Differentiation of Fungal, Tubercular and Pyogenic Brain Abscesses with Conventional, Diffusion MR imaging and Proton MR Spectroscopy

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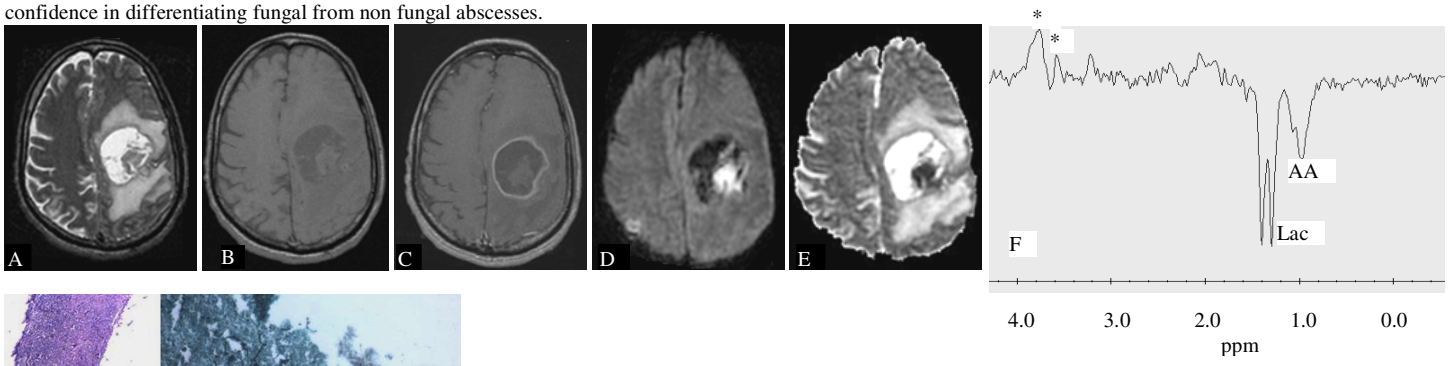
Introduction: Computed tomography (CT) and conventional magnetic resonance imaging (MRI) have been the main imaging modalities used in the diagnosis and management of the cerebral abscesses (1). However they lack specificity with respect to the identification of the offending microorganisms. In the recent years, there has been an effort to characterize the etiological agents on the basis of magnetization transfer (MT) (2), diffusion weighted imaging (DWI) (3), and in vivo proton MR spectroscopy (PMRS) (4, 5)**.** The diagnosis of intracranial fungal abscesses is almost always a clinical surprise. This study was done with an aim to define the unique features of primary fungal brain abscesses on conventional MRI, DWI and PMRS which may help to differentiate these from bacterial/tubercular etiology so that early therapy can be instituted for these often, fatal infections.

Material and methods: A retrospective analysis was performed on eight patients with culture proven abscesses of fungal etiology. In patients with multiple lesions, analysis of imaging features was done of those lesions which were actually aspirated and for which pus cultures were available. Imaging was performed on a 1.5 Tesla MR system (Signa, General Electric Medical Systems, Milwaukee, WI). Imaging studies included T2, T1, post-contrast T1, DWI and PMRS. The morphology of lesions was analyzed on T2 weighted images in all the cases on basis of outer margin, presence of intracavitary projections from the wall, debris (T2 isointense/hypointense area separate from the wall). Quantitative analysis of the apparent diffusion coefficient (ADC) of the wall and the cavity of the fungal abscesses were done. The selection of regions with low ADC was done visually on ADC map. Region of interest (ROI) was then placed in the regions with lowest signal intensity on ADC map. In vivo PMRS was performed using water suppressed localized single voxel spin echo (SE) sequence with TR/TE/n=3000/144ms/8 and a voxel size of 2-3 mL, depending on the size of lesion. The voxel placement was ensured within the cavity of the lesion with the aim to avoid contamination from the surrounding brain parenchyma as well as the wall of the cavity. Only long TE technique was used as identification of amino acids peak is facilitated by acquiring spectra at long TE of 144 ms, resulting in an inverted peak which is easily distinguished from the adjacent lipid peak which does not invert. These fungal abscesses were compared with pyogenic (n=8) and tubercular (n=8) abscess patients imaged during the same period, on the basis of their morphological, metabolite and physiological features.

Results: Fungal abscesses showed irregular wall (8/8) with intracavitary projections (8/8) Fig 1A. Rim enhancement (8/8) was seen only in the wall of these abscesses Fig1A&B. The wall and the projections showed low ADC (8/8) with high ADC (8/8) in the rest of the cavity Fig1E. PMRS showed lipid (4/8), lactate (7/8), amino acids (4/8) and multiple peaks between 3.6ppm and 3.8ppm (5/8) Figure 1F. Pyogenic abscesses had smooth (5/8) and lobulated (3/8) walls, tubercular abscesses had smooth (3/8), lobulated (4/8) walls and crenated wall (1/8) without any intracavitary projections (0/8). Predominant lipid peak (8/8) was seen in tubercular abscesses, while cytosolic amino acids (8/8), acetate (6/8) and succinate (4/8) were noted in pyogenic abscesses.

Discussion: We found primary fungal brain abscesses to possess certain consistent attributes on conventional T2, DWI and PMRS which appear to be different from tubercular and pyogenic abscesses. On evaluation of morphological characteristics the outer margin of the abscess wall was more irregular in the fungal abscesses. There were intracavitary projections directed centrally from wall in the fungal abscesses with no contrast enhancement in these projections. These projections seen on conventional imaging in all the patients with fungal abscess were not seen in other etiologies and appear to be a distinguishing feature of fungal etiology on conventional MRI. Fungal abscesses showed restricted diffusion in the projections and in the wall, the rest of the abscess core showed no restricted diffusion, while in the pyogenic and tubercular group restricted diffusion was also seen in the core of the cavity. In vivo PMRS of fungal abscesses showed cytosolic amino acids, lipid and lactate, not remarkably different from pyogenic abscesses (5). Multiple signals seen between 3.6 and 3.8 ppm were tentatively assigned to trehalose sugar known to be present in the fungal wall and were seen in 5/8 patients

Conclusion: A ring enhancing T2 heterointense lesion with irregular walls and irregular projections into the cavity with low ADC and no contrast enhancement of these projections carries a high probability of being a fungal abscess. The identification of multiple signals seen between 3.6 and 3.8 ppm may further add to the diagnostic confidence in differentiating fungal from non fungal abscesses.



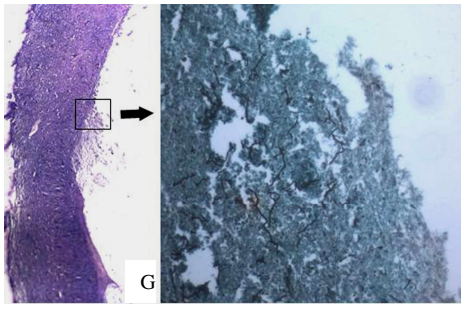


Figure1. Fungal abscess in left fronto-parietal region of a 46-year-old male immunocompetent patient. The lesion appears as a well defined hyperintense mass with irregular wall and intracavitary hypointense projections on axial T2 weighted image (A). Axial T1 weighted image (B) shows hypointense core with isointense intracavitary projections. Post contrast axial T1 weighted image (C) shows peripheral enhancement of wall with no enhancement of intracavitary projections. Hyperintense projections with hypointense cavity are seen on diffusion weighted image (D). ADC map (E) shows low ADC value (0.53×10-3 mm2/s) in the intracavitary projections with high ADC (2.17×10-3 mm2/s) in the cavity. PMRS (F) shows amino acids (AA, 0.9 ppm) and lactate (Lac, 1.3 ppm) with multiple peaks at 3.6 and 3.8 ppm. Stereomicroscope view (G) of abscess wall shows it to be composed of fibrocollagenous tissue with inflammation and neovascularisation. Lumen is lined by frayed necrotic material (H & E x 4). Inset high power view showing branching slender fungal hyphae in background of necrotic material (GMS x 200). Pus culture grew *Aspergillus fumigatus***.**

References:

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