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Case Report

Prognostic factors of paranasal sinusitis with intracranial invasion: A 14-year review of cases at Hualien Buddhist Tzu Chi Hospital

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ABSTRACT

Intracranial invasion of paranasal sinusitis is an emergency condition that requires surgical and medical intervention in order to avoid further deterioration. We surveyed patients at the Buddhist Tzu Chi Hospital (Hualien, Taiwan) who had paranasal sinusitis with intracranial invasion. A total of 505 patients with paranasal sinusitis were surveyed at Hualien Buddhist Tzu Chi Hospital over a 14-year period (2000–2013). Data on clinical presentations, microbiology, host factors, postinterventional morbidity, and postinterventional mortality are presented. Of the 505 patients, nine had intracranial invasions (incidence rate, 1.8%). The mortality rate was high among these patients (44.4%, 4/9). Among the various risk factors identified, diabetes had the greatest influence (66.7%, 6/9), which in combination with an immunocompromised condition and cirrhosis is indicative of a poor prognosis.

1. Introduction

The complications of paranasal sinusitis are defined as any extension of the local infectious process into adjacent structures or tissue planes. The most common complication among these is orbital cellulitis [1,2] followed by other intracranial complications, including meningitis [3], subdural empyema [4], epidural abscess [5], intracerebral abscess [6], and rarely, cavernous thrombophlebitis. In 1965, Bluestone and Steiner [7] reported four (11%) patients with intracranial complications among 38 patients admitted for acute frontal sinusitis. The aim of our survey is to understand the risk factors and the mortality rate among patients with intracranial invasion of paranasal sinusitis over a 14-year period from 2000 to 2013. Data on clinical presentations, bacteriology, host factors, postinterventional morbidity, and postinterventional mortality are presented.

2. Case report

We retrospectively screened patients according to the International Classification of Diseases, Ninth Revision (ICD-9), and reviewed the case history of 505 patients with acute sinusitis (ICD-9 461) admitted to our hospital during the period from 2000 to 2013. Of these 505 patients, nine were found to have an intracranial abscess (ICD-9 324.0). The surgical interventions followed for these patients are listed in Table 1. Increased attention was paid to analyze the case history of patients who died as a result of infection and the risk factors associated with their mortality. Diabetes was identified as the most common host factor in our series.

The mortality rate was high (44.4%, 4/9) among patients with intracranial abscess due to sinusitis that may possibly proceed to severe encephalitis. Although immunocompromised patients were treated with optimal antibiotics, there was no improvement in their condition, and therefore, early surgical drainage or even extensive debridement was considered. No postinterventional morbidity, such as cerebrospinal fluid leakage or wound infection was noted. A high culture rate (88.9%) was achieved even when the infective agent was fungal in origin. Diabetes was the most influential factor (66.7%, 6/9) in terms of host factors, and its presence seems to be related to a poor prognosis. The condition of two patients with coexisting diabetes and cirrhosis rapidly deteriorated and they subsequently died. Rupture of an internal carotid artery (ICA)

Conflicts of interest: none.

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Table 1
Factors, treatments, pathogens, and prognosis of paranasal sinusitis with intracranial invasion.

Case no.	Age/gender	Host factors	Pathogens	Surgery	Prognosis
1	81/M	Diabetes	*Aspergillus*	ESS	Cured
2	59/M	None	*Prevotella buccae*	Trephination	Cured
3	15/M	Diabetes	*Klebsiella pneumoniae*	Trephination	Cured
4	13/M	None	*Prevotella loescheii*	ESS	Cured
5	57/F	Diabetes	*K. pneumoniae*	Trephination EVD	Expired
6	57/M	Diabetes Cirrhosis ESRD	*Candida albicans*	ESS Transsphenoid Evisceration	Expired
7	62/M	Diabetes	*Streptococcus constellatus*	ESS	Expired
		Cirrhosis		Craniectomy	
8	38/F	None	No growth	Craniotomy	Cured
9	70/F	Diabetes	*Escherichia coli*	Trephination	Expired

ESRD = end-stage renal disease; ESS = endoscopic sinus surgery; EVD = external ventricular drainage; evisceration = excision of one eyeball.

dissecting aneurysm (Fig. 1) with a subarachnoid hemorrhage (Fig. 2) occurred in one patient, which was subsequently confirmed by brain autopsy examination (Fig. 3). Such a condition had not been reported previously.

Fig. 1. Cerebral angiographic image: lateral view of the left internal carotid artery showing a large dissecting aneurysm (black arrow) in a patient (Case 6).

3. Discussion

3.1. Anatomical aspects

Congenitally, the encephalocele, an isolated glial tissue with a dural connection, and the dermal fistula (or an isolated dermoid cyst), all of which hinder the communication of the skull base with other paranasal sinuses, are the leading natural routes for infection. Traumatic fractures with malunion may also result in a secondary defect and such events make it easier for the infection to invade the skull base and adjacent regions. Although the possibility of infection through the iatrogenic route may still be considered, it is difficult to prove its relationship with the intracranial invasion.

3.2. Venous route

The most common regions on the face through which infections spread are the upper lip, the lower part of nose, and adjacent areas. These sites are so identified because boils, infections of the nose, and injuries around the nose, especially injuries that have become infected, can readily spread to cavernous sinus, which then results in cavernous sinus thrombosis. The anterior facial vein begins at the side of the root of the nose through a union of the supraorbital and frontal veins. The vein drains the upper lip, the septum of the nose, and adjacent areas. The anterior facial vein communicates with the cavernous sinus through the ophthalmic veins. It also communicates with the cavernous sinus through the deep facial vein, which connects the pterygoid plexus with the anterior facial vein. Thus, retrograde thrombophlebitis may result in a hazardous intracranial extension. Another route is through the frontal diploic veins, which opens into the supraorbital vein and the superior sagittal sinus. Occasionally, perivascular or perineural spread along the olfactory nerve may also be responsible for the infection.

Direct osteomyelitis with bone erosion slowly progressing to the skull base is sometimes discovered after a computed tomographic scan of the paranasal sinus.

The young adolescent period should be carefully monitored because of the progressive pneumatization and continued development of the sinuses after birth and the late appearance of the frontal and sphenoid sinuses. These developments may result in some infections that will not appear until the later stages of childhood. A previous study reported on development of intracranial complications due to accumulation of debris in a 17-year-old patient [8]. Complications like these are hard to detect without an early imaging study and reasonable suspicion.

Host factors, including an immunocompromised condition and diabetes, were identified as a risk factor among the patients in our

Fig. 2. Brain computed tomographic image without contrast showing basal cistern and left sylvian fissure subarachnoid hemorrhage (black arrows) in a patient (Case 6).

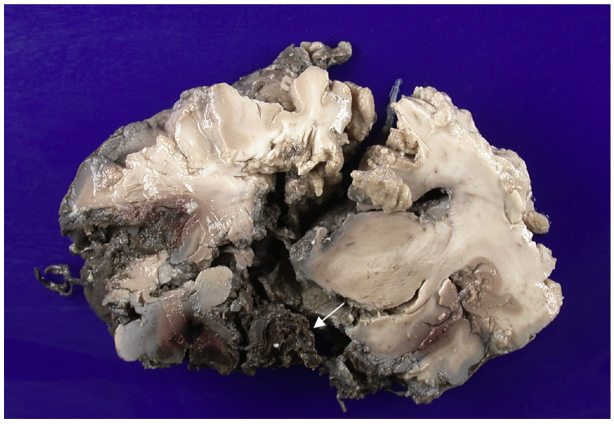

Fig. 3. Presence of the dissecting aneurysm (white arrow) was confirmed by brain autopsy (Case 6).

analysis. Diabetes was the most influential risk factor in terms of correlation with a poor prognosis. We retrospectively analyzed the 505 cases for the prevalence of diabetes (ICD-9 250) and found its incidence to be 5.3% (27/505), whereas the prevalence of cirrhosis (ICD-9 571.5) was only 0.8% (4/505). In total, there were only two patients with coexisting diabetes and cirrhosis (0.4%, 2/505) and they both expired.

Currently, to our knowledge, no molecular studies on these infections have been published, although the aforementioned anatomical route seems to be dominant. Allergic fungal sinusitis caused by *Aspergillus* spp. has been reported previously, and thus the association of microorganisms as a possible cause of infection or allergic reactions should not be excluded [9].

Immunocompromised patients with other host factors, such as diabetes and cirrhosis, may have serious complications resulting from an infection that started as a simple paranasal sinusitis. Therefore, physicians should be highly alert while treating these high-risk patients and arrange for a detailed survey of such patients as early as possible if they suspect spreading of infection. Frustratingly, although we carried every possible intervention available, the overall mortality rate among these patients was still high (44.4%) compared with the rate (25%) reported by Shaw et al [10]. Multimodality treatment combined with cranial and endonasal surgery [11] may help to obtain samples for culturing and help to bring about adequate drainage, which then provides a chance for the infection to be eliminated. Rarely, rupture of an ICA dissecting aneurysm with a subarachnoid hemorrhage occurs, as was the case in one of our patients.

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