Diffusion Magnetic Resonance Imaging in Multiple Sclerosis

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KEYWORDS

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Multiple sclerosis (MS) is considered the most common inflammatory autoimmune neurologic disorder, involving especially the white matter (WM), the main pathologic features of which include a primary perivascular inflammation, demyelination, gliosis, and axonal injury.[1,2] MS is a chronic disease, estimated to affect 2.5 million people worldwide, and almost 400,000 persons in only the United States. Women are affected twice to 3 times as frequently as men, and it is uncommon in children, accounting for only about 0.3% to 0.4% of all cases. The symptoms begin most frequently during the third and fourth decades. However, MS can develop after age 50 years, accounting for 10% of cases.[2,3] MS is the most frequent cause of nontraumatic neurologic disability in young and middle-age adults.[1] Thus, early diagnosis is required to promptly begin a more effective treatment.

Conventional magnetic resonance (MR) imaging has become a primary tool for the investigation of MS and for clinical diagnosis over the past 3 decades, since its introduction.[4] MR scans offer the most sensitive way to identify MS lesions and their changes, for example disease accumulation and disease activity.[5] Therefore, the use of MR imaging has had a major effect on early and more precise diagnosis as well as on treatment management, predicting the prognosis of patients (**Fig. 1**).[2]

The role of MR imaging in the diagnosis of MS has been strengthened with the introduction of the McDonald criteria,[6] because this modality is able to determine dissemination in both time and space of the demyelinating lesions. The McDonald criteria include the Barkhof-Tintore MR imaging criteria,[7,8] because a spinal cord lesion can substitute for any of the brain lesions.[6] Nevertheless, in the light of subsequent studies, new insights were added and the previous proposed 2001 criteria were revised at the reconvened international panel during 2005.[9] The Barkhof-Tintore MR imaging criteria were kept in the new diagnostic MS criteria. However, the 2 criteria differ in the extent to which a spinal cord lesion can also assist with fulfillment of dissemination in space.[2]

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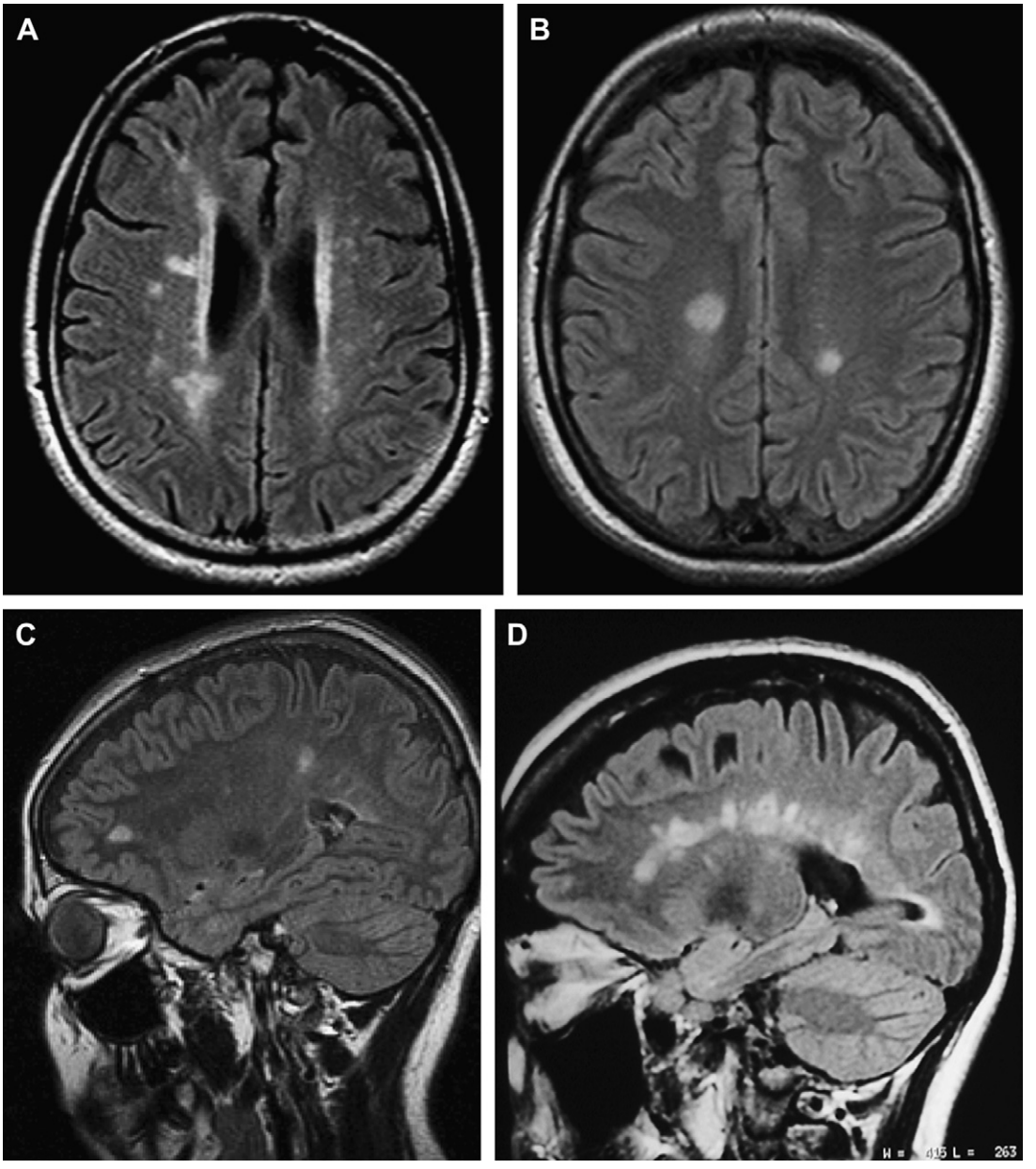

Fig. 1. MS: different imaging features. (*A, B*) Axial fluid-attenuated inversion recovery (FLAIR) shows typical appearance of deep WM plaques like multiple hyperintense lesions in subcortical and cerebral deep WM, mostly ovoid in shape. (*C, D*) Sagittal FLAIR shows demyelinating plaques along the margin of lateral ventricles and the corpus callosum, with the typical radial arrangement, called Dawson fingers.

As mentioned earlier, conventional MR imaging offers the most sensitive way to detect demyelinating plaques and their histopathologic changes over time. It is also useful in helping to determine the diagnosis of clinically defined MS as well as to rule out other conditions that may resemble the disease. Although high sensitivity has been described, the MR specificity is low and these findings may resemble other pathologic conditions, such as those secondary to atherosclerosis. MR imaging contributes decisively to the management of patients with MS, adding useful information regarding conversion to clinically definitive MS, earlier diagnosis, disease prognosis, and treatment response. MR imaging is the most versatile technique for depicting MS lesions. More recently, some investigators have suggested that diffusion tensor imaging (DTI) could play an