The role of MRI in the diagnosis of Multiple Sclerosis

LH is a 34 yo female with a history of relapsing remitting MS presents to the multiple sclerosis clinic for MRI follow up of disease progression.

Brice Gaudilliere, PhD
(Harvard Medical School year IV)

Gillian Lieberman, MD
Objectives

– Briefly review the pathogenesis of multiple sclerosis (MS).

– Introduce the McDonald's MRI criteria for diagnosis of MS.

– Describe the typical MRI findings and disease-progression of MS.

– Discuss limits and future prospects of MRI diagnosis of MS.
Multiple Sclerosis

1868: Jean-Martin Charcot describes the “Sclérose en Plaque” as a new disease linking clinical and postmortem findings.

Pathogenesis of MS

Extravasating T-cells

Demyelination

Disease Patterns

- Relapsing remitting (RRMS)
- Secondary progressive: initial RRMS then progression.
- Primary progressive: Progression from onset with occasional plateau.
- Progressive relapsing: Progression from onset with acute relapse.
Diagnostic criteria for MS

• **POSER criteria (1980s)**

  Two attacks + Two separate clinical lesions = Clinically definite MS

  Two attacks + one clinical lesion + Labs findings (CSF, OCB, IgG) = Laboratory definite MS
Diagnostic criteria for MS

- McDonald’s criteria (2001 and 2005)
  - Demonstrate dissemination of clinical events in space and time.
  - Demonstrate dissemination of MRI findings in space and time.
  - Assigns confidence for MS vs Possible MS vs. Not MS based on clinical and MRI findings.
MRI modality of choice for MS

- Conventional MRI is the most sensitive way to detect MS lesions.

- Typical MRI lesions correlate well with histopathology: Found in periventricular region, corpus callosum, subcortical region, brainstem, optic nerve and visual pathways.

- Lesions usually not seen on CT.

- Use of contrast allows early detection of acute lesions.

- Specificity 90%, sensitivity 80%, ppv 65%. (<50yo)⁸
Ant. Horn of lateral ventricles
Head of Caudate nucleus
Thalamus
Visual Cortex
Ant. And post. Limb of internal capsule
Putamen
Genu of Corpus Callosum

companion patient 1: MS lesions on MRI

Hypointense lesions on T1WI

Hyperintense lesions on T2WI

Companion patient 2: Fluid attenuated Inversion Recovery (vFLAIR) allows for better visualization of periventricular lesions

Hyperintense lesions on T2WI

Hyperintense lesions on T2 FLAIR

DDx of white matter lesion

- Ischemia
- Systemic lupus erythematosus
- HTLV-I
- Sarcoidosis
- Behcet's disease
- Vasculitides

Companion patient 3: axial FLAIR
Specific MRI findings to narrow the differential

• Review specific lesions found in MS.

• Apply McDonald’s criteria for dissemination in space and time.
Classical MS lesions: Dawson’s fingers (Patient LH)
Classical MS lesions: Black holes (patient LH)
Dissemination in Space

McDonald’s MRI criteria:
Three of the following are required:

- At least one gadolinium-enhancing lesion or nine T2 hyperintense lesions
- At least one infratentorial lesion
- At least one juxtacortical lesion
- At least three periventricular lesions

Dissemination in space (Patient LH)
Dissemination in Time:

- Detection of gadolinium enhancement at least 3 months after the onset of the initial clinical event.
- Detection of a new T2 lesion

Detection of recent MS lesions

• Acute MS lesions disrupt the Blood Brain Barrier.

• Can be seen as Gadolinium-enhancing lesions on T1-Post.

• Remain for days to months
Detection of recent MS lesions: T1 post-contrast (Patient LH)
Dissemination in time (Patient LH)

AXIALFLAIR (PACS, BIDMC)

Sagittal T2 (PACS, BIDMC)
Limitation of traditional MRI

• Many lesions seen on histopathology are missed on MRI.

• Conversely the number and size of lesions seen is dependent on field strength and amount of contrast given.

• Although useful in following the disease, poor correlation between T1, T2, T1-post findings and clinical evolution.
Companion patient 7: Volumetric analysis

- New uses of conventional MRI: subtraction measures for disease follow up.
Companion patient 8: Volumetric analysis

- Measures of diffuse cortical atrophy, some evidence correlating grey matter atrophy and functional impairment

Companion patient 9: Diffuse Tensor imaging

- Diffusion MRI allowing reconstruction of axonal tracts and may provide correlation between circuitry damage and functional impairment.
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Reference

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