Radiologic Findings in Multiple Sclerosis

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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
**T₂ Hyperintense Lesions**

- Probably indicative of chronic inflammation

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

(R. scan is of another MS patient)

Courtesy of PACS, BIDMC
$T_1$ Hypointense Lesions

- Probably indicative of old regions of chronic inflammation

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

Diagram:
- Unknown Trigger
  - Active Inflammation
    - Demyelination
    - Breakdown of BBB
      - Edema and repair at lesion site
        - Remyelination
          - Axonal Loss
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.
References-I

- NMSS webpage – [www.nmss.org](http://www.nmss.org)
References-II

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