

42. Mitchell I, Corey M, Woenne R. Bronchial hyperreactivity in cystic fibrosis and asthma. *J Pediatr* 1978;93:744-8.
43. Tepper RS, Eigen H. Airway reactivity in cystic fibrosis. *Clin Rev Allergy* 1991;9:159-68.
44. Tobin MJ, Maguire O, Reen D, et al. Atopy and bronchial reactivity in older patients with cystic fibrosis. *Thorax* 1980;35:807-13.

DISCUSSION

Dr. Richardson. Patients with CF have this increased adherence of *Pseudomonas* to the mucosa, which

seems to be very difficult to dislodge for some unknown reason.

Dr. Kaliner. We were curious to see if CF had an inherent mucosal defect, which we actually anticipated. Thus we measured their specific and nonspecific immune molecules in the nasal washings. We were unable to determine any abnormality.

Complications of sinusitis

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Even though they seldomly occur, the complications of sinusitis may be life-threatening. Complications can be local, orbital, and intracranial problems or combinations thereof. Orbital complications are the most frequent, and children with acute ethmoiditis are especially prone to them. To prevent permanent loss of vision, immediate and intense therapy is most important. Intracranial complications can have few symptoms, and discordance between symptoms and severity is not uncommon, which involves the importance of early radiologic diagnosis with computed tomographic or magnetic resonance imaging scans. Orbital and intracranial complications of sinusitis are medical emergencies and must be treated by specialists. Whenever possible, the underlying sinus infection should be drained at the same time. All physicians treating acute and chronic sinusitis must keep the potentially life-threatening complications of sinusitis in mind and remain suspicious because early recognition and treatment are crucial in these cases. (J ALLERGY CLIN IMMUNOL 1992;90:552-4.)

Key words: Sinusitis, infection, intraorbital, intracranial

Although sinusitis is a common disorder, major complications seldom occur. This article presents a brief description of the most frequent, major complications of sinusitis.

Complications occur most frequently in children and patients with depressed immune functions. In children most complications follow acute infections; involvement of the particular sinus determines the type of complication. *Haemophilus influenzae*, *Streptococcus pneumoniae*, and *Staphylococcus* are the most frequently cultured bacteria.¹ Severe fungal infections, which mostly occur in immunosuppressed patients, cause diagnostic and therapeutic problems.²

Because the eyes and the brain neighbor the paranasal sinuses, complications of sinusitis are medical emergencies, and patients should be hospitalized and treated by specialists. Furthermore, complications can arise rapidly. For example, a patient may rapidly develop purulent nasal discharge, headaches and fever after swimming or diving. Within a day, the patient may show signs of periorbital swelling, proptosis, chemosis and decreased visual acuity, which indicate the onset of an orbital complication.

Complications of sinusitis can be divided into local, orbital, and intracranial problems, but combinations often occur. For example, a bony erosion of the lamina papyracea caused by acute ethmoiditis can lead to the formation of an orbital abscess, which, if untreated, can spread to the cavernous sinus.

LOCAL COMPLICATIONS

Mucocele or mucopyocele are chronic, cystic lesions of the paranasal sinuses. They grow slowly and expand beyond the limits of the sinus by pressure and

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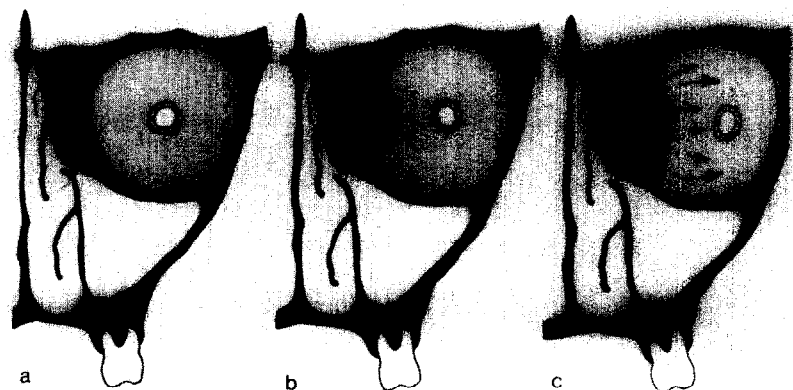


FIG. 1. Orbital complications of ethmoidal sinusitis: **a**, Orbital periostitis; **b**, subperiosteal abscess; **c**, orbital abscess. (From Becker W, et al. Hals-Nasen-Ohren-Heilkunde. 4th ed. Stuttgart: Georg Thieme Verlag, 1989:247.)

bony resorption. It may take years before they become symptomatic; headaches are a common symptom. Mucocoeles are diagnosed by radiography and often show evidence of hyperostosis. Because the lack of drainage is the major problem, rather than the abnormality of the mucosa, we believe that decompression of the mucocoeles by functional endoscopic sinus surgery is the preferred treatment. It leads to reduced surgical morbidity and superior conditions for follow-up.³

Most mucocoeles are located in the frontal sinus and can present as soft and painless tumors in the superior and medial aspect of the orbit and displace the eye inferiorly and laterally, causing diplopia. If the posterior wall of the sinus is eroded, infections of the central nervous system can result. Maxillary mucocoeles are frequently observed as incidental findings on radiographs. They occur most frequently in children with cystic fibrosis and tend to expand first into the nasal cavity, causing symptoms of nasal obstruction. The less frequent mucocoeles of the ethmoid and sphenoid sinuses can expand intraorbitally and occasionally intracranially.

Osteomyelitis that results from sinusitis is an unusual finding. It is most frequently found after trauma, radiation therapy, or debilitating disease. The frontal sinus is the site most frequently involved. Osteomyelitis of the anterior plate of the frontal bone will cause edema and swelling of the forehead, called Pott's puffy tumor. It is usually accompanied by high fever, and surgical drainage with excision of the sequestered bone is necessary. Acute spreading of osteomyelitis of the skull by septic thrombophlebitis by the valveless veins of Breschet can be life-threatening.

ORBITAL COMPLICATIONS

Orbital complications are the most common complications of sinusitis.² Children with acute eth-

moiditis are the group most prone to this complication. Orbital infections can be defined in relation to the orbital septum, which is the anterior extension of the periosteum of the orbit (Fig. 1). Preseptal cellulitis or inflammation anterior to the septum is common in young children and does not usually involve the post-septal anatomy. Thus physical examination will show lid edema and absence of orbital signs such as gaze restriction and proptosis. It should be treated with antibiotics, and surgery is not required. Postseptal infections are more severe, because they can involve orbital structures and are most commonly caused by local spread of inflammation from adjacent sinuses.⁴ Frequently the infection spreads directly through the lamina papyracea between the ethmoid sinus and the orbit. This thin and marrowless bone represents only a weak barrier to bacterial spread. The infection can also extend through thrombophlebitic ethmoid veins, because there is a free flow of blood between the valveless ophthalmic and ethmoid veins.⁵ Inflammation and edema of the eyelids are generally the first signs of the development of orbital cellulitis, a diffuse edema of the orbital contents and infiltration of the adipose tissue with inflammatory cells and bacteria. In a subperiosteal abscess, a collection of pus between the bony wall of the orbit and the periorbita occurs. Clinically, a subperiosteal abscess presents as increasing proptosis with displacement of the globe laterally or downward. The mobility of the eye will not be affected. An orbital abscess is a discrete collection of pus in the orbital tissues and causes exophthalmus, chemosis, and complete ophthalmoplegia. In this most severe stage, vision is usually severely impaired.⁵ Sometimes purulent frontal sinusitis can also lead to these complications, because the floor of this sinus contributes to the bony roof of the orbit. Intensive intravenous antibiotics are the initial management. Philosophies then vary. We believe that if any evidence

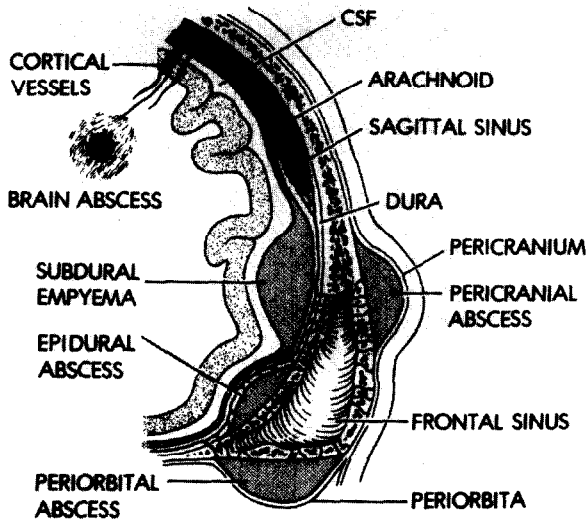


FIG. 2. Intracranial complications of sinusitis. CSF, Cerebrospinal fluid. (From Remmler D, Boles R. *Laryngoscope* 1980;90:1814-24, by permission.)

of orbital involvement is found, surgical drainage should be done immediately because permanent loss of vision can occur rapidly.^{4, 6} Others will observe carefully for resolution or progression while the patient receives intravenous antibiotics.

INTRACRANIAL COMPLICATIONS

It may be difficult to differentiate orbital cellulitis or abscess from cavernous sinus thrombosis, an intracranial problem. However, it is absolutely necessary to do so, because the latter is life-threatening. A spread of the infection from the sinuses (or the orbit) to the cavernous sinuses is facilitated by the valveless veins connecting them. In these conditions the orbital involvement is usually bilateral and includes progressive and severe chemosis, oculomotor involvement, retinal engorgement, fever, and prostration. Early recognition and treatment are of vital importance for the prevention of permanent loss of vision, meningitis, or death.²

Other intracranial complications can be accompanied by fewer symptoms, even though their severity may be equal or worse (Fig. 2). When a patient who has acute sinusitis of the frontal, ethmoidal, or sphenoid sinuses develops headache, meningismus, unexplained high temperatures, nausea, vomiting, or a change in mental status, meningitis should be suspected. Often a subdural empyema will be found; it should be kept in mind that the cerebrospinal fluid can be sterile in this case, because the arachnoid is an efficient barrier to the direct invasion of bacteria.⁷ Unfortunately, a discordance between symptoms and

the severity of the infection is not uncommon in this case. Therefore early radiologic diagnosis with computed tomographic or magnetic resonance imaging scans is of crucial importance.

Brain abscesses are one of the most severe complications. Their size can easily be underestimated, especially if they are located in the frontal lobe. Unfortunately, most brain abscesses after sinusitis occur in this neurologically relatively silent area.⁸ More than half of all brain abscesses result from acute, bacterial infections of the sinuses.⁹ High-dose antibiotics that penetrate the inflamed meninges should be given. Neurosurgical drainage of the intracranial processes is necessary. Whenever possible, the underlying sinus infection should be drained at the same time as the intracranial complications.

Although rare, potentially life-threatening complications of sinusitis must be remembered by all physicians treating acute or chronic sinusitis. Any sign of orbital or central involvement in association with sinus infection should lead to immediate and intense diagnostic studies. Computed tomographic and magnetic resonance imaging scans permit a much better assessment of the severity and stage than conventional roentgenograms. Treatment of the complications must be aggressive, and surgical therapy will often be necessary.

REFERENCES

- Gwaltney JM, Sydnor AJ, Sande MA. Etiology and antimicrobial treatment of acute sinusitis. *Ann Otol Rhinol Laryngol* 1981;90 (suppl):68-71.
- Johnson JT. Paranasal sinuses, clinical entities, infections. In: Cummings CW, Fredrickson JM, Harker LA, Krause CJ, Schuller DE, ed. *Otolaryngology—head and neck surgery*. Vol 1, 1st ed. St. Louis; The CV Mosby Co, 1986:887-900.
- Kennedy DW, Josephson JS, Zinreich SJ, Mattox DE, Goldsmith MM. Endoscopic sinus surgery for mucocoeles: a viable alternative. *Laryngoscope* 1989;99:885-95.
- Patt BS, Manning SC. Blindness resulting from orbital complications of sinusitis. *Otolaryngol-Head Neck Surg* 1991;104:789-95.
- Chandler JR, Langenbrunner DJ, Stevens EA. The pathogenesis of orbital complications in acute sinusitis. *Laryngoscope* 1970;80:1414-28.
- Maniglia AJ, Kronberg FG, Culbertson W. Visual loss associated with orbital and sinus diseases. *Laryngoscope* 1984;94:1050-9.
- Remmler D, Boles R. Intracranial complications of frontal sinusitis. *Laryngoscope* 1980;90:1814-24.
- Hadley JA, Bakos R, Regenbogen V. Middle cranial fossa epidural abscess: an unusual complication of acute sinusitis. *Am J Rhinol* 1991;5:181-6.
- Maniglia AJ, Goodwin J, Arnold JE, Ganz E. Intracranial abscesses secondary to nasal, sinus, and orbital infections in adults and children. *Arch Otolaryngol-Head Neck Surg* 1989; 115:1424-9.