Radiologic Findings in Multiple Sclerosis

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Courtesy of NMSS, Boston - www.nationalmssociety.org/

Objectives

- To introduce the basic framework of MS as it is currently understood
- To become familiar with the radiologic findings in MS patients

Multiple Sclerosis – The Basics

- ~ 400,000 people currently diagnosed with MS
- Estimate of about 2.5 million people worldwide
- Typically begins in early adulthood with variable prognosis – 50% will require aid in walking within 15 years
- One of earliest neurological diseases known, described by Charcot in 1868
- Understanding of the condition has evolved and is intertwined with advances in neuroscience, immunology, medicine, and radiology

Clinical Presentation

- B.B., a 24 y.o. Haitian woman w/ 4 yr diagnosis of MS
- Intermittent sensory disturbances and parathesias in all four extremities
- Gait ataxia
- Visual diplopia
- Mental status difficulties – memory, attention, and depression
- Received cyclophosphamide therapy and plasmapheresis within the past year
- MRI scans taken in March and in September

Diagnosis of MS

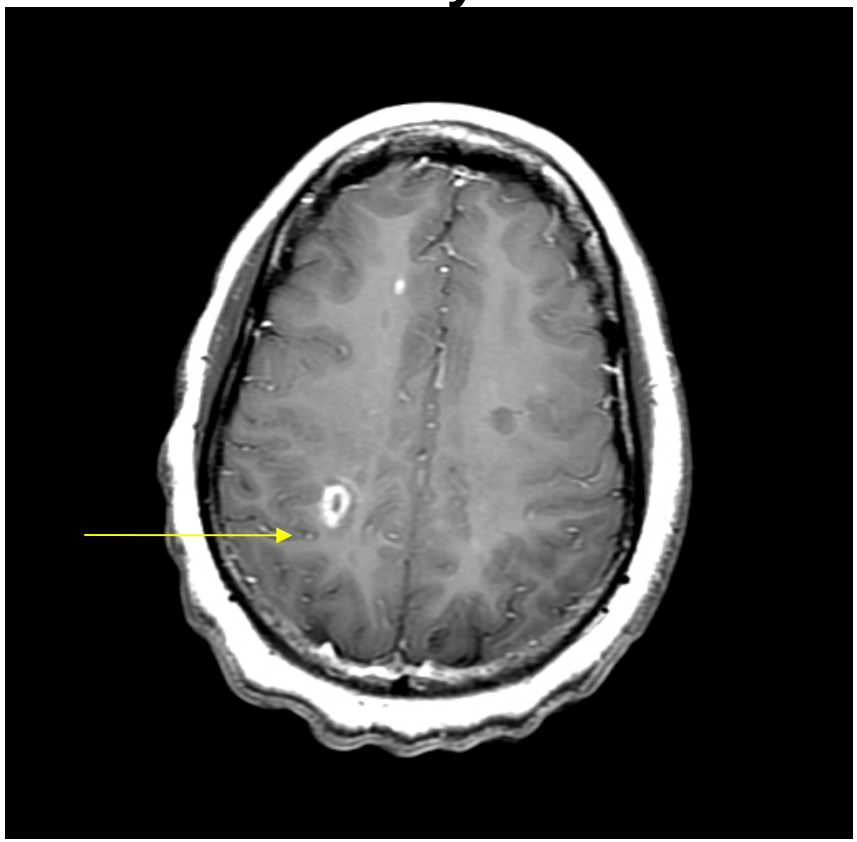
- “Disseminated attacks in space and time” [Poser Criteria, (Poser, 1983)]
  - Distinct neurological attacks in two different parts of the nervous system
  - At least two separate flare-ups
- MRI imaging is now a major part of the diagnosis and follow-up
  - T_2-weighted imaging
  - T_1 imaging with Gd-enhancement

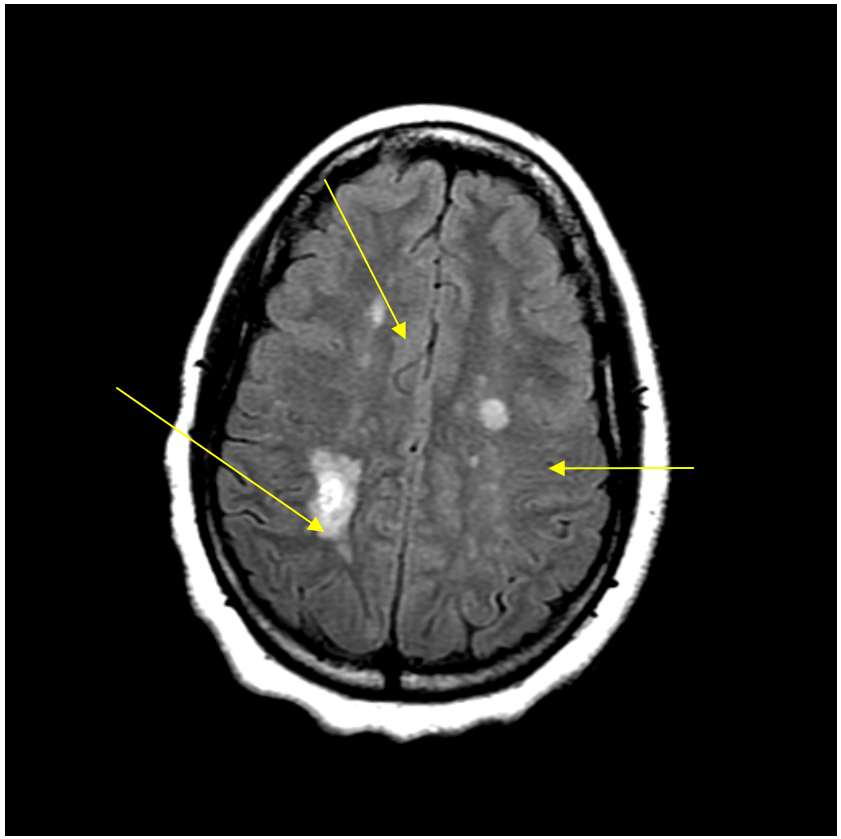
Clinical/MRI Paradox

- Despite the radiologic findings that help with diagnosis, MRI lesion load are weakly correlated with clinical progression (Brex et al.)
- Proposed explanations
  - Not all lesions are equivalently important (lesion heterogeneity)
  - Lesion location in brain matters
  - Abnormalities in the normal appearing white matter (NAWM) as well as the normal appearing grey matter
  - Spinal cord involvement

Gd-enhancing Lesions

- **Can be ring-enhancing or nodular**
- **Transient**
- **Variable in size and intensity**
- **Probably indicative of active inflammation**



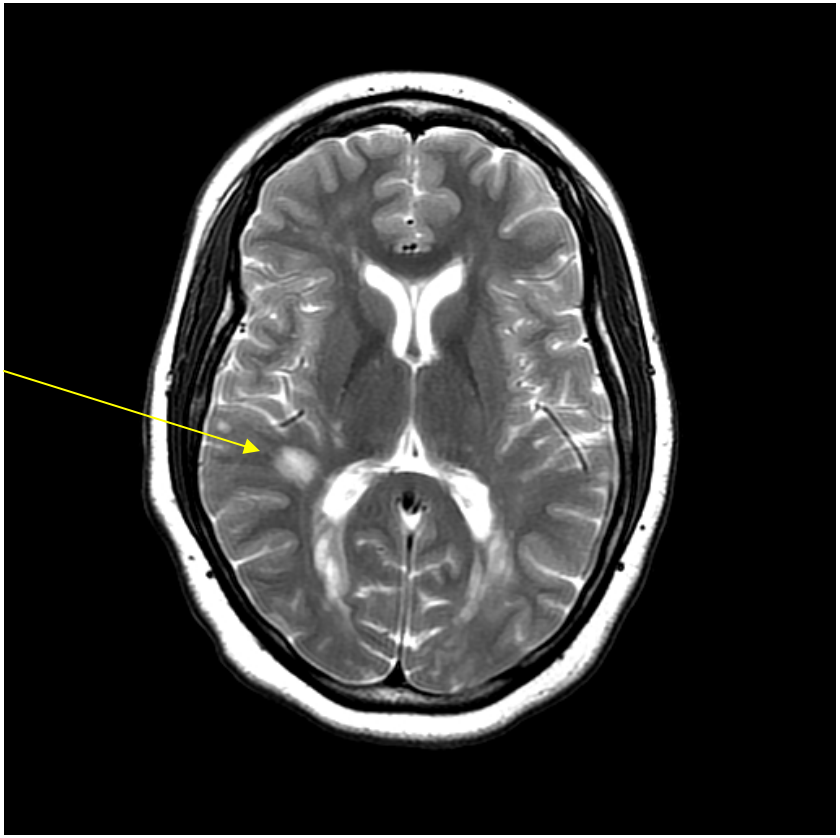


(Scans are of our patient, B.B.)

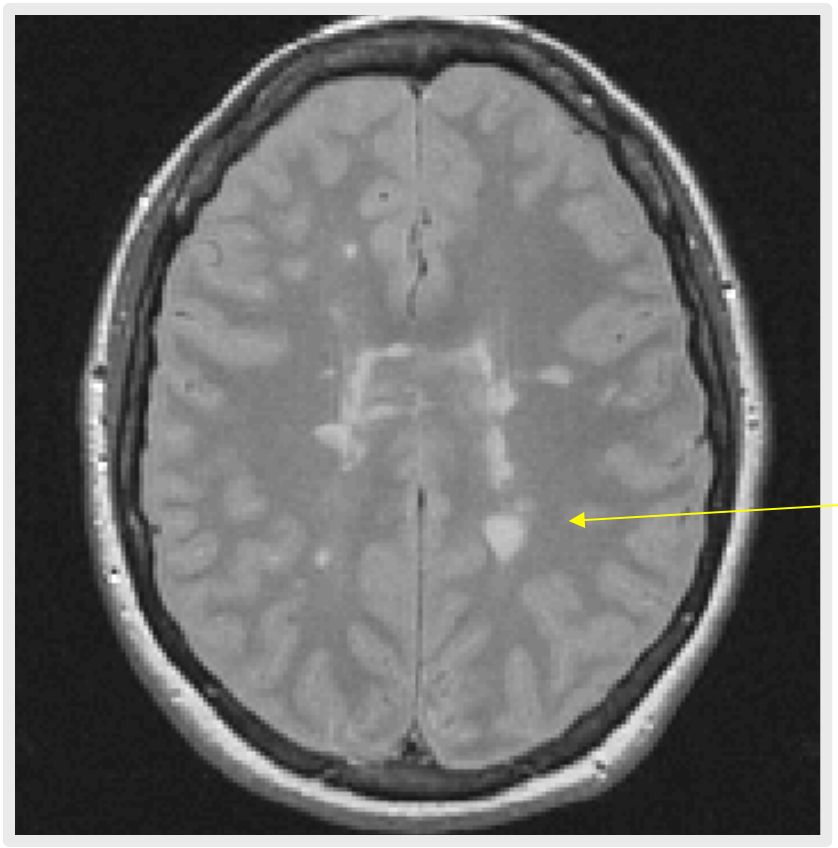
Courtesy of PACS, BIDMC

T_2 Hyperintense Lesions

- Probably indicative of chronic inflammation



(L. scan is of our patient, B.B.)

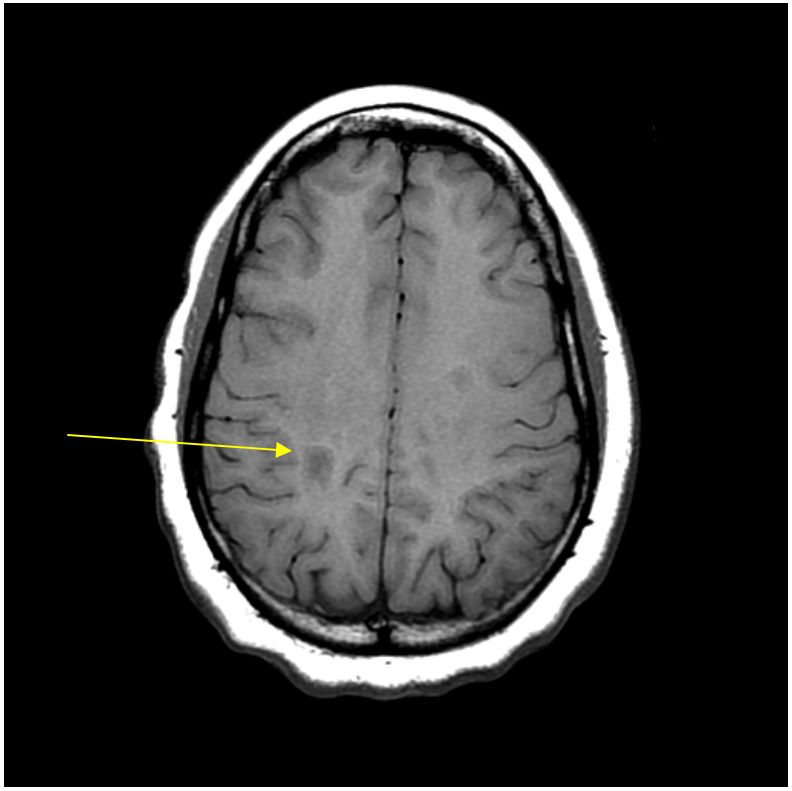


Courtesy of PACS, BIDMC

(R. scan is of another MS patient)

T_1 Hypointense Lesions

- Probably indicative of old regions of chronic inflammation



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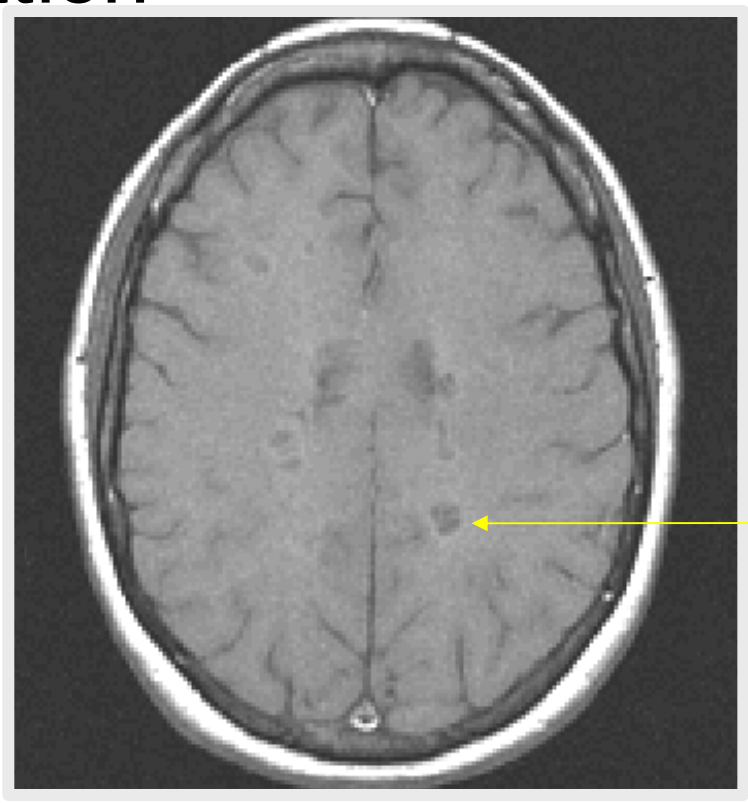
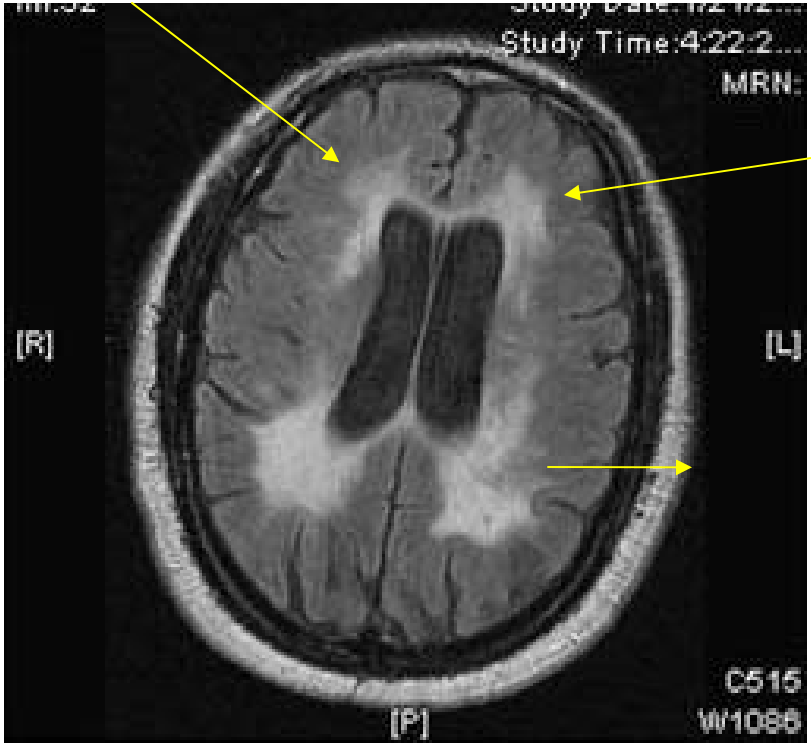


(R. scan is of another MS patient) Courtesy of PACS, BIDMC

Dawson Fingers

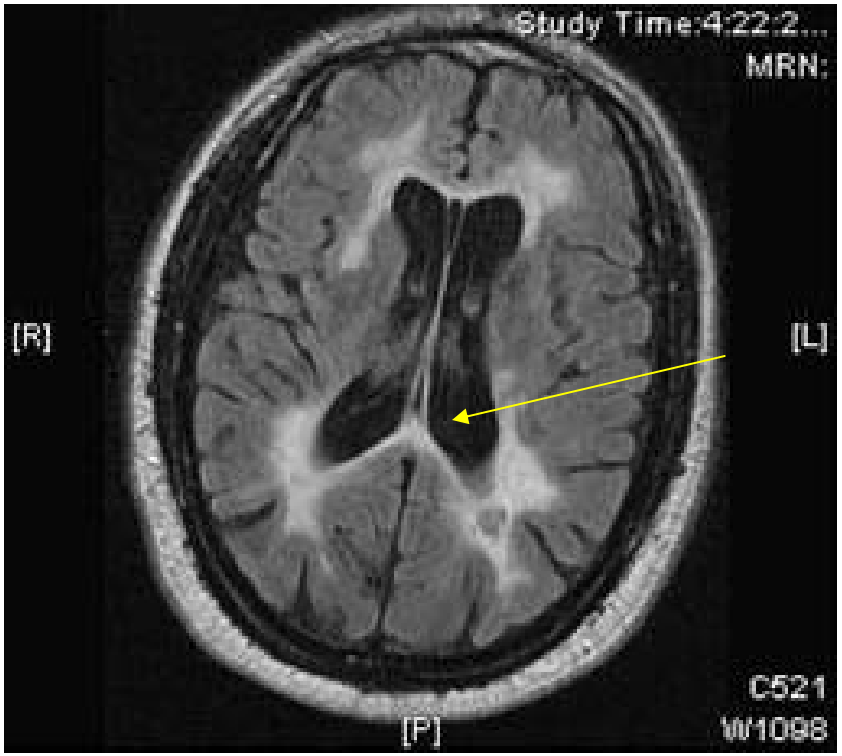
- Lesions tend to run along ventricles with “finger-like projections,” called Dawson Fingers



(Scan is of another MS patient) Courtesy of PACS, BIDMC

Dilated Ventricles

- Reflective of cortical atrophy that occurs throughout the disease process, particularly during the late stages

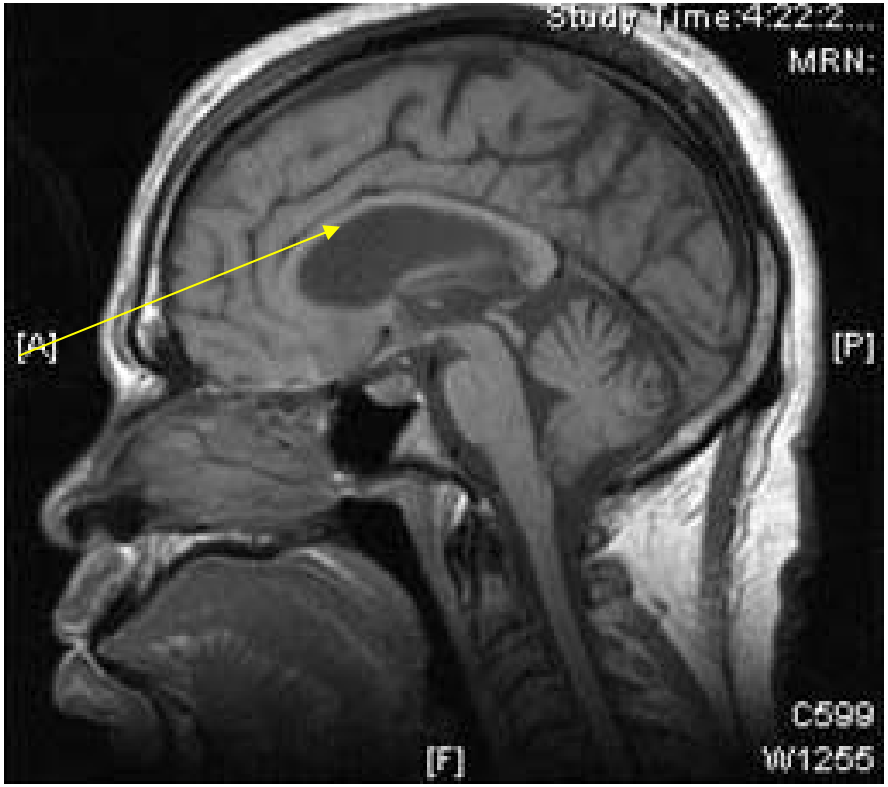


(Scan is of another MS patient)

Courtesy of PACS, BIDMC

Corpus Callosum Atrophy

- The corpus callosum tends to have “moth-eaten” appearance and appears atrophied, especially in later stages

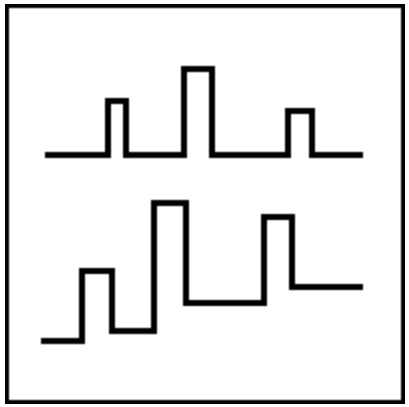


Courtesy of PACS, BIDMC

(Scan is of another MS patient)

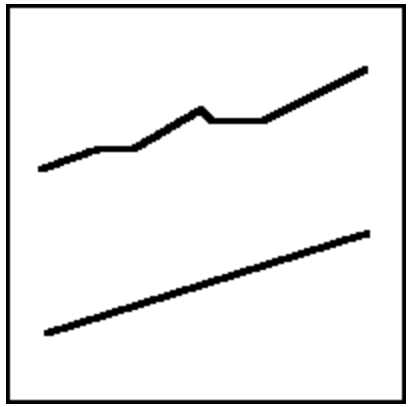
Progression of MS

4 major classifications



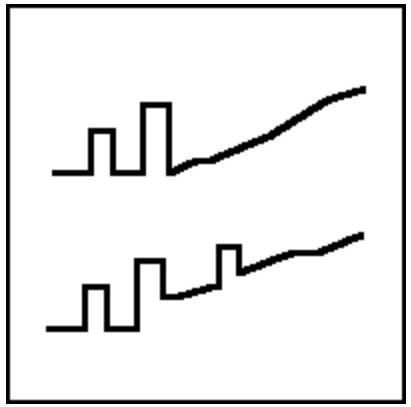
Relapsing-Remitting (RR)

(85% are initial diagnosed with RR)



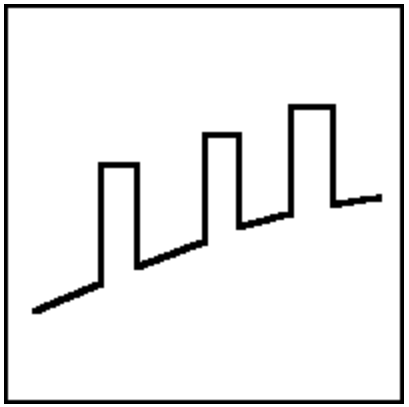
Primary Progressive

(10%)



Secondary Progressive

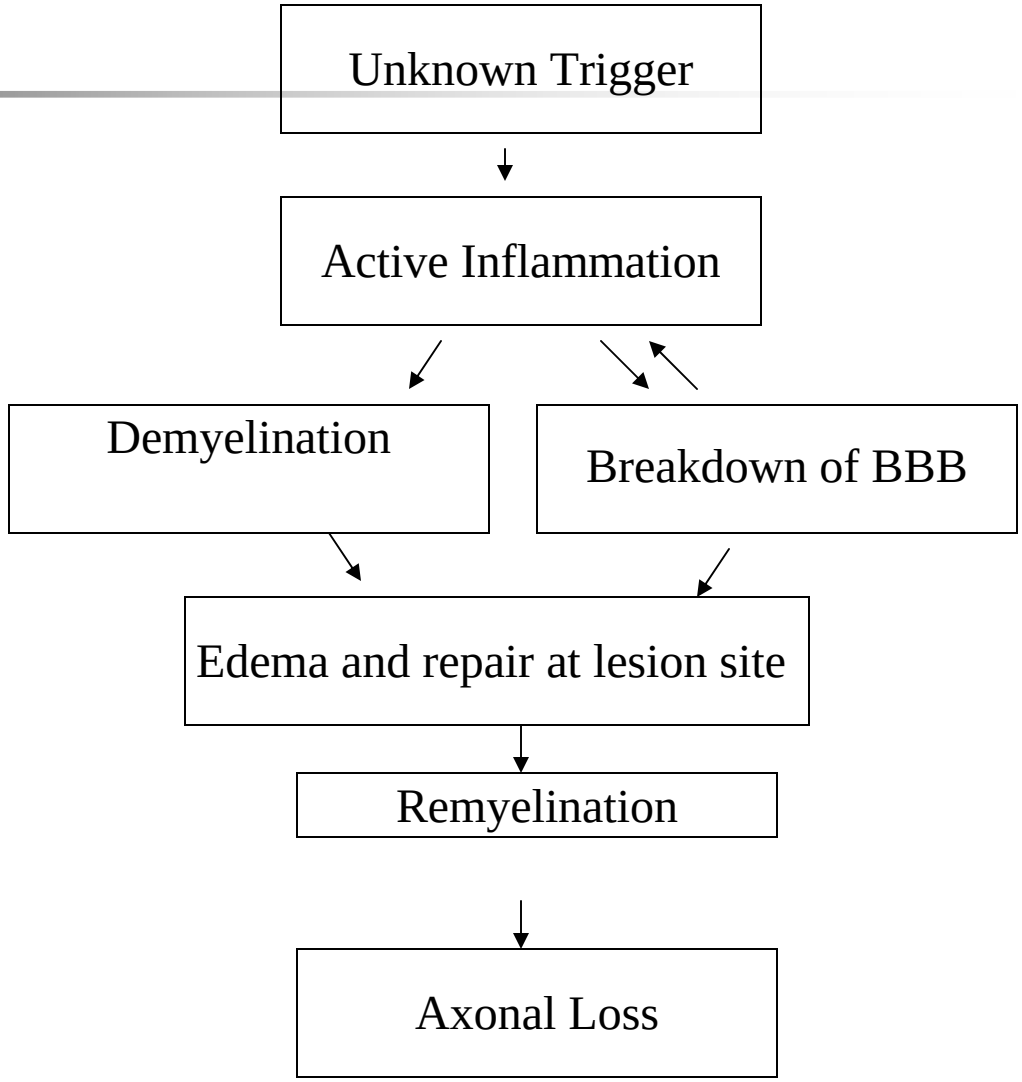
(50-60% of RR eventually become SP)



Progressive Relapsing

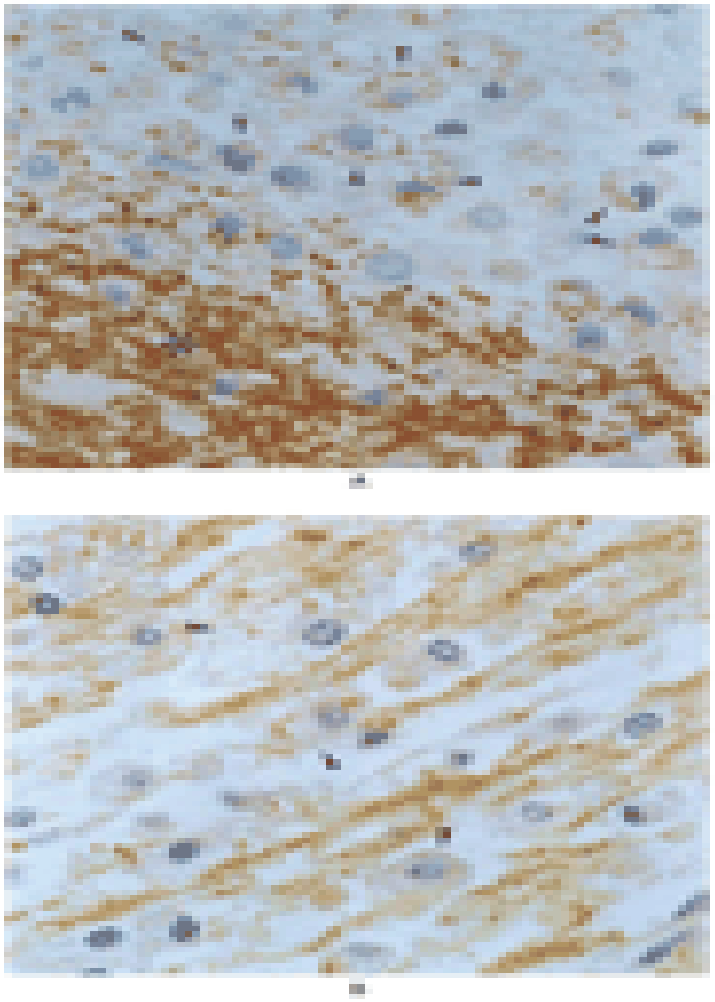
Pathophysiology

- Generally believed to be an autoimmune process
- Is a dynamic disease
- Order of pathologic process still not well understood
- Currently believed that axonal loss past threshold leads to clinical symptoms



Histopathology

- At site of lesion:
  - Edema
  - Recruitment of inflammatory cells
  - Demyelination
  - Loss of axons



Courtesy of Noseworthy et al., NEJM

Treatments used for MS

- Anti-inflammatory,
  - Corticosteroids
- Immunomodulatory
  - Beta-interferon
  - Natalizumab (suspended)
- Immunosuppressive
  - Cytotoxic therapy (cyclophosphamide, methotrexate, and others)
  - Plasmapheresis

The Road Ahead

- Better radiologic metrics that correlate well with clinical progression
- Better characterization of the lesions
- Better treatments for MS patients

Summary

- MS is a progressive neurologic disorder characterized by inflammation, demyelination, and axonal loss
- T_1, T_2, Gd-enhancing lesions are noted on MRI. Spinal cord lesions, cortical atrophy, and corpus callosum atrophy are also notable.

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