

Sinogenic intracranial complications

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Abstract

Two hundred and nineteen patients, with intracranial complications of sinusitis, are presented. Sinusitis is still a life-threatening condition and if neglected, or mismanaged, can lead to intracranial complications that result in a high mortality and morbidity.

Twenty-two patients had meningitis, 127 subdural empyema, 38 brain abscess, 15 combined brain abscess and subdural empyema and 17 extradural empyema. The diagnosis of intracranial abscess and sinusitis was made with the aid of a CT scan, and that of meningitis on cerebrospinal fluid microscopy, chemistry and culture. The most frequent presenting signs were fever (68 per cent) and headache (54 per cent). The most common localizing neurological sign was hemiparesis (35.5 per cent). Orbital inflammation was present in 41.5 per cent of patients.

Treatment entailed immediate, appropriate, intravenous antibiotic therapy and prompt surgery, performed within 12 hours of admission. In patients with meningitis, the surgery entailed surgery of the sinus disease only. In patients with subdural empyema, brain abscess and extradural empyema, evacuation of the primary source of infection by the radical frontoethmoidectomy approach, immediately after drainage of the intracranial collection of pus, was carried out.

There were 35 deaths (16 per cent). The highest mortality rate was recorded in patients with meningitis (45 per cent) followed by brain abscess (19 per cent) and subdural empyema (11 per cent). Despite advances in medicine, i.e. antibiotics and CT scan for early and accurate diagnosis, the mortality from sinogenic intracranial complications has remained significant. This can only be eliminated through education. This paper emphasizes to younger generations of otolaryngologists and primary care physicians that sinusitis is a serious disease and there is no place for delay or complacency when managing such patients.

Key words: Sinusitis, complications, intracranial

Introduction

Purulent sinusitis can be considered a life-threatening disease because of the intracranial complications associated with it. In the pre-antibiotic era, the mortality from intracranial sepsis was between 80 and 100 per cent (Kubik and Adams, 1943; Ray and Parsons, 1943, Courville, 1944; Ballantine and White, 1953). With the introduction of antibiotics, the mortality halved, but remained high, ranging between 27 and 53 per cent (Jooma *et al.*, 1951; Wright and Ballantine, 1967; Garfield, 1969). A high mortality for a condition considered preventable with appropriate management of the underlying disease, is unacceptable.

This paper serves to remind younger otolaryngologists and primary care physicians that sinusitis still is a potentially lethal disease and that intracranial complications, and possible death associated with it, can only be prevented with appropriate, early detection and eradication of the primary disease.

Materials and methods

From January 1985 to December 1990, 466 patients were managed who had complications of sinusitis. Of these 240 had extracranial complications and 226 intracranial complications. The patients with intracranial complications were divided into two groups, symptomatic (219 patients) and 'silent' (seven patients). Of the 219 symptomatic patients 124 were male and 95 female. Their ages ranged from 1 to 60 years, as shown in Figure 1. Twenty-two (10 per cent) had meningitis. Of the remaining group requiring neurosurgical intervention, 17 (eight per cent) had extradural empyema, 127 (58 per cent) subdural empyema, 38 (17 per cent) brain abscess and 15 (seven per cent) combined brain abscess and subdural empyema. The presenting signs and symptoms for patients with meningitis are shown in Figure 2.

The diagnosis of intracranial complications and sinusitis was made with the aid of an axial computed

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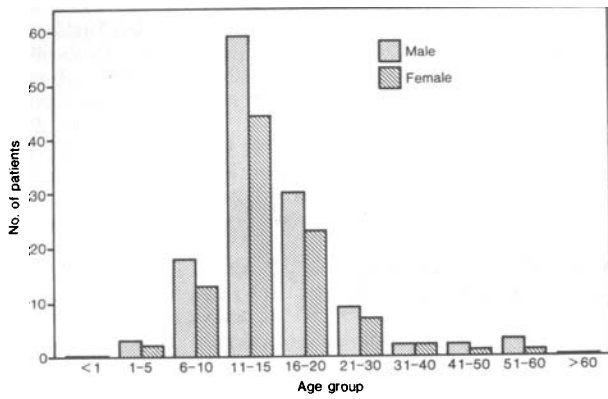


FIG. 1
Age and sex of patients.

tomography scan (CT), that of meningitis on the chemistry, microscopy and culture of the cerebrospinal fluid. Our initial treatment consisted of intravenous soluble penicillin 300 000 units/kg/day, sulphadiazine 30 mg/kg/day, chloramphenicol 30 mg/kg/day and metronidazole 20 mg/kg/day.

Radical sinus surgery, via the external frontoethmoidotomy approach, was performed on all patients, frontoethmoidectomy was performed on 166, ethmoidectomy on 38 (bilateral in five), sphenoidectomy on 131 and bilateral antral washout on all. One hundred and thirteen patients had pus in the frontal sinus, 78 in the ethmoid sinus, 18 in the sphenoid sinus. All patients had pus in the maxillary sinus, in 88 it was bilateral. Two hundred and nineteen patients had thickened mucosa in the ethmoid sinus, 166 in the frontal sinus, 131 in the sphenoid sinus. The intracranial complications, subdural empyema, brain abscess, extradural empyema and combined subdural and brain abscess were drained, as an emergency, by the neurosurgical service.

In all patients the sinus surgery and neurosurgical procedures were performed under the same anaesthesia, within 12 hours of admission. The neurosurgical procedure always preceded the sinus surgery.

Symptomatic intracranial complications

Meningitis

Twenty-two patients (10 per cent) had meningitis and of these 13 (59 per cent) had associated extracranial complications (orbital inflammation). Four (18 per cent) had forehead swelling and a

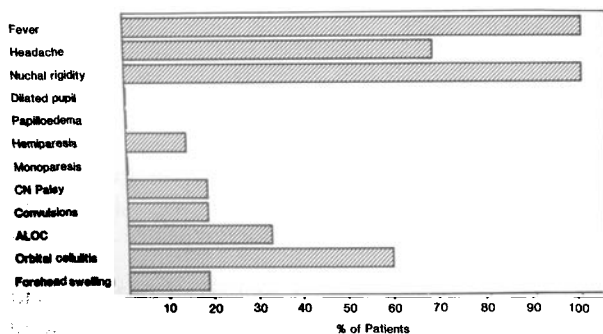


FIG. 2
Presenting signs and symptoms of patients with meningitis.

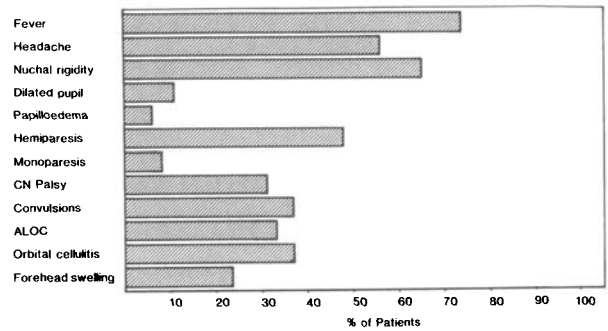


FIG. 3
Presenting signs and symptoms of patients with subdural empyema.

similar number seizures. Alteration of level of consciousness was noted in a third of patients, (four were admitted drowsy, two stuporous and one comatose). Three (14 per cent) also had hemiparesis and four lower motor neuron type VII cranial palsy. There were 16 deaths (46 per cent).

Subdural empyema

One hundred and forty-two (65 per cent) patients had subdural empyema (Figure 3) and of these 15 had a concomitant brain abscess and 53 (37 per cent) had associated orbital inflammation. Thirty four (24 per cent) had forehead swelling, 53 (37 per cent) seizures and alteration in level of consciousness was present in 47 (33 per cent), (two patients were admitted drowsy, 40 stuporous and five in a coma). Seventy-nine (56 per cent) presented with motor signs, (68 hemiparesis and 11 monoparesis). Forty-three (30 per cent) presented with cranial nerve palsies, (35 UMN VII cranial nerve palsy and eight VI nerve palsy). There were 16 deaths (11 per cent).

Brain abscess (see Figure 4)

Fifty-three (24 per cent) patients had frontal lobe abscess, 15 had concomitant subdural empyema and 14 (26 per cent) associated orbital inflammation. Nine had forehead swelling, and 17 (32 per cent) had seizures. Alteration in level of consciousness occurred in 30 (57 per cent) (seven drowsy, 18 stuporous and five comatose). Nine had hemiparesis and three monoparesis. Fourteen (26 per cent) had cranial nerve palsies, (10 UMN VII nerve palsy,

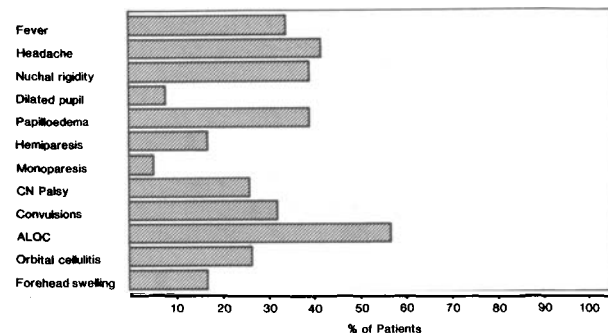


FIG. 4
Presenting signs and symptoms of patients with brain abscess.

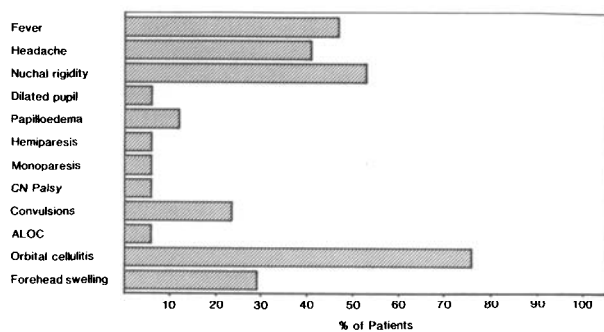


FIG. 5

Presenting signs and symptoms of patients with extradural empyema.

three VI nerve palsy and one III nerve palsy). There were 10 deaths (19 per cent).

Extradural empyema

Seventeen (eight per cent) patients had extradural empyema (Figure 5). Thirteen (76 per cent) had associated orbital inflammation, five (29 per cent) forehead swelling, and four (24 per cent) convulsions. Drowsiness was noted in only one patient. There were no deaths.

In total orbital inflammation was associated with intracranial complications in 91 (41.5 per cent) patients and forehead swelling in 47 (21.5 per cent) patients (Figures 2, 3, 4 and 5).

Mortality and morbidity

The mortality and morbidity, as previously described, were directly related to the level of consciousness on admission, as shown in Table I. Highest mortality was, however, recorded in patients with meningitis (46 per cent), followed by brain abscess (19 per cent), and subdural empyema (11 per cent).

'Silent' intracranial complications

In seven (three per cent) the intracranial complication was 'silent' in that the Glasgow coma scale was 15/15, there was absence of nuchal rigidity and localizing neurological signs. The age and sex, clinical presentation, reasons for requesting CT scan and the intracranial lesions are shown in Table II. The 'silent' intracranial lesion of patient 7 is displayed in Figure 6. Fifty-five (12 per cent) patients had forehead swelling (Pott's puffy tumour), 47 (85.5 per cent) were associated with intracranial

lesion. In two patients, the intracranial complications were 'silent'. The diagnosis was made on computed tomography (CT) scan.

The initial treatment, before the diagnosis of intracranial lesion, consisted of intravenous antibiotics, ampicillin 30 mg/kg/day and metronidazole 20 mg/kg/day. After the diagnosis of intracranial complications, chloramphenicol 30 mg/kg/day, sulphadiazine 30 mg/kg/day were added. The intracranial collection of pus was drained through burr holes and craniotomy. The sinus disease was excised via the radical frontoethmoidectomy approach. There was one death (patient no. 4). The others recovered without any neurological defect.

Discussion

With the introduction of antibiotics 50 years ago, the incidence of sinogenic intracranial complications has decreased worldwide with only a few isolated reports in the literature. However, in a developing country, such as South Africa, where malnutrition, poverty and inadequate medical services exist, the disease is very prevalent with an incidence similar to the pre-antibiotic era.

For unknown reasons, sinogenic intracranial complications occur, predominantly in males, and peak in the second and third decades. In the present series, there was a male predominance but the peak was in the second decade.

In the pre-antibiotic era meningitis was most common intracranial complication of sinus disease. It was more commonly associated with ethmoid and sphenoid disease (Courville and Rosenvold, 1938). With the advent of antibiotics the incidence decreased tremendously with Sable *et al.* (1984) reporting six per cent, Hoyt and Fisher (1991), 24 per cent, and Clayman *et al.* (1991) 29 per cent. The 10 per cent incidence noted in the present series is in keeping with the declining pattern. Surprisingly the advent of antibiotics has not affected the mortality significantly. The mortality remains high, the 46 per cent noted in the present series is in keeping with the high mortality (31 per cent) reported by Beckhuis and Taylor (1969).

The most common intracranial complication of sinus disease is subdural empyema (Kubik and Adams, 1943; Schiller *et al.*, 1948). On the other hand sinusitis is the most frequent cause of subdural empyema with Wood (1952) and Sable *et al.* (1984) reporting sinusitis as the cause in 82 per cent of patients, Schiller *et al.* (1948) and Bannister *et al.* (1981) 70 per cent, Hitchcock and Andreadis (1964)

TABLE I
MORTALITY AND MORBIDITY IN RELATION TO CONSCIOUSNESS LEVEL ON ADMISSION

Level of consciousness on admission	No. of patients	Death (%)	Hemiparesis (%)
Fully conscious	135	9 (6.6)	34 (25)
Drowsy	14	1 (7)	5 (35.7)
Stuporous	60	17 (28)	37 (61.6)
Comatose	10	8 (80)	2 (20)
Total	219	35 (16)	78 (35.5)

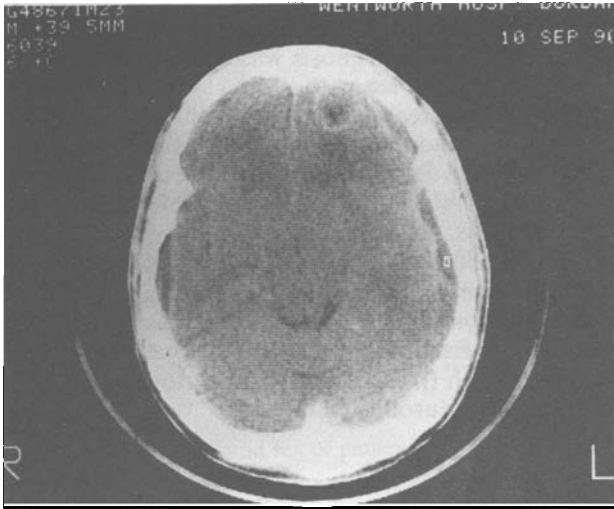


FIG. 6

CT scan of patient no. 7 displaying 'silent' frontal lobe abscess with surrounding oedema and subdural empyema.

69 per cent, Bhandari and Sarkari (1970) 54 per cent, Hoyt and Fisher (1991) 53 per cent.

The mortality from subdural empyema in the pre-antibiotic era was 100 per cent (Kubik and Adams, 1943; Ray and Parsons, 1943; Courville, 1944). With the introduction of antibiotics, the mortality decreased, but has remained high, ranging between 30 and 40 per cent (Wood, 1952; Hitchcock and Andreadis, 1964; Bhandari and Sarkari, 1970; Farmer and Wise, 1973; Kaufman *et al.*, 1975). In the present series there was a very low mortality of 11 per cent. When compared to the other series, it seems that the main factor, which might be responsible for the low mortality is the important change in the treatment policy, viz., the surgery to eradicate the primary source of infection is not delayed but is routinely carried out under the same anaesthesia as the emergency neurosurgical procedure, with the neurosurgical procedure always preceding the sinus surgery. Not surprisingly Hoyt and Fisher (1991) reported a low mortality of 14 per cent with a similar approach.

Sinogenic brain abscess frequently involves the frontal lobe. In the pre-antibiotic era, complicated paranasal sinus disease was responsible for between six and 32 per cent of all brain abscesses, but with the introduction of antibiotics, the figure decreased to 13 per cent (Loeser and Sheinberg, 1957; Carey *et al.*,

1971; Kornblut, 1972). Recently there have only been a few reports of sinogenic brain abscess with Sable *et al.* (1984) reporting on two patients, and Clayman *et al.* (1991) 11. In the present series there were 53 patients.

A frontal lobe abscess is usually neurologically silent, thus making the clinical diagnosis difficult. The symptoms of mental dullness, lethargy and headache may make one suspect a frontal lobe abscess, but CT scan is necessary to confirm it.

Despite the recommended treatment, the mortality reported remains high: in the region of 50 per cent (Buchheit *et al.*, 1970). In the present series, the mortality was low, 19 per cent. This low mortality rate is probably due to a high index of suspicion associated with an aggressive approach to eradicate the primary source of infection at the same time as the neurosurgical procedure.

Extradural empyema results when infection spreads from the paranasal sinus, usually the frontal sinus, through the Haversian canals of the frontal bone to produce osteomyelitis, which then ruptures through the inner table to produce an extradural abscess, or through the outer table to produce a subperiosteal swelling (Pott's puffy tumour). Extradural empyema is a very rare complication of sinusitis (Courville and Rosenvold, 1938), and it is surprising, therefore, that in the present series there were 17 patients (eight per cent) with extradural empyema. The majority were associated with orbital inflammation.

Surprisingly, less than half the patients had orbital inflammation to alert the examiner to the fact that sinusitis was the primary source of infection. It is therefore important to scan the paranasal sinus in all patients suspected of, or diagnosed as, having intracranial sepsis but without an obvious primary source of infection. The classical Pott's puffy tumour was present in only a fifth of the patients.

With regard to 'silent' sinogenic intracranial complications one must appreciate that the signs and symptoms of intracranial complications can be categorized into three groups (Table III). Although headache and fever are the most common presenting symptoms of patients with intracranial complications (Clayman *et al.*, 1991), they are not specific to intracranial lesions. They occur equally commonly in patients with uncomplicated, acute sinusitis. When patients with sinusitis are assessed to exclude

TABLE II
SUMMARY OF PATIENTS WITH 'SILENT' INTRACRANIAL COMPLICATIONS

Patient no.	Age	Sex	Clinical presentation	Reason for CT scan	Intracranial complications
1	14	M	Periorbital cellulitis	Persistent pyrexia and headache	Extradural empyema
2	16	F	Periorbital cellulitis	Persistent pyrexia	Extradural empyema
3	13	M	Periorbital cellulitis	Persistent pyrexia	Extradural and subdural empyema
4	15	M	Forehead swelling	Pott's puffy tumour	Multiloculated frontal lobe abscess
5	16	M	Forehead swelling	Pott's puffy tumour	Extradural and subdural empyema
6	8	F	Periorbital cellulitis	Persistent pyrexia	Frontal lobe abscess
7	23	M	Frontal headache	Persistent pyrexia and headache	Subdural empyema and frontal lobe abscess

TABLE III
PRESENTING SIGNS AND SYMPTOMS OF SINOGENIC INTRACRANIAL COMPLICATIONS

Category	Pathology	Signs and symptoms
Nonspecific	Infection	Fever
CNS related	Meningeal inflammation Increased ICP	Nuchal rigidity Headache Dilated pupil Papilloedema
	Cortical damage	Hemiparesis Monoparesis Cranial nerve palsy Convulsion ALOC
Associated EC complications	Orbital inflammation Pott's puffy tumour	Orbital cellulitis Forehead swelling

CNS = Central nervous system; ALOC = altered level of consciousness; EC = extracranial complications; ICP = intracranial pressure.

associated intracranial complications, the signs and symptoms sought are nuchal rigidity, the presence of localizing neurological signs and alteration in the level of consciousness. If these are absent, then it is assumed that the patient does not have an intracranial lesion. This is not true and cannot be relied upon (as noted in the present series). Here none of the patients had the classical signs and symptoms referable to an intracranial lesion.

The usual presenting signs and symptoms of patients with acute sinusitis, with or without orbital inflammation, are headache and fever. With surgical drainage of the sinus and intravenous antibiotic therapy, the symptoms subside within 48 hours. In those patients who fail to respond, an associated intracranial complication is always suspected. In the present series, there were five such patients.

Pott's puffy tumour is a fluctuant swelling on the forehead and suggests spread of infection from the frontal sinus. It is a sinister clinical sign which is often associated with osteomyelitis of the wall of the frontal sinus and the threat of intracranial sepsis (Clain, 1973). In the present series, this sign signified intracranial complication in 47 (85.5 per cent) patients. In two patients, the intracranial complications were 'silent', one patient had a frontal lobe brain abscess and the other extradural empyema. Because of the high association of Pott's puffy tumour with intracranial sepsis, any patient who presents with a recent history of spontaneous forehead swelling, must have a CT scan to exclude an intracranial lesion, whether the patient is symptomatic or not. Had the referring doctor of patient no. 4 been aware of such an entity, he would have referred the patient earlier to hospital, and death might have been prevented.

Although appropriate medical and surgical intervention will lead to a favourable outcome, the prognosis is largely dependent on the extent of neurological damage sustained from the effects of the intracranial lesion before the patient presents for treatment. If there is irreversible damage to the central nervous system, then no matter what is done, the outcome is generally bleak. Therefore, in order to prevent death occurring from sinogenic intracranial complications, speedy diagnosis and swift and

aggressive intervention for both the primary infection and its complications is absolutely essential.

Conclusions

The initial incidence of sinogenic intracranial complications decreased with the advent of antibiotics, but until recently the mortality rate virtually remained unchanged. Complications from sinus disease can only be eliminated through constant education.

This paper has been designed as a message especially to the younger generation of otolaryngologists and primary care physicians, that sinogenic intracranial complications may be a life-threatening condition. With early and appropriate treatment of the sinusitis, however, the complications can be prevented and death almost entirely eliminated.

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