International Journal of Pediatric Otorhinolaryngology 86 (2016) 200–212

Contents lists available at ScienceDirect

International Journal of Pediatric Otorhinolaryngology

journal homepage: www.elsevier.com/locate/ijporl

Review Article

Systematic review and case report: Intracranial complications of pediatric sinusitis

Neha A. Patel [a,*], David Garber [b], Shirley Hu [b], Ameet Kamat [b]

[a] New York Eye and Ear Infirmary of Mount Sinai, New York, NY, USA
[b] New York Medical College, Valhalla, NY, USA

ARTICLE INFO

Article history:
Received 14 March 2016
Received in revised form 5 May 2016
Accepted 8 May 2016
Available online 11 May 2016

Keywords:
Sinusitis
Sinus disease
Intracranial complications
Pediatric

ABSTRACT

Context: Intracranial complications of rhinosinusitis are rare in the post-antibiotic era. However, due to potentially devastating outcomes, prompt recognition and management are essential.
Objective: This study aims to perform the first systematic review of the intracranial complications of rhinosinusitis in order to better characterize their clinical presentation, diagnosis, and treatment, and report a case of frontal lobe empyema secondary to pediatric frontoethmoid sinusitis.
Data Sources: Ovid MEDLINE, Cochrane Library, and Google Scholar.
Study Selection: Full-text, peer-reviewed journal publications from 1947 to January 1, 2015 in English; focus on intracranial complications of sinusitis; pediatric patients (<18 years of age); studies including data on diagnostic workup and treatment.
Data Extraction: Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines.
Results: Sixteen studies involving 180 patients were included. An overwhelming majority of patients were young adolescent males (70%). The most common intracranial complications were subdural empyema (49%), epidural abscess (36%), cerebral abscess (21%), and meningitis (10%). Patients most often presented with nonspecific symptoms such as headache, fever, nausea and vomiting. Computed tomography with contrast or magnetic resonance imaging confirmed the diagnosis when intracranial complications were suspected. Typical treatment included surgical incision and drainage, often involving joint neurosurgical and otolaryngological procedures, combined with a long course of antibiotics. The morbidity rate was 27%, and the mortality rate was 3.3%.
Limitations: All studies were retrospective chart reviews, case series or case reports.
Conclusions: A review of the currently available literature shows that with a high degree of suspicion, multidisciplinary cooperation and aggressive treatment, favorable outcomes are attainable. The most effective surgical treatment for intracranial complications remains unclear and should be investigated further.

Contents

* Corresponding author at: 310 East 14th St., New York, NY 10003, USA. Tel.: +1 2129794545; fax: +1 2129794315.
E-mail address: nepatel@nyee.edu (N.A. Patel).

http://dx.doi.org/10.1016/j.ijporl.2016.05.009
0165-5876/

1. Introduction

The frontal sinuses are the last paranasal sinuses to develop and are generally detectable only after five years of age. In the pediatric population, the frontal sinuses are poorly developed until the age of 10 [1]. For this reason, it is believed that complications of pediatric sinusitis are relatively rare and mostly affect older children. There is a higher probability of developing intracranial complications in children who present with acute frontal sinusitis to a tertiary care hospital [2]. The odds ratio for developing intracranial complications if the frontal sinus is involved in the inflammatory process is 20 (95% CI 2.30–176.4) compared to an odds ratio of 0.2 if the ethmoid sinus is involved [2]. It is hypothesized that the frontal skeleton is more vulnerable to the spread of infection because of its abundant network of diploic veins, the frequency of frontal and anterior ethmoid infections, and the rapid growth of the frontal sinuses in adolescents [3].

While only 5%–10% of all upper respiratory tract infections in children are complicated by sinusitis [4], a 10% incidence of intracranial complications from sinusitis has been reported in patients hospitalized with sinusitis [5]. Intracranial complications include meningitis, cavernous and/or sagittal sinus thrombosis, and epidural, subdural and cerebral abscesses. The frontal sinuses are most commonly associated with sinogenic intracranial suppuration, followed in order by the ethmoid, sphenoid and maxillary sinuses [6]. The exact method of intracranial extension of frontal sinusitis is unclear. It is thought to occur directly or by indirect hematogenous spread. Direct extension can progress by bacterial penetration of the posterior wall of the frontal sinus through necrotic areas of osteomyelitis. Retrograde extension of thrombophlebitis originating in the sinus mucosal veins can progress through the valveless diploic venous system (veins of Breschet) that interconnects the sinus mucosa to the meninges, skull and brain parenchyma [7].

Fortunately, the incidence of intracranial complications of sinusitis has decreased with the improvement in the management of sinusitis. However, mortality rates for intracranial complications of sinusitis have been reported to be as high as 10%–20%. Long term neurologic morbidity such as hemiparesis, aphasia and epilepsy occurs in 13%–35% of survivors [3].

2. Case report

A 10-year-old otherwise healthy female presented to our tertiary care pediatric emergency room after new onset seizure. Her family reported that approximately two weeks prior to her presentation she complained of bilateral nasal congestion associated with purulent discharge, mild facial pain and pressure. There was no initial history of headaches, fevers or change in smell. She was started on amoxicillin as an outpatient by her pediatrician when a pharyngeal swab demonstrated *Streptococcus pyogenes*. However, her symptoms did not improve, and one week after the initial onset of her symptoms she developed severe frontal headaches. Over the course of the following week, her symptoms progressed and included decreased appetite, fatigue and two episodes of emesis. On the day of presentation, the patient's mother noticed an acute episode of her tensing her upper extremities, rolling back her eyes, and becoming unresponsive. On presentation to an outside institution, she was given lorazepam and levetiracetam and transferred to our tertiary emergency room for neurologic evaluation.

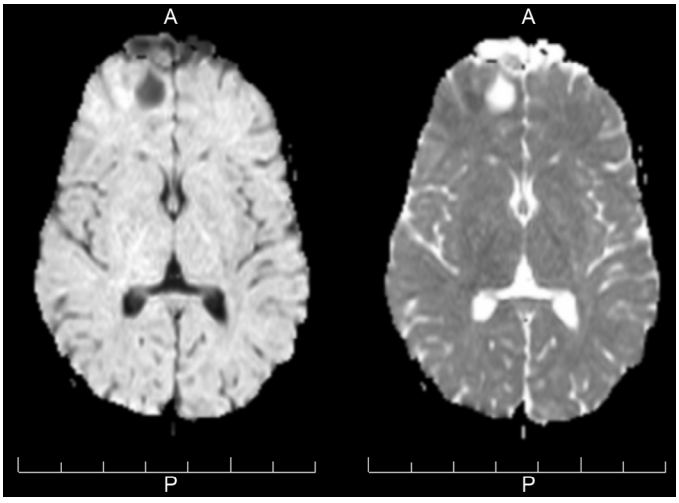

Fig. 1. MRI of the brain showing a subdural frontal empyema.

On examination, the patient was neurologically intact but in a drowsy, postictal state. However, she demonstrated severe tenderness over her right frontal sinus. She had no neck stiffness or photophobia. She was afebrile with stable vital signs. Laboratory evaluation was significant for an erythrocyte sedimentation rate of 95 mm/hr (normal 0–20) and C-reactive protein (CRP) of 1.2 mg/dL (normal 0–0.5). Notably, her white blood cell (WBC) count was 11.7/μL (normal 5.3–15).

Computed tomography (CT) of the head and sinuses without contrast showed near-complete opacification of the frontal sinuses and diffuse bilateral mucosal thickening of all the sinuses. A 4 mm collection was seen in the anterior right frontal lobe of the brain subjacent to the right frontal sinus. Magnetic resonance imaging (MRI) of the brain with and without contrast showed a right frontal sinus opacification and a 24 mm × 10.2 mm × 15.8 mm subdural empyema adjacent to the posterior aspect of the right frontal sinus (Fig. 1).

The patient was brought to the operating room immediately after imaging for drainage of her subdural abscess in a joint otolaryngology and neurosurgery procedure. Image-guided neuronavigation was used, and a bicoronal incision was performed to gain access to the site of the abscess through a craniotomy (Fig. 2). The craniotomy was conducted inferiorly enough to include the anterior table of the frontal sinus. Pus and granulation tissue were removed from the bilateral frontal sinuses along with the entirety of the mucosa. Care was taken to drill all aspects of the anterior table off the field and the remaining frontal sinus floor on the field with a diamond burr to prevent retention of the mucosa. The posterior table of the frontal sinus was fully resected, and the frontal sinus outflow tract was occluded with temporalis muscle and pericranium. The subdural empyema was then evacuated and specimens were obtained for culture. A pericranial flap was placed along the anterior dural defect after dural repair. The anterior cranial bone flap was replaced at the end of the procedure. Postoperatively, the patient was admitted to the pediatric intensive care unit and started on vancomycin. She did well without continued seizure activity and no evidence of a cerebrospinal fluid (CSF) leak. On postoperative day six, the patient underwent a bilateral maxillary antrostomy, total