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☐ Review Article ☐

An Obscure Etiology for Headache: Sphenoid Sinus Disease

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One of the most common and often most challenging problems which the primary care physician must face is the patient who complains of headaches. In addition to the common differential diagnoses (Table 1), it is important to consider diseases of the sphenoid sinus. The sphenoid sinuses, because of their location above and behind the nasopharynx, are hidden within the skull, thus making detection of disease in the sphenoid sinuses difficult.

Table 1. Differential diagnosis of headache

VASCULAR
Migraine (classic, common)
Cluster
Ophthalmoplegic migraine
Hangover
MUSCULAR CONTRACTION
TRACTION
Tumor
Hematoma
Abscess
CRANIAL INFLAMMATION
Meningitis
Subarachnoid hemorrhage
Arteritis
OTOLARYNGOLOGICAL
Sinus disease
Vasomotor rhinitis
DELUSIONAL OR CONVERSION REACTION
CRANIAL NEURALGIAS
MEDICATION-INDUCED

Sphenoid sinus disease most typically presents as headache (especially recurrent retro-orbital, frontal, or vertex headache); if detected early, it can oftentimes be cured with little or no sequelae. However, if the disease is overlooked, the complications can be severe, possibly leading to permanent neurological deficits, and occasionally, even to death. In order to recognize and evaluate the signs and symptoms of sphenoid sinus diseases, one must be familiar with the anatomy of the sphenoid sinus.

ANATOMY

The sphenoid sinuses represent air-containing cavities within the sphenoid bone which are found in the midline of the head near the base of the skull. They are inferior to the pituitary gland, superior to the nasopharynx, posterior to the ethmoid sinuses, and anterior to the pons (Lee 1987). These paired sinuses are extremely variable in size and shape with an average width of 17.4 mm and height of 19.5 mm (Van Alyea 1941), and are separated by an intersphenoidal septum which typically deviates to one side (Fig. 1). This variability in anatomy is the result of the complex fusion of many bones during the development of the sinus. In fact, though the sinuses begin forming as evaginations from the posterior nasopharynx at the third fetal month, it is not until the age of 3 or 4 years that the sphenoid sinuses are defineable cavities, and not until the teenage years that the sinuses are fully developed. The sphenoid sinuses drain into the sphenoethmoidal recess in the anterior superior nasopharynx via the sphenoid ostium (Van Alyea 1941; Kron and Johnson 1983; Graney 1986).

The central location of the sphenoid sinuses places them in close proximity to 13 critically important struc-

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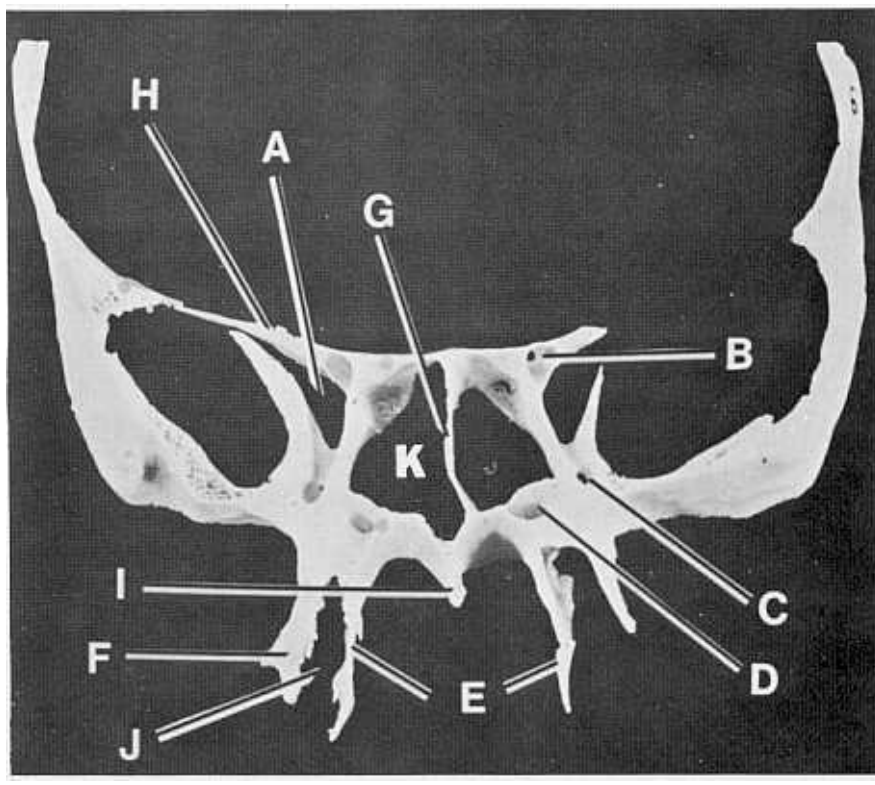

Fig. 1. Coronal section of human skull revealing sphenoid sinus and neighboring structures. A. superior orbital fissure, B. optic canal, C. foramen rotundum, D. pterygoid canal, E. medial pterygoid plate, F. lateral pterygoid plate, G. intersphenoidal septum, H. lesser wing of sphenoid, I. sphenoid rostrum, J. pterygoid fossa, K. sphenoid sinus.

Table 2. The 13 vital structures adjacent to the sphenoid sinus (Proetz, 1949)

Dura mater
Pituitary gland
Cavernous sinus
Internal carotid artery
CN II – optic nerve and optic chiasm
CN III – oculomotor nerve
CN IV – trochlear nerve
CN V1 – ophthalmoc nerve
CN V2 – maxillary nerve
CN VI – abducens nerve
Sphenopalatine ganglion
Sphenopalatine artery
Pterygoid (vidian) canal and nerve

tures described by Proetz (1949): dura mater, pituitary gland, cavernous sinus, internal carotid artery, optic nerve and optic chiasm, oculomotor nerve, trochlear nerve, ophthalmic nerve, maxillary nerve, abducens nerve, sphenopalatine ganglion, sphenopalatine artery, pterygoid canal and nerve (Table 2) (Fig. 2). The cavernous sinuses are venous channels located supero-lateral to the sphenoid sinuses which drain the ophthalmic veins, and contain the internal carotid artery and cranial nerve (CN) VI. In its lateral dural wall are contained CN III, IV, V1, and V2. Disease of the sphenoid sinuses can affect any or all of these structures by invasion or compression. Thus the signs and symptoms seen in the patient may represent involvement of these neighboring structures rather than the sphenoid sinus itself (Kron and Johnson 1983; Lee 1978; Wyllie *et al.* 1973 Wurster *et al.* 1986).

CLINICAL SIGNS AND SYMPTOMS

The challenge of sphenoid sinus disease to the

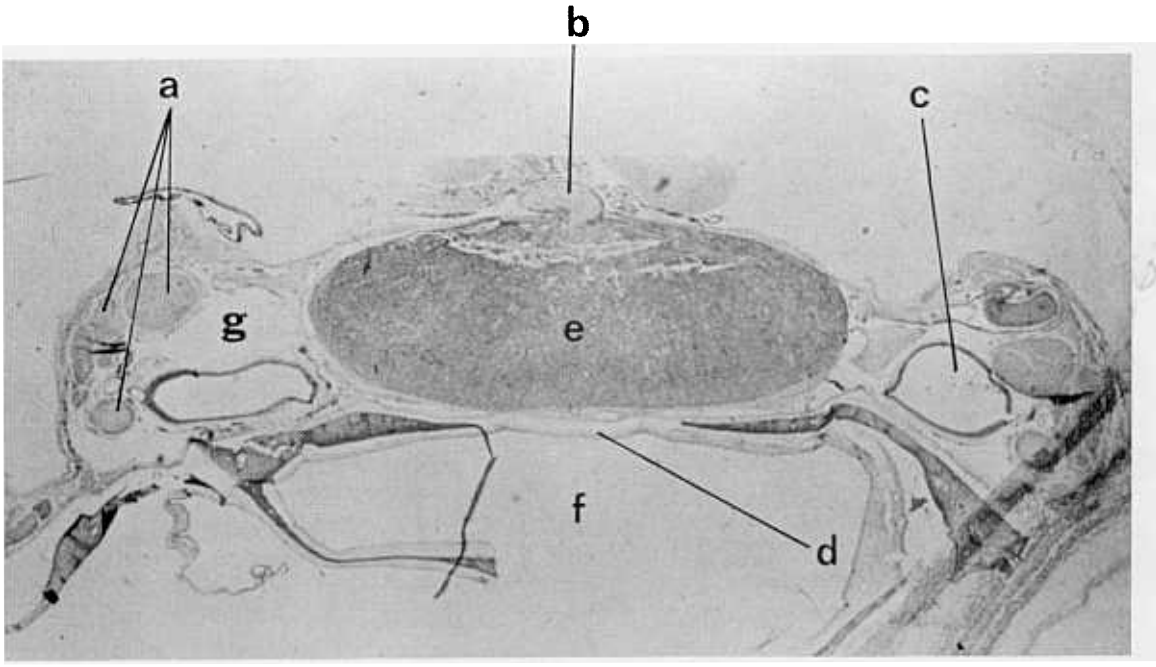

Fig. 2. Coronal histological section through the sellar region demonstrating the structures in close proximity to the sphenoid sinus. a. cranial nerves III, IV, V, VI, b. pituitary stalk, c. carotid artery, d. circular sinus (intracavernous sinus), e. pituitary gland, f. sphenoid sinus, g. cavernous sinus.

physician is to detect and to suspect the sometimes subtle symptomology which is produced. Three basic steps in making the diagnosis have been proposed: (Wyllie *et al.* 1973; Levine 1978) (1) to localize the problem to the sphenoid sinus based on history and physical examination; (2) to elucidate the nature of the lesion, i.e., inflammatory or neoplastic; and (3) to determine whether the disease is primary from the sphenoid sinus or secondary from another source. The most important thing to remember is to include sphenoid sinus disease in the differential diagnosis of those patients presenting with recurrent headaches.

The most common presenting symptom in patients with sphenoid sinus disease is headache (60-70%) (Wyllie *et al.* 1973; Wurster *et al.* 1986), (Table 3). Most commonly, the headache is described as transient, intermittent retro-orbital pain, with frontal pain being next most common. Vertex, occipital, and diffuse headaches have also been described (Wyllie *et al.* 1973; Norman and Yanagisawa 1964; Nugent *et al.* 1970). Early in the disease, headache may be the only presenting symptom (Levine 1978), and ideally, it is at this stage that one hopes to make the diagnosis.

Table 3. Signs and symptoms of sphenoid sinus disease

HEADACHE	– usually retro-orbital, frontal, vertex
	– intermittent, recurrent
	– duration: weeks to years
	– worse at night
VISUAL DISTURBANCES	
	Diplopia (CN VI)
	Oculomotor palsy (CN III, IV)
	Diminished visual acuity (CN II)
	Exophthalmos
NASAL STUFFINESS	
RHINNORHEA	
PANHYPOPITUITARISM (rare)	

The headaches tend to be worse in the evening as well as during acute episodes of sinusitis, and are aggravated by stooping, straining, or fatigue (Sellars and Devilliers 1981). Frequently, there is radiation to the face or orbit. The pain is relieved with spontaneous

drainage from the sinus (Norman and Yanagisawa 1964; Nugent *et al.* 1970). Headaches may be present for a few weeks to 25 years, with an average of 2 years before the correct diagnosis is established (Wurster *et al*, 1986).

Visual disturbances secondary to cranial nerve involvement are the next most common symptom (40%) (Kron and Johnson 1983). Oftentimes, visual changes represent the symptom which brings the patient to the physician, and which directs the physician towards the sphenoid sinus. Wyllie *et al.* (1973) noted that this symptom was usually caused by a space-occupying lesion (tumor, mucocele) rather than by sinusitis. The most common complaints described are diplopia (due to CN VI palsy), oculomotor palsies (due to CN III and IV involvement), blurred vision or loss of vision (due to CN II compromise) and exophthalmos (Wyllie *et al.* 1973). When detected and treated early, many of the defects are reversible. However, if left untreated, permanent deficits may ensue; cavernous sinus thrombosis (proptosis, chemosis, eyelid edema), and intracranial extension of disease are the most serious and often fatal, (Kron and Johson 1983; Lee 1987).

In approximately 25% of patients, primary otolaryngological symptoms such as nasal stuffiness and rhinorrhea are reported. Panhypopituitarism, though rare, has also been reported (Wurster *et al.* 1986).

DIAGNOSIS

Once suspicion is raised about a sphenoid sinus lesion based on history and physical examination, diagnostic tests, specifically radiological studies, are indicated. A set of plain sinus films is the first test, with particular interest in the lateral and submentovertical

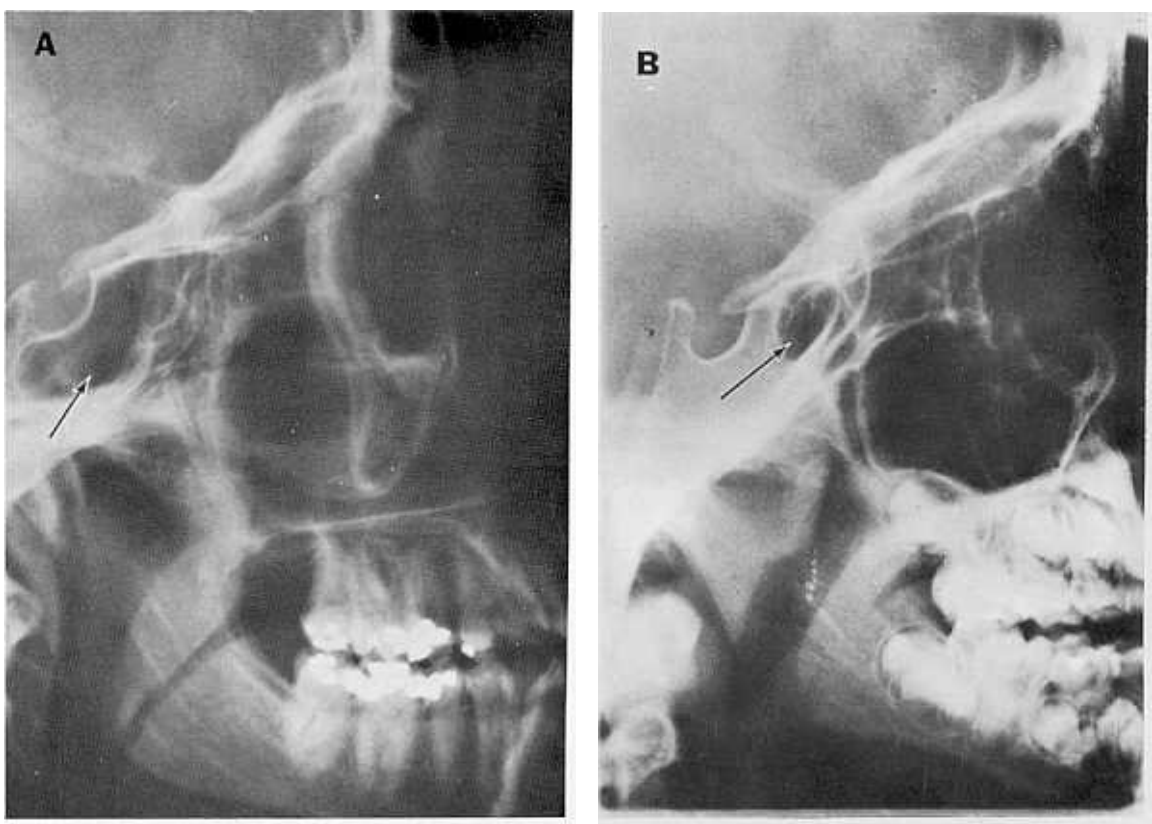

Fig. 3. Lateral sinus x-rays demonstrating normal sphenoid sinus anatomy. Note the variability in size of the sphenoid sinuses in A and B (arrows). A. Well pneumatized sphenoid sinus. B. Partially pneumatized sphenoid sinus.

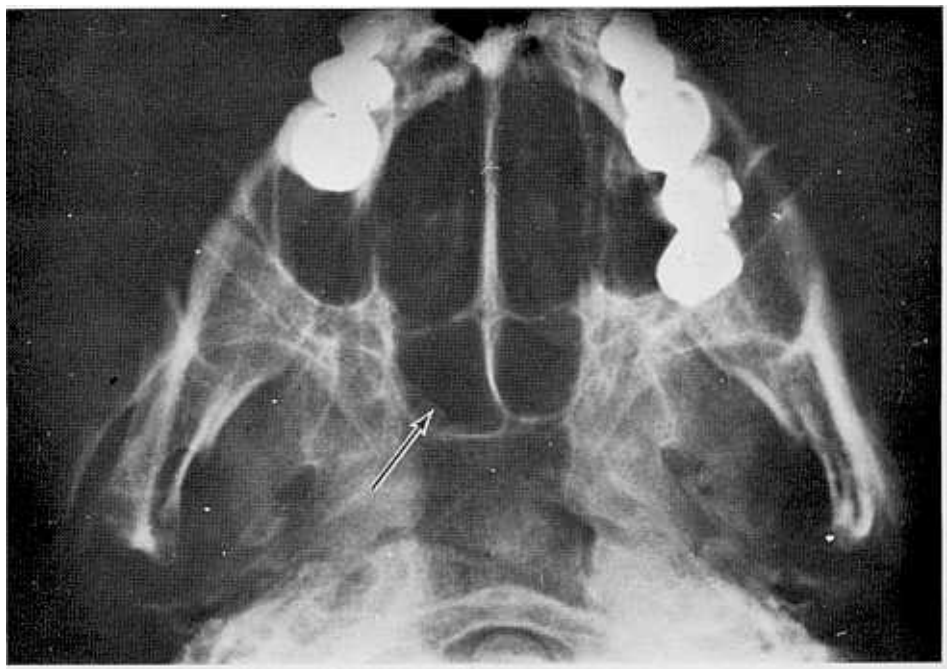

Fig. 4. Submentovertical view showing normal sphenoid sinuses (arrow). Note the slight deviation of the intersphenoidal septum to the right and the asymmetry of the sphenoid sinus volumes.

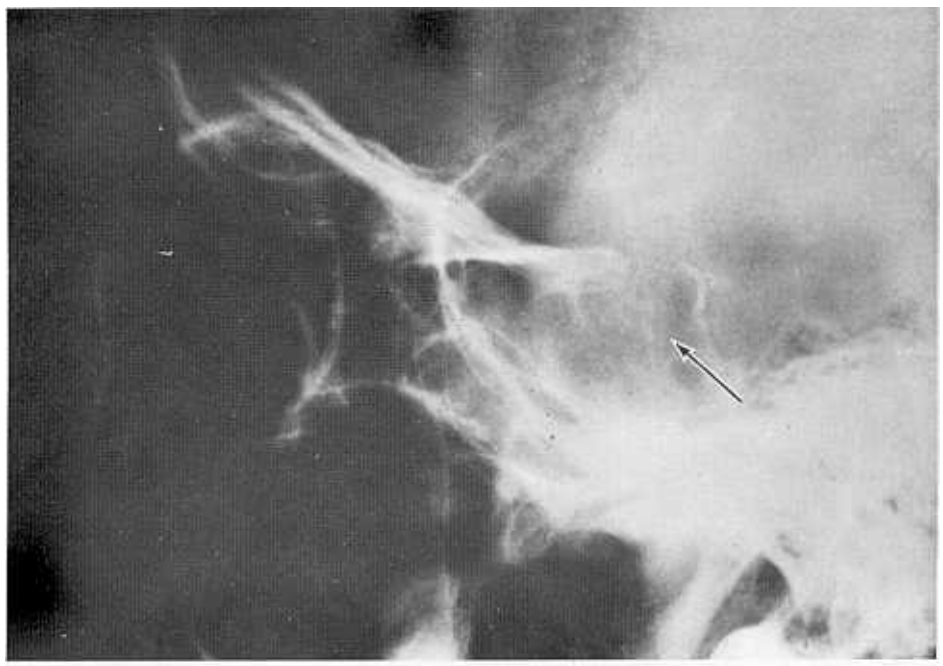

Fig. 5. Lateral sinus x-ray showing destruction of the roof of the sphenoid sinus and the floor of the sella turcica (arrow) which is suggestive of a malignant process. However, this lesion proved to be a benign mucocele of the sphenoid sinus.

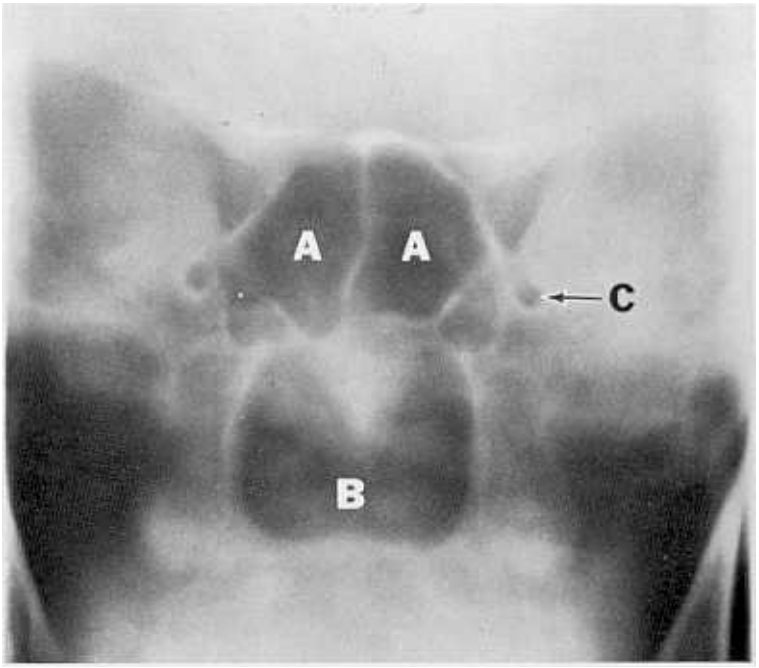

Fig. 6. Tomogram demonstrating normal sphenoid sinus anatomy, A. sphenoid sinus, B. nasopharynx, C. foramen rotundum.

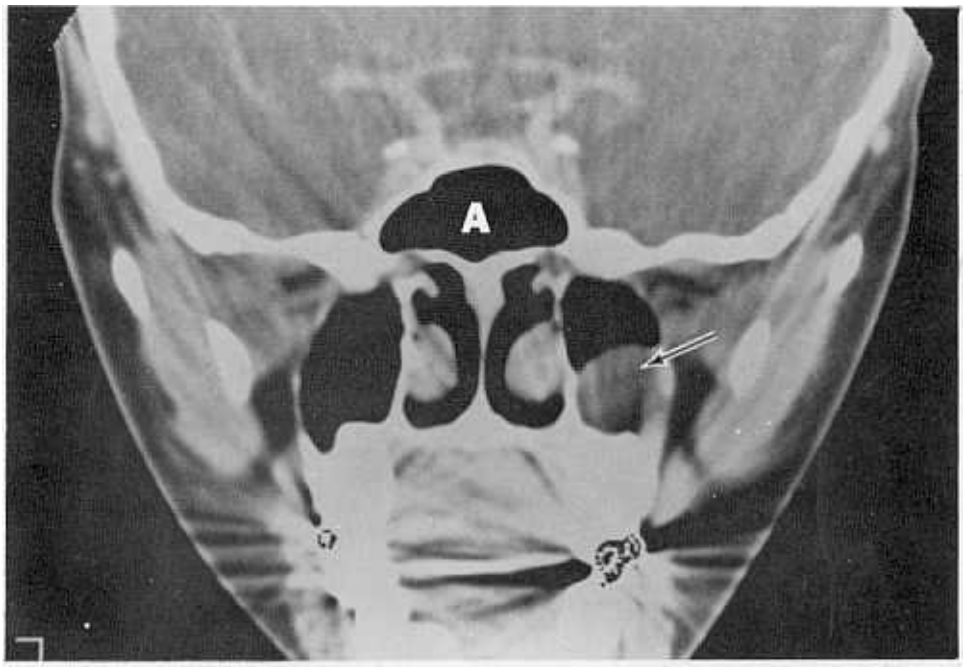

Fig. 7. Coronal computed tomography (CT) scan of head revealing normal sphenoid sinus. Note, however, the cyst in the left maxillary sinus (arrow). A. sphenoid sinus.

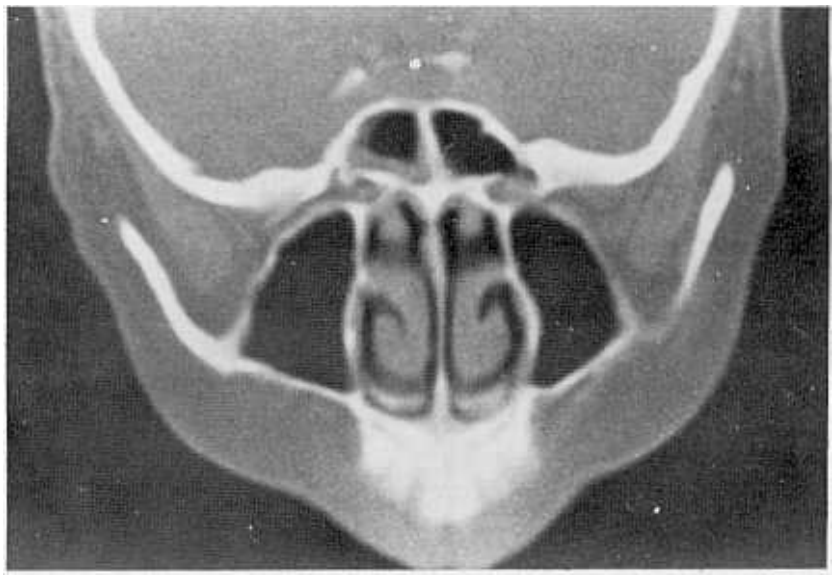

Fig. 8. Coronal CT scan of the head showing right sphenoid sinusitis. Note the mucosal thickening in the right sphenoid sinus.

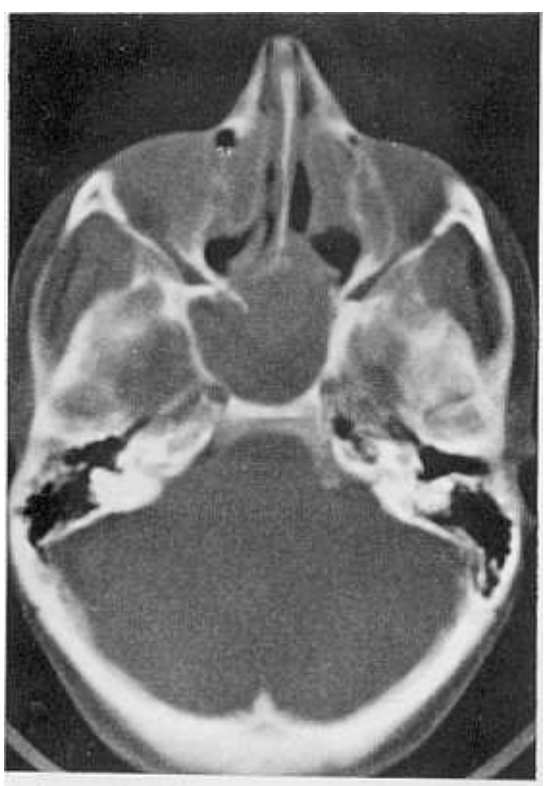

Fig. 9. Axial CT scan of a sphenoid sinus mucocele. The mucocele has filled the entire sphenoid sinus cavity and is expanding anteriorly into the ethmoid sinuses. (courtesy of Marc D. Shapiro, M.D.).

views which best demonstrate the sphenoid sinuses (Fig. 3,4). Opacification of the sinus, thinning and expansion of the sinus walls, destruction of the sella turcica, and destruction of the intersphenoidal septum are all positive signs of sphenoid sinus pathology (Sellars and DeVilliers 1981; Close and O'Conner 1983; Waldman *et al.* 1967) (Fig. 5). Polytomography permits a more detailed examination of this region (Fig. 6). However, computed tomograpy scans provide the best evaluation of the extent of the lesion, the nature of the lesion (solid or cystic), and the amount of bony involvement (Fig. 7-10). If disease if present, carotid angiography may be needed to determine the presence of large blood vessels feeding into the lesion, and the vascularity of the lesion itself. The angiogram will rule out the presence of a carotid aneurysm as well as revealing displacement of the carotid artery due to a mass in the sphenoid sinus (Levine 1978; Norman and Yangisawa 1964).

If a sinus discharge is present before or even during surgery, cultures should be obtained and sent for bacterial and fungal identification and antibiotic sensitivities.

DIFFERENTIAL DIAGNOSIS

The differential diagnosis for disease of the sphenoid sinus includes: inflammatoty lesions (sinu-

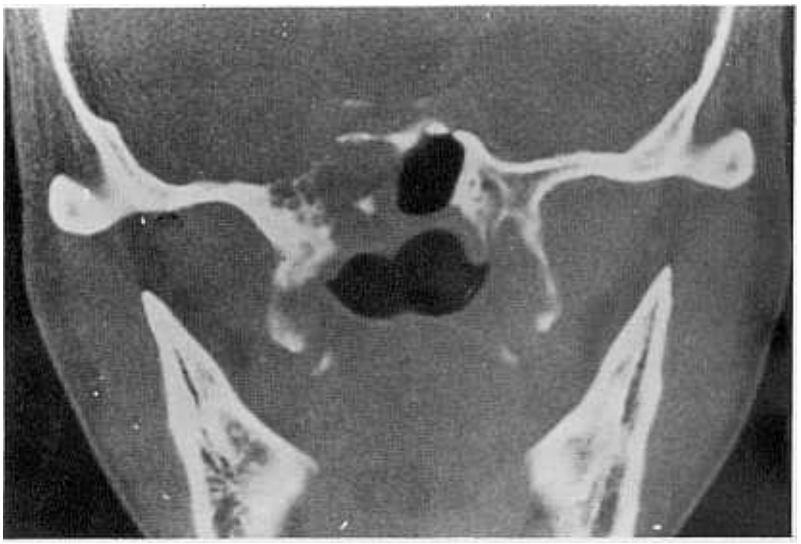

Fig. 10. Coronal CT scan of the head showing squamous cell carcinoma involving the right sphenoid sinus and nasopharynx. Note the destruction of the superior and lateral walls of the sphenoid sinus.

Table 4. Differential diagnosis of sphenoid sinus lesions

INFLAMMATORY
Sinusitis – bacterial, fungal
Mucocele
PRIMARY BENIGN NEOPLASM
Osteoma
Fibrous dysplasia
PRIMARY MALIGNANT NEOPLASM
Squamous cell carcinoma
Adenocarcinoma
Sarcoma
REGIONAL TUMOR INVASION
Meningioma
Pituitary tumor
Nasopharyngeal carcinoma
Craniopharyngioma
Maxillary and ethmoid sinus tumors
Chordoma
METASTATIC CARCINOMA
Kidney
Prostate gland
Large bowel
ANEURYSM OF INTERNAL CAROTID ARTERY
OPHTHALMOPLEGIC MIGRAINE
SYSTEMIC DISEASE
Histiocytosis X
Wegener's granulomatosis

sitis-bacterial and fungal, mucocele), primary benign neoplastic lesions (osteoma, fibrous dysplasia), primary malignant neoplastic lesions (squamous cell carcinoma, adenocarcinoma, sarcoma), tumors invading from adjacent structures (meningioma, pituitary tumor, nasopharyngeal carcinoma, craniopharyngioma, maxillary and ethmoid sinus tumors, chordoma), metastatic carcinoma (McClatchey *et al.* 1985) (renal, prostate, large bowel), aneurysm of the internal carotid artery, ophthalmoplegic migraine, and systemic diseases (histocytosis X (Wurster *et al.* 1986), Wegener's granulomatosis), (Lee 1987; Wyllie *et al.* 1973; Wurster *et al.* 1986; Levine 1978) (Table 4).

INFLAMMATORY

Sinusitis: Sphenoid sinusitis is most often caused by *Staphylococcus* species followed by *Haemophilus influenzae, Streptococcus pneumoniae,* and occasionally by *Escherichia coli* and *Proteus.* Thus ampicillin, the usual drug of choice for infection of the other paranasal sinuses, may be ineffective. Kron and Johnson (1983) advocate the addition of an antistaphylococcal agent as well as a broad coverage gram-negative antibiotic initially. A second generation cephalosporin such as Ceclor is an alternative which also provides good antimicrobial coverage. When specific culture and sensitivity results are available, the

therapy may be tapered appropriately.

Nonbacterial (fungal) sinusitis, though uncommon, has been reported with pathogens including *Aspergillus, Mucor, Candida, Histoplasma,* and *Coccidiodes* (Johnson 1986).

Mucocele: Mucocele refers to an encapsulated, cystic, mucoid-filled lesion in the sphenoid sinus which is lined by low columnar or pseudostratified epithelium with occasional goblet cells (Close and O'Conner 1983; Johnson 1986). They are the most common space-occupying lesion of the sphenoid sinus (Wyllie *et al.* 1973). Two etiologies for mucocele formation have been proposed: (1) obstruction of the sphenoid sinus ostium by chronic infection, chronic allergy, tumor or trauma, and (2) obstruction of a mucous gland secretory duct within the lining of the sphenoid sinus (Wurster *et al.* 1986; Johnson 1986). Although mucocele is a benign condition, it can cause bony destruction during the course of its gradual expansion within the sphenoid sinus. Based on the radiographic findings of bony destruction, mucoceles have often been mistaken for malignancy. In fact, Nugent *et al.* (1970) approached 16 cases of suspected pituitary tumor via craniotomy which actually turned out to be sphenoid sinus mucoceles: three patients died from infectious complications, and two patients developed nonfatal meningitis. The best method for the otolaryngologist to identify the nature of a sphenoid sinus lesion is by exploration of the sphenoid sinus, typically via an intranasal sphenoidotomy.

Tumors: Primary tumors of the sphenoid sinus are rare: only 3% of upper respiratory and upper alimentary tract carcinomas represent carcinoma of the nose and paranasal sinuses. Carcinoma of the sinuses affects, in order of frequency, the maxillary, ethmnoid, sphenoid, and frontal sinuses (McClatchey *et al.* 1985). More than 70% of paranasal sinus carcinoma is squamous cell or undifferentiated carcinoma (Kenady 1986). In Whyllie *et al.*'s series of 6 patients with grade 3 or 4 carcinoma (2 squamous cell epitheliomas, 2 lymphoepitheliomas, 1 undifferentiated squamous cell carcinoma, 1 adenocarcinoma), the survival following surgery and radiation therapy ranged from 7 weeks to 33 months, with a mean survival of 16 months (Wyllie *et al.* 1973).

Metastatic carcinoma to the sphenoid sinus is extremely rare, with primary tumor site usually involving the kidney, prostate gland, and large bowel (McClatchey *et al.* 1985) Patients who present with bony erosion of the sphenoid in whom malignancy is strongly suspected warrant complete metastatic work-up.

When there is a question of a pituitary tumor invading the sphenoid sinus versus a primary sphenoid sinus process such as a mucocele, symptoms of bitemporal hemianopsia and pituitary insufficiency should be sought. These symptoms are not typically seen in patients with mucoceles.

Ophthalmoplegic Migraine: This entity is seen in young patients with a less chronic duration of headache and eye pain symptoms. Nausea and vomiting is classically associated with this disease (Nugent *et al.* 1970).

TREATMENT

The patient who appears to have sphenoid sinus disease, without complications, should be treated by the primary care physician for sinusitis and allergy. If there is worsening of the symptoms despite medical treatment, or if there are signs of cranial nerve involvement, the otolaryngologist should become involved in the patient's care. Following radiographic studies, any mass lesion should be biopsied. No biopsy should be attempted if carotid angiography reveals a vascular mass. If disease is limited to the sphenoid sinus, a transnasal or transantral sphenoidotomy should be made.

In sphenoid sinus mucocele, the treatment of choice is drainage of the sinus, thus the sphenoidotomy with close follow-up is usually effective (Norman and Yanagisawa 1964).

If a tumor is involved within the sphenoid sinus, the mass sould be biopsied and removed with follow-up radiation therapy in most cases of malignancy. When disease has extended outside of the sphenoid sinus, involving several cranial nerves, craniotomy may be indicated to permit adequate access for tumor removal (Levine 1978).

CONCLUSION

Chronic headache, especially if it is intermittent in nature, and retro-orbital, frontal, or vertex in location, should raise the suspicion of the primary care physician about the possibility of sphenoid sinus disease. Findings of visual disturbances and nasal discharge would support the diagnosis. Disease of the sphenoid sinus is not very common, perhaps because of its deep, hidden location where it faces less exposure to pathogens, temperature shifts, and allergens. Nevertheless, the sphenoid sinus lies in such close

communication with the 13 vital structures that Proetz described (Proetz 1949), including cranial nerves III through VI, the internal carotid artery, and the brain, that serious complications may result in disease which is left untreated. Even the benign mucocele can, over time, cause extensive bone and soft tissue damage due to its expansion within a limited cavity.

The keys to diagnosis and prevention of severe complications are familiarity with the presentation of sphenoid sinus disease, and a high degree of suspicion. With early detection by the primary care physician, and referral to the otolaryngologist in cases which are refractory to therapy, or which present with neurological disturbances, the appropriate aggressive work-up and intervention can be undertaken with a result of significantly reduced morbidity and mortality for the patient.

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