Disclosures and Funding

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Outline

• Imaging in Diagnosis of MS

• Imaging for Prognosis in MS

• Imaging to Make Initial Treatment Decisions in MS

Case Study

• 25 y/o RH AAF who is 2 months postpartum and presents with one week of numbness and tingling involving her hands and feet

• She admits to left LE weakness and balance difficulties

• PMH of unilateral right eye vision loss 6 years ago lasting 2 weeks with complete resolution
Case Study MRI Results

What imaging feature in MS correlates to the greatest extent with clinical disability?

A. T2 Lesions Volume
B. Gray Matter Volume
C. Number of Gad Enhancing Lesions
D. White Matter Volume
2010 McDonald Diagnostic Criteria

Dissemination in Space

≥1 T2 hyperintensity in 2 or 4 areas:
• Periventricular
• Juxtacortical
• Infratentorial
• Spinal cord

Dissemination in Time


T2 lesions
Corpus Callosum

Corpus Callosum Area


Posterior Fossa

6/8/2014
Gad enhancing lesions

Enhancement patterns

T1 hypointensities “Black Holes”

Characteristics that predict persistent BHs

1) Gad enhancement on two months MRIs
2) Ring enhancing pattern of enhancement
3) Enhancement >6 mm in diameter

Persistent Black Holes


Predictors of Cognitive Impairment

• Baseline MRI features in CIS were predictive of cognitive impairment at 7 years follow-up
  – T1 hypointensity metrics at baseline predicted executive dysfunction
  – A new T2 lesion predicted slowed information processing


Atrophy
Gray Matter Atrophy as Predictor of Future Disability

- GMV correlated in MSFC but not EDSS\(^1\)
- At 13 years follow up, only baseline GMV predicted accumulation of disability\(^2\)
- T2 lesion volume may complement atrophy measures in predicting disability\(^3\)
- BL EDSS and GMV predict conversion to SPMS\(^4\)

\(^3\)Lavorgna et al. Mult Scler. 2013.
\(^4\)Popescu et al. JNNP. 2013. 84: 1082-1091.

Thalamic Atrophy

Thalamic Atrophy

- Can occur very early in MS
- Present in RIS
- Correlates with fatigue, cognitive dysfunction

Case Study

- 31 year old female, presents with right arm numbness.
- A brain MRI is obtained that demonstrates one periventricular lesion and 2 juxtacortical lesions. No corpus callosum or posterior fossa involvement. No enhancement.
What should be the next step?

A. Start treatment immediately for MS
B. Obtain a repeat brain MRI in 3 months
C. Obtain spinal cord MRI
D. Obtain CSF oligoclonal bands
E. Obtain VEPs

Spinal cord MRI

- Asymmetry
- Postero-lateral location
- Spanning one segment
- Patchy involvement
- Margins non-discrete

Spinal cord atrophy

- Spinal cord atrophy correlates with EDSS (R=-0.7)
- More prominent in progressive subtypes

Figure used with permission.

Case Study

- 29 y/o male presents with ascending numbness in BLE
- No prior history of neurological symptoms
- Enhancing lesion at T8
What spinal cord features predict a worse prognosis?

A. Presence of enhancement  
B. Number of spinal cord lesions  
C. Dorsal column involvement  
D. Thoracic cord involvement


Natural History of CIS  
Baseline MRI and Disease Evolution

Percent Patients with EDSS >3 after 14 years

Percent Patients with EDSS >6 after 14 years

2010 McDonald Diagnostic Criteria

In CIS and a normal brain MRI, the likelihood of MS at 10 follow up is:
A. 1%
B. 11%
C. 21%
D. 51%


2010 McDonald Diagnostic Criteria

In CIS and an MRI with 1 or more lesions, the likelihood of MS at 10 follow up is:
A. 11%
B. 51%
C. 83%
D. 98%

T2LV accumulation over time

- Baseline gad-enhancing lesion number is predictive of EDSS and MSFC at 6 years
- Brain atrophy and lesion load over one year relate to clinical status after 6 years.

Early Changes in CIS

Di Filippo et al. JNNP. 2010. 81:204-208.
RIS – What is the #1 predictor of a future clinical event

A. More than 1 gad enhancing lesion
B. Corpus callosum involvement
C. Spinal cord involvement
D. At least one T1 hypointensity

Okuda et al. PLoSOne. 2014.

RIS – predictors of a future clinical event

![Graph showing cumulative probability of clinical events with and without spinal cord involvement](image)

HR = 3.08

Okuda et al. PLoSOne. 2014.
Case Study

• 25 year old male
• Previous history of right groin numbness 4 years ago lasting one month
• New bilateral arm and leg numbness

Baseline MRI
Based on this initial presentation on baseline MRI, what treatment would you start?

A. Glatiramer acetate  
B. Fingolimod  
C. Dimethyl fumarate  
D. Natalizumab  
E. High dose Beta-interferon

Summary

• MRI essential in MS diagnosis  
  – Characteristic features on brain MRI  
  – Spinal cord MRI can help confirm diagnosis  
• At baseline, atrophy and large disease burden may predict future disability  
• MRI can help with initial disease modifying treatment selection