MRI AND MS: IS A PICTURE WORTH A THOUSAND WORDS?

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Overview

Magnetic resonance imaging (MRI) has long been used to assist in the diagnosis of patients with multiple sclerosis (MS). Since there is no single diagnostic test, and several diseases can mimic MS, diagnostic criteria based on clinical features supplemented by paraclinical tests (including MRI) have been used. The recently revised McDonald criteria were developed by a panel of MS experts after review of extensive supportive scientific data focusing on the utility of MRI as part of the diagnostic criteria (see below).[1]

2010 Revised McDonald Diagnostic Criteria for MS[1]

Diagnosis of MS requires elimination of more likely diagnoses and demonstration of dissemination of lesions in space and time

CLINICAL (ATTACKS)	LESIONS	ADDITIONAL CRITERIA TO MAKE DX
2 or more	Objective clinical evidence of 2 or more lesions or objective clinical evidence of 1 lesion with reasonable historical evidence of a prior attack	None. Clinical evidence alone will suffice; additional evidence desirable but must be consistent with MS
2 or more	Objective clinical evidence of 1 lesion	Dissemination in space, demonstrated by ➢ ≥ 1T2 lesion in at least two MS typical CNS regions (periventricular, juxtacortical, infratorial, spinal cord); **OR** ➢ Await further clinical attack implicating a different CNS site
1	Objective clinical evidence of 2 or more lesions	Dissemination in time, demonstrated by ➢ Simultaneous asymptomatic contrast-enhancing and non-enhancing lesions at any time ; **OR** ➢ A new T2 and/or contrast-enhancing lesions(s) on follow-up MRI, irrespective of its timing; **OR** ➢ Await a second clinical attack
1	Objective clinical evidence of 1 lesion	Dissemination in space, demonstrated by ➢ ≥ 1T2 lesion in at least two MS typical CNS regions (periventricular, juxtacortical, infratentorial, spinal cord); **OR** ➢ Await further clinical attack implicating a different CNS site **AND** Dissemination in time, demonstrated by ➢ Simultaneous asymptomatic contrast-enhancing and non-enhancing lesions at any time; **OR** ➢ A new T2 and/or contrast-enhancing lesions(s) on follow-up MIR, irrespective of its timing; **OR** ➢ Await a second clinical attack
0 (progression from onset)		One year of disease progression (retrospective or prospective) **AND** at least 2 out of 3 criteria: ➢ Dissemination in space in the brain based on ≥1 T2 lesion in periventricular, juxtacortical or infratentorial regions; ➢ Dissemination in space in the spinal cord based on ≥2 T2 lesions; **OR** ➢ Positive CSF

[1]Polman C et al. *Annals of Neurology* (2011;69:292-302) http://onlinelibrary.wiley.com/doi/10.1002/ana.22366/abstract

MRI is considered as the most useful test for confirming the diagnosis of MS. MRI aids in the MS diagnosis through the demonstration of CNS lesions disseminated in time and space**.** A brain MRI performed on a high field magnet is abnormal in 95% of patients with clinically definite MS. If there is absence of high signal abnormalities in either the brain or spinal cord, then a diagnosis of MS should be questioned.

The major change associated with the latest McDonald criteria is that a diagnosis of MS can be made even when a patient presents with their initial clinical demyelinating attack; as long as there is a gadolinium enhancing lesion present in an asymptomatic region. There are MRI lesion characteristics that increase the likelihood of an MS diagnosis including periventricular, juxtacortical, infratentorial, spinal, and contrast enhancing lesions. Of course, even with these criteria there must be no better explanation/disease present that calls a diagnosis of MS in question. Hence, it is important to recognize imaging red flags for alternative diagnoses.

General Guidelines on MRI Recommendations:[2]

A brain MRI with and without gadolinium is recommended for: 1) patients suspected of having MS, 2) patients with an established diagnosis of MS and new to your clinical practice

A spinal cord MRI with and without gadolinium is recommended for: 1) symptoms presenting that are referable to the spinal cord, 2) older age of symptom onset, 3) recurrent transverse myelitis.

Low-risk clinically isolated syndrome (CIS) early on should be monitored with MRI every 12 to 24 months and high-risk CIS monitored with MRI every 6 to 12 months.

In established MS, the recommended timing of a brain MRI include: 1) no recent prior imaging available, 2) postpartum to establish a new baseline, 3) unexpected clinical deterioration, 4) reassessment of original diagnosis, 4) prior to starting or switching disease modifying therapies (DMTs), 5) at specific intervals after switching DMTs. More frequent surveillance MRIs may be indicated in aggressive cases or atypical MRI lesions. In addition, routine spinal cord follow up MRIs may not be required for all people.

Basic Imaging Red Flags that may be Indicative of an Alternative Diagnosis[2]

1) Normal MRI
2) Small and many white matter lesions especially in an individual with vascular risk factors
3) Tumor like lesions
4) Persistently enhancing lesions
5) Meningeal enhancement
6) Confluent lesions
7) Longitudinally extensive spinal cord lesions

References

1. Polman CH et al. *Ann Neurol*. 2011;69(2):292-302
2. Traboulsee A, et al. *AJNR* 2016.