Key points on MRI in Multiple Sclerosis

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Learning objectives

Describe the appearance and locations of lesions suggestive of multiple sclerosis (MS) on MRI

Background

Definition

Multiple sclerosis (MS) is a chronic inflammatory and demyelinating pathology of the central nervous system of unknown cause. It is the most common chronic neurological disorder responsible for disability in young adults. Its clinical presentation is variable. Diagnosis is often difficult due to the lack of specific tests: based on dissemination of lesions in time and space as well as CSF inflammation. Nonetheless, MRI and lumbar puncture still constitute most contributive diagnostic tools.

Materials and methods

- A retrospective study involving 129 patients being monitored for MS from May 2009 to October 2014.

- Revealing neurological manifestations were polymorphic.

- All patients had received an MRI of the brain and spine (1.5 tesla).

- The following was the imaging protocol used:

  cerebral imaging: - T1 and T2 weighted sequences
  - flair and diffusion sequences in the axial plane.
  - sagittal T2 in the corpus callosum
  - and T1 with gadolinium injection in the axial plane

  At the cervical level: sagittal T2 completed in case of lesions by spinal sections and axial T2 and T1 gadolinium in both planes.
Findings and procedure details

Results
- 169 patients (115 women and 54 men).
- Average age of 33yrs (ranging between 22 and 45 yrs

Elements of Positive Diagnosis
There are no specific biomarkers of the malady.
Its diagnosis is based on an array of supporting arguments.
The most essential contributive elements:
- Dissemination in time.
- Dissemination in space with respect to possible locations in the brain and the spine.
- The presence of an inflammatory lesion in the central nervous system
- Absence of any other underlying progressing disease.

Lesions typical of MS in MRI
- Typically these lesions are found in the white matter of the central nervous system.
The most notable locations:
Regions close to the ventricles
Corpus callosum notably the calloso-septale interface.
Juxta-cortical regions
Brain stem:cerebral peduncle
Spinal cord (Fig 1, 2, 3 and 4)
- These lesions measure at least 3mm in diameter.
- They are isointense to hypointense in T1 and hyperintense T2/FLAIR

- Arranged in the same direction as venules (perpendicular to the lateral ventricles)

- In the spinal cord, the plaques extend beyond at least 2 vertebral bodies and less than half the surface of axis of the cord.

- Criteria for diagnostic imaging for MS were defined by McDonald and later revised in 2005 by Polman et al.

**Dissemination Criteria, Mc Donald 2005 (Polman et al.)**

**Dissemination in space**

(At least 3 out of 4 of the following elements).

- At least 1 lesion with enhanced contrast in T1 after gadolinium injection or 9 lesions in T2
- At least one infratentorial lesion
- At least one juxta cortical lesion
- At least 3 lesions around the ventricles

NB: A spinal cord lesion can replace an infratentorial lesion and could be used in overall scoring of lesions.

**Dissemination in time.**

- A lesion enhanced after gadolinium injection 3 months later after onset of isolated clinical syndrome
- A recent T2 lesion in comparison with a reference imaging dating at least 30 days to the isolated clinical syndrome.

**ATYPICAL PSEUDO-TUMORAL LESIONS OF MS IN MRI**

- Characteristically the lesions, extensively demyelinating mesure more than 2 cm in diameter.

- They can simulate all type of lesions such as low grade ou high grade glioma, a lymphoma, metastasis, even cerebral abscess or ischemic stroke.

- However, 3 anatomo pathological forms for which there are radiological correlations can be generally identified with regards to pseudo tumoral forms:

  Marburg type

  Schilder type

  Balo concentric sclerosis
MARBURG TYPE
In MRI, this entails several large lesions which may rarely be partially enhanced after gadolinium contrast.
The affection is often monophasic. (Fig 5)

SCHILDER TYPE
Affects primarily children.
In MRI:
- Several generally symmetric lesions measuring at least 2 to 3 cm in large diameter located in the semioval centre.
- Absence of peripheral nervous system lesions.
- Absence of lesions in the adrenal glands. (Fig 6)

BALO CONCENTRIC SCLEROSIS
IN MRI:
- These lesions are made up of concentric alternating bands of myelinated and demyelinated matter
- Hence, this form appearing as concentric circles in imaging is commonly referred to as the « onion bulb sign ».
- The clinical course is often monophasic. (Fig 7)

DIFFERENTIAL DIAGNOSIS
Arguments in favor of MS:
- Clinical presentation.
- The presence of other demyelinated lesions.
- A mass effect non proportional to size of lesion
- An open ring « horse shoe like » enhancement opened towards grey matter.
-sometimes a roundel like appearance with a more hyperintense centre and a less intense ring in T2.

Images for this section:

**Fig. 1:** 35 yr old female, with MS lesions located in the semioval center and in white matter surrounding ventricles (arrow)
Fig. 2: Patient, 30 year old female, MS lesions around the callosum
Fig. 3: Same patient: juxta cortical lesions
Fig. 4: Same patient: spinal cord lesion
Fig. 5: Cerebral MRI of a male patient showing acute MS, Marburg type
Fig. 6: Schilder type MS lesions (arrow)

Fig. 7: Patient, 28 yr old female with Balo concentric sclerosis (arrow)
Conclusion

MRI constitutes an important and indispensable contributive tool in the diagnosis of MS. It allows, in conjunction with clinical presentation, the confirmation of dissemination in space and time. The advent of recent immunomodulators allow for MRI to be used an important surveillance tool in the treatment of patients with MS.

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References