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Aspergillosis of the paranasal sinuses

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Summary. The CT appearances of 13 cases of pathologically proven aspergillosis involving paranasal sinuses were reviewed. Symptoms included rhinorrhea, nasal obstruction, headache, facial pain and foul smell from the nose. At operation, these lesions appeared yellowish, brownish, grey or black in colour, and contained dirty or muddy material. Microscopic examination of the tissue removed showed an *Aspergillus* ball with chronic inflammation but without invasion of the nasal or sinus mucosa in 6 cases, and tissue invasion with necrosis and inflammation in 7. The structures involved, in order of frequency, were: maxillary sinus, nasal cavity, ethmoid sinus, orbit and cavernous sinus. The orbit was involved in 2 cases, therefore categorized as invasive; the other 11 cases were non-invasive as judged by CT. Calcification was seen in the lesions of 9 cases. In most cases the adjacent bony structures showed areas of erosion and sclerosis. Aspergillosis should be suspected in the presence of a mass in the paranasal sinuses or nasal cavity with calcification within it, which may not appear solid or dense and is separate from the walls of the sinus.

Key words: Computed tomography – Paranasal sinuses – Fungus – Aspergillosis

Aspergillus is a fungus of the Ascomycetes class, most commonly encountered in human environment, especially in the lung. However, many other sites may be involved, including the paranasal sinuses, liver, spleen, bone and meninges [1, 2]. It is the most common fungal pathogen in sinus disease [3, 4], the maxillary sinus being predominantly involved. As *Aspergillus* is not contagious, sources of infection are endogenous. The paranasal sinuses are at risk when their ostium is obstructed [5]. The fungus grows best anaerobically, so that bacterial infection with subsequent occlusion of the ostium of the sinus leads to conditions which favour fungal proliferation.

Aspergillus fumigatus is the most common species implicated in paranasal sinus disease in the Unites States and Austria [5, 6], while *A. flavus* is the most common in the Sudan. *A. niger, A. oryzae, A. terreus, A. gloccus* and *A. nodulans* have also been reported as sinus pathogens [7, 8].

Histologically, *Aspergillus* can be identified by septate hyphae and dichotomous branching. Other phycomycetes are excluded from the diagnosis because of the smaller septate hyphae and the 45° angle of branching [5].

To understand better paranasal sinus involvement by aspergillosis, we reviewed the CT studies of 13 cases with histological confirmation.

Materials and methods

Thirteen proven cases of aspergillosis involving the paranasal sinuses studied by CT from 1987 to 1991 were reviewed retrospectively. Eight of the patients were male; their ages ranged from 47 to 71 years (Table 1).

The indications for CT included the following, plus suspicious or positive ENT findings: rhinorrhoea, purulent or not (9 cases), nasal obstruction (5), headache (3), blood-tinged sputum or haemoptysis (3), facial pain (2), foul smell from the nose (2), general malaise (1), and nausea (1). Symptoms had been present for 2 months–10 years before CT. At operation, the lesions were yellowish, brownish, grey or black (Table 1), and described as dirty or muddy on gross inspection. All specimens were reviewed by one pathologist, for evidence of invasion of the nasal or sinus mucosa.

CT studies were performed in coronal and/or axial planes, with 4-mm slices at 4-mm intervals. The images were reviewed as regards the extent of involvement and bony changes and other features.

Results

The CT findings are listed in Table 1. Most cases involved the maxillary sinus. In 2 patients there was invasion of the orbit or cavernous sinus (Fig. 1). The other lesions were confined to the paranasal sinuses or nasal cavity. The structures involved in order of frequency were: maxillary sinus (12 cases), nasal cavity (8), ethmoid sinus (6), orbit (2) and cavernous sinus (1). Calcification was seen in the lesion in 10 cases (77%) (Figs. 2, 3). A mass lesion mixed with gas bubbles, indicating an inflammatory process was seen in 3 cases. In all cases involving the maxillary sinus its lateral wall was sclerotic (12 cases) and one of these pa-

Table 1. Clinical and radiological features of 13 cases of *Aspergillus* sinusitis

Case	Sex/Age (years)	History	Gross	Microscopic	CT extension					Bony change		
					Ma	E	N	O	S	Er	Sc	Cal
1	M 62	F,M,B 3 months	Black	I	−	+	−	+	−	−	−	+
2	M 69	P 1 year	Yellowish dirty	A	+	+	+	−	−	+	+	−
3	M 70	R,O 5 months	Black	A	+	+	−	−	−	+	+	+
4	M 58	P,B 5 months	Yellowish brown	A	+	−	+	−	−	+	+	+
5	F 59	O,H 5 years	Brownish black	I	+	−	+	−	−	+	+	+
6	F 66	H,N 3 months	Brownish muddy	I	+	−	−	+	+	−	+	+
7	M 62	P,F 2 months	Grey	A	+	−	+	−	−	+	+	+
8	F 47	R 10 years	Hard material	A	+	−	−	−	−	−	+	+
9	M 65	P,O 3 years	Yellowish muddy	I	+	+	+	−	−	+	+	+
10	M 69	R,B 6 months	Yellowish black	A	+	−	+	−	−	+	+	−
11	F 66	P,H 3 months	Black	I	+	+	+	−	−	+	+	−
12	F 60	O 5 months	Fungus ball and pus	I	+	−	−	−	−	−	+	+
13	M 71	R,O 6 months	Brownish black	I	+	+	+	−	−	+	+	+

Symptoms: R, rhinorrhea; O, nasal obstruction; P, purulent rhinorrhea; H, headache; N, nausea; F, facial pain; M, general malaise; B, haemoptysis or blood-tinged sputum. Microscopic findings: A, *Aspergillus* ball with chronic inflammation; I, tissue invasion with necrosis and inflammation. CT extension: Ma, maxillary; E, ethmoidal; N, nasal chamber; O, orbit; S, cavernous sinus. Bony change: Er, erosion; Sc, sclerosis; Cal, calcification

tients also had sclerosis of the ethmoid septum and lamina papyracea. Erosion of the medial wall of the maxillary sinus, next to the ostiomeatal complex, was present in 9 cases (Fig. 4).

Microscopic examination of the removed material showed an *Aspergillus* ball and chronic inflammation, without invasion of the nasal or sinus mucosa in 6 cases, and tissue invasion with necrosis and inflammation in 7.

Discussion

According to the clinical presentation and the structures involved, aspergillosis involving the paranasal sinuses can be non-invasive, invasive, fulminant, or allergic [9–13]. Hora and Houston [9] recognized the non-invasive or invasive types. The non-invasive type generally resembles bacterial sinusitis: the patients complain of nasal obstruction, a pressure sensation and rhinorrhoea, and plain radiographs may only show clouding or opacification of the paranasal sinuses [5]. The invasive type may present with extension into the cheek or orbit, and is manifest radiologically as a paranasal sinus mass with invasion to and destruction of the sinus walls, orbit and soft tissues of the face. It is seen in both immunocompetent and immunocompromised individuals. McGill et al. [10] described a fulminant form of paranasal sinus aspergillosis, which occurs in immunodepressed patients, and is characterized by a rapidly progressive gangrenous mucoperiostitis with destruction of the nasal cavity, lateral nasal wall, and paranasal sinuses

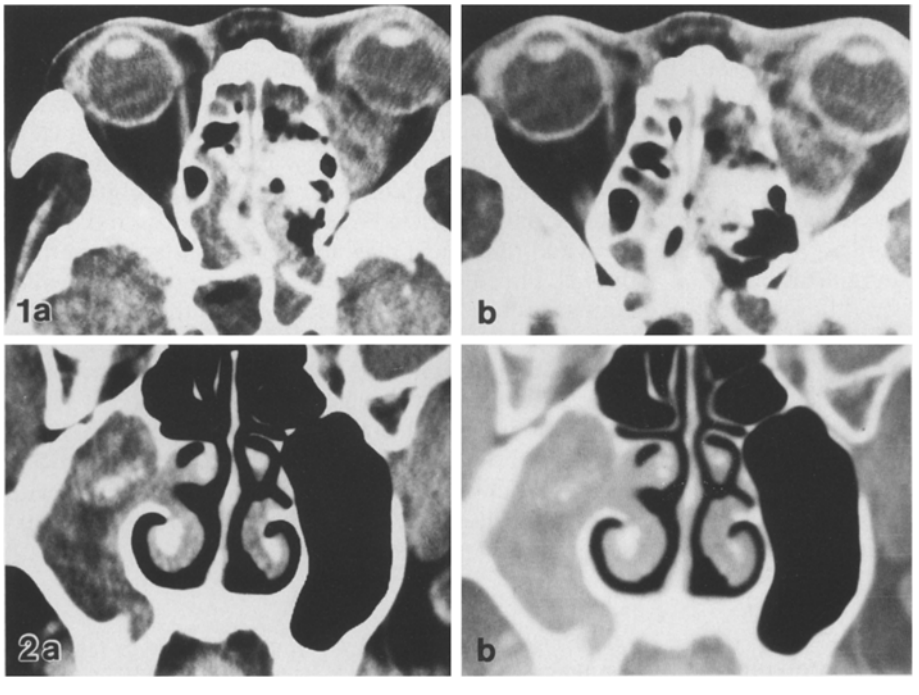

Fig. 1a,b. Case 1. A 62-year-old man with facial pain, general malaise and blood-tinged sputum for 3 months. Axial CT before (**a**) and after (**b**) intravenous contrast medium shows mass in the left ethmoid sinuses, with involvement of the orbit

Fig. 2a,b. Case 7. A 62-year-old man with purulent rhinorrhoea and facial pain for 2 months. Coronal CT (**a**, soft tissue window; **b** bone window) shows a partly calcified mass in the right maxillary sinus, lateral wall of which is sclerotic

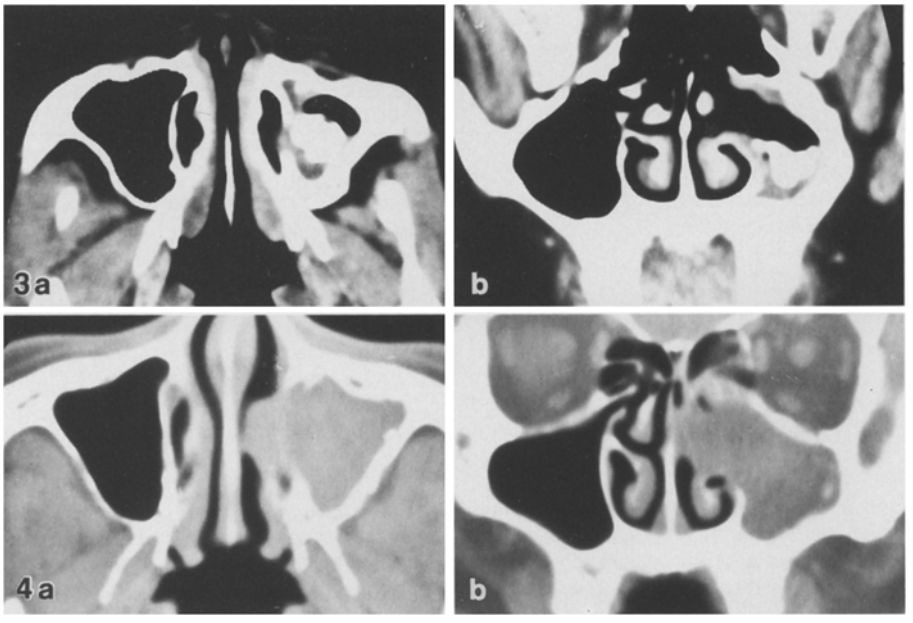

Fig. 3a, b. Case 8. A 47-year-old woman with rhinorrhoea for 10 years. Axial (**a**) and coronal (**b**) CT shows sclerosis change of the wall of the left maxillary sinus a calcified mass within it

Fig. 4a, b. Case 10. A 69-year-old man with rhinorrhoea and blood-tinged sputum for 6 months. Axial (**a**) and coronal (**b**) CT shows a relatively homogeneous mass, without calcification, in the left maxillary sinus. This could be a polyp or other solid tumour. The lateral wall of the sinus is sclerotic and its medial wall is eroded

within a few days [10]. It frequently extends to the anterior cranial fossa and may disseminate to involve lungs, spleen and liver. Katzenstein et al. [11] described the allergic type of aspergillosis, recognized by the mucinous material's containing eosinophils, fungal hyphae and Charcot-Leyden crystals. There is no direct mucosal, soft tissue or bone invasion by fungi in the allergic form [11–13].

In our study, none was fulminant, since all the patients had symptoms for more than 2 months. Two cases invaded the orbit, and were thus of the invasive type. The other 11 cases were non-invasive. None had clinical or histological findings compatible with allergic aspergillosis.

Of the 6 patients with microscopic findings of invasion of the mucosa with tissue necrosis suggesting the invasive type, only 2 had CT evidence of extension into the orbit, compatible with a clinical classification of invasive aspergillosis. Microscopic invasion does not therefore, necessarily indicate clinical invasiveness, but clinically invasive aspergillosis does show microscopic soft tissue invasion with tissue necrosis.

Our patient's symptoms were not specific for aspergillosis.

As in previous reports, the maxillary sinus was the structure most commonly involved [5, 8, 14].

Bone change was not specific for aspergillosis either. The type of bone erosion seen cannot be differentiated from acute sinusitis with hypertrophic sinus mucosa prolapse [15].

Stammberger et al. [6] found metallic densities, resembling foreign bodies, in one of the sinus in 27 of 59 (45.7 %) cases studied radiologically. Such high density is compatible with local enrichment of calcium, manganese, and iron in the fungal masses [6, 16]. Ten of our patients (77 %) had calcification on CT images; a mass lesion with spotty calcification in the paranasal sinus should arouse suspicion of aspergillosis.

Differential diagnosis of aspergillosis involving the paranasal sinus includes: a solid tumour such as polyp, carcinoma or lymphoma; bacterial sinusitis; foreign body retention; and rhinolith. Differential diagnosis between a solid tumour and aspergillosis is usually not difficult, as a tumour mass is "solid", contiguous with the wall of the sinus, and has a density similar to muscle. Aspergillus sinusitis usually shows a large amount of low density mucus. The more solid portion may not be contiguous with the wall, and may occasionally be mixed with gas pubbles. When an *Aspergillus* mass is associated with gas bubbles, it is difficult to differentiate from bacterial sinusitis or from retention of a foreign body such as gauze. Calcification in bacterial sinusitis is uncommon. Foreign body or rhinolith should also be considered when the fungus ball is totally calcified.

On MRI, aspergillosis of the paranasal sinus gives decreased signal intensity on T1-weighted images and extremely low signal on T2-weighted images, more characteristic of a mycetoma than CT findings [16].

Surgery is the primary treatment of invasive and non-invasive aspergillosis of the paranasal sinuses. Most cases can be cured through surgical excision and aeration of the involved sinus. If the fungus spreads into the orbit or intracranially, amphotericin B should be administered. Flucytosine and rifampicin may also be used as adjuvant therapy [11]. For fulminant aspergillosis, surgical removal of all gross lesions, and amphotericin B is the treatment of choice [5]. All our patients were treated by surgical excision. The two with clinically invasive disease also received amphotericin B intravenously; one of them died of a head injury 1 month after diagnosis, and the other died at home 71 days after diagnosis for unknown reasons, but also had a Pancoast tumour and atrial fibrillation. All patients with non-invasive disese were completely cured by surgical excision.

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