

Conventional and diffusion-weighted MR imaging of cerebral aspergillosis

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ABSTRACT

Central nervous system aspergillosis has increased dramatically in recent years. Most of the cases are immunocompromised patients infected from a primary site, usually the lungs or paranasal sinuses, and the organism may spread to the central nervous system. Different neuroimaging patterns that have been reported vary depending on the immunological status of the patients and on the age of the lesions. Description of typical radiological patterns in cerebral aspergillosis patients may be helpful in establishing early diagnosis and treatment. In this case report, we present magnetic resonance images of cerebral aspergillosis and the contribution of diffusion-weighted magnetic resonance imaging to the diagnosis.

Key words: • *neuroaspergillosis* • *abscess* • *magnetic resonance imaging*

Invasive central nervous system aspergillosis is a rather infrequent pathology seen in patients with immune deficiency. Its frequency has been increasing in relationship to the use of corticosteroid drugs and bone marrow transplantation (1-3). It is mainly disseminated through blood from a paranasal sinus or directly from a paranasal sinus. Clinical or laboratory diagnosis of this pathology, which has a rather high mortality rate, is difficult. Aggressive antifungal or surgical treatment is beneficial in cases diagnosed early. Therefore, early diagnosis is essential. Computed tomography (CT) and magnetic resonance (MR) imaging play important roles in the early diagnosis of invasive cerebral aspergillosis and can help direct treatment. In this report, a case with cerebral aspergillosis is presented with emphasis in the diagnostic contribution of diffusion-weighted MR imaging.

Case report

In the previous cranial CT of a 28 year-old male with complaints of headache, blurred vision, and loss of consciousness, a number of mass lesions in circular form were seen. For this reason, the patient was pre-diagnosed with abscess, and cranial MR imaging examination was performed in our clinic. The patient had a history of bronchial asthma for the last 10 years, and chronic obstructive lung disease. In the thorax CT of about 1 year earlier, bronchiectasis and cavitations were observed together with consolidation and nodular infiltrates. Tuberculosis bacilli were not found in bronchial lavage at that time. Tests for immunoglobulin (IgE) specific for aspergillus was positive. A diagnosis of allergic bronchopulmonary aspergillosis (ABA) was made, and he was followed-up in the outpatient clinic.

Cranial MR imaging examination was performed with a system capable of echo-planar imaging and equipped with a 1.5 Tesla magnet. In this examination, multiple lesions with centers mildly hypodense (as compared to the white matter) were observed on T1 weighted images of basal ganglia, brain stem, and hemispheric deep and subcortical white matter (Figure 1a). The surrounding edema and the peripheral parts had the characteristics of more hypointense signals whereas central parts of the lesions were hyperintense (Figure 1b). After injection of intravenous paramagnetic contrast material, all lesions enhanced in circular form (Figure 1c). In isotropic ($b=0, 500, 1000 \text{ m/sec}^2$) and trace diffusion weighted images, the particular lesions had the characteristics of hyperintense signal (Figure 1d and e), and hypointense signal characteristics on ADC (apparent diffusion coefficient) maps (Figure 1f and g). All these findings indicated restriction of diffusion. With these features, it was thought that the lesions could be consistent with a pyogenic abscess. Repeated aspergillosis-specific IgE tests were positive and leukopenia was found. Anti-HIV test was negative. These abscesses were diagnosed as

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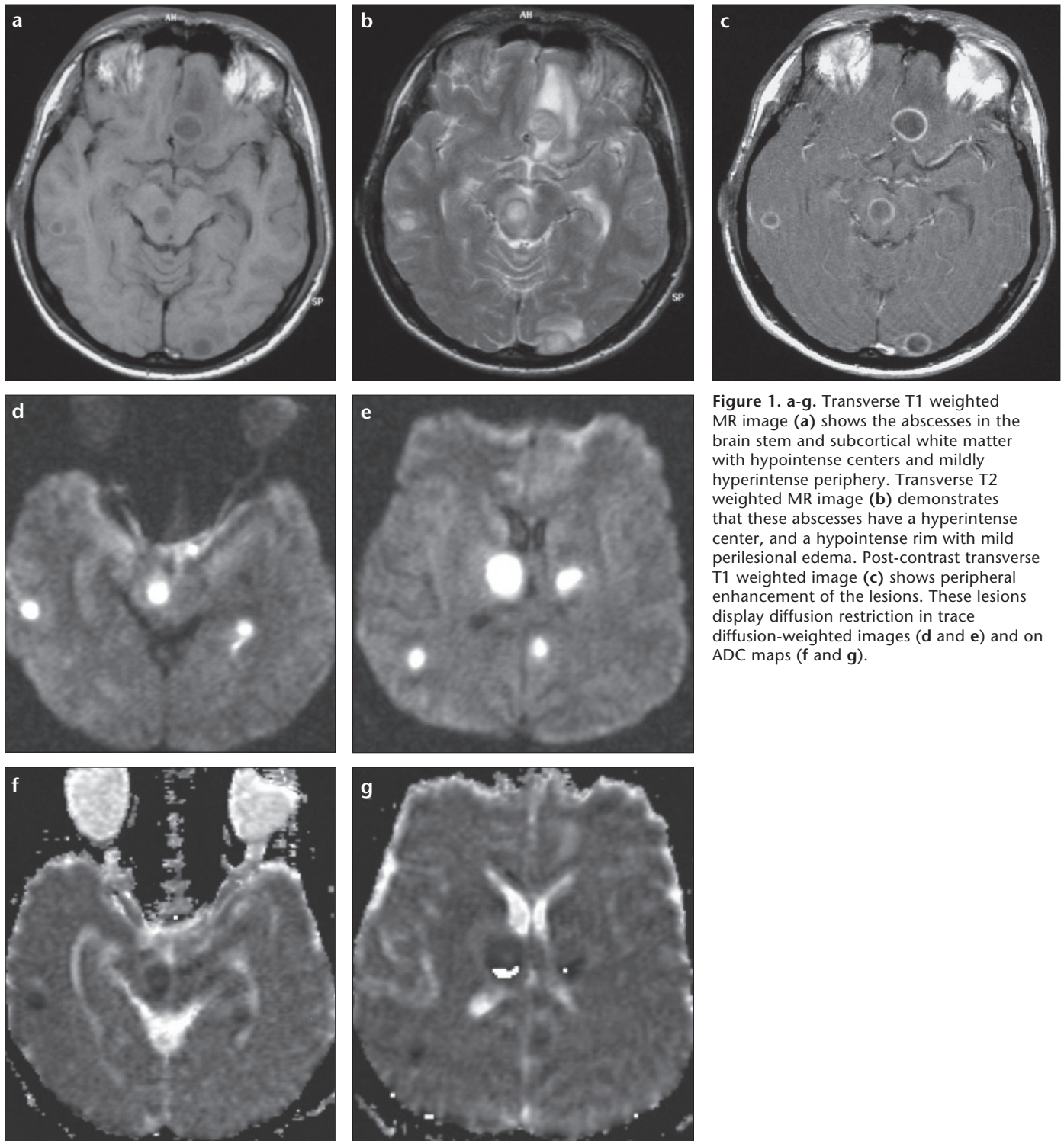


Figure 1. a-g. Transverse T1 weighted MR image (a) shows the abscesses in the brain stem and subcortical white matter with hypointense centers and mildly hyperintense periphery. Transverse T2 weighted MR image (b) demonstrates that these abscesses have a hyperintense center, and a hypointense rim with mild perilesional edema. Post-contrast transverse T1 weighted image (c) shows peripheral enhancement of the lesions. These lesions display diffusion restriction in trace diffusion-weighted images (d and e) and on ADC maps (f and g).

cerebral aspergillosis when evaluated together with the clinical history of the patient. Antifungal therapy (amphotericin B and metronidazole) was started. It was observed in the follow-up cranial MR imaging examination that the lesions had almost totally resolved (Figure 2).

Discussion

Cerebral aspergillosis is seen in about 10-20% of all invasive aspergillosis cases (1, 2). In humans, *Aspergillus fumigatus* is the most frequently seen pathogen of the *Aspergillus* genus. *Aspergillus niger* and *flavus* are less frequently seen. These all have dichotomous branched hyphae and produce spores in great

numbers. Humans are infected after inhaling these spores, and the causative microorganism locates itself in lungs. Most of the time symptoms are not marked. There can be mild increase in protein content of cerebrospinal fluid (CSF). Serological tests of blood provide insufficient results in those with immune deficiency (2).

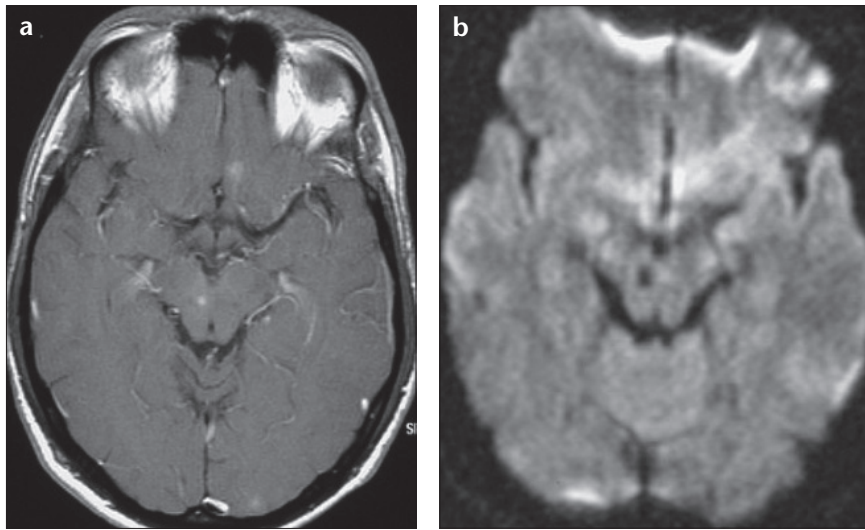


Figure 2. a, b. Post-contrast transverse T1 weighted MR image (a) and diffusion-weighted MR image (b) taken after treatment with amphotericin B reveal the regression of the lesions.

Cerebral aspergillosis can give clinical findings of meningitis, abscess, or mass lesions when in the form of granulomas, or thrombosis, infarction, hemorrhage, or mycotic aneurysm caused by vascular invasion (1, 3-5). MR imaging findings are variable according to the immune status of the patient and stage of the lesion, and rarely, different clinical pictures can be seen in the same patient (6). The form presenting with abscess or granulomas is seen in patients with immune deficiency that is mild or moderate, and the microorganism is encapsulated by the host (1, 3). Our case might have been this form.

Abscesses in aspergillosis can be confused with candidiasis, tuberculosis, or toxoplasmosis. The micro-abscesses are multiple (in candidiasis smaller than 3 mm) with typical rim enhancement. They are most frequently located in the cortico-medullary junction, basal ganglia, and cerebellum. Vasculitis, intraparenchymal hemorrhage, and thrombotic infarcts can be seen. Granuloma-like lesions and big abscesses are rare. Meningitis is frequent in tuberculosis and candidiasis (4, 7). All of the abscesses in our case were bigger than 1 cm, and all the laboratory tests for tuberculosis were negative. Likewise, anti-HIV test was found to be negative. Neutropenic patients receiving corticosteroids are at risk in terms of aspergillosis. Our case was receiving corticosteroid treatment for the diagnosis of ABA, and he was leukopenic. Other microorganisms presenting with multiple abscesses are *S. aureus*, *Streptococci*

and gram-negative bacteria, *Cryptococcus*, and *Nocardia* (7, 8). Clinical information and CSF analysis are beneficial in differential diagnosis.

To the best of our knowledge, diffusion-weighted MR findings of aspergillosis abscesses are not currently available in the literature. Diffusion restriction in pyogenic abscesses is explained with the decreased motion of water related to the intense cellular content and viscosity of inflammation (9). Observation of diffusion restriction in the lesions of our case can be related to the histopathological similarity of aspergillosis abscesses to pyogenic abscesses.

The hypointense rim observed on T2 weighted images in our case has previously been defined in mycetomas, pyogenic abscesses, metastatic lesions, and subacute hematomas. It has been reported that this appearance can be related to the presence of methemoglobin in the wall of the capsule, or to the free radicals produced by macrophages. It appears thin and regular in pyogenic abscesses, and thin and slightly irregular in fungal abscesses (1). In our case, hypointense rim was thin and regular in all lesions.

In its severe form, cerebral aspergillosis causes infarction by occluding the veins with the organisms' hyphal elements. This is frequently observed in basal ganglia, thalamus, corpus callosum, and cortical or subcortical localizations (3, 4, 10). They are most frequently localized in the basal ganglia and thalamus by occluding lenticulostriate and thalamoperforating arteries.

Diffusion-weighted MR imaging can ensure the observation of early septic or non-septic infarcted areas in this form of cerebral aspergillosis, and can be beneficial in differentiating it from progressive multi-focal leukoencephalopathy and tumoral lesions. Septic foci of infarction were not seen in our case.

Localized meningitis develops in the cerebral aspergillosis form disseminating from a paranasal sinus and/or orbital neighbourhood (1, 3, 8). This clinical picture is seen in individuals with mild or moderate immune deficiency, or in normal individuals (2).

In conclusion, cerebral aspergillosis has a fatal course. It is an infection with clinical and imaging features that vary according to the immune status of the patient. Diffusion-weighted MR imaging examination is a valuable method in the early diagnosis of cerebral aspergillosis presenting with abscesses or septic infarcts.

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