Multiple Sclerosis

Biomedical Engineering - URJC

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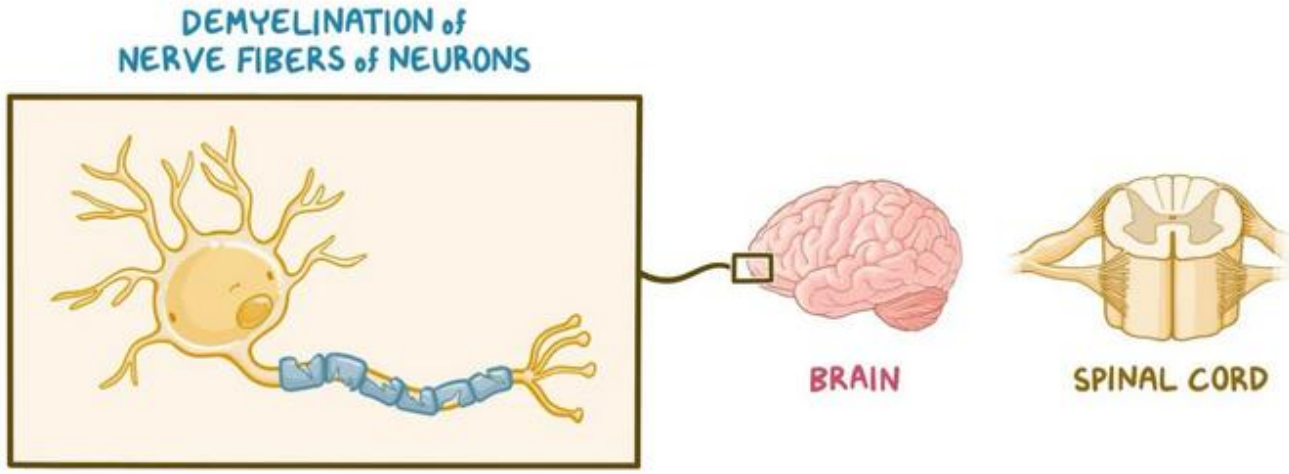
Introduction

Definition

Multiple sclerosis (MS) is a chronic autoimmune disease affecting the central nervous system (CNS), characterized by inflammation, **demyelination**, gliosis, and neuronal loss.



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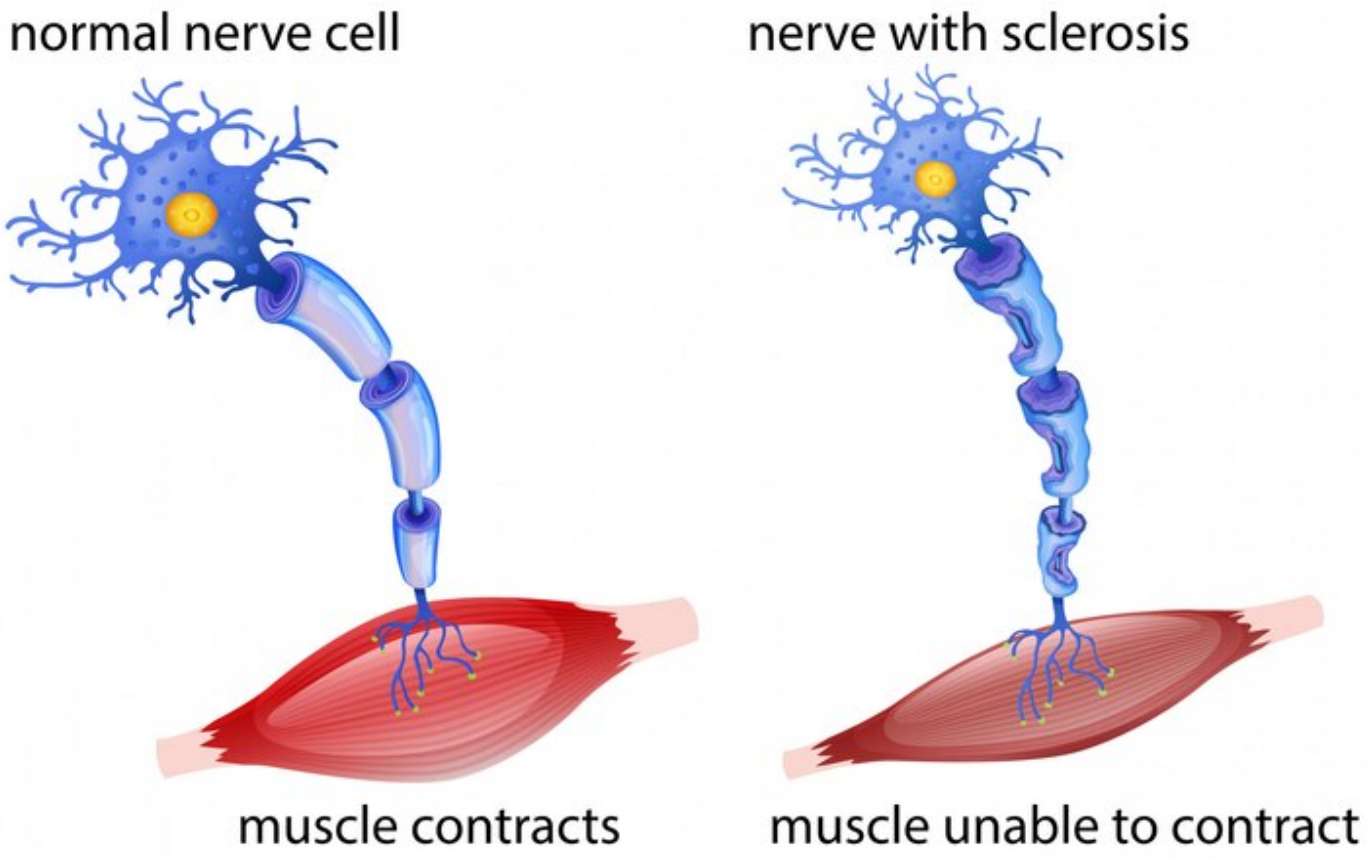

Introduction

Overall Symptoms

- Vision impairment
- Numbness and tingling
- Focal weakness
- Bladder and bowel dysfunction
- Cognitive impairment

Disease Courses

- Relapsing-remitting (RR)
- Primary progressive (PP)
- Secondary progressive (SP)
- Progressive-relapsing (PR)

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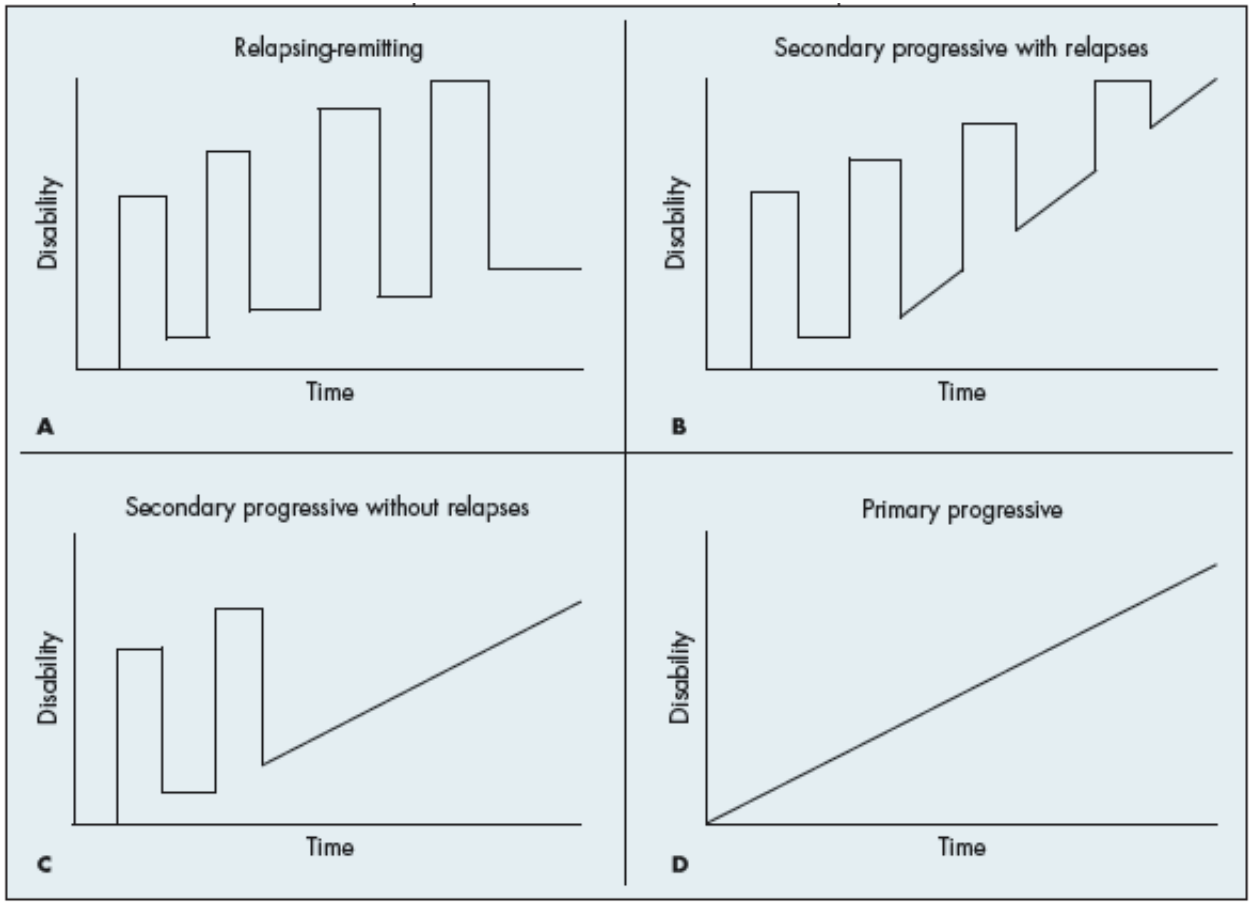

Figure 1 – The clinical courses of multiple sclerosis (MS) are differentiated by disability over time. The relapsing-remitting course is the most common and carries the best prognosis (A). Although symptoms remit, there is usually a mild residual deficit, and in time, these mild deficits produce disability. The secondary progressive course evolves in approximately 30% to 40% of cases of relapsing-remitting MS after about 6 to 10 years. The secondary progressive course may or may not be associated with superimposed relapses (B and C). Thereafter, symptoms worsen insidiously without a clear period of remission. In the primary progressive form, there are no periods of remission; instead, steady progression of symptoms leads to disability from the start (D).

Etiology

Immune Factors

Dysimmunity with an autoimmune attack on the CNS is the leading hypothesized etiology.

Environmental Factors

- Vitamin D deficiency
- Viral infections
- Latitudinal gradients

Genetic Associations

- Higher risk in first-degree relatives
- HLA types strongly correlated with MS

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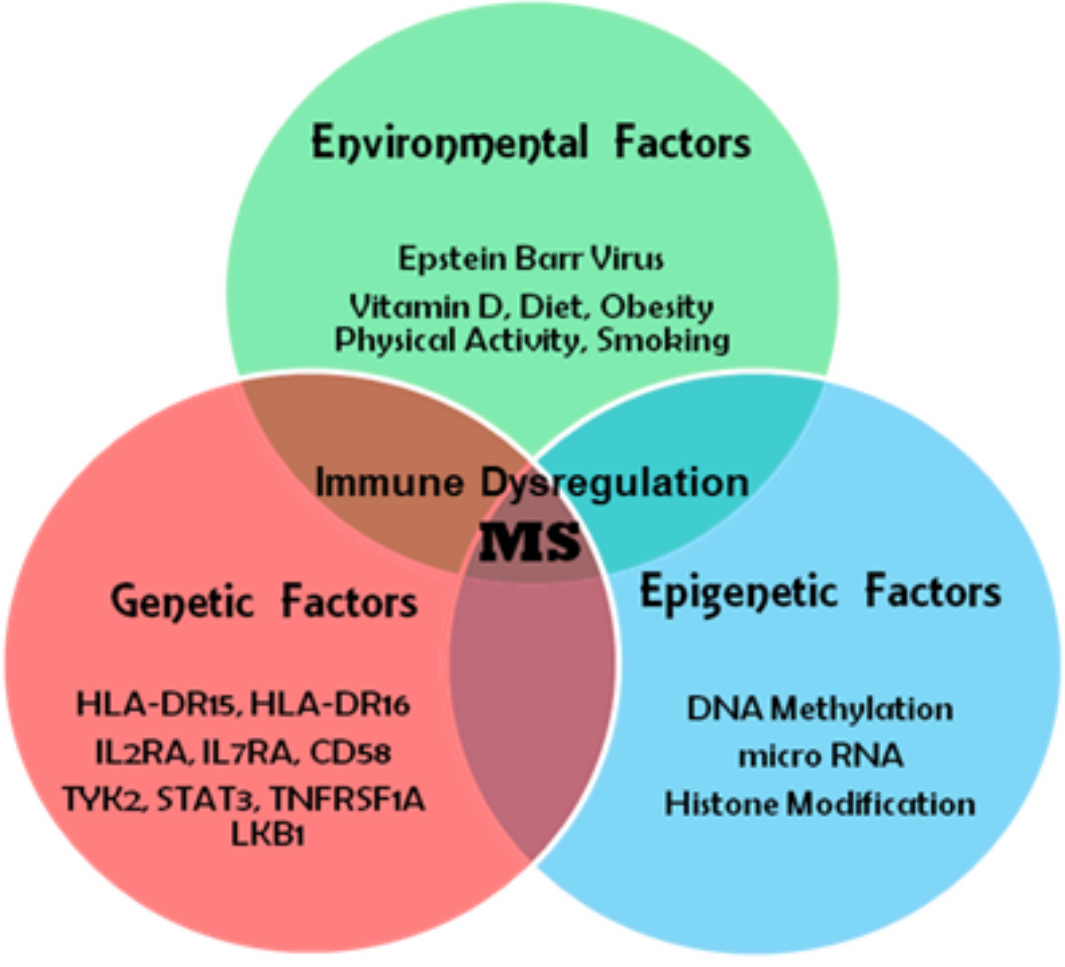

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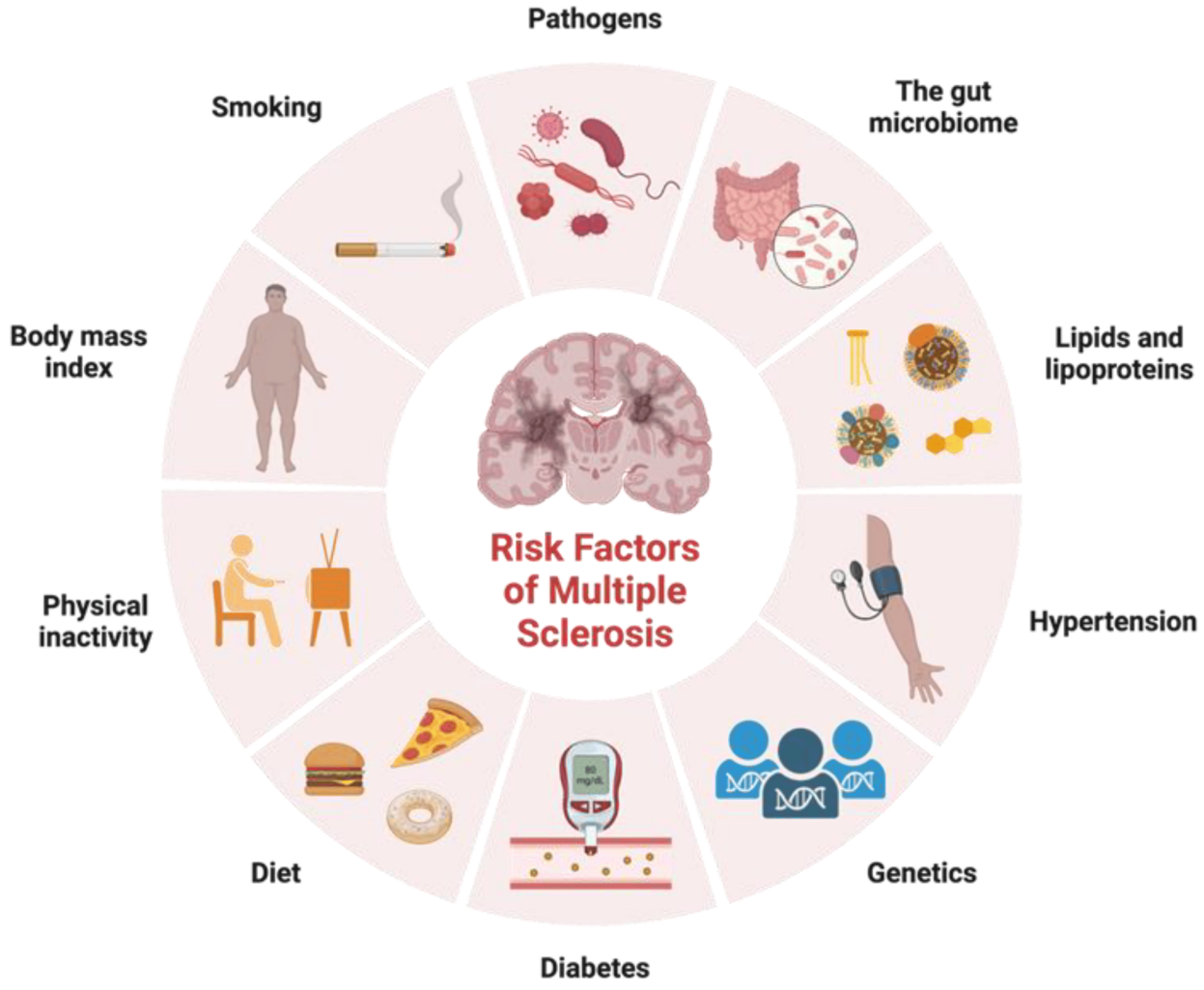


Epidemiology

Prevalence

- Affects 400,000 individuals in the US
- 2.5 million worldwide
- 3-fold more common in females

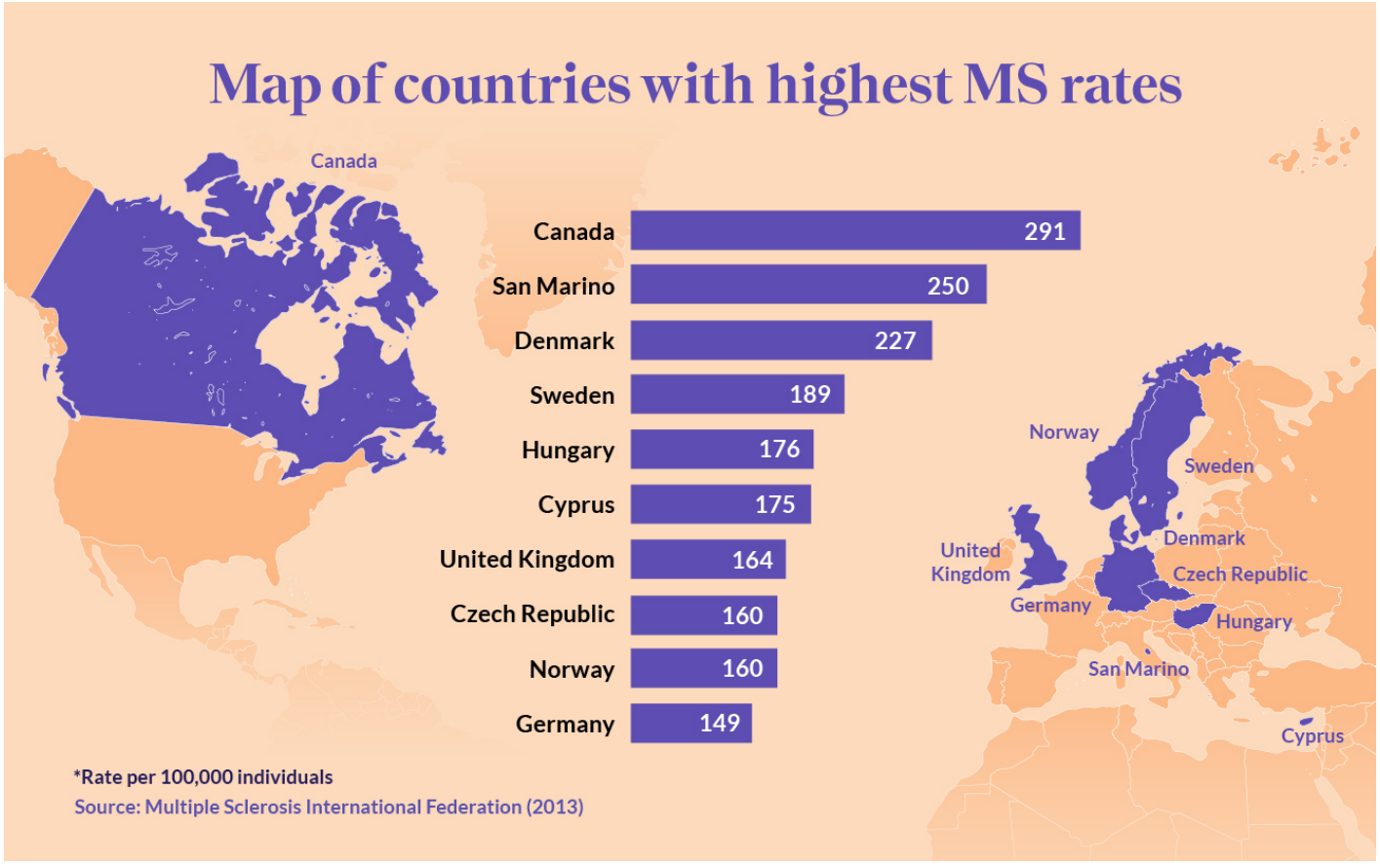
Age of Onset

- Typically between 20 and 40 years

Geographical Distribution

- Higher prevalence in northern latitudes
- Lower prevalence in East Asian and African populations

Geographical Distribution



Pathophysiology

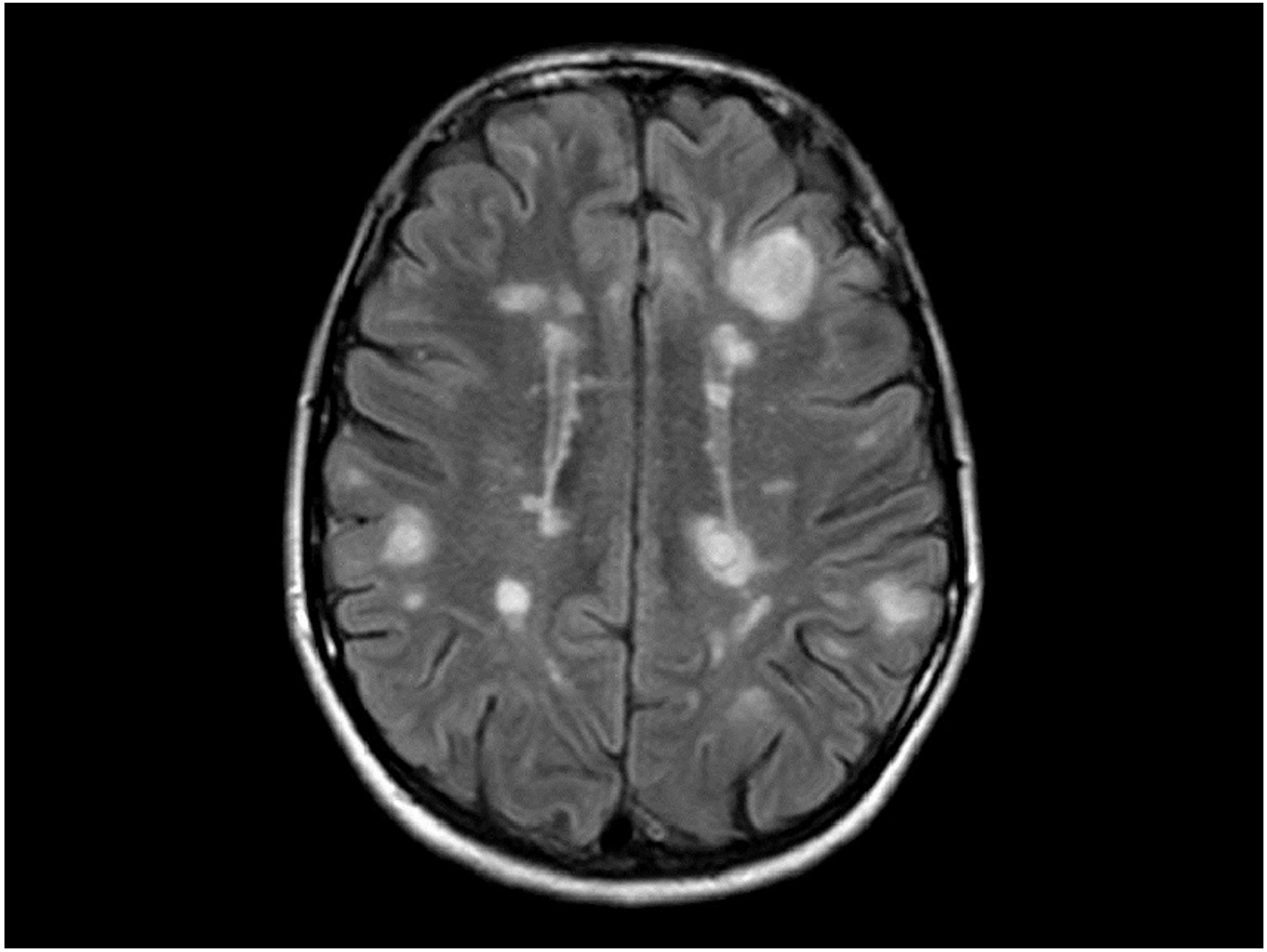
Key Processes

- Focal inflammation leading to plaques
- Neurodegeneration involving axons, neurons, and synapses

MRI Findings

- T2 hyperintense lesions
- Gadolinium-enhancing active lesions
- Thinning of the corpus callosum

Geographical Distribution



Histopathology

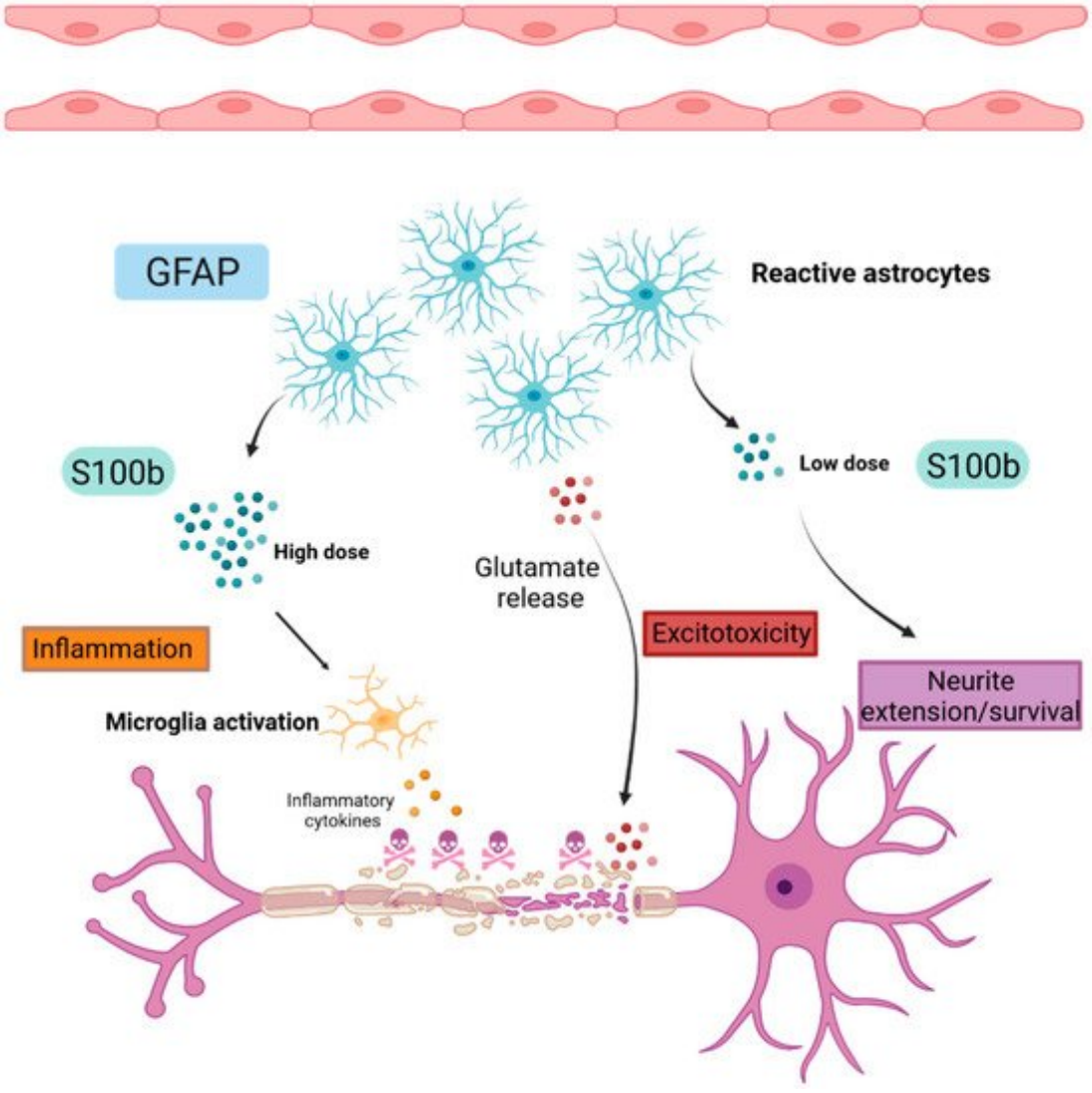
Active Plaques

- Macrophage infiltration
- Myelin debris within macrophages
- Perivascular inflammatory infiltrates

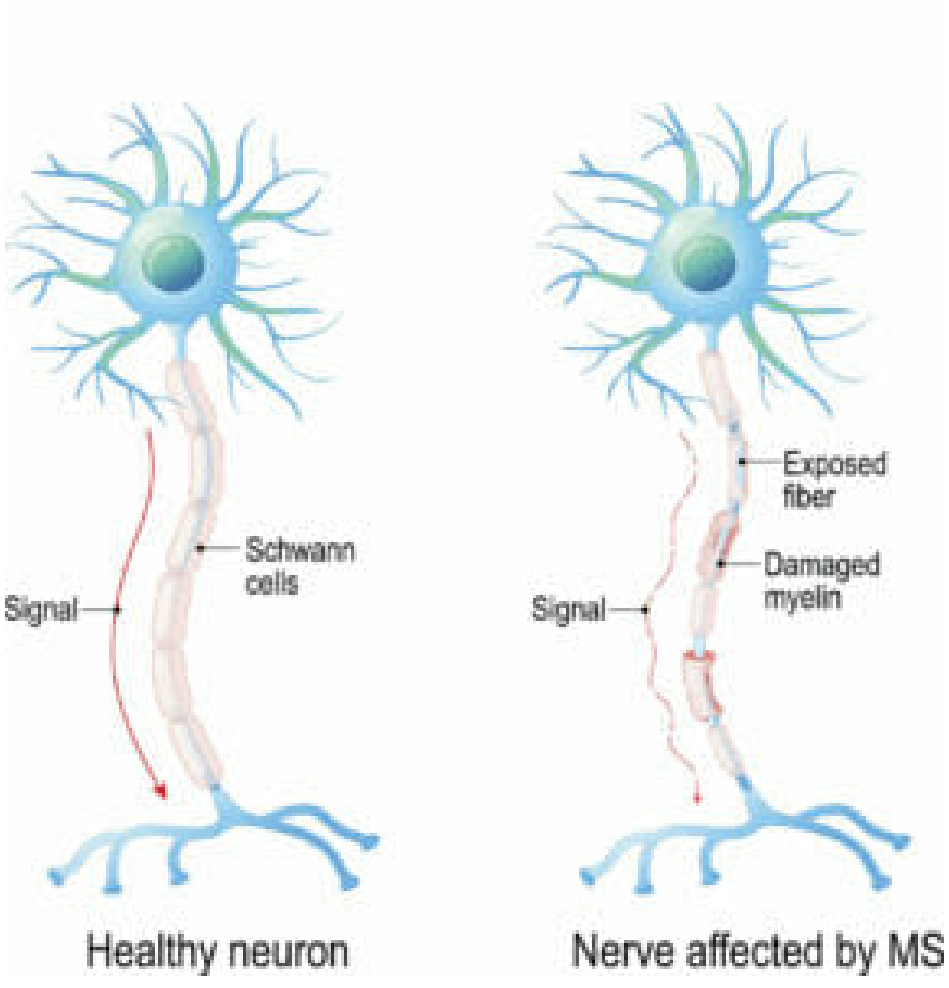
Chronic Plaques

- Hypocellularity and demyelination
- Macrophages laden with myelin
- Resolving edema

Histopathology



Histopathology



Diagnosis

Key Criteria

- Clinical presentation and examination

Diagnostic Tools

- MRI
- Evoked potentials
- CSF analysis (oligoclonal bands)

McDonald Criteria (2017)

- Inclusion of symptomatic lesions
- Use of cortical lesions

Treatment

Disease-Modifying Therapies

- Glatiramer acetate, Interferon-beta preparations
- Natalizumab, Mitoxantrone
- Fingolimod

Acute Exacerbation

- IV methylprednisolone (3-7 days)
- Oral prednisone (1250 mg/d)

Long-Term Goals

- Decrease MRI lesion activity
- Prevent secondary progressive MS

Conclusion

Key Takeaways

- MS is a complex autoimmune disease with multiple disease courses.
- Early diagnosis and treatment are crucial for managing the disease.
- Disease-modifying therapies can help reduce relapses and slow progression.

Future Directions

- Further research into genetic and environmental factors.
- Development of more effective therapies for progressive forms of MS.