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Differential image diagnosis demyelinating disease

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Outline

- Multiple Sclerosis (MS)
- Neuromyelitis Optica Spectrum Disease (NMOSD)
- Myeline oligodendrocyte glycoprotein-antibody-associated disease (MOGAD)
- Image Findings: Comparison among MS, NMOSD and MOGAD



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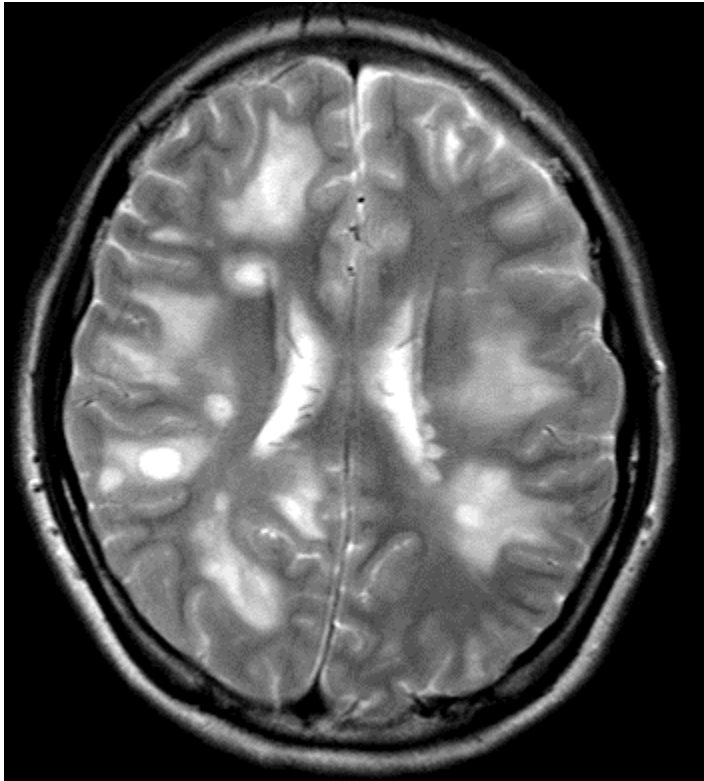
Multiple Sclerosis: MS

- Multiple sclerosis (MS) is the most common demyelinating disease, and likely to occur in 20s to 30s female dominantly.
- Specific biomarkers are lack, so it is likely to be difficult to make a diagnosis of MS.
- In particular, the MRI finding plays a more important role in making a diagnosis of MS as image biomarker in McDonald criteria 2024 revisions. Moreover, MS is likely to be diagnosed based on MRI findings.
- I will talk about MS specific findings such as ovoid lesions, T1 black hole, central vein sign, paramagnetic rim sign, cortical lesions, spinal lesions, optic nerve lesions and so on.

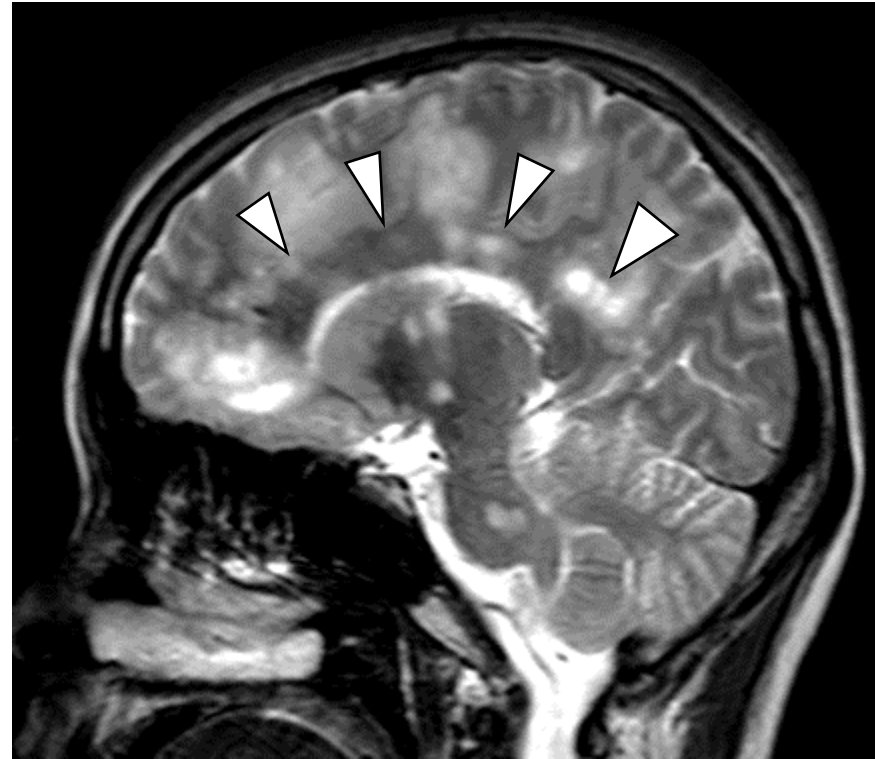
Lancet Neurol 2025; 24: 850–65.

Ovoid Lesions in Paraventricular White Matter

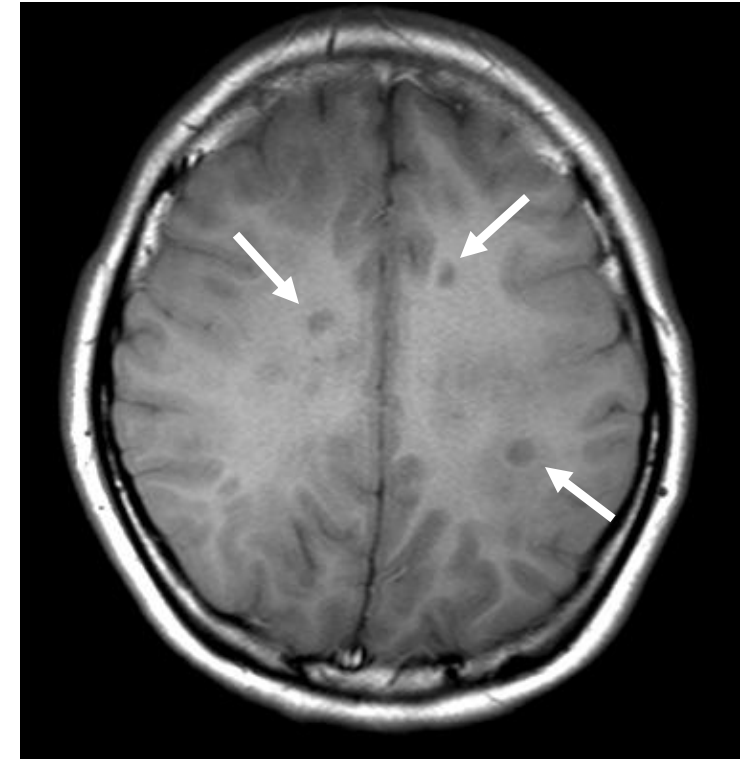
19F Multiple Sclerosis (our case)



T2WI ax



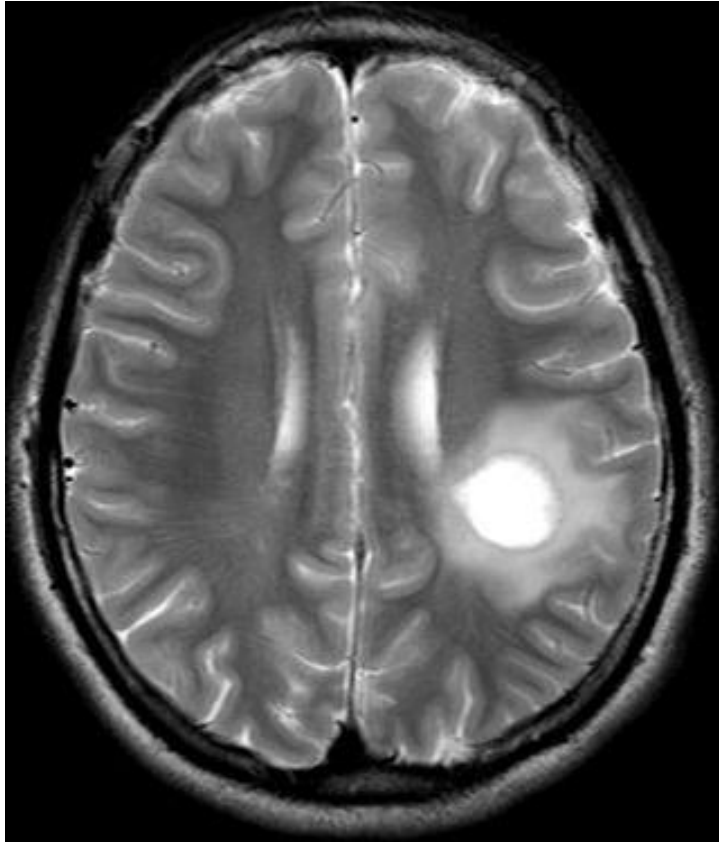
T2WI sag



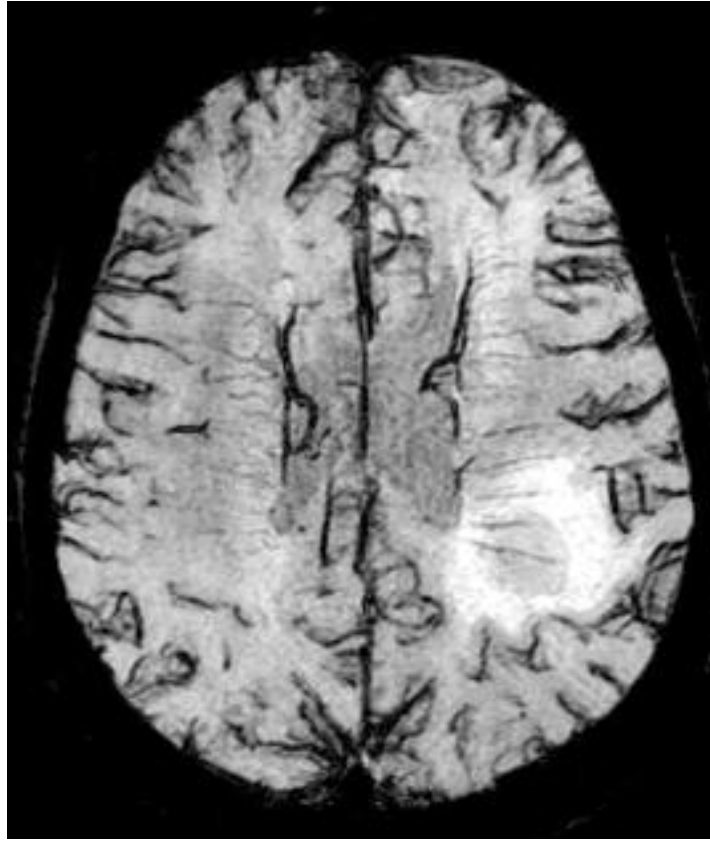
T1WI ax

- On T2WI, multiple ovoid lesions is observed in paraventricular white matter.
- On sagittal image, so called, Dawson's fingers is also observed ($\triangle$).
- On T1WI, T1 black hole, which is chronic demyelination, is seen ($\Rightarrow$).

Central Vein Sign : CVS



T2WI



SWI

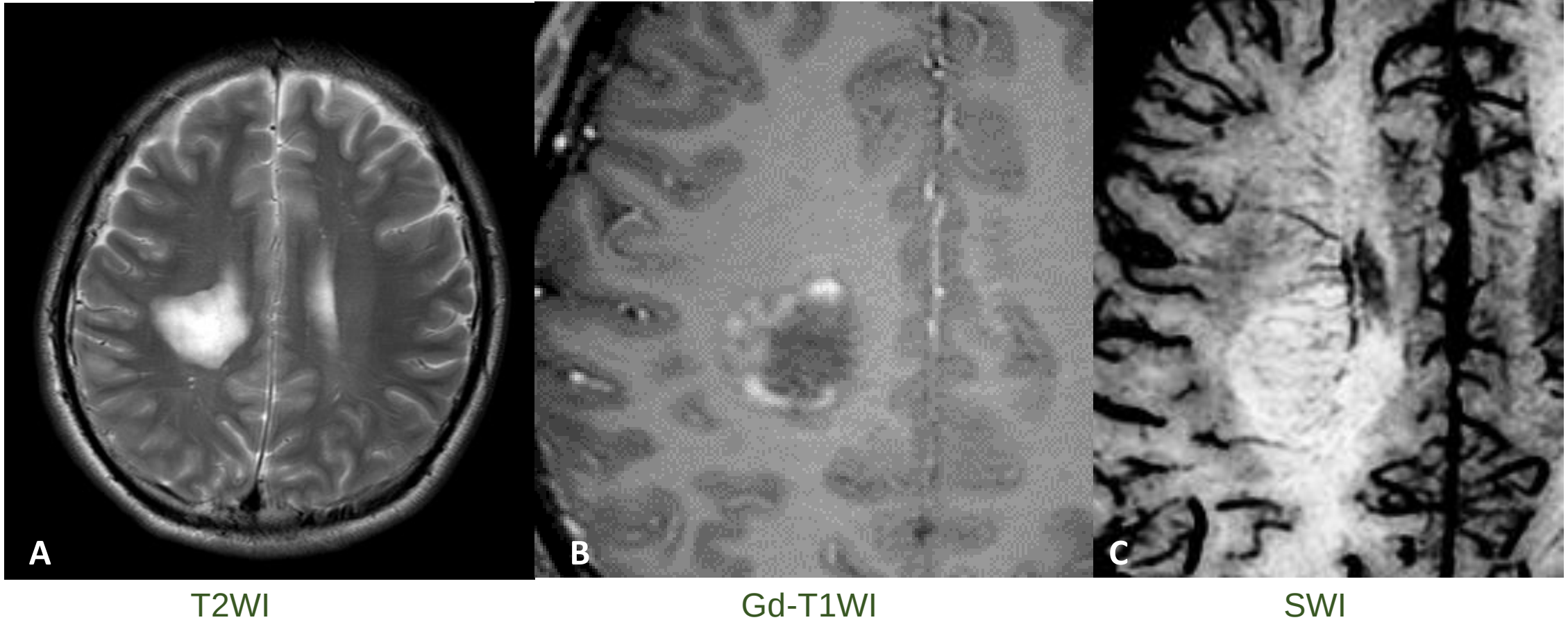


18F Multiple Sclerosis
(our case)

CVS is the sign that medullary veins penetrate into MS plaque on SWI.

Central Vein Sign : CVS

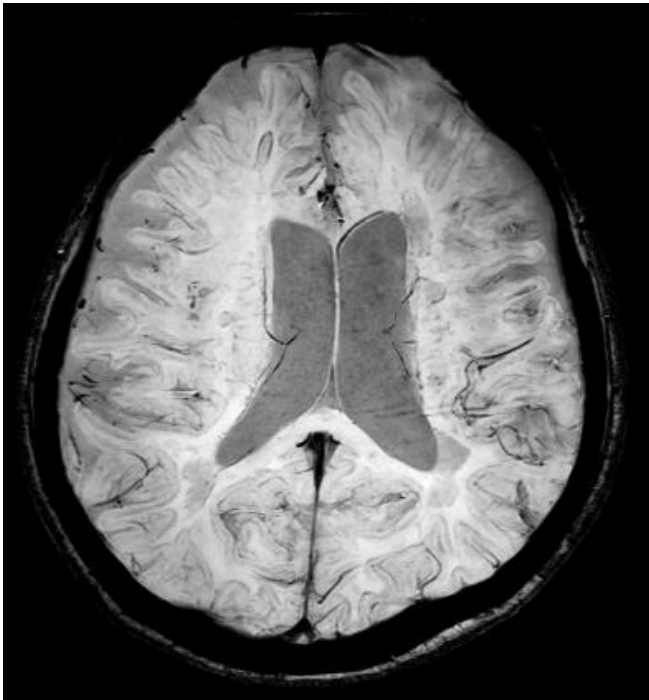
17F Multiple Sclerosis (our case)



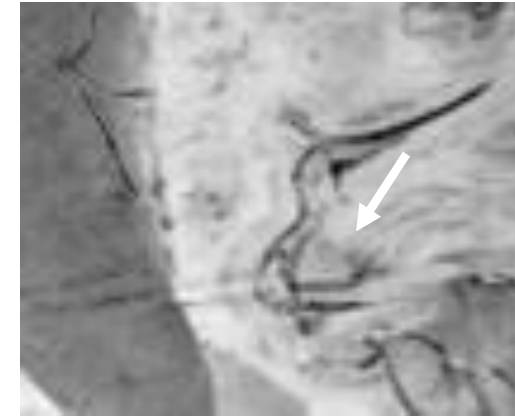
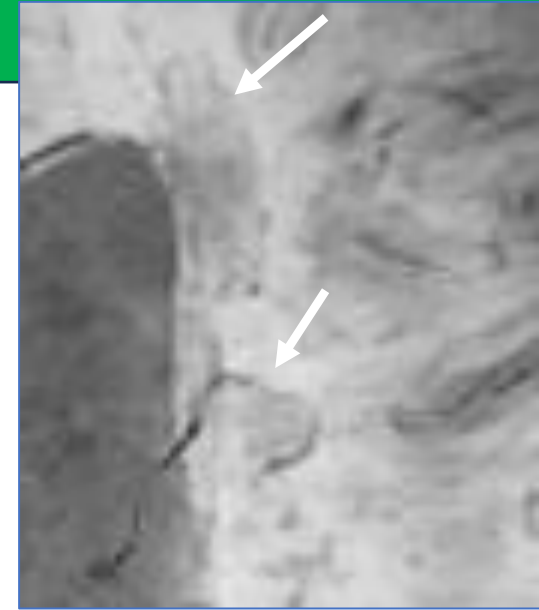
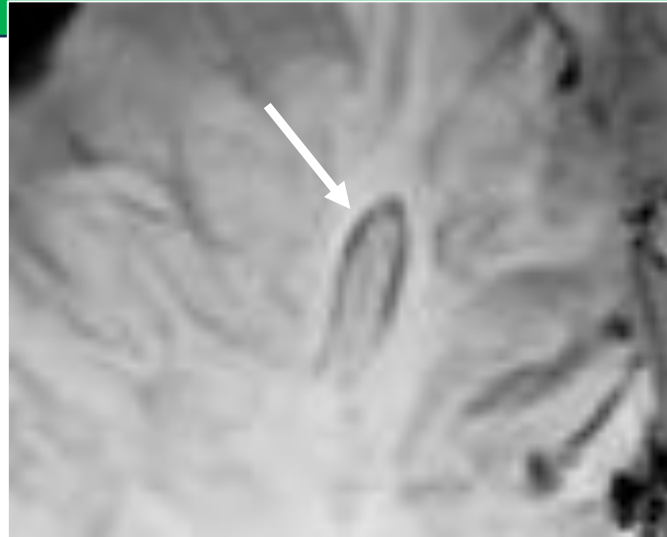
CVS is the sign that medullary veins penetrate into MS plaque on SWI (C). Contrast enhancement is also seen on Gd-T1WI (B).

Paramagnetic Rim

48F Multiple Sclerosis (our case)



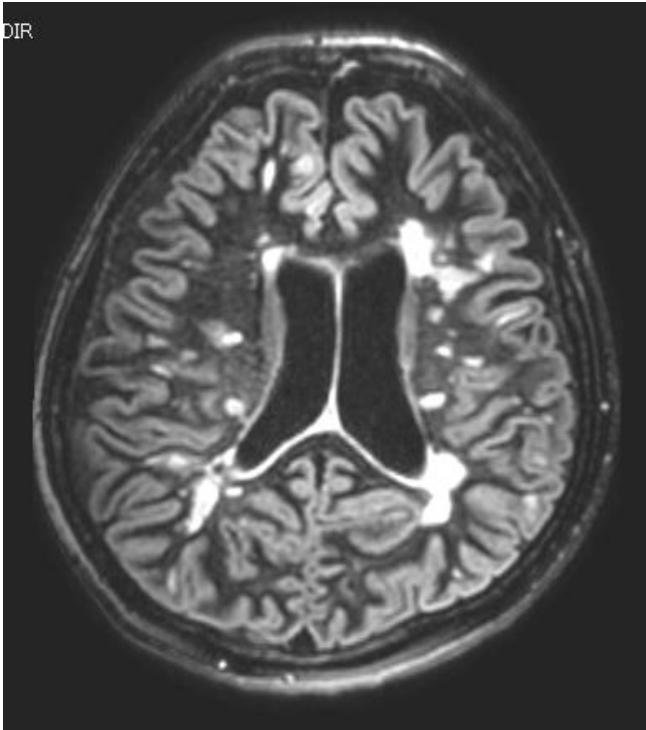
SWI



- ✓ Paramagnetic rim sign which is a specific finding in MS is a dark rim surrounding MS plaque on SWI (⇒).
- ✓ It reflects iron deposit due to chronic inflammation.

Cortical Lesions

48F Multiple Sclerosis (our case)



Cortical lesions are likely to be clearly observed on the double inversion recovery method (DIR, $\triangle$).

Spinal Lesions

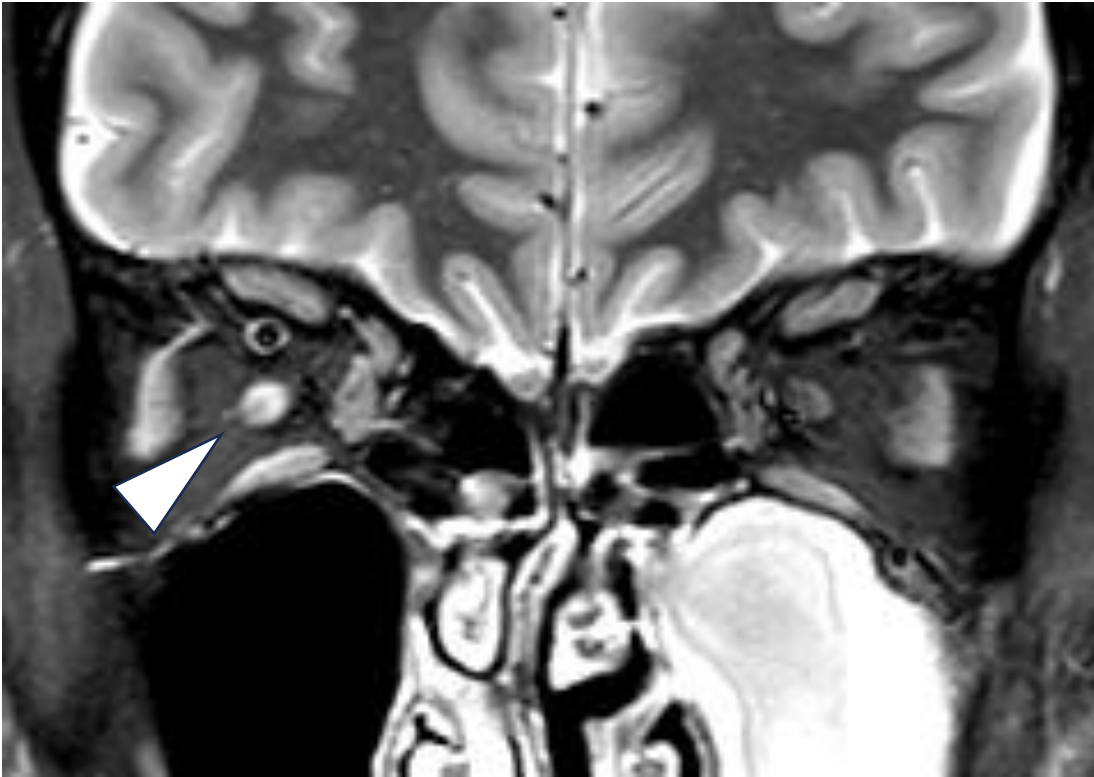


17M Multiple Sclerosis, T2WI (our case)



Spinal lesion of MS distributes short longitudinally and marginal area.

Optic Nerve Lesions



51M Multiple Sclerosis with Rt. Optic neuritis

STIR cor / ax

- Optic nerve lesion is characteristic of MS.
- Optic nerve swelling is observed unilaterally or bilaterally.
- Optic neuritis is likely to involve in relatively short range (arrow head).

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Neuromyelitis optica spectrum disease: NMOSD

- It was reported in 1894 as Devic's disease. It was initially characterized by monophasic bilateral optic neuritis and myelitis.
- In 2006, the presence of antibodies against aquaporin-4 (AQP4-IgG), a water molecule channel on the cell membrane, was identified and added to the diagnostic criteria for NMO.
- Because NMO damages astrocytes, symptoms worsen with multiple sclerosis (MS) treatments such as interferon therapy. For this reason, differentiation is important.
- Patients with NMO are older than those with multiple sclerosis (mean age 51 y.o.) and are more common in women.
- Areas with relatively high Aquaporin-4 expression, such as the periventricular white matter and the spinal cord around the central canal, tend to be affected. In particular, lesions in the area postrema are characteristic findings.
- Spinal cord lesions are often observed over a wide area spanning three or more vertebrae, which is a distinguishing feature from multiple sclerosis.

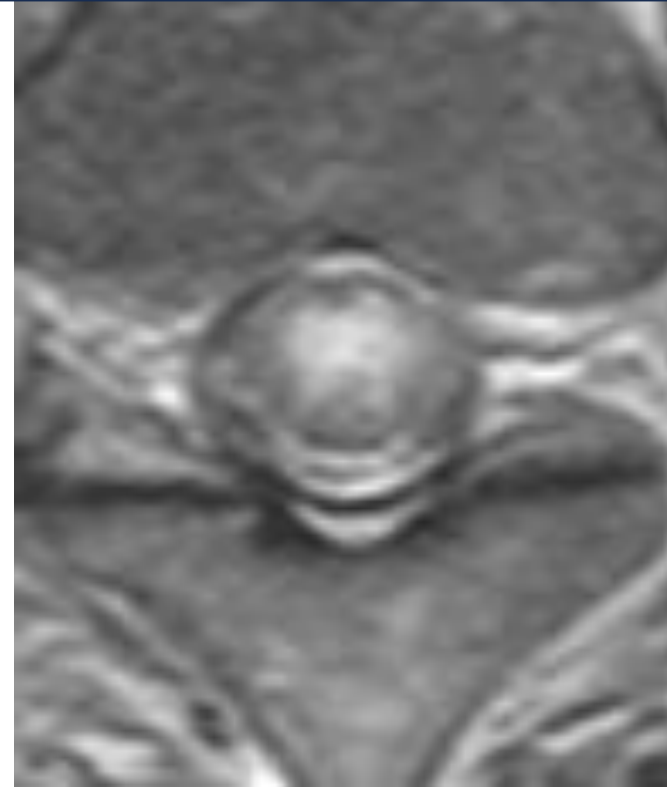
□ Wingerchuk DM et al. Neurology. 2015 Jul 14;85(2):177-89.

□ Nakamura M et al. J Neurol 255:163-170, 2008.

□ Pittock SJ et al. Arch Neurol 63:390-396, 2006.

□ Kim SH, J Neurol 257:920-925, 2010.

□ Tatekawa H, Miki Y et al. AJNR Am J Neuroradiol 2018;39:1239-47.

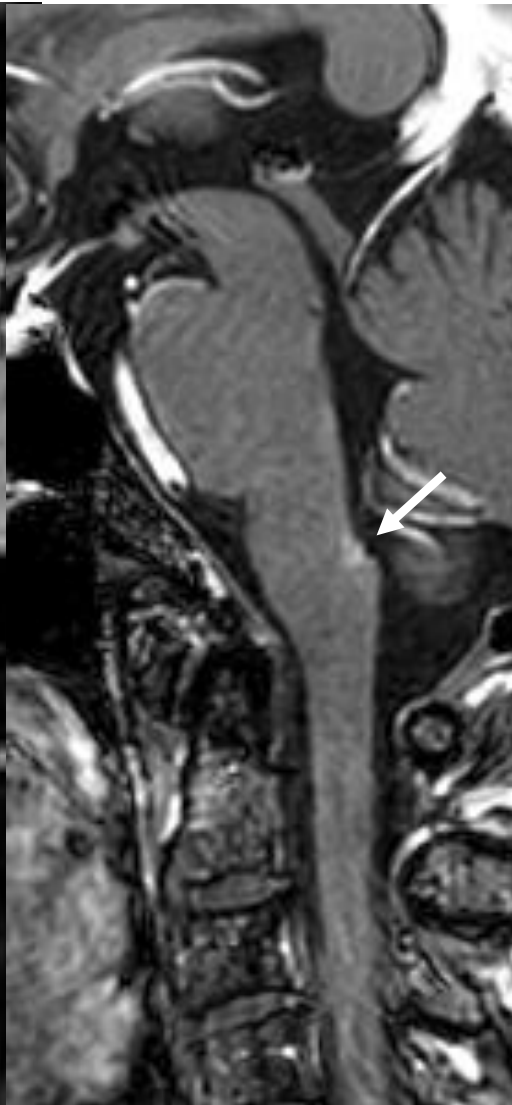


60s, female: NMOSD (our case)

- ✓ A lesion with extensive swelling extending over three or more vertebrae is observed at the cervical and thoracic spinal cord levels.
- ✓ Transverse images reveal a lesion in the center of the spinal cord.



FLAIR sag



Gd-T1WI sag

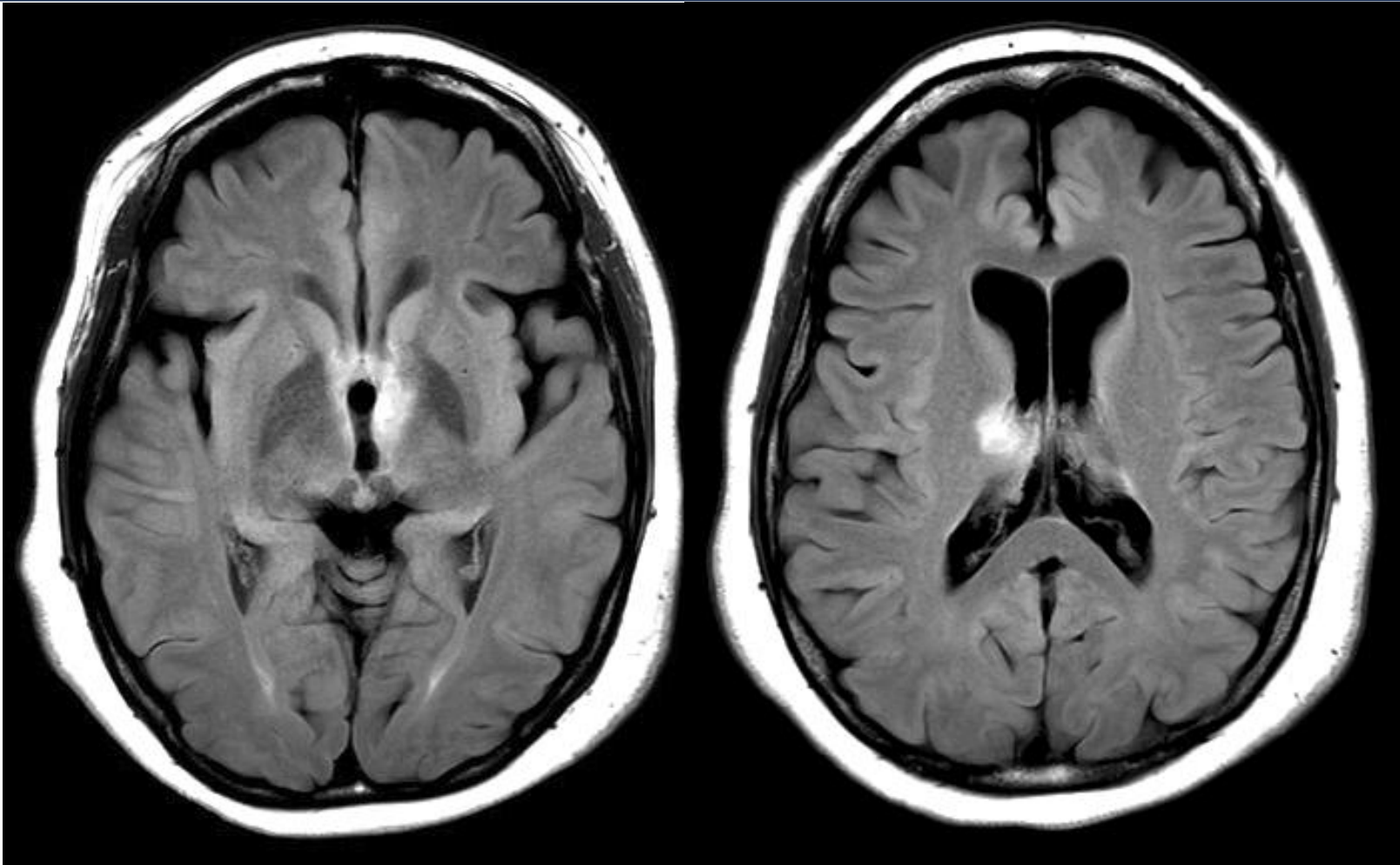
50s female: NMOSD (our case)

Hiccoup and vomiting:

Lesion in medulla oblongata area postrema
which is characteristic of (⇒).



FLAIR ax

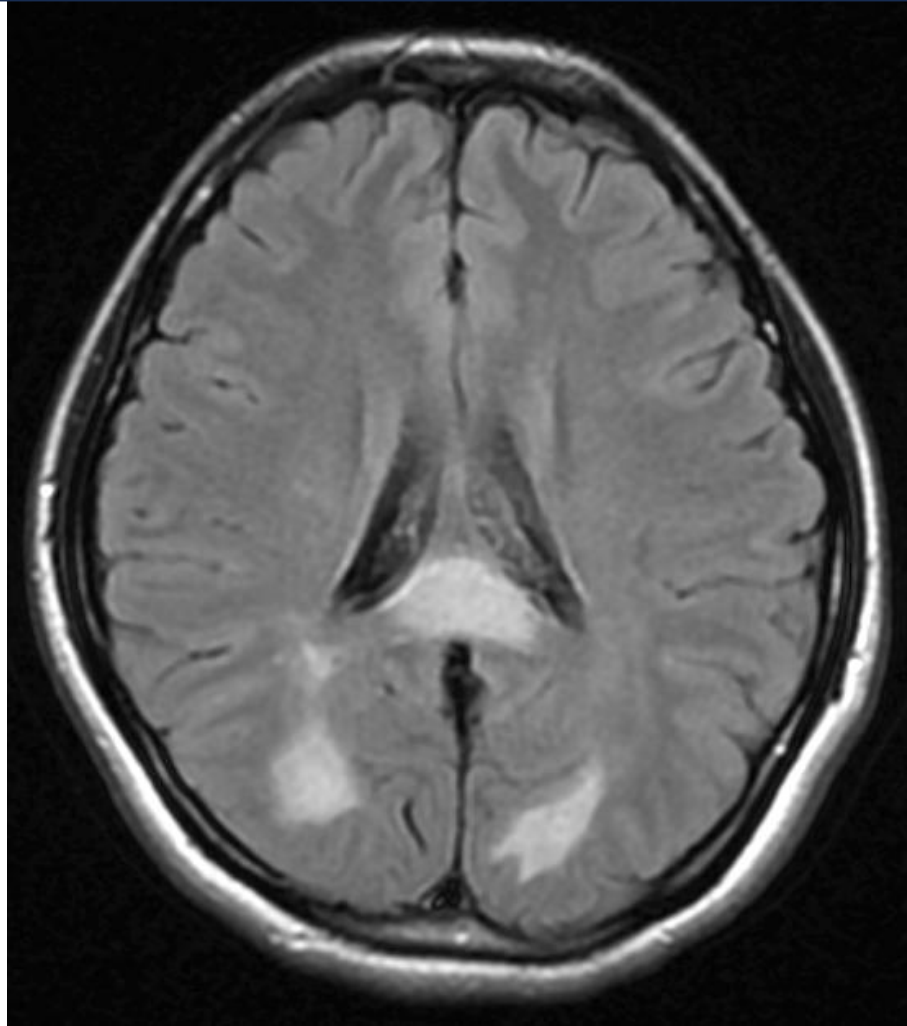


FLAIR

50s female: NMOSD (our case)

Brain parenchymal lesions : Typical case

Hyperintensity lesions in the periventricular white matter.

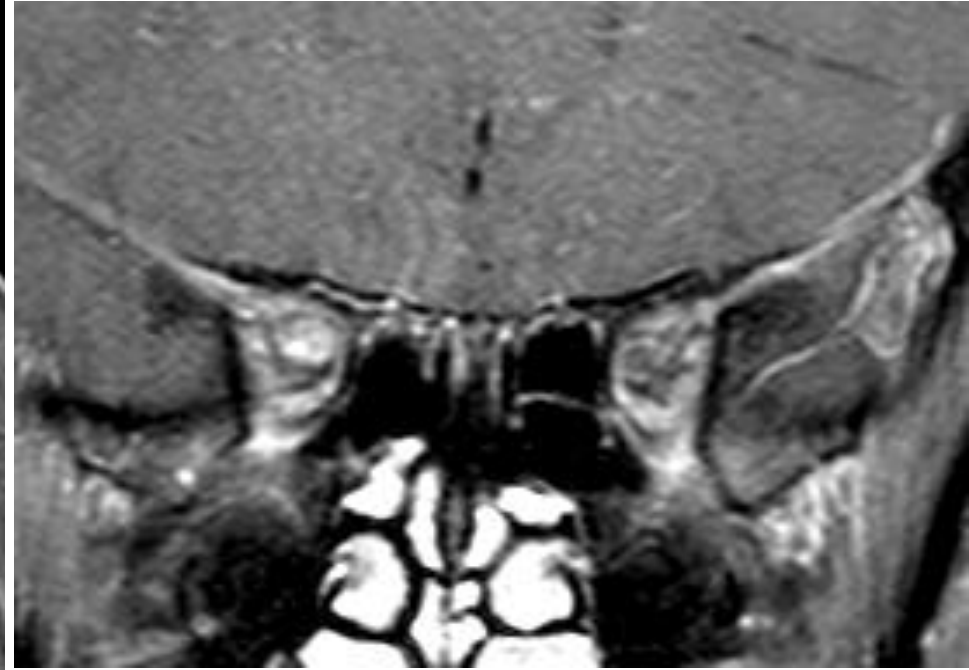


FLAIR

10s female: NMOSD (our case)

Multiple lesions in splenium of corpus callosum and white matter.

Optic Nerve Lesion. 30s female: NMOSD (our case)



Gd-T1WI

- ❑ Lesion in right retro optic nerve in this case.
- ❑ It is characterized by inflammation of the bilateral or unilateral retro optic nerve to optic chiasm.

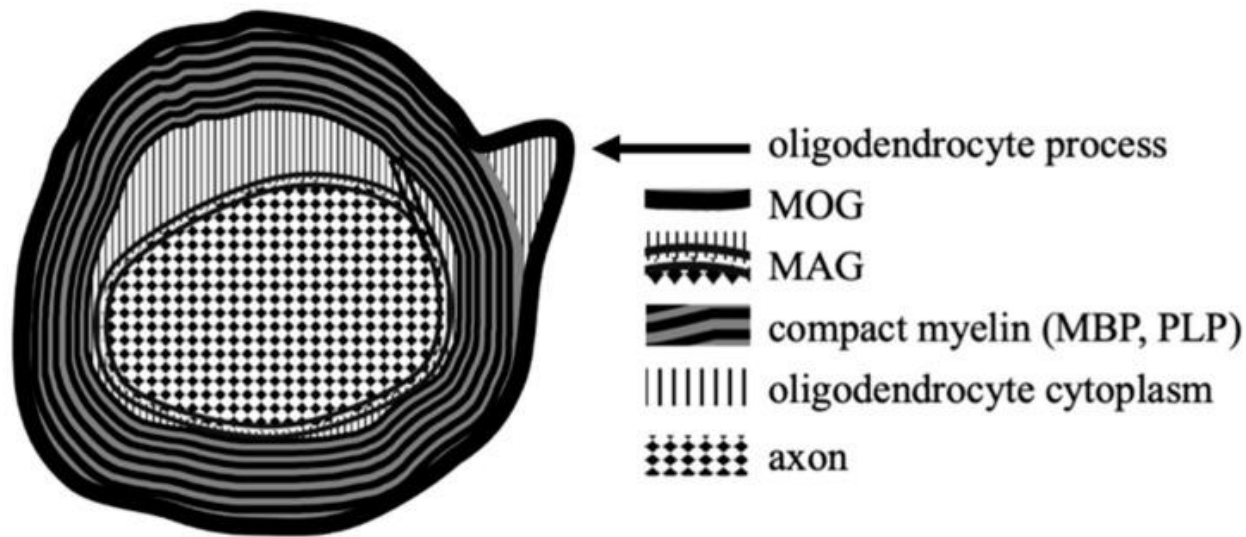
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Myeline oligodendrocyte glycoprotein-antibody-associated disease : MOGAD

- Myelin oligodendrocyte glycoprotein (MOG) is present in the outermost layer of the myelin sheath and is an easy target for autoantibodies because its Ig domains are extracellular.
- Therefore, it is susceptible to the influence of latent antibodies and T cells.



- Dale RC et al. Brain 123:2407-2422, 2000.
- Ambrosius W et al. Int J Mol Sci. 2020;22(1):100.

The locations of MOG and other myelin proteins on oligodendrocytes within CNS.

Int J Mol Sci. 2020 Dec 24;22(1):100.

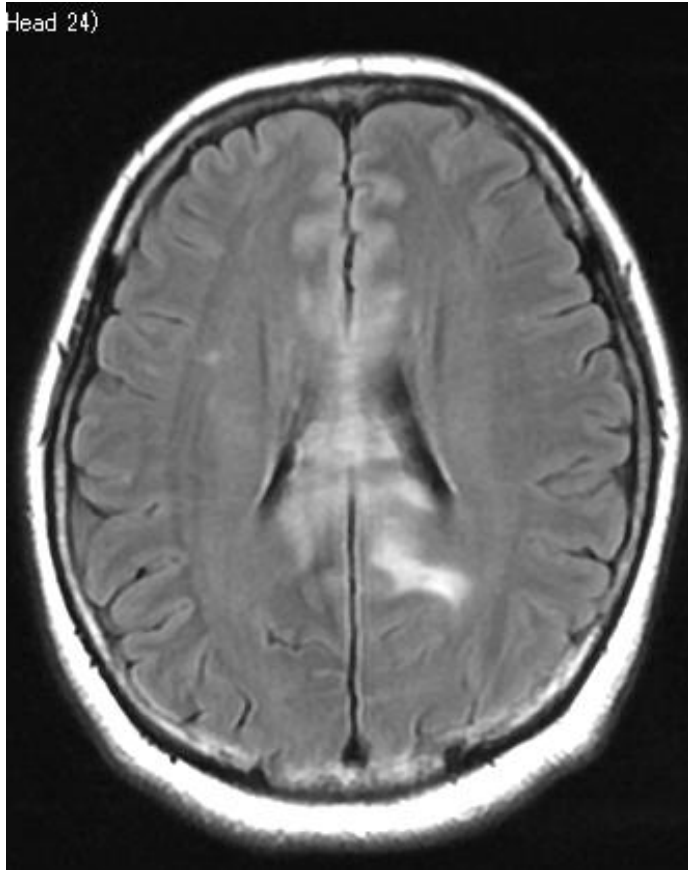


T2WI ax

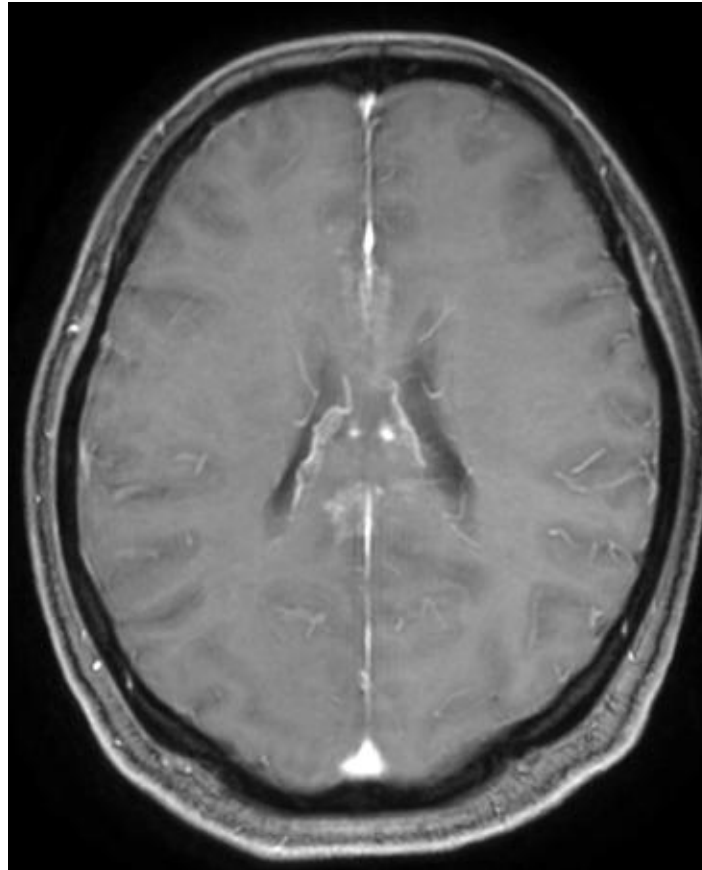
Spinal Lesion. 30s female: MOGAD (our case)

- ❑ Longitudinal lesion in thoracic spinal cord on sagittal images.
- ❑ So called, *“H shape”* hyperintensity lesion in spinal central grey matter on axial images.

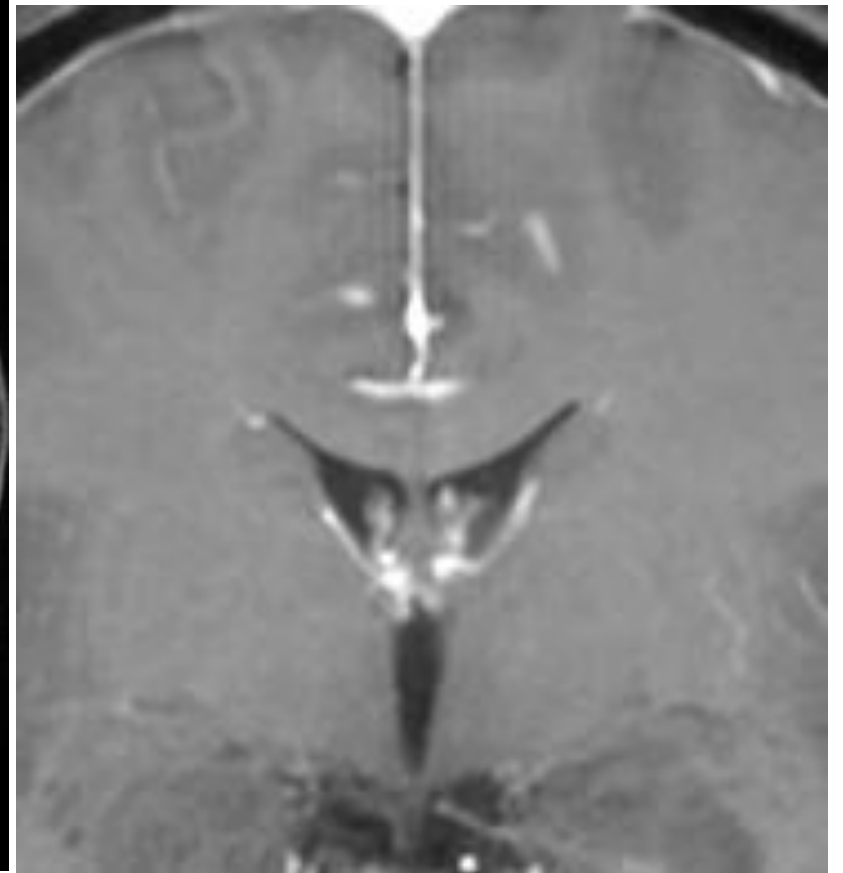
50s female: MOGAD (our case)
Corpus callosum and cortical lesions.



FLAIR

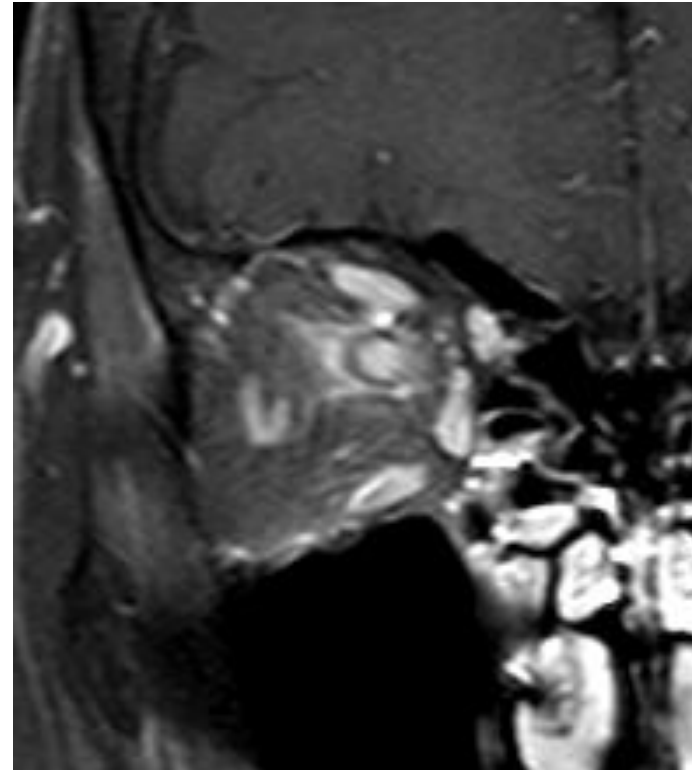
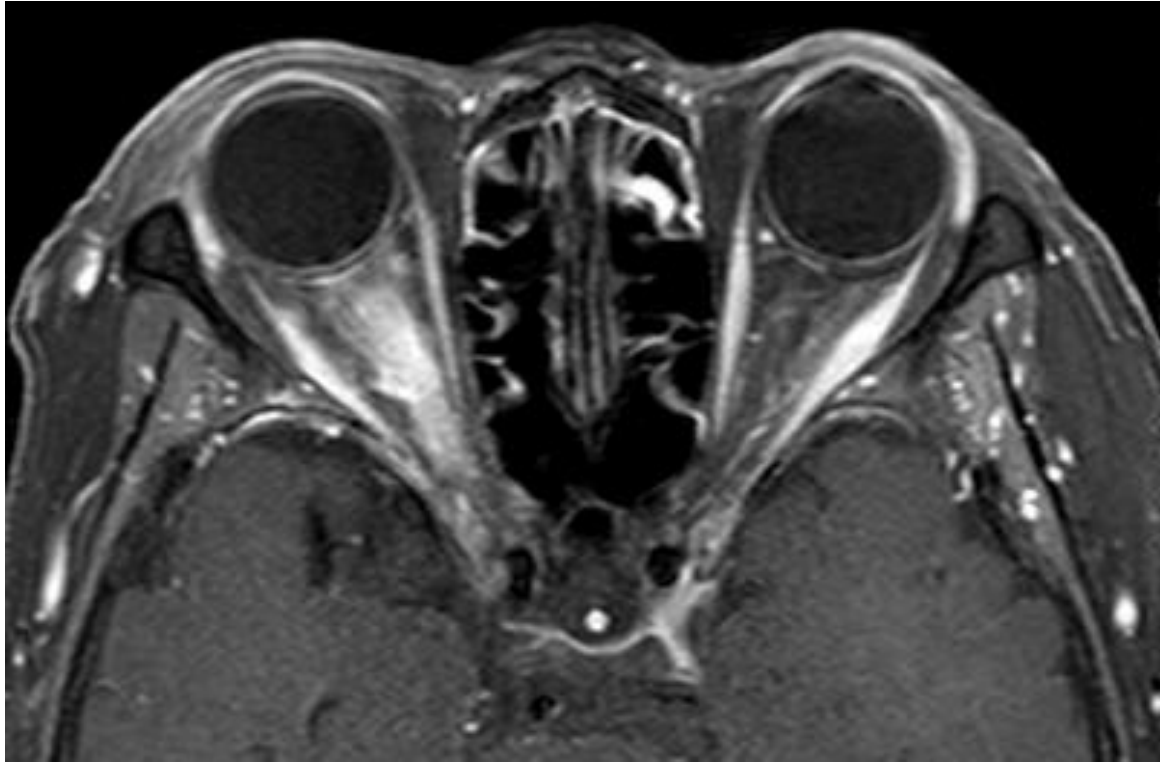


Gd-T1WI ax



Gd-T1WI cor

60s female: MOGAD, Rt. optic neuritis (our case)



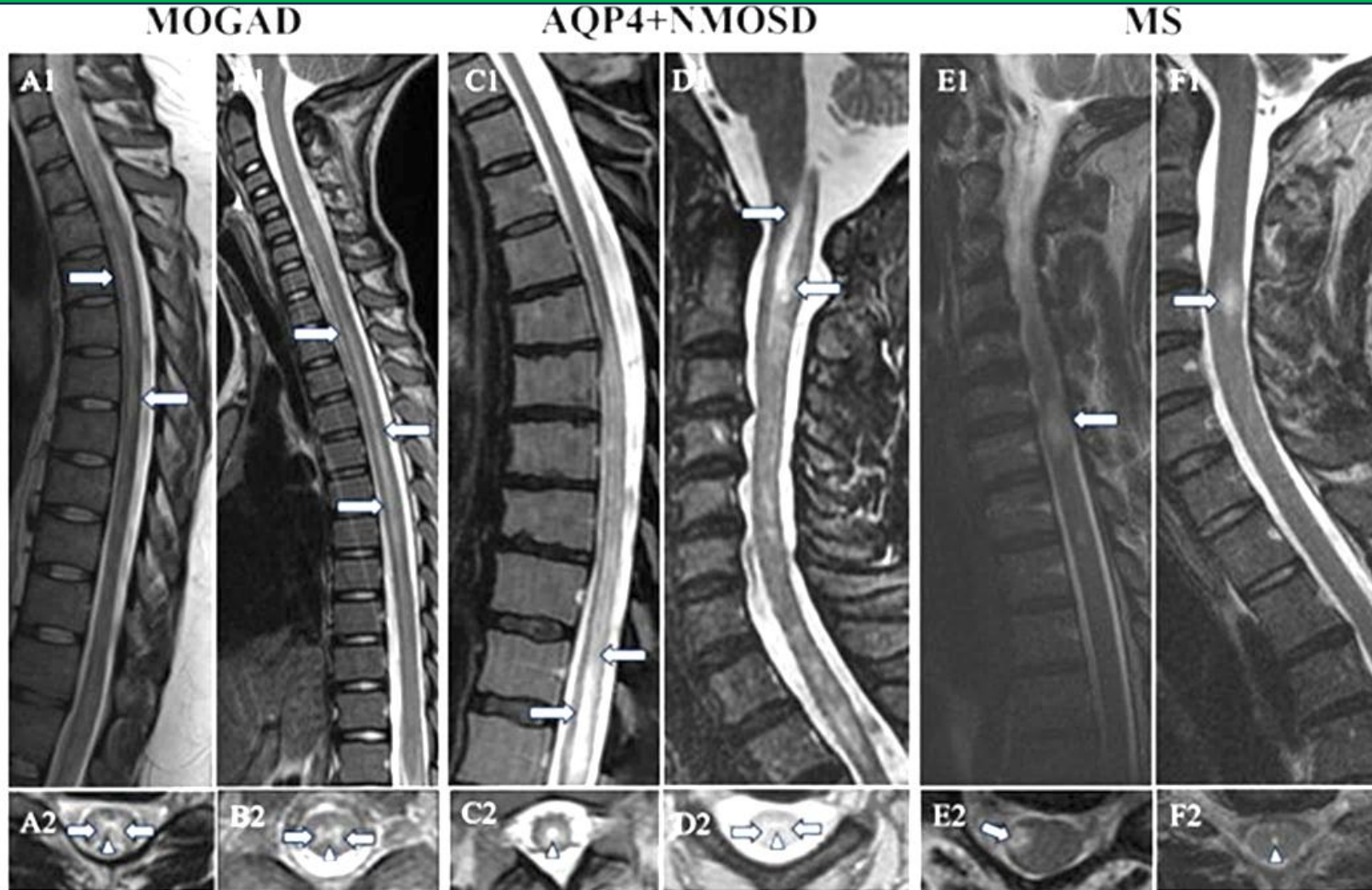
Gd-T1WI

MOG is present in the outermost layer of the myelin sheath.
Therefore, optic sheath and surrounding intraorbital tissue is likely to be irregularly involved in MOGAD.

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MOGAD

- ✓ Long spinal lesion.
- ✓ Spinal central grey matter lesion, "H shape".

NMOSD

- ✓ Long spinal lesion with swelling.
- ✓ Spinal central region hyperintensity lesion.

MS

- ✓ Short spinal lesion
- ✓ Spinal central or peripheral hyperintensity lesion.

Spinal lesions



H-sign

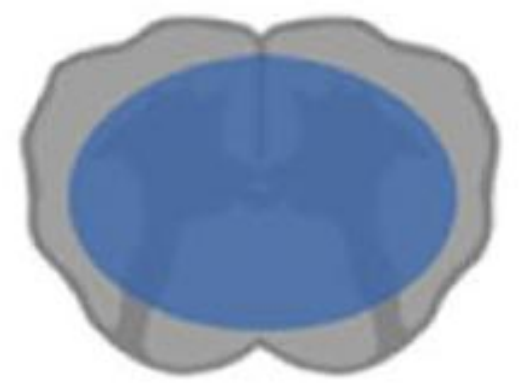


Central involvement

MOGAD



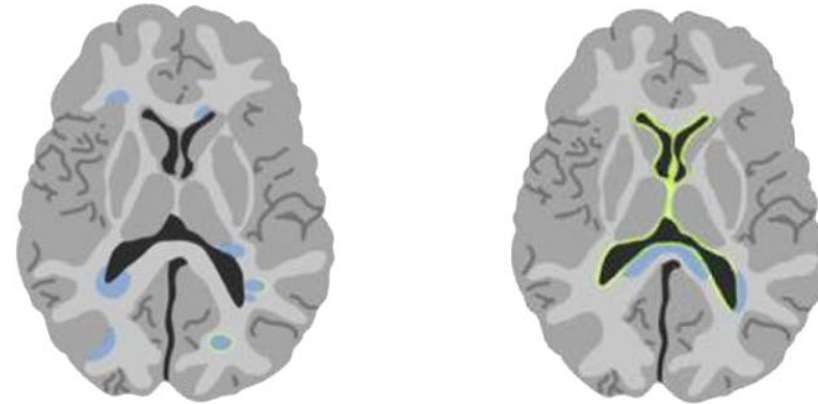
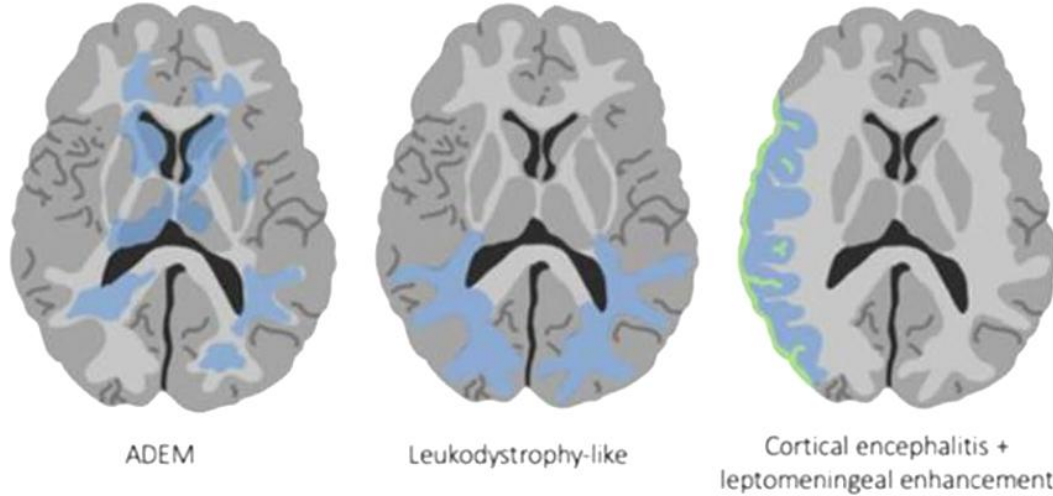
MS



NMOSD

Brain lesions

Li-Tal Pratt et al. Pediatric Radiology 2024.



MOGAD



MS



NMOSD

MOGAD

- Multiple brain stem, cortex and white matter lesions.

MS

- Multiple ovoid lesions in periventricular white matter.

NMOSD

- Peri-third ventricular white matter lesions.
- Basal ganglia lesions

Optic neuritis

Li-Tal Pratt et al. Pediatric Radiology 2024



MOGAD

MOGAD

- Long bilateral or unilateral optic neuritis.
- Inflammation of the optic nerve sheath and surrounding area often extend.



MS

MS

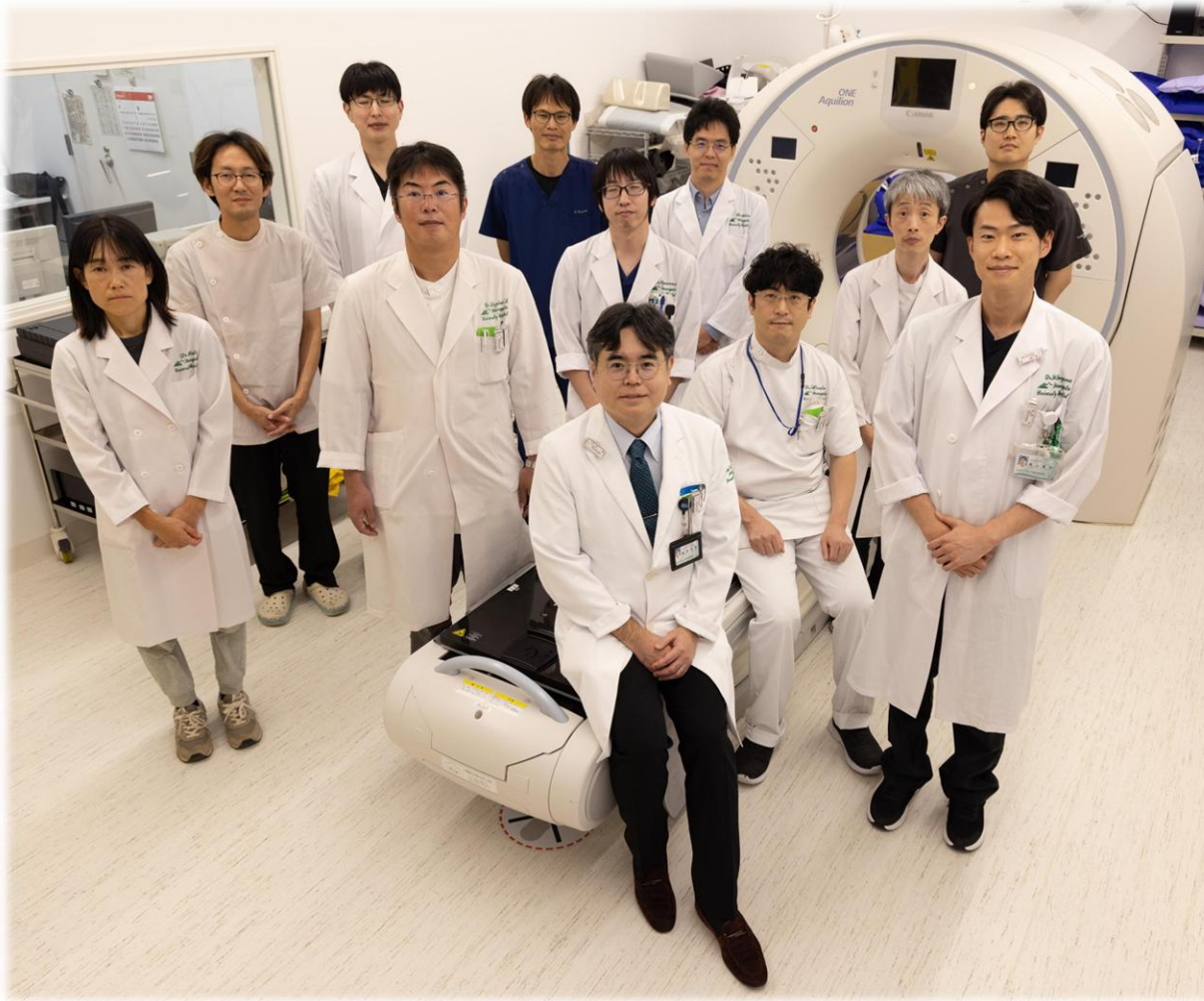
- Unilateral short range optic neuritis.



NMOSD

NMOSD

- It is characterized by inflammation of the bilateral retrooptic nerve to optic chiasm.



Thank you for your
attention !

*We are looking forward to seeing you
again in Yamagata, Japan JSRS2028.*



