

Multiple Sclerosis: An Overview of Pathogenesis, Diagnosis, and Management

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Abstract

Multiple sclerosis (MS) is a chronic, demyelinating autoimmune disorder of the central nervous system (CNS) that predominantly affects young adults. The disease results from an aberrant immune response targeting the myelin sheath, leading to impaired neural transmission and progressive neurological dysfunction. This paper reviews the etiology, pathogenesis, clinical manifestations, diagnostic approaches, and current treatment strategies for MS. Despite the lack of a definitive cure, advances in immunotherapy and early diagnosis have significantly improved patient outcomes and quality of life.

Keywords: Multiple sclerosis, demyelination, autoimmune disease, neuroinflammation, immunotherapy.

Introduction: Multiple sclerosis (MS) is a multifactorial, immune-mediated disease of the CNS characterized by inflammation, demyelination, and neurodegeneration. It primarily affects individuals aged 20–40 years and represents one of the leading causes of non-traumatic neurological disability among young adults. The disease is more common in women, with a female-to-male ratio of approximately 3:1.

Etiology and Pathogenesis

Although the exact cause of MS remains unknown, several interrelated factors contribute to its development. Genetic predisposition, particularly the HLA-DRB1 gene variant, plays a critical role in susceptibility. Environmental influences such as vitamin D deficiency, limited sunlight exposure, Epstein–Barr virus (EBV) infection, smoking, and psychological stress have also been implicated. Pathophysiologically, MS is driven by autoreactive T cells and B cells that cross the blood–brain barrier, initiating inflammation and demyelination. This immune-mediated damage leads to axonal loss and gliosis, producing the characteristic plaques visible on MRI.

Clinical Manifestations

MS presents with diverse neurological symptoms depending on lesion localization. Common early signs include optic neuritis, muscle weakness, numbness, spasticity, ataxia, and fatigue. Cognitive impairment—such as reduced memory and attention—may develop in later stages. The disease course varies, most frequently appearing as relapsing–remitting MS (RRMS), followed by secondary progressive (SPMS) or primary progressive (PPMS) forms.

Diagnosis

Diagnosis relies on a combination of clinical evaluation, neuroimaging, and laboratory investigations. Magnetic resonance imaging (MRI) is the gold standard for detecting demyelinating lesions in the brain and spinal cord. Cerebrospinal fluid (CSF) analysis for oligoclonal bands supports the diagnosis, and evoked potential tests assess delayed neural conduction. The McDonald criteria (2017 revision) provide a standardized framework for confirming MS.

Treatment and Management

While no cure exists, disease-modifying therapies (DMTs) can reduce relapse frequency and slow progression. Interferon-beta and glatiramer acetate remain first-line agents, while newer drugs such as natalizumab, ocrelizumab, and fingolimod target specific immune mechanisms. Corticosteroids are used

for acute relapses, and supportive interventions—including physiotherapy, pain management, and psychological counseling—are essential for maintaining quality of life.

Prevention and Lifestyle Considerations

Preventive strategies emphasize modifiable risk factors: maintaining adequate vitamin D levels, avoiding smoking, engaging in regular physical activity, and managing stress. Emotional and social support play an important role in improving adherence to therapy and psychological resilience.

Conclusion

Multiple sclerosis is a complex, heterogeneous disease with significant neurological and psychosocial implications. Early recognition and multidisciplinary management are vital for improving long-term outcomes. Future research into neuroregenerative therapies and precision medicine offers hope for more effective treatments and possibly prevention.

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