Computerised tomographic detection of intracranial complications of paranasal sinus infections

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Summary

Ninety-four patients were referred for CT examination of the paranasal sinuses within a five year period. Only 11 (11.7%) of them had intracranial complications. These include cerebral, subdural and epidural abscesses, frontal bone osteomyelitis. The maxillary and ethmoidal sinuses were mostly involved and can be implicated as the sinogenic causes of intracranial infections. Sphenoidal sinus was not involved in any of the patients.

Keywords: ***Intracranial Complications, Sinusitis, Computed tomography.***

Résumé

94 patients ont été envoyés chez un spécialiste pour un examen CT des sinusetes para nasales en moins d'une période de cinq ans. Seulement 11 soit 11,7% d'entre eux étaient atteints des complications intracrâniennes. Y compris sous dural cérébral, et des abcés épi durites, os frontal ostéomyélite. Les sinusites maxillmaires et ethmoidales étaient principalement concernés, donc, on peut conclure qu'ils sont des causes sinogéniques des infections intracraniennes. La sinuite sphénoidale n'était pas indique chez aucun des patients.

Introduction

Intracranial complications secondary to paranasal sinus (PNS) infections are much less frequently encountered in this era of antibiotics[1]. Through rare, these complications are life-threatening and carry a high rate of mortality and morbidity. They include: meningitis extradural abscess, subdural empyema, intracerebral abscess, cavernous sinus and superior sagittal sinus thrombosis[2,3,4]. Pericranial abscess and cranial osteomyelitis are also documented complications[2,5,6].

Patients with sinusitis often present first with signs and symptoms of complications and these are best evaluated by computerised tomography (CT) as plain radiographs lack sensitivity and specificity in this regard[7,8]. The ability of CT to evaluate the intracranial complications as well as the primary source of infection in the PNS at the same examination makes it the most suitable imaging modality. Several cases in our experience illustrate this.

Clinical materials and methods

The CT scans of patients referred for PNS examination within a period of five consecutive years (January 1996 and December 2000) at the CT suite of the University College Hospital Ibadan, Nigeria, were reviewed retrospectively for evidence of intracranial complications. The clinical information, age and sex of the patients were obtained from the radiological request cards of subjects.

CT technique

The examinations were performed on a GE 9000 machine. Slice intervals were 5mm through the sinuses and 10mm through the brain. Pre-and post-contrast axial slices of the paranasal sinuses and the entire brain were obtained with coronal slices at 5mm interval through the sinuses.

Results

A total of 94 patients had PNS examination during the period but only 11 patients had intracranial complica-

Table 1 Distribution of patients by sex and age group

Age-group	Male	Female	Frequency
0 – 10	0	1	1
11 – 20	5	0	5
21 – 30	3	1	4
31 – 60	0	0	0
61 – 70	0	1	1
Total	8	3	11

Table 2 Clinical presentation in the 11 patients

Clinical presentation	Frequency
Rhinorrhea	4
Headache	4
Ear discharge	4
Ear ache	3
Fever	3
Hemiparesis	2
Peri-orbital swelling	2
Convulsion	2
Restlessness	1
Positive kerning's sign	1

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Table 3 CT scan findings and their frequency

CT Scan findings	Frequency
Intracerebral (parenchymal) abscess	6
Subdural abscess	3
Epidural abscess	1
Hyperdensity of all sinuses (Parasinusitis)	4
Sinus mucosal thickening	6
Enlarged nasal turbinates	2
Epicranial abscess	2
Gyral enhancement	1
Calcified abscess	2
Hyperdense mastoids and auditory meati	2
Mass effect (ventricular compression and midline shift)	3
Frontal bone osteomyelitis	1

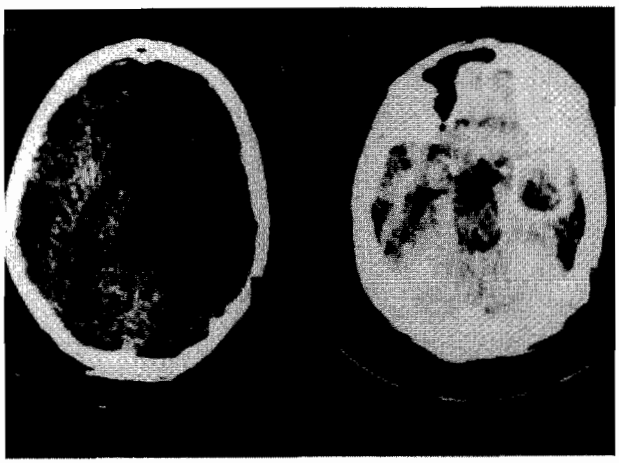

Fig. 1 ***Pre-and post contrast axial brain CT scans showing a well demarcated encapsulated intracerebral abscess in the left temporoparietal lobe. The capsule of the abscess shows brilliant ring enhancement after contrast injection. The surrounding brain is hypodense due to oedema.***

tions of PNS infections. The patients' ages ranged from 8 years to 68 years with a mean of 22.7 years. There were 8 males and 3 females. Nine of the patients were in the 11 to 30 years age group (Table 1).

Table 2 shows the clinical presentation of the patients. Rhinorrhea, headaches and ear discharge featured most frequently. Table 3 shows the various radiological findings on CT scan. Cerebral Abscesses Fig. 1 was the most common finding. Subdural and epidural abscesses were seen in three and one patient respectively Fig. 2. A review of the records showed that only one of the patients had an initial plain radiograph of the paranasal sinuses.

The maxillary sinus was involved in four patients, ethmoidal in two, frontal in one, while four patients had pansinusitis. The sphenoidal sinus was not involved in any of our patients.

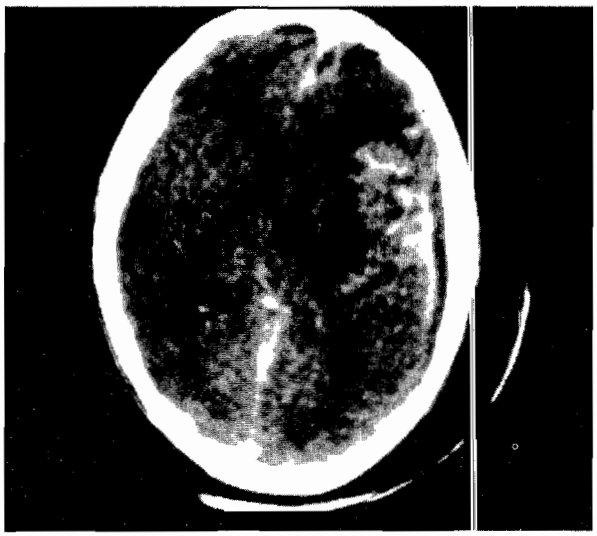

Fig. 2 ***Post-contrast axial brain CT scan showing a left subdural abscess. There is mass effect with a shift of the midline contralaterally. Arrow points to a small epidural abscess along the interhemispheric fissure anteriorly.***

Discussion

Intracranial extension of infection from the PNS is the second most common complication of sinusitis, orbital complications being the most common [9]. Though the former is reported to be rare and clinically unremarkable in children[10], one of our patient was eight years old. In a study of 35 cases of purulent meningitis in Ivory Coast, portal of entry for the infection was found to be in the sinus in 23% of cases [1]. Sinusitis is also a recognised cause of recurrent bacterial meningitis[11]. In the United States of America, 22 of 176 studied cases of intracranial suppuration were secondary to sinusitis[2]. A separate study however recorded a low incidence of 9% for sinogenic causes of intracranial suppuration[12]. Ethmoidal and frontal sinuses were mostly implicated[6,13] but in our study the incidence in this study is 5.6%, the maxillary and the ethmoidal sinuses being the most frequent cause. Multiple intra and extra cranial complications of sinusitis may be seen in a single patient[3]. A strong association is said to exist between *Streptococcus anginosus* sinusitis and intracranial sequelae[13].

Infection may enter the intracranial compartment by two major routes: direct extension through necrotic areas of osteomyelitis in the posterior wall of frontal sinus or through the valveless venous network, which inter-connects the intracranial venous system and the vasculature of the sinus mucosa[14]. The direct route of intracranial extension is more commonly associated with chronic otitic infections while the intravenous route is common with PNS infections.

CT scan is now recognised to be the most definite

test for the diagnosis of intracranial infections[15]. It is relatively non-invasive and is able to define even small purulent collections. CT gives an exact localisation of abscesses and minimizes the risk of missing multiple lesions. In diagnosing subdural empyemas. Enhanced CT with contrast is a useful aid but findings may be subtle and contrasted. Magnetic resonance imaging is superior in difficult cases[13] where the adjacent dense cranial vault produces an edge artefact on CT scan. Also, the ostiomeatal unit is currently postulated to be a critical area in the pathogenesis of sinus disease and the anatomy of this unit can be accurately assessed by coronal CT scan[16].

Intracranial complications of sinusitis present classically with headache, altered mental status and fever[3] but in a few patients, the symptoms are more subtle. Four of the patients studied presented with headache and three had fever. A high level of suspicion is required especially in unconscious, mentally retarded and psychomotor handicapped patients as a rapidly fatal course may develop in absence of warning signs[5].

The CT findings of intracranial abscess vary depending on the stage of development of the abscesses at the time of the scan. Early in the formation, it is seen as a poorly defined hypodense area exhibiting little enhancement. This may progress to a well demarcated encapsulated lesion with the capsule enhancing brilliantly after contrast injection and the surrounding brain appears hypodense due to oedema (Fig. 1). There may be mass effect with displacement of midline structures or compression of the ventricles causing some degree of hydrocephalus. This was evident in the brain CT scans of three patients in this study (Fig. 2). Most of the intracranial abscesses demonstrated on CT in this study were located in the frontoparietal regions. Two patients had abscesses in multiple sites and in one of these it was bilateral. Cortical gyri enhancement may be seen following intravenous administration of contrast in cases of meningitis with or without associated ventricular dilatation. Extradural abscess is usually lentiform in shape on CT and is limited by dural attachment to the suture line between individual skull bones. Four distinct sites of subdural empyema have been described in the literature[14,17]. These are (i) the frontoparietal convexity (ii) loculated focus anywhere over the hemisphere especially frontal and occipital lobes, (iii) along the interhemispheric fissure and (iv) under the tentorium in the posterior fossa.

The early recognition of intracranial complications of sinusitis made possible by CT would ensure that prompt treatment is instituted. The treatment of the causative sinusitis as well as neuro-surgical drainage of abscesses and use of antibiotics are paramount in obtaining the best chance for a full recovery[2,6].

Conclusion

We agree with other authors that the incidence of intracranial complication of paranasal sinus disease is low but the consequences of delayed diagnosis are grave[3,11]. The initial clinical features of intracranial sepsis may be non specific, so a high index of suspicion is needed to make appropriate diagnosis and institute immediate and aggressive treatment before serious neurological sequelae occur. CT imaging of the brain and paranasal sinuses offers a most valuable diagnostic approach to early detection of the intra-cranial complications. It is also gives a better assessment of the primary sinus disease.

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