Cavernous Sinus Thrombophlebitis Caused by Porphyromonas Gingivalis With Abscess Formation Extending to the Orbital Cavity

—Case Report—

Eiji ITO, Kiyoshi SAITO*, Tetsuya NAGATANI, Masaaki TERANISHI**, Yuri AIMI***, and Toshihiko WAKABAYASHI

Abstract

A 67-year-old man presented with a rare case of cavernous sinus thrombophlebitis (CST) caused by Porphyromonas gingivalis with abscess formation extending to the orbital cavity. Neuroimaging demonstrated a cystic lesion in the right cavernous sinus that was hyperintense on diffusion-weighted imaging. The patient was successfully treated with surgical drainage and antibiotic administration. CST is rare and often has a fulminant progression with high rates of morbidity and mortality. The differential diagnosis of cavernous sinus lesions should include CST. Early recognition and differentiation from other diseases with aggressive medical and possible surgical intervention are necessary to reduce mortality and long-term sequelae. Diffusion-weighted imaging is useful for the early recognition and differentiation of CST from other diseases.

Key words: cavernous sinus thrombophlebitis, cavernous sinus, orbital abscess, Porphyromonas gingivalis, diffusion-weighted magnetic resonance imaging

Introduction

Cavernous sinus thrombophlebitis (CST) is a type of septic thrombosis occurring within the cavernous sinus, initially described by Bright in 1831 as a complication of epidural and subdural infections. CST is rarely encountered in clinical practice and often has a fulminant progression with high rates of morbidity and mortality. Staphylococcus aureus is the responsible pathogen in 60–70% of patients, although streptococci, pneumococci, and fungi may be implicated in rare cases. The diagnosis is based on the clinical symptoms, but the clinical findings are seldom specific. Therefore, early recognition and differentiation from other diseases is necessary to prevent mortality and morbidity.

We describe a case of CST caused by Porphyromonas gingivalis infection, in which abscess formation extended to the orbital cavity.

Case Report

A 67-year-old man presented with throbbing headache on the right. No neurological deficit was evident. Head computed tomography (CT) found no abnormalities. A diagnosis of muscle contraction headache was made at another hospital, but therapy with nonsteroidal anti-inflammatory agents was unsuccessful. After 10 days, diplopia developed, indicating right abducens nerve palsy. Magnetic resonance (MR) imaging demonstrated an enhanced cystic lesion with heterogeneous component in the right cavernous sinus (Fig. 1A–C). Diffusion-weighted imaging indicated a hyperintense area in the right cavernous sinus (Fig. 1D), which was part of the lesion. The patient was referred to another neurosurgeon, who suspected a tumor of the cavernous sinus. Methylprednisolone at 50 mg/day was given orally for 3 weeks, but no clinical improvement was identified. Four weeks after the initial symptom, the patient also developed retro-orbital pain and exophthalmos on the right. MR imaging demonstrated...
Fig. 1 A: T₁-weighted magnetic resonance (MR) image showing an isointense lesion in the right cavernous sinus. B: T₂-weighted MR image showing a hyperintense lesion with heterogeneous component (arrow). C: T₁-weighted MR image with gadolinium showing an enhanced cystic lesion. D: Diffusion-weighted MR image showing a hyperintense lesion.

Fig. 2 A: Preoperative T₁-weighted magnetic resonance (MR) image with gadolinium showing an additional cystic mass lesion in the right intraorbital cavity (arrow), which was connected to the cavernous sinus lesion. B: T₁-weighted MR image with gadolinium taken 1 week after surgery showing an enhanced lesion (arrow) in the sphenoid sinus. C: T₁-weighted MR image with gadolinium taken 14 months after surgery showing no mass lesion in the cavernous sinus, intraorbital cavity, or sphenoid sinus.

However, MR imaging 1 week after surgery demonstrated an enhanced lesion in the sphenoid sinus (Fig. 2B). Endoscopic sphenoidotomy was performed under local anesthesia to establish a drainage route from the sphenoid sinus. No active infection was present, and bacterial culture of the surgical specimen detected no pathogen. The patient was discharged without neurological deficit. Follow-up MR imaging at 14 months after surgery demonstrated no lesions in the cavernous sinus, intraorbital cavity, or sphenoid sinus (Fig. 2C), and no symptoms of recurrent infection had occurred.

Discussion

The diagnosis of infectious disease was difficult to make in the present case of CST based on the initial symptoms. Several diseases localized in the cavernous sinus may cause abducens nerve palsy, including vascular abnormalities (aneurysms, carotid-cavernous sinus fistula), neoplasms (pituitary adenoma, meningioma, schwannoma), metastases, nasopharyngeal carcinoma, metabolic problems (diabetic infarction), infectious disease (herpes zoster, Aspergillus granuloma, CST), and inflammatory conditions (sarcoideosis, Tolosa-Hunt syndrome). The clinical presentations of CST vary in frequency and severity and are not specific in the early stages of the disease. The incidence of CST has been significantly reduced since the introduction of antibiotics. Nonetheless, CST should be considered in the differential diagnosis of cavernous sinus lesions.

MR imaging provides excellent resolution in the area of the sella turcica and cavernous sinus, and is therefore essential in the evaluation of patients with
cavernous sinus lesions. In contrast, CT can be inconclusive due to bone artifacts. High-resolution MR imaging can detect all stages of thrombus formation in CST. Early thrombus formation is isointense (to the gray matter) on T1-weighted images and hyperintense on T2-weighted images, becoming hyperintense on T1- and T2-weighted images with time.\(^{11}\)

Diffusion-weighted imaging can detect intracranial infectious lesions. In the present case, diffusion-weighted imaging showed the cavernous sinus lesion as hyperintense in the initial stages. Brain abscesses characteristically appear as hyperintense,\(^{6,8,13}\) subdural empyemas as hyperintense, and epidural empyemas as hypointense\(^{24}\) on diffusion-weighted imaging. The hyperintensity seen in the necrotic area on diffusion-weighted imaging is probably related to restriction of the movement of water molecules contained inside a complex matrix of proteins, inflammatory cells, cellular debris, and bacteria in high-viscosity pus.\(^{30}\) Other diseases appearing as hyperintense on diffusion-weighted imaging include ischemic lesions, hypercellular tumors, fibrous tumors, subacute hematomas, and axonal injury.\(^{1,17}\) Therefore, diffusion-weighted imaging may also be valuable in the differential diagnosis of cavernous sinus lesions. Moreover, the hyperintense area on diffusion-weighted imaging in this case was part of the lesion, which may indicate the process of abscess formation. Longitudinal follow up of a large number of patients with this condition is required to clarify all stages of abscess formation on diffusion-weighted imaging.

Other potentially useful examinations for the diagnosis of cavernous sinus thrombosis include flow analysis and venography, which can identify thrombus-induced occlusion in the cavernous sinus as a defect in the filling of the sinus. MR imaging with contrast medium can show a structure that does not contain contrast material in the cavernous sinus, associated with the filling defect, indicating a thrombotic lesion.\(^{11}\) Although these examinations can identify thrombotic lesion, the diagnosis of thrombophlebitis in the cavernous sinus is difficult to establish.

CST can spread rapidly to structures such as the contralateral cavernous sinus within 24–48 hours of initial presentation.\(^{9,29}\) Such fulminant progression has potentially lethal consequences, so CST requires emergent treatment. The mortality rate from CST was close to 100% due to septic shock before the introduction of antimicrobial agents, but has since markedly decreased to approximately 20–30%.\(^{5,31}\) However, morbidity rates remain as high as 60–75%.\(^{21,30}\) with cranial nerve palsy and blindness as the most common sequelae. In the present case, the progression was subacute and recovery was complete after treatment. The most likely explanation is that the capsular abscess was localized within the cavernous sinus and orbital cavity, possibly preventing spread to other structures and subsequent neural damage.

Orbital infections are classified according to a five-tier system: preseptal cellulitis, orbital cellulitis, subperiosteal abscess, orbital abscess, and cavernous sinus thrombosis.\(^{4,20}\) Any or all of these presentations can occur. However, orbital abscess secondary to cavernous sinus thrombosis is rare,\(^{7,29}\) because the incidence of cavernous sinus thrombosis has fallen considerably with the introduction of effective antibiotics.\(^{9}\) The valveless venous system in the orbit can explain the retrograde spread of lesions from the cavernous sinus to the orbital cavity. In the present case, serial neuroimaging showed extension of the cavernous sinus lesion to the intraorbital cavity. Intraorbital infections develop in only two ways, direct inoculation and extension from adjacent structures, most commonly the ethmoidal sinus, or hematogenous spread.\(^{10}\) The three main connections between the cavernous sinus and orbit are the optic canal and the superior and inferior orbital fissures, and the superior and inferior ophthalmic veins contain no valves between the face and the cavernous sinus.\(^{10}\) This valveless venous system between the face and the intracranial sinuses can facilitate the extension or dissemination of lesions.

Surgical drainage is necessary in some cases of CST, although the main treatment is antibiotic administration. In the present case, the orbital abscess secondary to CST was successfully treated by surgical drainage, thus preventing visual deterioration, and the subsequent sphenoidotomy was effective in managing recurrence of infection. Surgical drainage of the cavernous sinus is hardly ever performed, but may be essential for the management of primary sinusitis, facial cellulitis, or dental infection, or for complications such as brain abscess, orbital abscess, or subdural empyema.\(^{9,10,22}\) In addition, surgical treatment has the advantage of obtaining pathogen isolate.

Central nervous system infection by \(P.\) gingivalis is extremely rare, with only one reported case of brain abscess.\(^{12}\) \(P.\) gingivalis is a nonfermentative, black-pigmented, Gram-negative, obligate anaerobic rod bacteria,\(^{20}\) which has been isolated from the oral cavity and is well known as an important periodontopathogen.\(^{19}\) \(P.\) gingivalis has also been implicated in nonoral diseases, including chronic sinusitis, paranasal infected mucocele, tonsillitis, peritonsillar abscesses, pleuropulmonary infection, thoracic empyema, lung abscess, chronic supplicative otitis
media, gas gangrene, perforated appendix, and appendicitis. Fortunately, *P. gingivalis* is sensitive to a wide array of antibiotics.

**References**


Address reprint requests to: Kiyoshi Saito, M.D., Department of Neurosurgery, Fukushima Medical University, 1 Hikarigaoka, Fukushima 960–1295, Japan. e-mail: kiyoshi@fmu.ac.jp

*Neurol Med Chir* (Tokyo) 49, August, 2009