Multiple Sclerosis: An Overview

Rameen Nadeem

1st Year BDS, Islamabad Medical and Dental College, Islamabad, Pakistan

Key points

- Introduction
- Causes of Multiple Sclerosis
- Risk Factors
- Symptoms
- Diagnosis
- Treatment Options
- Conclusion

Introduction

Multiple Sclerosis (MS) is a chronic, often disabling disease of the central nervous system (CNS) that affects millions worldwide. The immune system attacks the protective sheath (myelin) that covers nerve fibers, disorderly communication between the brain and the rest of the body. As of 2024, the global prevalence of MS is increasing, but so are the advances in diagnostics and treatments. This article is a complete guide to MS, with a focus on post-2021 breakthroughs that are changing how we understand and manage this condition.[1]

Causes of Multiple Sclerosis

The exact cause of MS is unknown, but it's believed to be a combination of genetic predisposition and environmental triggers. Several factors have been linked to MS:

- Autoimmune Reaction: The immune system attacks myelin in the CNS.
- Viral Infections: Especially Epstein-Barr Virus (EBV), which is strongly associated with MS.[2]
- Vitamin D Deficiency: Low levels may impair immune regulation.
- Genetic Factors: Certain HLA gene variants increase vulnerability[1]

Risk Factors

Several conditions and exposures increase the risk of MS:

- Age: Most people are diagnosed between 20–40.
- Sex: Women are two to three times more likely to develop MS.
- Geographic Location: Higher prevalence in temperate regions, especially Northern Europe and North America.
- Family History: First-degree relatives have a higher risk.
- Smoking: Increases disease activity and progression.
- Obesity during Adolescence: Linked with higher MS risk.[1]

Symptoms

MS symptoms vary depending on the location and severity of nerve damage. Common symptoms:

- Unresponsiveness or weakness in limbs
- Vision problems (optic neuritis)
- Fatigue and dizziness
- Loss of coordination
- Bladder and bowel dysfunction
- Cerebral issues like memory loss.[2]

Diagnosis

Diagnosis has improved significantly in recent years. It's based on:

- MRI Scans: Lesions in the brain and spinal cord
- Lumbar Puncture: Abnormalities in cerebrospinal fluid (CSF)
- Evoked Potential Tests: Electrical activity in the brain
- Blood Tests: To rule out other conditions

The 2017 McDonald Criteria, refined in later studies, allow for earlier diagnosis by focusing on dissemination of lesions in time and space.[3]

Treatment Options

1. Disease-Modifying Therapies (DMTs)

   These medications reduce relapses, slow progression and new lesion formation.

   - Interferons (e.g., Avonex)
   - Glatiramer acetate
   - Oral agents: fingolimod, dimethyl fumarate
   - Monoclonal antibodies: natalizumab, ocrelizumab, ofatumumab (approved 2020)[5]

2. Symptom Management:
   - Muscle relaxants (e.g., baclofen)
   - Pain relievers
   - Antidepressants
3. Recent Advances Beyond 2021

   - Remyelination Therapies: There's some exciting research happening around reversing nerve damage. Drugs like clemastine fumarate and opicinumab are currently being tested to see if they can help regenerate myelin.[6]

   - Biomarkers for Monitoring Measuring: Neurofilament light chain (NfL) levels in blood or cerebrospinal fluid (CSF) is proving useful for tracking disease activity and how well treatments are working.[4]

   - Artificial Intelligence (AI): AI and machine learning are stepping up to the plate, helping to predict relapses, tailor therapies, and pinpoint different disease subtypes using MRI data.[7,8]

   - New Drug Developments: BTK inhibitors, such as evobrutinib and tolebrutinib, are in trials to explore their combined anti-inflammatory and neuroprotective benefits for progressive MS.[9]

   - Lifestyle and Mental Health Support: A well-rounded approach to MS care includes lifestyle changes and mental health support:

     1. Exercise: Boosts asset, balance, and mood
     2. Vitamin D Supplementation: Might help slow down disease progression
     3. Dietary Interventions: Anti-inflammatory diets are currently being researched
     4. Mental Health Care: Cognitive Behavioral Therapy (CBT) and mindfulness techniques are effective in managing depression and anxiety, which impact over 50% of MS patients.[10]

Conclusion

Living with Multiple Sclerosis can be a life-changing experience, but the way we approach care is evolving quickly. With personalized treatments, AI-driven diagnostics, and the potential for remyelination, the advancements made since 2021 are bringing fresh hope to patients and their families. The future of MS care is all about ongoing research, embracing technology, and taking a holistic view of both physical and mental health.

References

1. Thompson AJ, Baranzini SE, Geurts J, Hemmer B, Ciccarelli O. Multiple sclerosis. The Lancet. 2018 Apr 21;391(10130):1622-36.
2. Bjornevik K, Cortese M, Healy BC, Kuhle J, Mina MJ, Leng Y, Elledge SJ, Niebuhr DW, Scher AI, Munger KL, Ascherio A. Longitudinal analysis

reveals high prevalence of Epstein-Barr virus associated with multiple sclerosis. Science. 2022 Jan 21;375(6578):296-301.
3. Filippi M, Preziosa P, Rocca MA. "Multiple sclerosis: current imaging techniques and future developments." Neuroimaging Clinics. 2017; 27(2): 195–213.
4. Thebault S, Booth RA, Freedman MS. Blood neurofilament light chain: the neurologist's troponin?. Biomedicines. 2020 Nov 21;8(11):523.
5. Hauser SL, Bar-Or A, Cohen JA, Comi G, Correale J, Coyle PK, Cross AH, De Seze J, Leppert D, Montalban X, Selmaj K. Ofatumumab versus teriflunomide in multiple sclerosis. New England Journal of Medicine. 2020 Aug 6;383(6):546-57.
6. Green AJ, Gelfand JM, Cree BA, Bevan C, Boscardin WJ, Mei F, Inman J, Arnow S, Devereux M, Abounasr A, Nobuta H. Clemastine fumarate as a remyelinating therapy for multiple sclerosis (ReBUILD): a randomised, controlled, double-blind, crossover trial. The Lancet. 2017 Dec 2;390(10111):2481-9.
7. Huang S, Yang J, Fong S, Zhao Q. Artificial intelligence in the diagnosis of COVID-19: challenges and perspectives. International journal of biological sciences. 2021 Apr 10;17(6):1581.
8. Eshaghi A, Young AL, Wijeratne PA, Prados F, Arnold DL, Narayanan S, Guttmann CR, Barkhof F, Alexander DC, Thompson AJ, Chard D. Identifying multiple sclerosis subtypes using unsupervised machine learning and MRI data. Nature communications. 2021 Apr 6;12(1):2078.
9. Reich DS, Lucchinetti CF, Calabresi PA. "Multiple sclerosis." New England Journal of Medicine. 2018; 378(2): 169–180.
10. Boeschoten RE, Braamse AM, Beekman AT, Cuijpers P, Van Oppen P, Dekker J, Uitdehaag BM. Prevalence of depression and anxiety in multiple sclerosis: a systematic review and meta-analysis. Journal of the neurological sciences. 2017 Jan