PEDIATRIC DEMYELINATING DISEASES: DIAGNOSTIC PEARLS AND PITFALLS

Julia R Wieland, BS, Creighton University School of Medicine, Phoenix

Kennedy Sparling, BS, University of Arizona College of Medicine, Phoenix

Cory M Pfeifer, MD, MBA, MPH, MS, Phoenix Children's Hospital

TEACHING POINTS:

- Define and differentiated between major pediatric demyelinating:
  - Acute Disseminated Encephalomyelitis (ADEM)
  - MOG Antibody–Associated Disease (MOGAD)
  - Multiple Sclerosis (MS)
  - Neuromyelitis Optica Spectrum Disorder (NMOSD)
- Highlight key distinguishing clinical, radiologic, and serologic findings
- Review current diagnostic criteria and disease management

BACKGROUND AND ETIOLOGIC CATEGORIES

Pediatric acquired demyelinating syndromes are immune-mediated CNS disorders with monophasic or chronic courses. Incidence is 1.6 per 100,000 children/year.[1]

Syndrome	Definition	Key Features
ADEM (Acute Disseminated Encephalomyelitis)	Monophasic demyelinating event with polyfocal deficits and encephalopathy	Often post-infectious; diffuse, bilateral white matter involvement
MOGAD (Myelin Oligodendrocyte Glycoprotein Antibody-Associated Disease)	Inflammatory demyelination associated with serum MOG-IgG	Often bilateral optic neuritis or ADEM-like presentations
MS (Multiple Sclerosis)	Chronic, relapsing demyelinating disease with dissemination in time and space	Often follows clinically isolated syndrome (CIS); oligoclonal bands + MRI criteria[2]
NMOSD (Neuromyelitis Optica Spectrum Disorder)	Astrocytopathy often targeting AQP4-IgG[3]; relapsing course	Longitudinally extensive transverse myelitis, bilateral optic neuritis, area postrema syndrome

Developed using Thompson AJ, et al. and Lennon VA, et al.

CLINICAL FEATURES

- ADEM: Encephalopathy, multifocal deficits (ataxia, hemiparesis)[4]
- MOGAD: Unilateral or bilateral optic neuritis, ADEM-like symptoms, or transverse myelitis[5]
- MS: Monofocal or multifocal deficits, usually without encephalopathy[6]
- NMOSD: Bilateral optic neuritis, severe LETM[7], area postrema syndrome[8]

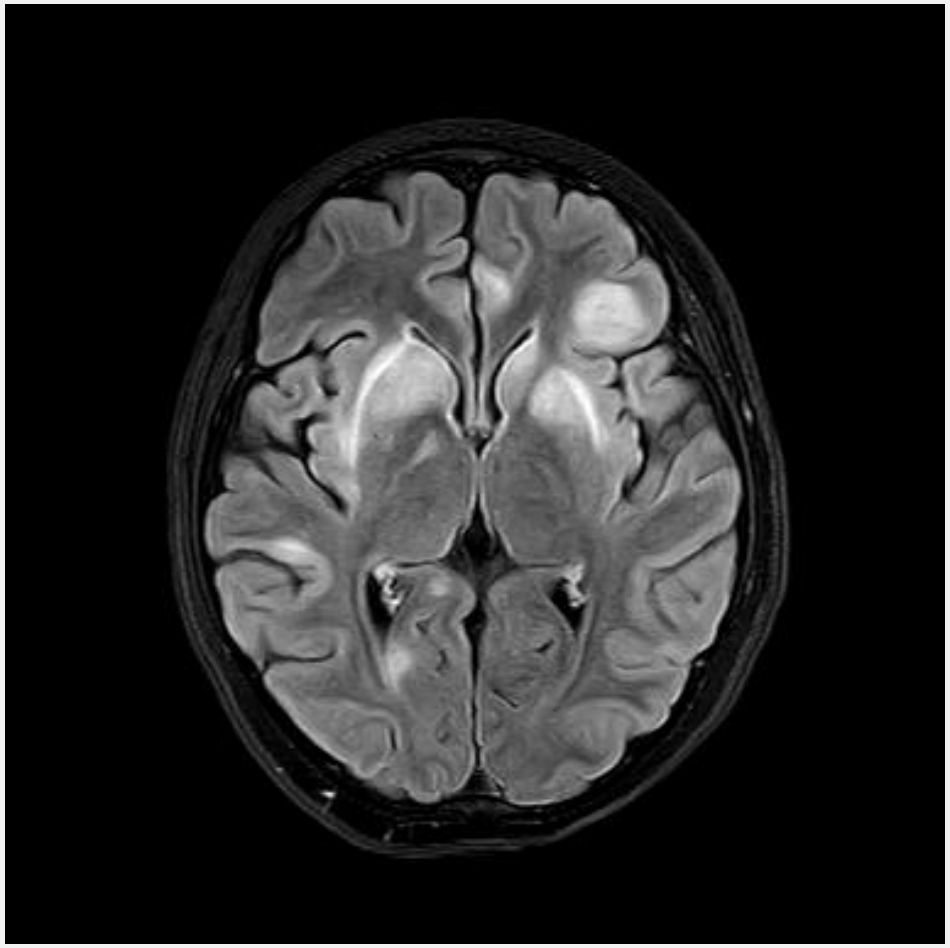
SEROLOGY AND CSF TESTING

SYNDROME	ANTIBODY	CSF FINDINGS
ADEM	None specific[9]	Rare OCBs, mild pleocytosis[10]
MOGAD	MOG-IgG (cell-based assay)[11]	Mildly inflammatory; OCBs typically absent[12]
MS	None specific	OCBs present in >90%[13]
NMOSD	AQP4-IgG (cell-based assay)[14]	Often normal; may have mild pleocytosis[15]

IMAGING

- MRI brain and spine are essential for diagnosis and monitoring
  - ADEM: Large, poorly demarcated bilateral lesions, predominantly in white matter[16]
  - MOGAD: Bilateral optic nerve enhancement; conus medullaris lesions[17]; "fluffy " brain lesions[18]
  - MS: Periventricular, juxtacortical, and infratentorial lesions; Dawson's fingers
  - NMOSD: LETM (≥3 vertebral segments)[19], area postrema lesions

ACUTE DISSEMINATED ENCEPHALOMYELITIS



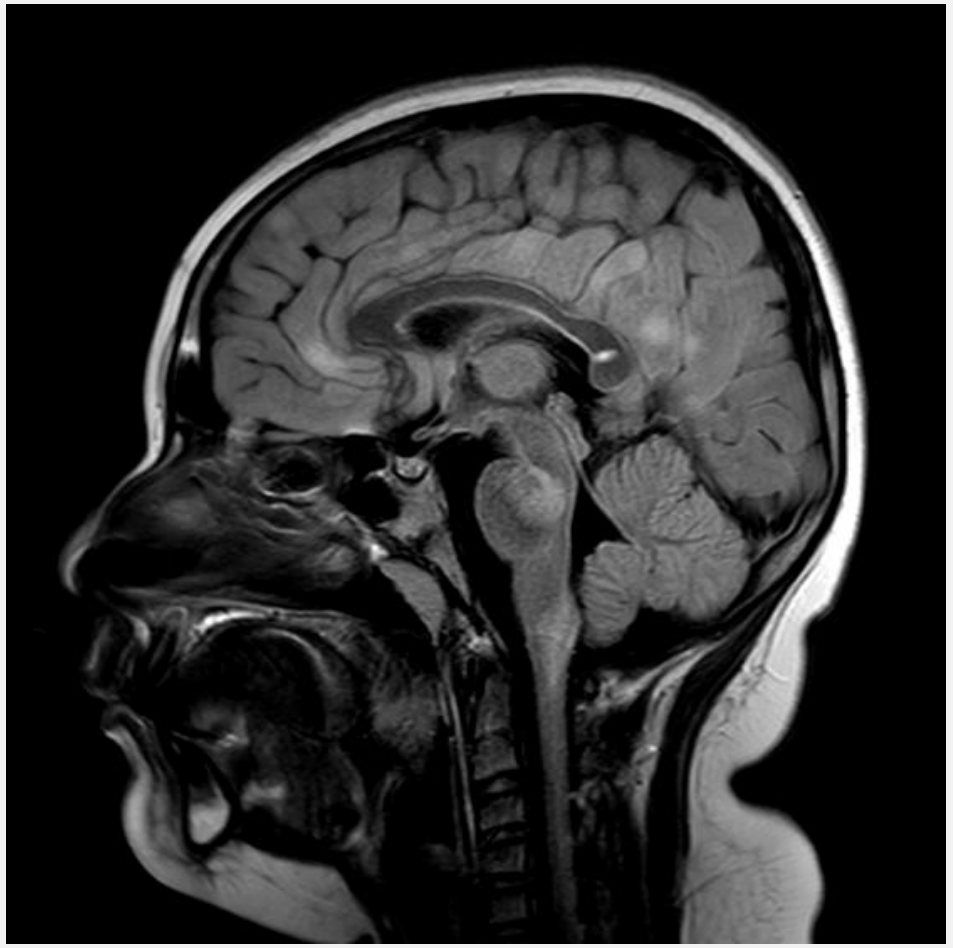
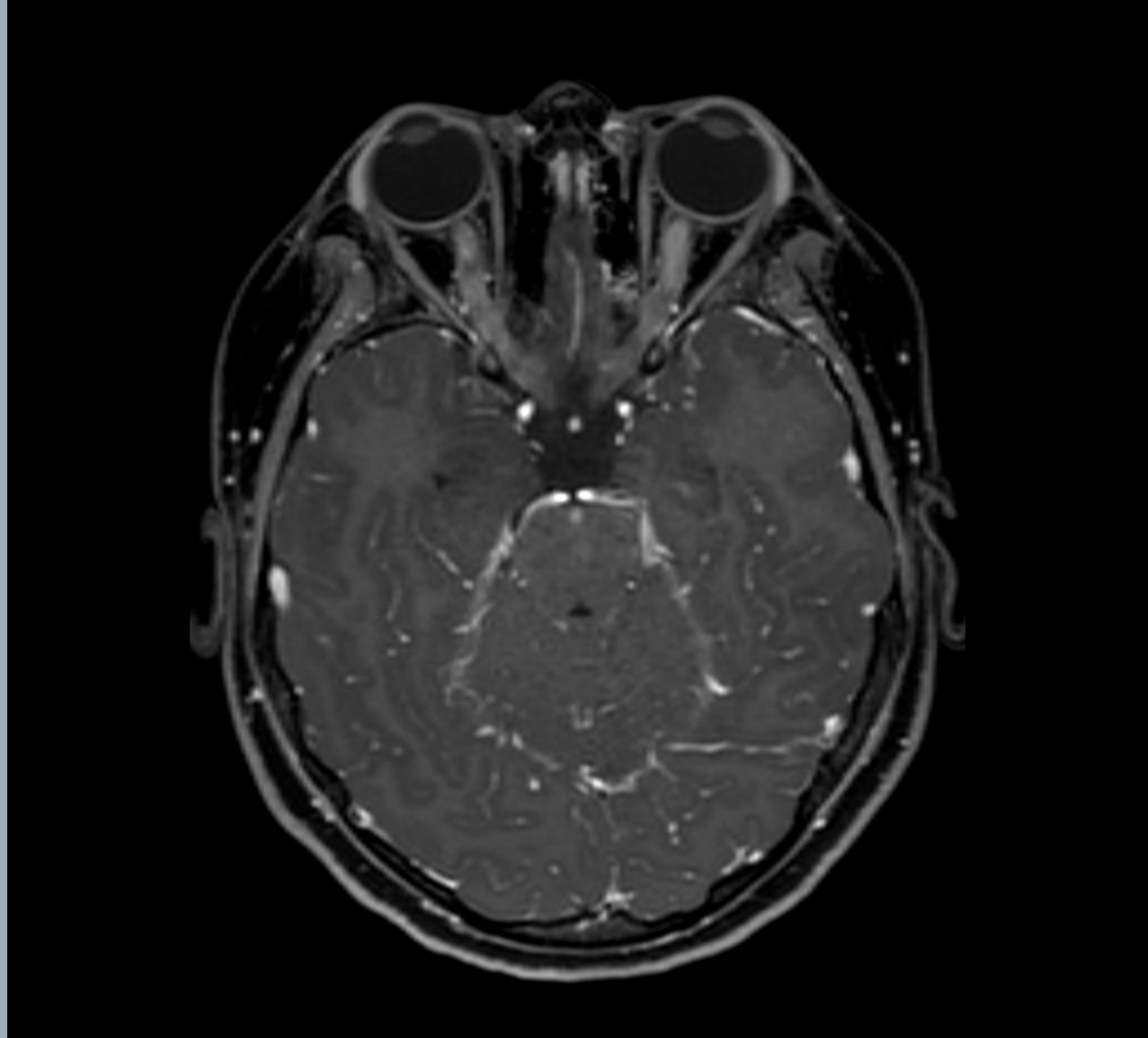


Figure 1 and 2: Axial and Sagittal FLAIR of a 9-year-old patient with ADEM demonstrates FLAIR hyperintense lesions throughout both basal ganglia, subcortical white matter, central pons, dorsal inferior medulla, upper cervical cord, and corpus callosum.

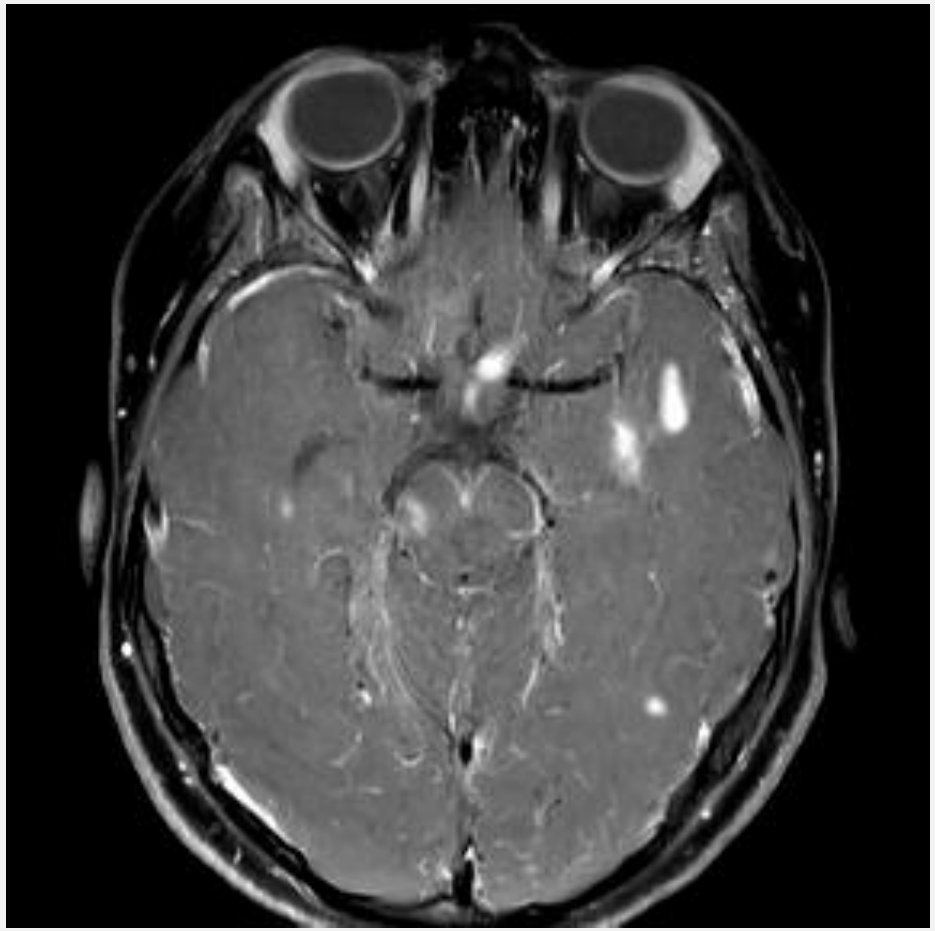
MOGAD

Figure 3: MRI of in MOGAD in a 10-year-old patient.

Axial T1-weighted image with contrast shows bilateral optic nerve enhancement compatible with acute optic neuritis.



MYELIN OLIGODENDROCYTE GLYCOPROTEIN ANTIBODY-ASSOCIATED DISEASE



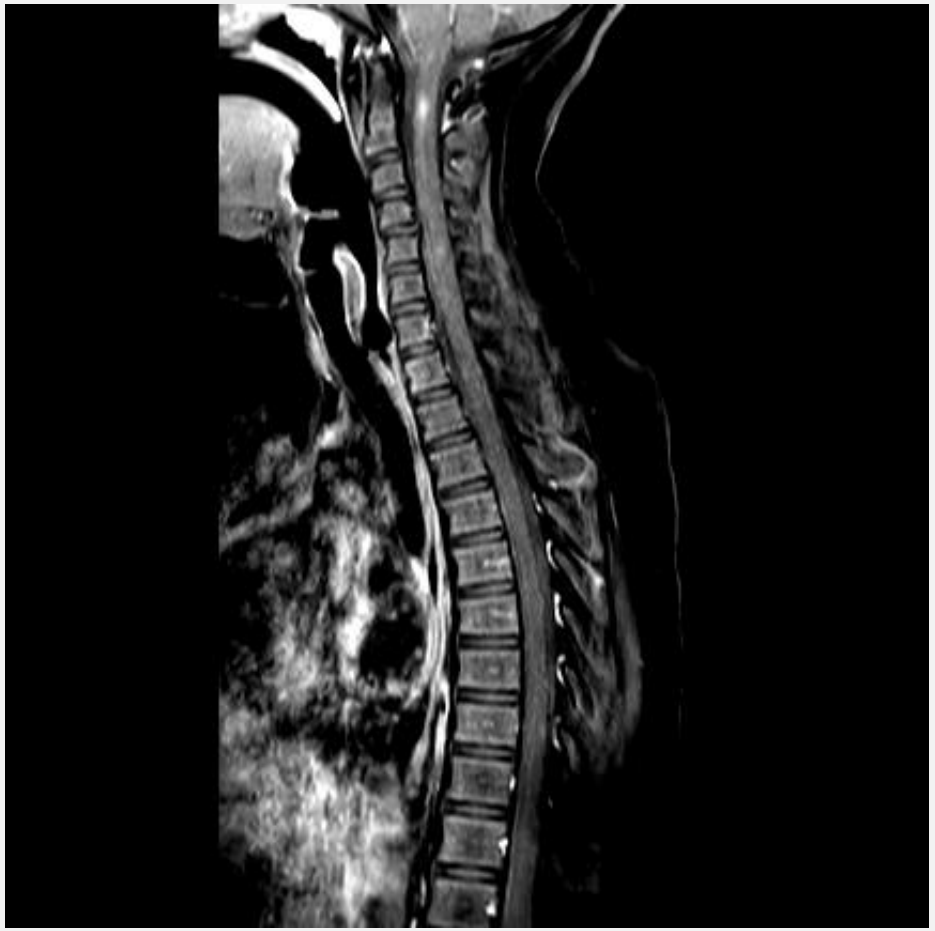
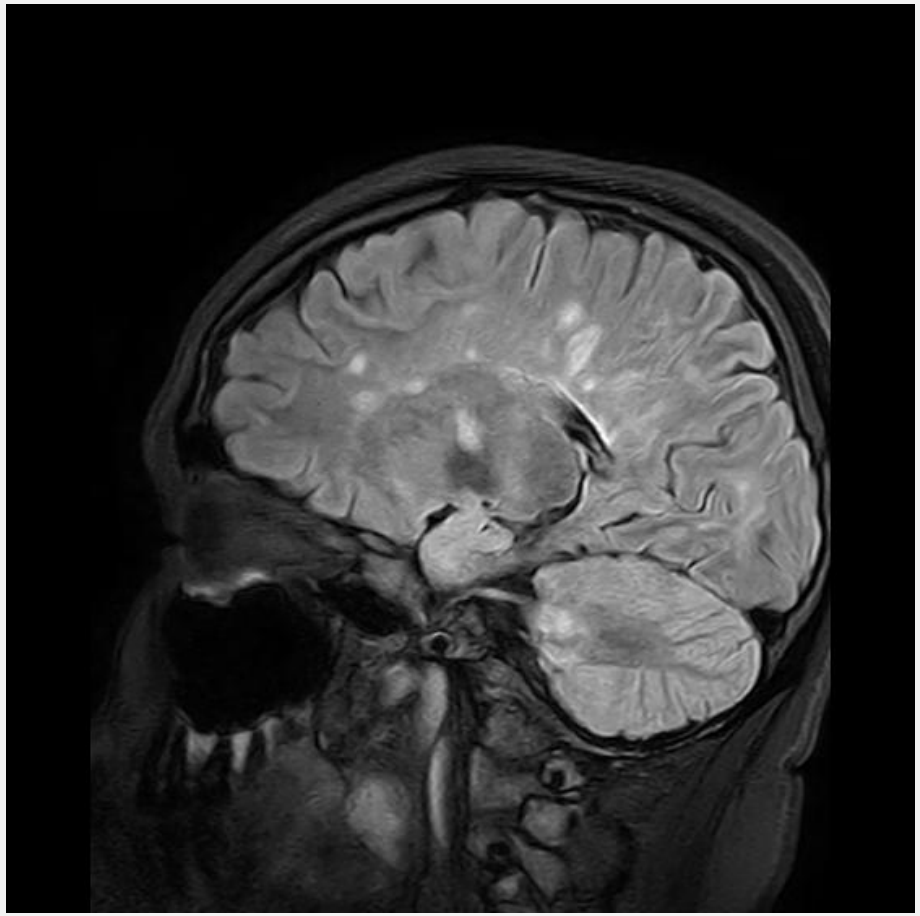


Figure 4 and 5: New brain and spinal cord lesions in the same patient from Figure 3. Contrast-enhanced axial T1-weighted image (left) and contrast-enhanced sagittal spine (right) show variably sized enhancing lesions in the left frontal and temporal lobes, right cerebral peduncle, and upper spinal cord. These lesions do not have the typical C-shaped enhancing pattern common in multiple sclerosis.

MULTIPLE SCLEROSIS



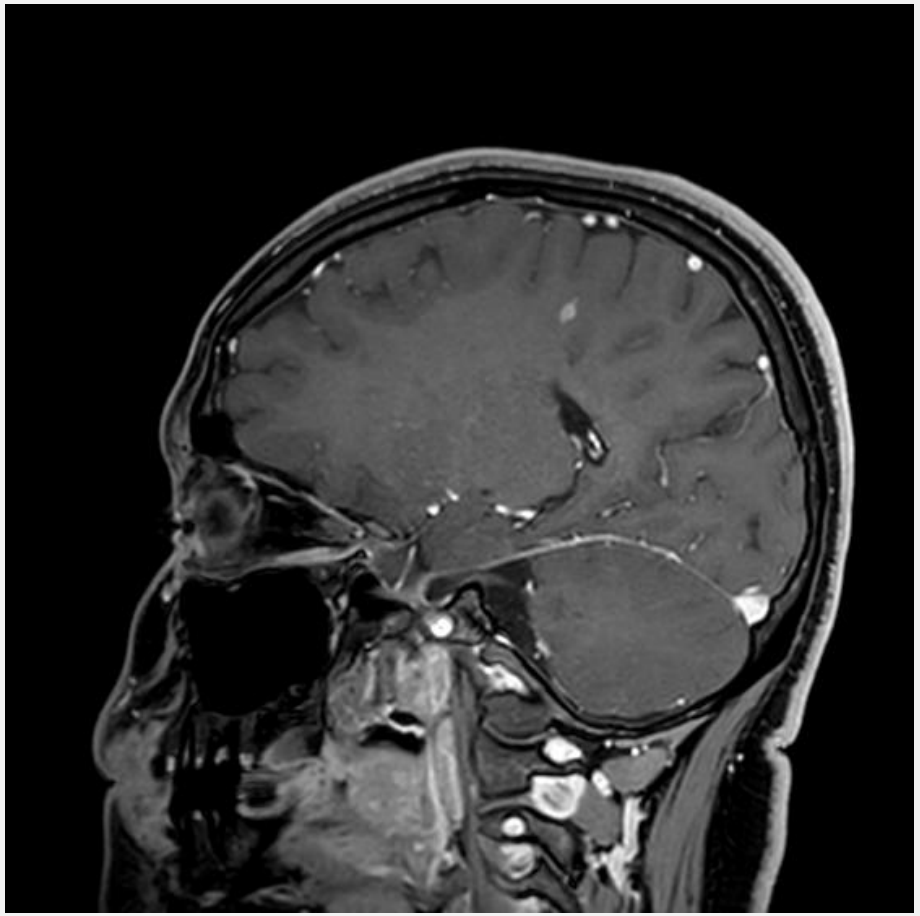
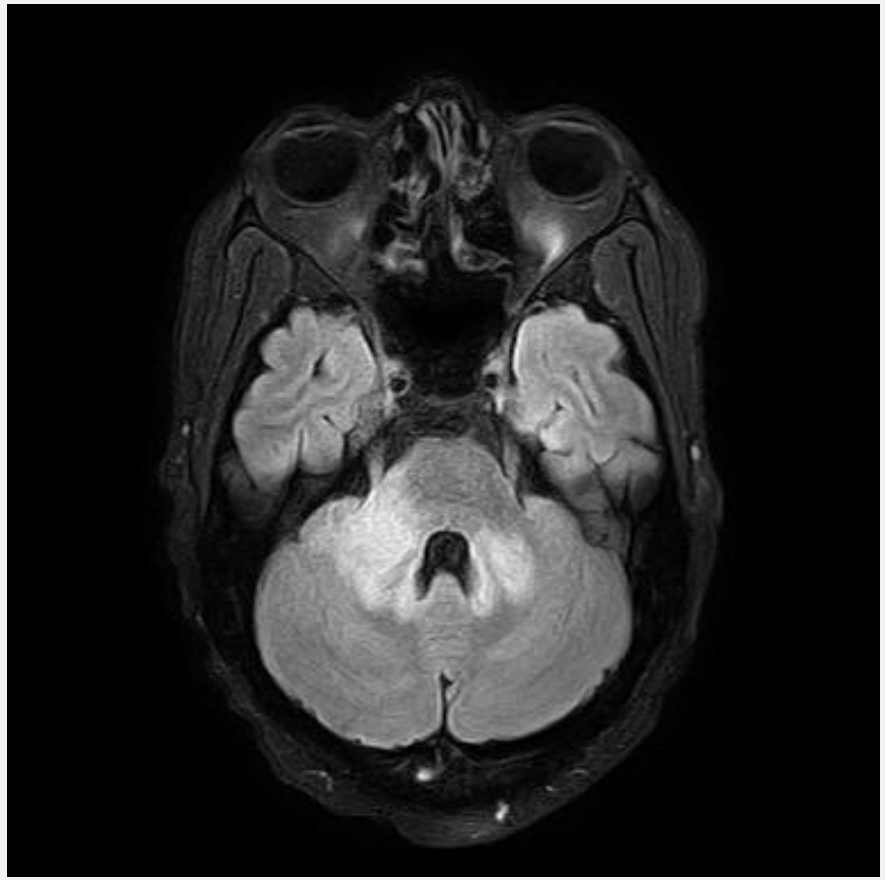


Figure 6 and 7: Patient with known MS with FLAIR hyperintense lesions (left), one of which enhances (right). MS plaques tend to be peri-venular and radial in distribution with common involvement of the corpus callosum.

NEUROMYELITIS OPTICA SPECTRUM DISORDER



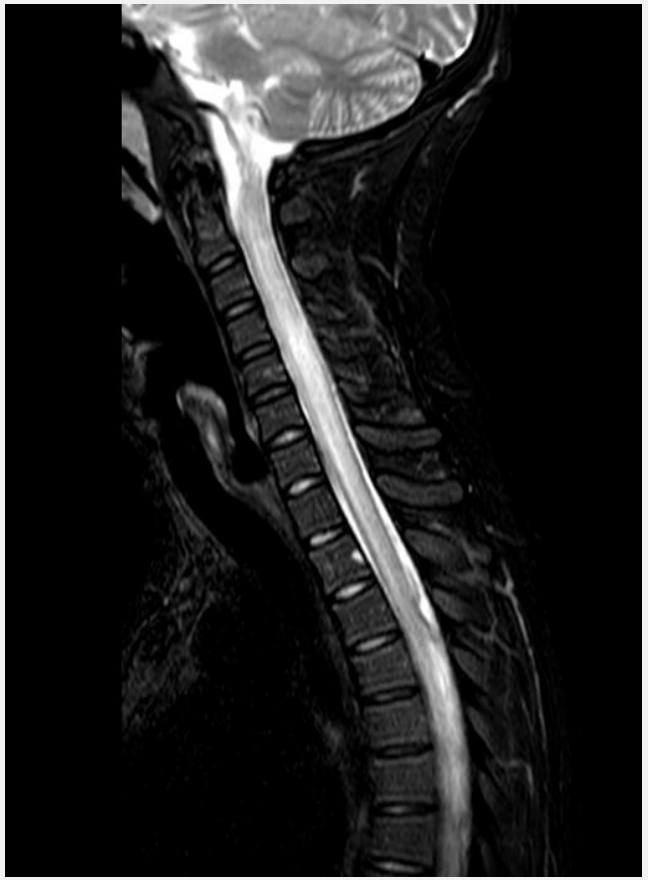


Figure 8 and 9: Axial FLAIR of the brain and sagittal fat-suppressed T2-weighted image of the spine of 16-year-old patient with NMO. Geographic FLAIR hyperintensities are centered in the bilateral middle cerebral peduncles (left); expansile T2 hyperintense lesion in the central upper spinal cord (right).

MANAGEMENT AND PROGNOSIS

Syndrome	First-line Treatment	Long-Term Considerations
ADEM	IV methylprednisolone ± IVIG	Usually monophasic; full recovery[20]
MOGAD	High-dose IV steroids ± IVIG/PLEX[21]	40–60% relapse rate; long-term immunotherapy[22] for recurrent cases, low mortality rates[23]
MS	High-dose IV steroids for relapse[24]; DMTs[25] (interferons, natalizumab, etc.)	Lifelong relapsing course
NMOSD	Acute steroids ± PLEX; chronic immunotherapy (rituximab/satralizumab)[26]	High relapse risk; treat to prevent disability, high mortality rate[15]

MONITORING

- Repeat MRIS to monitor new lesions/relapses
- Serial antibody titers in MOGAD
- Long-term neurologic follow-up for cognitive, visual, and motor sequalae
- Consider psychological and neurocognitive support for chronic cases

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