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CT Observations Pertinent to Septic Cavernous Sinus Thrombosis

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The use of high-resolution computed tomography (CT) is described in four patients with septic cavernous sinus thrombosis. In all patients CT findings included multiple irregular filling defects in the enhancing cavernous sinus. Unilateral or bilateral inflammatory changes in the orbital soft tissues were also present. Enlargement of the superior ophthalmic vein due to extension of thrombophlebitis was noted in three patients.

Since the introduction of antibiotics, septic cavernous sinus thrombosis (thrombophlebitis) has become a rare disease [1–4]. Despite considerable improvement in morbidity and mortality (previously almost universal), it remains a potentially lethal disease. The diagnosis of cavernous sinus thrombophlebitis requires a careful clinical evaluation supplemented with appropriate laboratory and radiographic studies.

Current computed tomographic (CT) scanners (having higher spatial and contrast resolution) play an important role in the radiographic evaluation of the diverse pathologic processes that involve the cavernous sinus [5–7]. The use of CT has been documented in several isolated cases [8–13], and small series [14] dealing with the diagnosis and management of cavernous sinus thrombophlebitis. CT scanning in these cases was reported to be normal in two instances [8, 10]. In other cases so studied, CT showed abnormalities such as orbital changes [11, 14], paranasal sinusitis [12], and associated manifestations of intracranial infection [9]; however, no mention was made in these cases of thrombosis within the cavernous sinus itself. Direct CT demonstration of thrombosis within the cavernous sinus has been rarely reported [13]. One explanation is that thick CT sections have not permitted adequate detailed imaging of the cavernous sinus [13, 15]. In this report, we describe findings with high-resolution CT in four patients with the diagnosis of septic cavernous sinus thrombosis.

Methods

The cavernous sinus is generally best evaluated with direct coronal sections. It is, however, quite difficult to perform coronal CT scanning in patients with cavernous sinus thrombosis. These patients are often very ill and unable to hyperextend their necks due to frequently associated meningitis. Therefore, we studied all of these patients with axial views using a GE 8800 scanner. The scans consisted of 5-mm-thick slices with 3 mm slice spacing. The plane of section was about 10° cephalad to the orbitomeatal line (including the orbit and passing through the sellar region). All scans were obtained after rapid drip infusion of 300 ml of Reno-M-DIP (pressurized by injection of air into the container). CT findings in our four patients are summarized in table 1.

Case Reports

Case 1

A 53-year-old male alcoholic drug abuser was admitted with nausea, vomiting, chills, and

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tenderness over the right side of his face. He was noted to be confused. Examination confirmed right periorbital edema and proptosis and revealed bilateral complete sixth nerve palsies. Cerebrospinal fluid (CSF) examination showed pleocytosis (66 polymorphonuclear cells and 5 monocytes/ml) and increased protein. Bilateral thrombosis of the cavernous sinus extending into the right superior ophthalmic vein was seen on CT (fig. 1). After intravenous antibiotic therapy all abnormalities resolved aside from his abducens pareses, which were unchanged at discharge 1 month later.

Case 2

A 3½-year-old boy was admitted to another hospital with swelling of his left eye after a left otitis and mastoiditis. His CSF contained 5200 white blood cells/mm^3 (95% polymorphonuclear cells), a protein of 196 mg/dl, and no detectable glucose. He was begun on intravenous antibiotic therapy, but developed increasing left periorbital swelling. On transfer to the LAC/USC Medical Center 2 days later, he was stuporous, and his left eye was immobile with a fixed pupil. He had severe right hemiparesis. CT revealed massive cerebral infarction in the left middle and anterior cerebral artery distribution. Sections at the level of the cavernous sinus showed multiple, bilateral, irregular filling defects in the enhancing cavernous sinuses. A few of these filling defects corresponded to the anatomic location of the intracavernous part of the left internal carotid artery (fig. 2). Orbital abnormalities included left proptosis, periorbital swelling, and slightly prominent intraorbital veins. Opacification of the left mastoid air cells indicated mastoiditis, which was probably the source of the thrombophlebitis. The infection was promptly controlled with antibiotics. He was discharged with residual right hemiparesis.

TABLE 1: **Summary of CT Findings in Patients with Septic Cavernous Sinus Thrombosis**

CT Finding	No. of Patients (n = 4)		
	Unilateral	Bilateral	Total
Multiple, irregular filling defects (low attenuation)	1	3	4
Exophthalmos, periorbital swelling	2	2	4
Prominent superior ophthalmic vein	3	0	3
Associated thrombosis of cavernous internal carotid artery and cerebral infarct	1	0	1

Case 3

A 59-year-old man was admitted to the hospital because of confusion and fever. He had a 1-month history of headache and pain over his face. Sinus films showed right maxillary and sphenoid sinusitis. Analysis of his CSF revealed 12 monocytes/ml, slight protein elevation, and normal glucose levels. On the second hospital day, he rapidly developed right proptosis with moderate chemosis. Movements in that eye were limited in all directions to about one-half the normal range, but vision and facial sensation were intact. CT showed multiple filling defects in the enhancing cavernous sinus. There was enlargement of the right superior ophthalmic vein and slight prominence of the extraocular muscles. Proptosis and periorbital swelling were present bilaterally, but more severe on the right side. Treatment with intravenous antibiotics produced prompt improvement. Within 3 weeks his signs and symptoms had completely resolved.

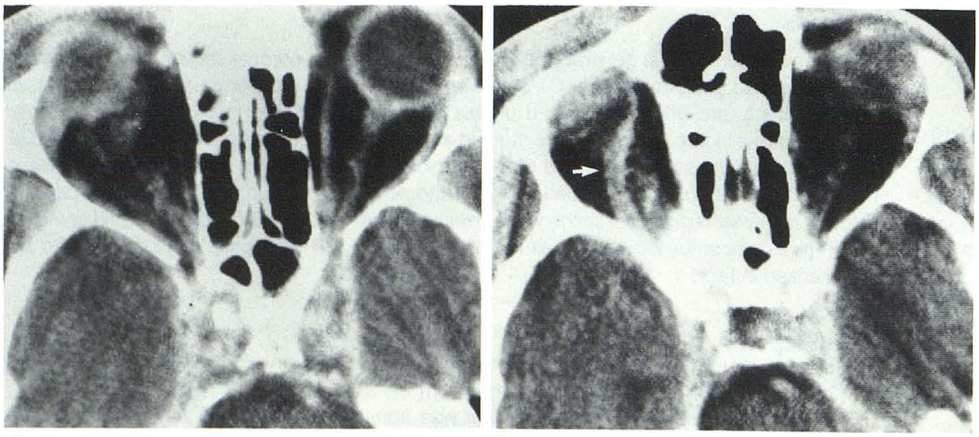
Case 4

A 65-year-old diabetic man was admitted to the hospital with a 4 day history of pain and swelling about the left eye. Within 3 days, his left eye rapidly became frozen with loss of vision in that eye. On examination the left eye was immobile. He had suffered a recent central retinal artery occlusion. CSF analysis showed 143 polymorphonuclear cells and 95 monocytes/ml, protein of 55 mg/dl, and a glucose of 65 mg/dl. CT showed left proptosis, periorbital swelling, filling defects in the left cavernous sinus, and paranasal sinusitis. The diagnosis of phycomycosis was confirmed by a nasal sinus biopsy. Despite aggressive therapy with amphotericin, the patient died on hospital day 18.

Discussion

In most reported cases of septic cavernous sinus thrombosis the diagnosis was made on clinical grounds. Only a few cases have been documented pathologically [16, 17]. Infection of the orbital tissue, infiltration of the extraocular muscles with inflammatory cells, septic thrombi in the cavernous sinus, thrombophlebitis of the ophthalmic veins, and meningitis were observed in the postmortem examinations.

Multiple irregular filling defects (low attenuation values) within the enhancing cavernous sinus were considered to represent thrombi in our cases. The lateral margin of the cavernous sinuses remained straight without evidence of expansion. Case 2 developed a severe right hemiparesis and CT evidence of massive left cerebral infarction. This patient



A B

Fig. 1.—Case 1. Bilateral thrombophlebitis of cavernous sinus extending into right superior ophthalmic vein. **A**, Multiple irregular areas of low attenuation in enhancing cavernous sinuses. **B**, Inhomogeneous enhancement of enlarged superior ophthalmic vein (*arrow*). Swelling of right side of face and orbit.

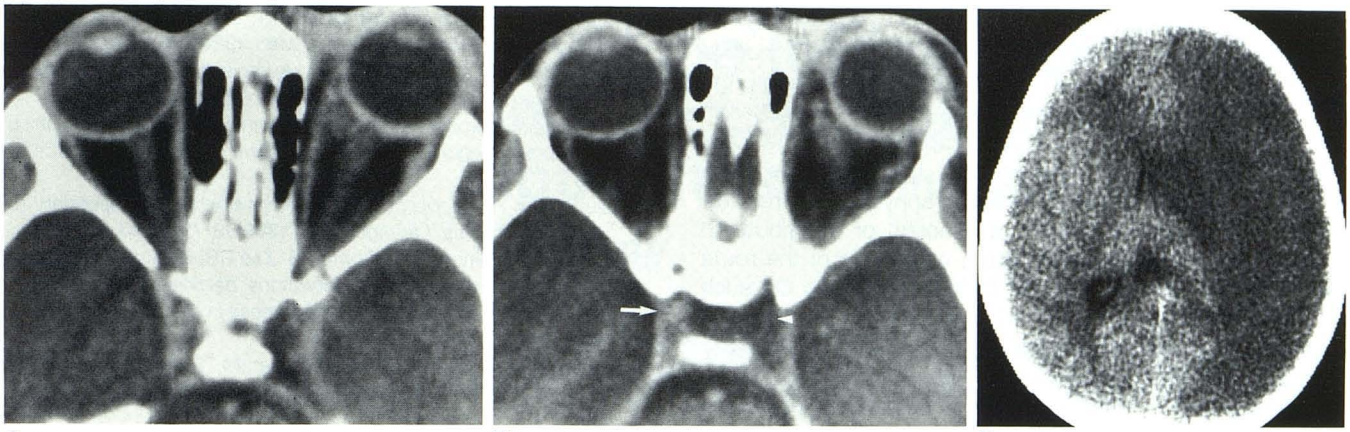


Fig. 2.—Case 2. Bilateral thrombophlebitis of cavernous sinus, thrombosis of left intracavernous internal carotid artery, and massive left hemispheric infarct. **A**, Filling defects in cavernous sinuses, more extensive on left. **B**, Normal right internal carotid artery (*arrow*). Lack of enhancement of left internal carotid artery (*arrowhead*). **C**, Massive left anterior and middle cerebral arterial territory infarction.

Fig. 3.—Low-attenuation areas (−35 H) in enhancing cavernous sinuses (*arrows*) may be an extension of retroorbital fat or ectopic fatty rests.

had an internal carotid artery thrombosis associated with thrombosis of the cavernous sinus. Some of the filling defects in the left cavernous sinus were related to lack of enhancement of the intracavernous part of the left internal carotid artery (fig. 2). However, documentation of such with cerebral angiography was not believed to be indicated. Narrowing or occlusion of the carotid artery associated with cavernous sinus thrombosis is a familiar complication and has been reported [13, 18, 19].

In the normal individual, intracavernous neural structures may be seen in the enhancing cavernous sinuses [5, 6]. The filling defects (due to septic thrombi) are irregular and do not correspond to the anatomic course of neural structures. These filling defects are also more prominent on the side of maximal orbital involvement. Varying amounts of overlying fat may exist along the course of the carotid artery in the cavernous sinus. The presence of a large amount of adipose tissue within the cavernous sinus has been described as an incidental CT finding [6, 20] and in association with Cushing disease [21].

We have recently obtained a CT scan in a 46-year-old alcoholic man who developed proptosis of the right eye after sustaining a hip fracture complicated by pneumonia. CT showed mild proptosis bilaterally, a slightly prominent right medial rectus muscle, and low-attenuation areas (−35 H) in the enhancing cavernous sinuses bilaterally (fig. 3). Antibiotic therapy was followed by a prompt and uneventful recovery of his orbital symptoms. However, low-attenuation areas in the cavernous sinus remained unchanged. We are convinced that these low-attenuation areas are due to adipose tissue within the cavernous sinuses and that they may represent ectopic rests of lipomatous tissue or might represent an extension of the retroorbital fat. This patient did not have clinical or CT evidence of pituitary tumor or endocrinopathy. Such deposits could be confused with clots in the cavernous sinus, but more careful analysis will establish their fatty nature.

Partial or complete thrombosis of an intracavernous carotid artery aneurysm, trigeminal neurinomas, and intracavernous metastases may all demonstrate abnormal low-attenuation values within the enhancing cavernous sinus. These lesions, however, expand the cavernous sinus and are generally not associated with orbital changes [5, 6]. Spontaneous aseptic thrombosis of the cavernous sinus and/or its tributaries (particularly the superior ophthalmic vein) may occur in a preexisting carotid–cavernous sinus fistula (with or without cavernous sinus expansion) [7, 22, 23]. Such a development may cause abrupt proptosis, chemosis, and periorbital swelling, or it may exacerbate existing symptoms. If the underlying carotid-cavernous fistula has not been diagnosed previously, it would be difficult to differentiate it from septic cavernous sinus thrombosis. Clinically, the absence of fever and the signs and symptoms of meningeal irritation (commonly associated with septic cavernous sinus thrombosis) is a useful clue. Cerebral angiography in this instance can establish the correct diagnosis by showing changes associated with the carotid-cavernous fistula.

Angiography, which is not without hazards, has a very limited role in the diagnosis of septic cavernous sinus throm-

bosis. Nondemonstration of cavernous sinuses during the venous phase of the angiogram is likely to be a normal phenomenon. On technically good cerebral angiograms, the cavernous sinuses are only seen in about 42% of cases in the venous phase [24]. Orbital venography may provide some information concerning thrombosis of the cavernous sinus and orbital veins [19]. However, venography could be hazardous and cause dissemination of infection or contribute to further extension of the thrombosis regardless of the route by which it is injected [25, 26]. Orbital findings on CT such as proptosis, periorbital swelling, and enlargement of extraocular muscles are nonspecific and may be seen in a variety of other conditions, such as carotid-cavernous fistula, Graves ophthalmopathy, orbital cellulitis, and acute orbital pseudotumors [5, 7, 27–29].

Before the advent of CT scanning, distinguishing cavernous sinus thrombophlebitis from orbital cellulitis required evidence of spread to the opposite sinus, severe cranial neuropathy, or concomitant meningitis [30]. Spread from orbital cellulitis is a common cause of cavernous sinus thrombophlebitis, and coexistence of these conditions has been documented in a few pathologic studies [16, 17]. Although both conditions require prompt and aggressive antibiotic therapy, their differential diagnosis is important because of the different prognosis. Residual cranial nerve palsies, visual loss, and development of hypopituitarism after recovery from septic cavernous sinus thrombosis have been documented [10, 30–32]. It is important to follow these patients clinically with neurologic examinations and pituitary function testing. Two of our patients had residual neurologic deficits, one associated with thrombosis of the cavernous segment of the internal carotid artery.

CT can now reveal directly thrombosis in the cavernous sinus and the associated orbital changes and will permit earlier diagnosis and treatment with maximal vigor. CT is also useful in detecting intracranial complications that may impede recovery, such as abscesses, empyema, or infarction.

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