Necrotizing external otitis caused by *Aspergillus fumigatus*: computed tomography and high resolution magnetic resonance imaging in an AIDS patient

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Necrotizing external otitis caused by *Aspergillus fumigatus*: computed tomography and high resolution magnetic resonance imaging in an AIDS patient

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Abstract
Most necrotizing (malignant) external otitis (NEO) occurs in diabetic patients and is commonly caused by *Pseudomonas aeruginosa*. We report an acquired immunodeficiency syndrome (AIDS) patient with NEO caused by *Aspergillus fumigatus* in which computed tomography (CT) showed destructive petrous bone involvement and magnetic resonance imaging (MRI) of the ear discovered extensive soft tissue and facial nerve involvement. Dedicated MRI studies of the ear in this type of pathology provide new insights relating to nerve dysfunction, that cannot be obtained with CT.

Key words: Otitis externa, necrotizing; Acquired immunodeficiency syndrome; *Aspergillus fumigatus*; Tomography X-ray computed; Magnetic resonance imaging

Introduction
*Aspergillus* species have become an increasingly common pathogen amongst immunocompromised patients. This is particularly true of those with prolonged neutropenia from chemotherapy for lymphoproliferative or solid neoplasms. Despite the severe immunosupression seen in patients with acquired immunodeficiency syndrome (AIDS), *Aspergillus* is a relatively uncommon pathogen amongst patients with human immunodeficiency virus (HIV) infection (Lortholary et al., 1993).

Necrotizing or malignant external otitis is an invasive form of external otitis, which when severe may spread to the mastoid, petrous, and tympanic bone, leading to skull base osteomyelitis. It is almost always found in elderly diabetic patients, and rarely in other immunocompromised patients or in immunocompetent patients. *Pseudomonas aeruginosa* is the infecting organism in the majority of cases.

The utility of CT in the diagnosis of NEO by *Pseudomonas aeruginosa* has been well reported (Curtin et al., 1982; Rubin et al., 1990). Furthermore, comparative studies of CT and MRI in NEO have been carried out in seven patients (Grandis et al., 1995). However, to our knowledge only three cases of malignant otitis externa caused by *Aspergillus fumigatus* in HIV and AIDS patients have been described (Reiss et al., 1991; Strauss and Fine, 1991), and none of them with high resolution MRI of the ear. We report NEO due to *Aspergillus fumigatus* in a patient with AIDS, in which CT demonstrated destructive osseous changes on the petrous bone and high resolution enhanced MRI specifically showed signs of facial nerve involvement, not demonstrated on CT.

Case report
A 27-year-old woman complained of a two-month history of severe left otalgia that radiated to the neck and did not allow her to sleep. Examination revealed pain, swelling and inflammatory signs in the left periauricular and perimastoid regions. She was treated empirically at out-patients with cefaclor, with little relief of the pain. Previous clinical records disclosed a diagnosis of HIV infection in May 1989 and an AIDS C3 stage, following AIDS-defining diagnoses of *Candida* oesophagitis in October 1995, microinfiltrating epidermoid carcinoma of cervix treated with hysterectomy and pelvic lymphadenectomy in December 1995, cytomegalovirus (CMV) retinitis in January 1996 and anaemia and leucopenia probably due to CMV disseminated chronic infection in January 1996.

Two weeks later she was admitted to hospital because of a febrile pulmonary infection with dry cough, shivers and dyspnoea, as well as a constitutional status. There were no inflammatory signs on the left periauricular and mastoid areas at this time. However, an intense ear pain persisted and a left facial palsy developed. The patient did not develop vestibular symptoms and there were no additional cranial nerve deficits. Admission laboratory values were remarkable for mild anaemia and leucopenia. The total white blood cell count was 2790/mm³ with 85.5 per cent segmented neutrophils, 7.1 per cent lymphocytes, 4.8 per cent monocytes and 0.5 per cent eosinophils. Immunological studies revealed a total lymphocyte count of 110 cells/ml, absolute CD3 count of 87 cells/ml, absolute CD4 count of 1 cell/ml, with a CD4/CD8 ratio of 0.01 and CD3/CD8 ratio of 0.71. Bronchoalveolar lavage was positive for

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CMV. Ganciclovir and empirical treatment for Pneumocystis carinii was started with marked improvement of respiratory symptoms.

Otoscopy demonstrated a left external ear canal filled with whitish and soft polyploid granulation tissue and a small amount of mucopurulent exudate. The left tympanic cavity was congestive and erythematous, and the left tympanic membrane showed an anterior perforation and posterior sclerotic rests. A trans tympanic tube was placed. Culture of exudate from the left ear yielded Aspergillus fumigatus. A biopsy from the external ear mucosa revealed fungal hyphae within necrotic granulation tissue and the culture confirmed the presence of Aspergillus fumigatus.

A CT of the left petrous bone with sections 1.5 mm thick taken at 1.5 mm intervals in the axial plane by the high resolution-bone algorithm technique was performed. The CT scan revealed soft tissue swelling of the external auditory canal and filling of mastoid air cells and middle ear, particularly the mesotympanum, tympanum, prehypotympanum and the anteromedial part of the epitympanum. There was extensive bone erosion of the middle-ear walls, especially in the anterior part of the mesotympanum, indicating osteitis (Figure 1). The incus and stapes were also eroded. Osteitic involvement of the facial canal involving the fallopian aqueduct and labyrinthine portion was also present.

An MRI of the left ear (0.5 T superconductive machine) with 3 inches receiver surface coil fixed in the temporomandibular joint, with and without paramagnetic contrast agent at a standard dose (0.1 mmol/kg of gadolinium-DTPA) was also performed. Three-millimeter-thick axial and coronal sections T1 and T2-weighted were obtained. The study showed increased signal intensity in T2W images indicating inflammatory involvement in the peri-auricular area, external auditory canal, middle ear and mastoid air cells. There was diffuse enhancement of the geniculate ganglion and labyrinthine segment of the facial nerve, as well as in the superior and medial area of the masticator space (Figure 2). Enhancement was also seen in the meninges of the adjacent temporal lobe.

The patient refused intravenous therapy, so she was treated with oral systemic antifungal treatment (itraconazole, 400 mg/day) and analgesic therapy.

Three months later she was readmitted because of a febrile moderate-severe distress respiratory syndrome with confluent alveolar infiltrates in chest radiographs. General and neurological examinations were negative with the exception of persistent left peripheral facial nerve palsy and pain on the pinna under pressure and in the left temporomandibular area. Fibrobronchoscopy was tried twice, but it could not be performed because of the patient's intolerance. Repeated sputum and blood cultures were negative. Considering the possibility that the aetiological agent responsible for lung disease was also Aspergillus fumigatus, intravenous amphotericin B therapy was started. After eight days of treatment there was an important decrease in pain in the left otomastoid region, which allowed the reduction of analgesic therapy, but no modification in febrile and respiratory manifestations. Afterwards, ganciclovir, antimycobacterial therapy with five drugs (pyrazinamide, rifampicin, isoniazid, myambutol, clarithromycin) and low doses of corticosteroids were added. There was an objective decrease of fever, but no modification of respiratory symptoms, and the patient continued worsening progressively until she died six days later.

**Discussion**

Necrotizing (invasive or malignant) external otitis is a severe, destructive infection originating in the squamous epithelium of the external ear canal with a tendency to spread to adjacent areas of soft tissue, blood vessels, cartilage and bone; it may involve the mastoid and petrous parts of the temporal bone, leading to skull base osteomyelitis. The causative agent is usually Pseudomonas aeruginosa (Rubin and Yu, 1988), and other pathogens, such as Aspergillus fumigatus have been identified only in

![Fig. 1](A and B). Axial CT scan of the petrous bone (bony window setting).

A. At the level of atticum. There is a soft tissue mass and bone destruction at the fallopian aqueduct (asterisk) and anterior labyrinthine portion of the facial nerve.

B. At the level of the mesotympanum. There is a soft tissue mass and bone destruction (asterisk) at the anterior component of the tympanic bone with osteitic involvement of the fallopian tube. Notice soft tissue mass involving external auditory canal and periauricular region.
FIG. 2  
(A–C). MRI of the petrous bone.  
A. Coronal enhanced T1W (400/21) MR scan at the level of VII–VIII complex. Notice focal left facial nerve (arrowhead), as well as meningeal and soft tissue enhancement.  
B and C. Axial enhanced T1W (400-21) (B) and T2W (1800/120) (C) demonstrating soft tissue enhancement in middle ear (arrowhead) and soft tissue inflammatory mass (asterisk). There is also enhancement of the membranous labyrinth of the middle and basilar turn of the cochlea.
Aspergillus fumigatus is the most common cause of cranial nerve involvement, particularly the facial nerve. The commonest cranial nerve to be affected is the facial nerve (Cunningham et al., 1988; Phillips et al., 1990). It usually occurs in elderly non-insulin-dependent diabetic patients and occasionally in patients with other underlying illnesses, but rarely in normal hosts. Since AIDS patients primarily have deficiencies in T-cell function, not in granulocytes or macrophages, which are thought to be involved in the normal host defense against Aspergillus infection, they are said to be not so susceptible to infection by Aspergillus species as other immunocompromised patients. Indeed, AIDS itself is not considered to be a full risk factor for invasive aspergillosis. In 1984 it was removed from the list of AIDS-defining illnesses because of its infrequent occurrence (Lortholary et al., 1993).

Neutropenia, which is often a side-effect of AIDS-related therapies such as zidovudine and ganciclovir, and steroid therapy, are the most commonly reported predisposing risk factors for aspergillosis in AIDS patients. Other reported risk factors include prior recent broad-spectrum antibiotic administration and recent bacterial, Pneumocystis, or CMV infection (Miller et al., 1994).

Aspergillus affects mainly the lungs, and rarely produces extrapulmonary involvement such as central nervous system infections, endocarditis, oesophageal or gastrointestinal ulcerations, necrotizing skin ulcers, bone lesions, or renal and prostatic manifestations. The diagnostic criteria for extrapulmonary invasive aspergillosis include both positive histology and culture (Bennett, 1995).

The clinical manifestations of NEO in HIV and AIDS are similar to those in non-AIDS patients (Hern et al., 1996). The commonest presenting symptom is otalgia which is severe, unremitting and tends to worsen at night. Headache, usually temporal or occipital, may be present and it is remarkable too for its severity and may be associated with temporomandibular joint pain and tenderness. Purulent otorrhoea occurs in the majority of cases. Examination of the ear reveals oedema, erythema and granulation tissue in the external ear canal particularly at the junction of the bony and cartilaginous regions. Cranial nerve dysfunction may occur at any time during the course of the illness but usually occurs approximately two months after the onset of otitis externa. In non-AIDS patients the commonest cranial nerve to be affected is the facial nerve with an incidence ranging from 24 to 43 per cent. Other cranial nerve palsies secondary to skull base osteomyelitis have an incidence of 14 to 35 per cent. They frequently reflect advanced disease (Rubin and Yu, 1988). Our patient had several risk factors predisposing her to Aspergillus fumigatus infection, as she had mild neutropenia, recent previous CMV infection as well as recent treatment with wide spectrum antibiotics. She suffered from NEO with peripheral facial palsy, as it occurs in two of the three cases of NEO by Aspergillus in AIDS patients described in the literature (Reiss et al., 1991; Strauss and Fine, 1991).

High resolution CT of temporal bone has largely demonstrated its ability to show inflammatory changes involving the external and middle ear. Its demonstration of bony components, including the ossicular chain as well as the destructive osseous changes associated with inflammatory or tumoral pathology makes these studies useful for many diseases in this area. However, an important drawback of CT scans is the lack of sensitivity in detecting inflammatory changes of the VIIth and VIIIth cranial nerves.

CT findings associated with NEO vary depending on the stage of the invasiveness and include oedema of the external auditory canal, pinna and soft tissues, opacification of the mastoid air cells and middle ear, bone destruction and parapharyngeal mass with obliteration of the fat planes about the carotid sheath and stylomastoid foramen. End-stages lead to necrosis of large portions of the temporal bone (Curtin et al., 1982; Chakers et al., 1985; Rubin et al., 1990).

Specific CT findings reported in cases of NEO in HIV and AIDS patients are primary soft tissue fullness of the ear canal and mastoid bone, but infrequently bone erosion (Hern et al., 1996). Our patient, however, exhibited extensive osseous and cartilaginous destruction, demonstrated by CT, associated with a soft tissue mass in the masticator space, external auditory canal and filling of the tympanic cavity and mastoid bone.

MRI has been reported in only one patient with NEO caused by Aspergillus fumigatus, but MR scan was made with conventional head coil and no focussing on the ear cavity. The finding was nonspecific inflammatory filling of the mastoid and tympanic cavity (Strauss and Fine, 1991).

MR of the ear is gaining attention when performed with state of the art equipment and an ear surface coil, thus allowing detection and characterization of many pathologies previously undetected. When dealing with inflammatory pathology of the ear, dedicated ear studies with surface coil MR have demonstrated its usefulness in many diseases such as chronic cholesteatomatous otitis and its complications, cholesterol granuloma, and other inflammatory diseases involving petrous bone (Weissman, 1996).

Grandis et al. recently reported a comparative study between CT and MR in NEO in seven patients (Grandis et al., 1995). Their population included mild stages of disease with few destructive petrous bone lesions. None of them had reported cranial nerve impairment. In this study, although soft tissue changes were slightly more obvious on MR than on CT, CT was the preferred radiological test for assessing the changes associated with NEO, because bone destruction was better demonstrated. However, their study was conducted with head coil equipment, and despite the administration of a paramagnetic contrast agent, their population did not show VIIth or VIIIth cranial nerve dysfunction. So far, we are not aware of specific MR studies in NEO in which VIIth or VIIIth cranial nerve abnormality was observed by radiological studies.

Our patient showed extensive inflammatory changes involving the periauricular area, external auditory canal, middle ear, mastoid air cells and masticator space. On MR, after the introduction of a paramagnetic contrast agent, diffuse enhancement of the geniculate ganglion and labyrinthine segment of the facial nerve was seen, suggesting blood-brain barrier nerve breakdown and indicating facial neuritis, which fits with the clinical symptoms and signs of peripheral facial palsy that the patient suffered. Thus, MR specifically contributes to the detection of neurological complications not demonstrated by CT and previously unreported in this type of pathology. MR also demonstrated meningeal enhancement around the temporal lobe.

Facial nerve enhancement has been reported in several pathologies including idiopathic facial palsy (Bell’s palsy), herpetic, tumoral, and postsurgical amongst others. It may also show nonspecific enhancement, and it is the cranial nerve that most commonly enhances focally (Martin-Duverneil et al., 1997). However, it is not accompanied by clinical signs nor petrous bone destruction, as in our case.

Almost all AIDS patients with invasive aspergillosis have a very low CD4 cell count, usually below 50/mm³. A direct effect of CD4 cells on the function of neutrophils and macrophages has been advocated (Denning et al., 1991). As in our case, all three reported cases of invasive otitis externa caused by Aspergillus fumigatus in AIDS patients had a severely reduced peripheral blood CD4 cell count.
lymphocyte count (Reiss et al., 1991; Strauss and Fine, 1991).

Surgical excision has been used successfully to treat invasive aspergillosis of the brain, and paranasal sinus. Intravenous amphotericin B (0.5–1.5 mg/kg/day) remains the drug of choice for invasive aspergillosis, but response is poor in markedly immunosuppressed patients. Itraconazole (200 to 600 mg/day) has been useful in some of the less immunosuppressed patients with indolent or slowly progressive invasive aspergillosis (Bennett, 1995).

In summary, we present an AIDS patient with persistent otitis which was eventually diagnosed by biopsy of NEO caused by Aspergillus fumigatus. Radiological studies including CT and MR discovered extensive involvement of the external, middle and inner ear with osteitis and soft tissue involvement. Both CT and MR have a complementary role in detecting and demonstrating the extensiveness of the lesion involving the petrous bone, tympanic cavity and mastoid bone. MR particularly is very suitable in patients with cranial nerve dysfunction, since it can demonstrate specifically inflammatory changes of the VIIth or VIIIth cranial nerve.

References


