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REVIEW

Magnetic resonance features of pyogenic brain abscesses and differential diagnosis using morphological and functional imaging studies: A pictorial essay

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Summary The aim of this paper is to illustrate the potential of magnetic resonance imaging (MRI) in diagnosis, differential diagnosis, treatment planning and evaluation of therapy effectiveness of pyogenic brain abscesses, through the use of morphological (or conventional) and functional (or advanced) sequences. Conventional MRI study is useful for the identification of lesions, to determine the location and morphology and allows a correct hypothesis of nature in the most typical cases. However, the differential diagnosis from other brain lesions, such as non-pyogenic abscesses or necrotic tumors (high-grade gliomas and metastases) is often only possible through the use of functional sequences, as the measurement of diffusion with apparent diffusion coefficient (DWI-ADC), proton magnetic resonance spectroscopy (^{1}H-MRS) and perfusion weighted imaging (PWI), which complement the morphological sequences and provide essential information on structural, metabolic and hemodynamic characteristics allowing greater neuroradiological confidence. Modern diagnostic MRI of pyogenic brain abscesses cannot be separated from knowledge, integration and proper use of the morphological and functional sequences.

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Introduction

Cerebral abscess is a localized infection of the central nervous system (CNS). It is formed by a central necrotic area surrounded by an external wall (collagen, granulation tissue, macrophages, gliosis).

Abscesses account for 1—2% of brain occupying space lesions in western countries and 8% in developing countries [1]. They are frequent in adults while in only 15—30% of the cases, they involve young patients (< 15 years) [2—5].

Pyogenic brain abscesses are not common, accounting for one third of all the cerebral abscesses [6]. They are caused by cerebral dissemination of bacteria coming from neighbouring infections (sinusitis, otitis, mastotiitis) or by hematogenous spread of a remote infection (sepsis); however, in approximately 40% of cases, the primary site of infection remains unknown.

Other causes of cerebral bacterial dissemination in CNS are cranio-facial trauma (with penetration of foreign bodies or bone fragments), meningitis and neurosurgery (iatrogenic infections).

Clinical features are different according to the site of the abscess. Diagnosis is challenging and imaging has a primary role in differentiating brain abscesses from other lesions that can have similar clinical spectrum. MR is the imaging modality of choice for diagnosis and follow-up of brain abscesses.

The aim of this paper is to analyze the role of combined use of morphological and advanced magnetic resonance imaging (MRI) techniques (diffusion weighted imaging — DWI/ADC; perfusion weighted imaging — PWI; spectroscopy — ^{1}H-MRS) in the diagnosis, differential diagnosis, treatment planning and follow-up of pyogenic abscesses. An extensive review of the literature is also provided.

Etiology and pathogenesis

Bacteria responsible for brain abscesses can be both aerobic (most frequently *Staphylococcus*, *Streptococcus* and *Pneumococcus*) and anaerobic [7]. It is also important to highlight that often there are different kinds of bacteria involved in the formation of an abscess.

The most common localization of a pyogenic abscess in the brain is the supratentorial region, in the subcortical white matter, especially, if they come from hematogeneous spread of a distant infection (Figs. 1 and 4) [8,9].

Abscesses secondary to middle hear otitis are typically located in the temporal lobe or in the cerebellum (Fig. 2).

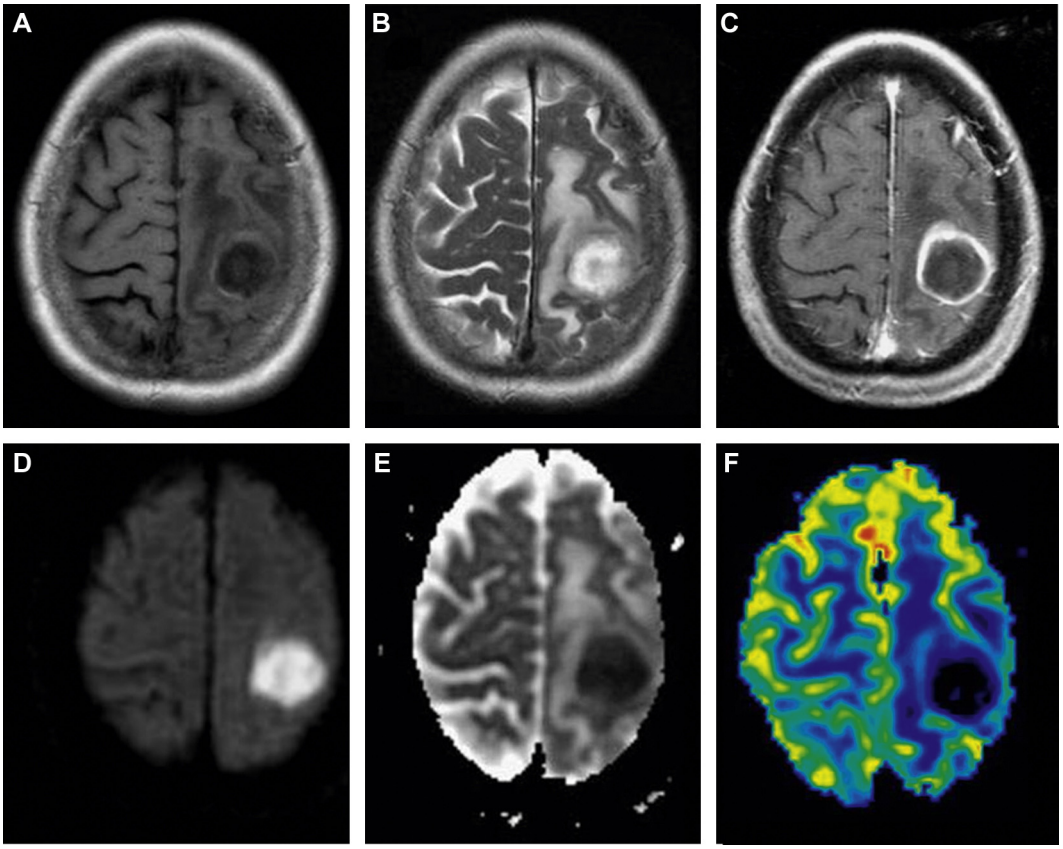

Figure 1 A—F: supratentorial pyogenic abscess in the gray-white junction: T1-weighted (A), T2-weighted (B), gadolinium-enhanced T1-weighted (Gd-MR) (C), DWI ($b = 1000$) (D), ADC (E) and PWI map of CBV (F) MR images. The capsule of the abscess is hyperintense in T1-weighted image (A), partially hypointense in T2-weighted image (B) with surrounding vasogenic oedema. Gd-MR image shows a ring-enhancing mass. The central component of the lesion shows high signal intensity in DWI image (D), and hypointense signal in ADC map, findings that are consistent with restricted diffusion (ADC = 0.440×10^{-3} mm^2/s). At PWI, the CBV map (F) does not show evidence of increased perfusion in the gadolinium-enhancing rim (rCBV = 0.85).