facial nerve compression prompted review of the facial CT performed at ED just prior to transfer to our tertiary pediatric care center. Our pediatric radiologist noted a probable epidural abscess on that CT scan. Pediatric neurosurgery, otolaryngology, and infectious disease subspecialists were consulted and magnetic resonance imaging (MRI) of the brain and CT of the sinuses were performed on day 0 that revealed a small epidural abscess in the right middle cranial fossa anterior to the right temporal lobe measuring 1.6 × 0.6 × 1.0 cm, located superior to the right greater wing of the sphenoid (Fig. 1A and B and Fig. 2A and B) and a second abscess in the right infratemporal fossa inferior to the right greater wing of the sphenoid measuring 1.1 × 1.4 × 1.3 cm (Fig. 2B). These two abscesses were in close proximity to the right greater wing of the sphenoid, which separated the two abscesses (Fig. 2B). The right sphenoid sinus mucosa produced hyperdensity on the CT (Fig. 2A–B) and hypointensity on T2-weighted MRI (Fig. 1A), which is typically seen with fungal involvement of the mucosa. The right sphenoid sinus was completely opacified and obstructed on CT scan (Fig. 2A–B). It was noted on the CT scan that the right sphenoidal emissary foramen (Fig. 3A and B) was larger on the right than the left side, likely accounting for the intracranial extension via a larger emissary vein of Vesalius.

On day 0, the antibiotic regimen was changed to ceftriaxone, vancomycin, and metronidazole for empiric treatment of the intracranial abscess and she was started on oxymetazoline and saline nasal sprays for

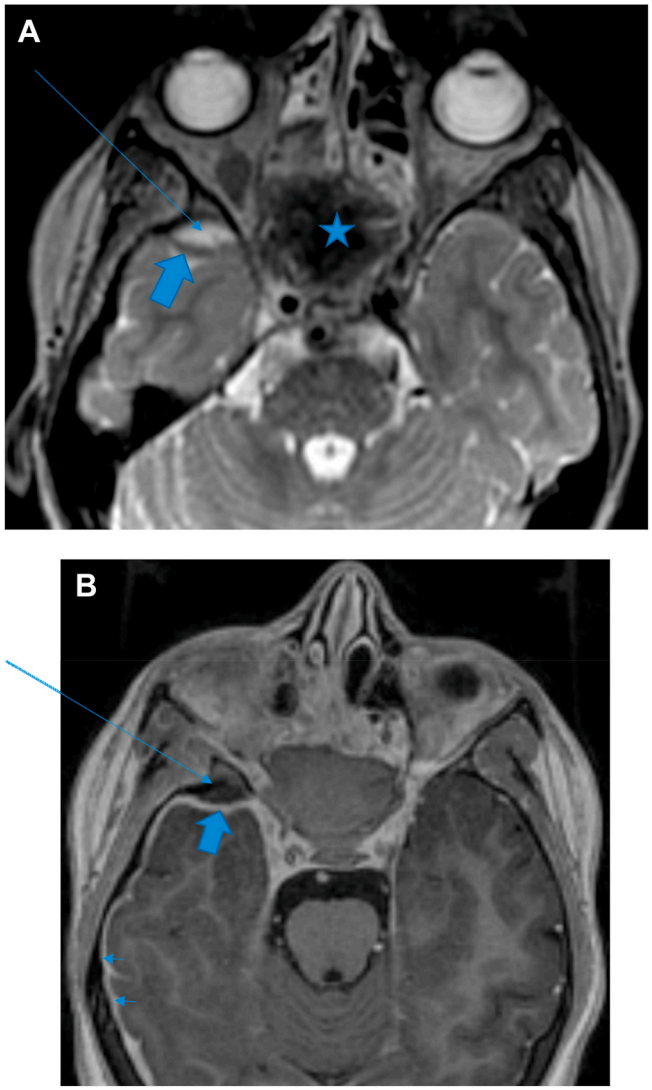

Fig. 1. MRI cerebrum on day of admission.

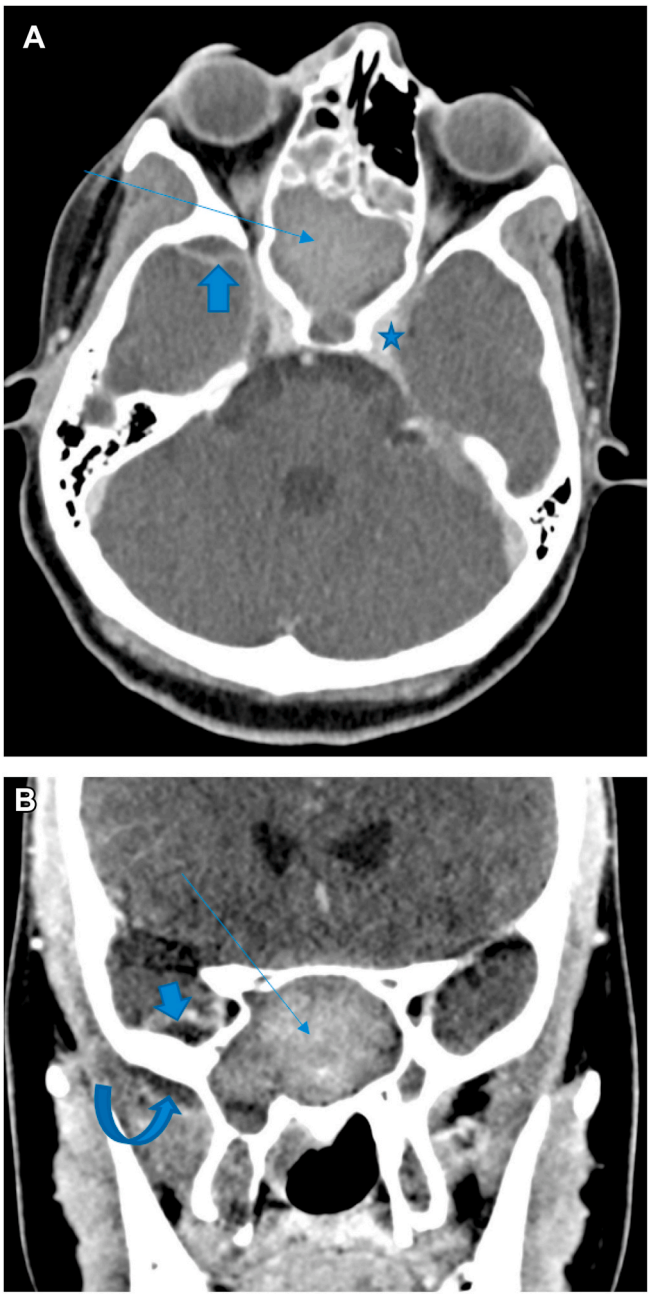

Fig. 2. CT cerebrum on day of admission.

severe sinusitis.

On day 1, endoscopic sinus surgery was performed. Sinus drainage had "peanut butter" appearance consistent with extensive AFRS in the right ethmoid and sphenoid sinuses. Pathology demonstrated predominantly fibrino-purulent debris with degenerated inflammatory cells and possible needle like structures consisting of Charcot-Leyden crystals. Thick walled fungal hyphae were identified and confirmed with Grocott's methenamine silver stain. Intraoperative fungal, anaerobic, and aerobic cultures remained negative. A diagnosis of AFRS was made and high dose prednisone (1mg/kg/day) was initiated. Itraconazole was started, then changed to oral voriconazole (200 mg bid) on day 5 given the intracranial extension. Voriconazole was only given orally and not intravenously. Therapeutic drug monitoring was not performed. After surgery, mildly elevated inflammatory markers and IgE were noted, c-reactive protein 3.9 mg/dL, erythrocyte sedimentation rate 58 mm/hour, and IgE 168 kU/L (normal <115 kU/L).

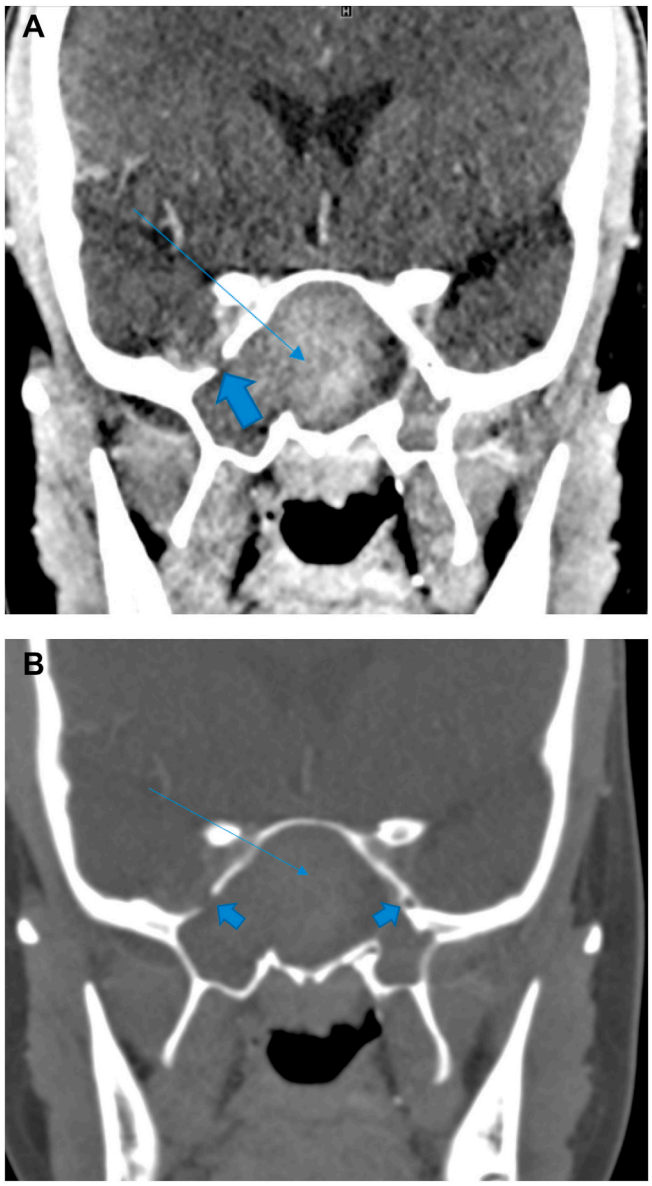

Fig. 3. CT cerebrum on day of admission.

Repeat MRI of the brain on day 3, showed no change in the size of the two abscesses, but a marked improvement in the appearance of the paranasal sinuses. Her periorbital swelling and facial numbness also improved significantly.

On day 6, the patient was discharged with plans to continue high dose prednisone for three weeks followed by a five week taper along with four to six weeks of voriconazole.

The patient returned to the ED at two weeks and again at nine weeks following discharge. At both visits, she presented with eye pain and had MRIs revealing resolution of the two abscesses. No specific etiology for eye pain could be identified and the eye pain was attributed to the ongoing sinusitis. She ultimately completed eight weeks of voriconazole. She was also seen by allergy and immunology who extended the high dose prednisone for three weeks followed by a five week taper. Skin prick testing revealed allergies to several types of mold including *Drechslera* and *Bipolaris*, but not to *Curvularia* or *Aspergillus*.

3. Discussion

AFRS is a distinct subtype of fungal rhinosinusitis and is considered a noninvasive disease. It is analogous to allergic bronchopulmonary aspergillosis with similar pathophysiology resulting from a type 1 hypersensitivity to inhaled fungi. AFRS is typically caused by a single fungus in a given patient. The most common fungi known to cause AFRS are *Bipolaris*, *Curvularia*, *Aspergillus*, and *Drechslera*, although many others have been reported [12].

Despite some controversy, the original diagnostic criteria for AFRS proposed in 1994 [3] are still the most widely used [1]. These include the presence of type 1 hypersensitivity to fungi by skin test or serum specific IgE, nasal polyposis, characteristic CT findings, eosinophilic mucin, and positive fungal stain. Characteristic CT findings consist of differential densities within the opacified sinuses which corresponds to the dense accumulation of eosinophilic mucin.

There are several known complications of AFRS with the most common being ophthalmic including proptosis, epiphora, vision loss, diplopia, and dystopia [8,13]. The second most common complication is bony erosions reported in 20–90% of patients [8]. This erosion can be interpreted as invasive disease, but is actually due to bone remodeling in response to increased pressure from expanding mucin [14].

There have only been two prior case reports describing AFRS with an intracranial abscess [10,11], but unlike our patient, both had a history of prior sinus surgery, which has been suggested to lead to mucosal and dural penetration with resultant seeding leading to abscess formation [11,15]. On later review of our patient's CT, it was noted that the right sphenoidal emissary foramen (Fig. 3A and B) was larger on the right than the left side, likely accounting for the intracranial extension via a larger emissary vein of Vesalius. The latter traverses the sphenoid emissary foramen connecting the pterygoid plexus to the cavernous sinus [16].

Current recommendations for treatment of AFRS consist of a combination of surgery and systemic and/or topical corticosteroids [12]. The objective of surgery is the removal of polyps, fungal debris, and eosinophilic mucin along with the enlargement of the sinus ostia and preservation of the mucous membranes. Steroids can be used both pre and postoperatively. Preoperatively they are useful in decreasing bleeding and edema, thus improving surgical landmarks. Doses with reported benefits in adult patients have ranged from prednisone 30mg daily for five days to 1mg/kg/day for 10 days [17,18]. Postoperatively they play an important role in preventing recurrence. The only randomized control trial in adults used prednisone 50mg daily for six weeks followed by six weeks of tapering. All 12 patients who received steroids had complete symptom relief compared to one of 12 who received placebo [19]. Significant side effects from the steroids were reported including weight gain, cushingoid features, and steroid-induced diabetes. Many experts advise lower doses and shorter durations [12]. There is no comparable study in children and no optimal dosing has been established. In addition to the side effects reported in adults, pediatricians should be mindful of the negative effects steroids may have on growth and development in children.

Systemic and/or topical antifungals have been used with mixed results and are a grade C recommendation based on the most recent practice parameters of three allergy and immunology societies [12]. Research by Khalil et al. have not shown any convincing evidence that use of antifungal therapy is of any significant benefit in the treatment of AFRS [20].

We elected to use systemic steroids and voriconazole given the severity of her presentation with both an intracranial and extracranial abscess. Despite recurrent eye pain and a three week extension of her steroid course, our patient ultimately did well.

In conclusion, AFRS is a relatively common disease with a typically benign course. Our patient had a history of mild allergic rhinitis, yet presented with severe sphenoid sinus obstruction and an intracranial abscess requiring the input of multiple medical and surgical subspecialists. Importantly, the history of headache and evidence of facial nerve compression on physical exam prompted a review of previous images where novel pathology was suspected and ultimately confirmed.

In addition to an awareness of AFRS and its complications, this case highlights the need to keep a high index of suspicion for alternate diagnoses and to reassess available data with experts when clinical courses deviate from the expected.

Declaration of competing interest

There are none.

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None.

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