Secondary Demyelination Disorders and Destruction of White Matter

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KEYWORDS

• Secondary demyelinating disorders • White matter • Destruction • Central nervous system

KEY POINTS

- Secondary demyelinating disorders are a group of diseases defined by damage to neurons and axons with subsequent myelin breakdown.
- Disorders of secondary demyelination are a heterogeneous mix of conditions, including infections, nutritional/vitamin deficiencies, vascular diseases, chemical agents, and genetic disorders.
- Imaging of secondary demyelinating diseases is characterized by white matter damage in various patterns. Although some of the imaging findings of secondary demyelinating diseases are nonspecific, many diseases have specific imaging patterns that, in correlation with clinical history, aid in diagnosis.

INTRODUCTION

Demyelinating disorders of the central nervous system (CNS) are classically characterized by the breakdown of myelin, with or without the preservation of the associated axons.[1] Primary demyelinating diseases, including multiple sclerosis (MS), typically involve the loss of myelin with relative sparing of axons.[1] In contrast, secondary demyelinating disorders represent a spectrum of white matter disease characterized by damage to neurons or axons with the resultant breakdown of myelin.[1] The pathologic changes seen in secondary demyelinating disorders are varied, ranging from pure demyelination to necrosis with subsequent demyelination.[1] Secondary demyelinating diseases are associated with a wide variety of conditions, including infections/vaccinations, nutritional/vitamin deficiencies, chemical agents, genetic abnormalities, and vascular insult. Demyelinating diseases are usually diagnosed using a combination of cerebrospinal fluid (CSF) analysis, neuroimaging, patient history, and neurologic examination. Many disorders of secondary demyelination have nonspecific imaging findings with signal abnormalities seen within the white matter. However, some diseases of secondary demyelination have characteristic imaging features; recognition of these characteristic features is crucial to make a prompt and correct diagnosis.

Associated with Infection/Vaccination

Acute disseminated encephalomyelitis

Acute disseminated encephalomyelitis (ADEM) is an inflammatory demyelinating disorder of the CNS typically preceded by a viral infection or vaccination.[2] ADEM most commonly affects the cerebral hemisphere, brainstem, and spinal cord. The incidence of ADEM is 0.4 per 100,000 per year in patients less than 20 years old.[3] ADEM is predominantly a disease of children, with a mean age at presentation of 5 to 8 years and an equal presentation among females and males.[4]

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Consistent with the pathogenesis of a preceding infection, ADEM has a winter and spring predominance.[3] ADEM typically occurs within 2 to 4 weeks of viral infection or vaccination, with up to 90% of patients reporting an identifiable preceding infection.[3] Patients with ADEM present with acute multifocal neurologic symptoms and encephalopathy. CSF analysis often shows a mild increase in total protein without bacterial growth or positive viral polymerase chain reaction (PCR). Clinical symptoms are varied and include pyramidal signs, hemiplegia, ataxia, cranial nerve palsies, optic neuritis, seizures, spinal cord involvement, speech impairment, and change in mental status.[2] Treatment involves corticosteroids and/or other immunomodulating agents along with supportive care. Complete recovery has been reported in 53% to 94% of cases, and mortality is rare.[2]

Magnetic resonance (MR) imaging is the most valuable imaging tool in the diagnosis of ADEM. It is characterized by T2-weighted and fluid-attenuated inversion-recovery (FLAIR) sequence signal abnormalities. The signal abnormalities seen in ADEM are large, multiple, and patchy with an asymmetric distribution. The most commonly affected site is the subcortical white matter, seen in up to 90% of cases (**Fig. 1**A).[5] Lesions of ADEM can also be seen in the deep nuclei, cerebellum, brainstem, and spinal cord (see **Fig. 1**B–D).[5] Although the periventricular white matter can also be involved, it has been suggested that it is less commonly involved as compared with

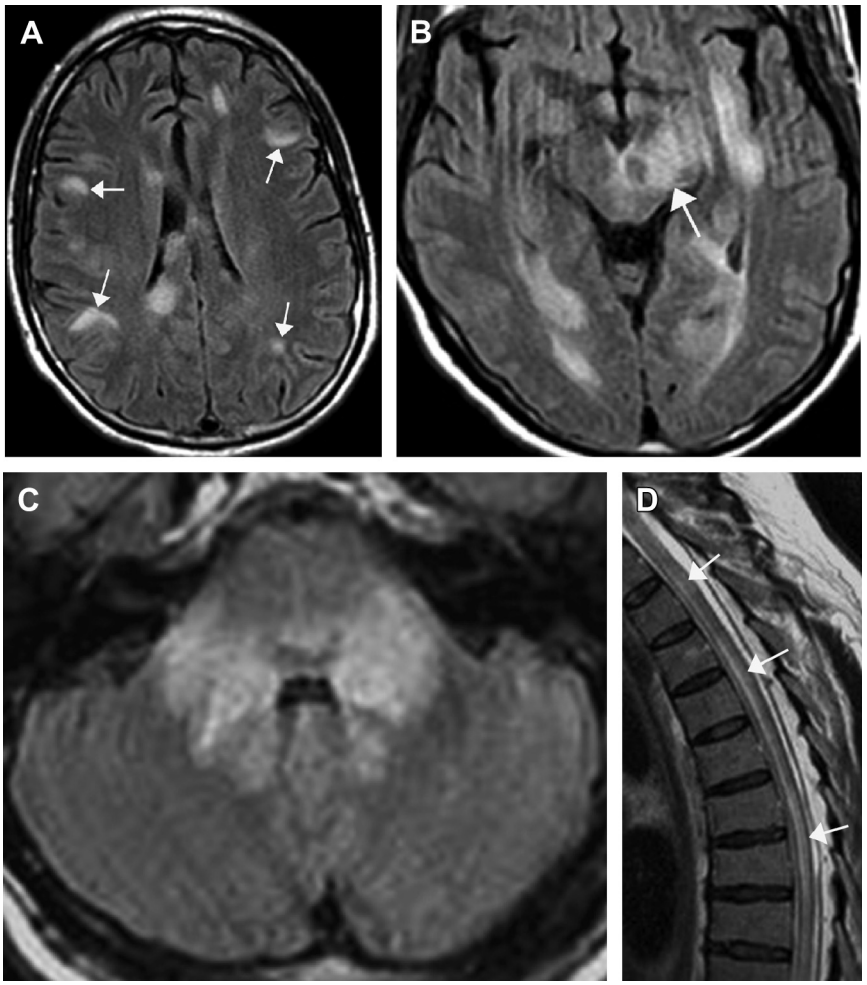

Fig. 1. ADEM. Axial FLAIR-weighted MR imaging at the level of corona radiate (*A*), midbrain (*B*), and cerebellum (*C*) in a 38-year-old man with ADEM. Multiple areas of signal abnormality are noted in the subcortical white matter (*arrows*) and also in the periventricular region. Lesions are seen in the midbrain (*B*) (*arrow*) and in bilateral middle cerebellar peduncles (*C*). Sagittal T2-weighted MR imaging (*D*) shows hyperintensity involving the cervicothoracic cord (*arrows*).