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Original

Utility of Magnetic Resonance Imaging to differentiate optic neuritis due to inflammatory demyelinating diseases among patients presented to the Institute of Neurology at the National Hospital of Sri Lanka

Arandara VL[1], Pallewatte AS[2], Senanayake B[2], Nazeer N[3], Rajakaruna VPC[4]

[1]*Postgraduate Institute of Medicine, University of Colombo*
[2]*National Hospital of Sri Lanka*
[3]*Faculty of Medicine, University of Kelaniya*
[4]*Faculty of Medicine, University of Ruhuna*
**Correspondence: m24273@pgim.cmb.ac.lk*

Abstract. Optic neuritis (ON) is an inflammatory condition of the optic nerve, commonly linked to demyelinating diseases such as Multiple Sclerosis (MS), Neuromyelitis Optica Spectrum Disorder (NMO/NMOSD), and Myelin Oligodendrocyte Glycoprotein antibody-associated disease (MOGAD). Early differentiation is crucial for appropriate treatment. Magnetic Resonance Imaging (MRI) plays a key role in distinguishing disease-specific patterns. A retrospective cross-sectional study analyzed MRI data of ON patients at the Institute of Neurology, National Hospital of Sri Lanka (NHSL, from April 2018 to December 2021. Diagnoses were confirmed through clinical evaluation, Visual Evoked Potential (VEP), Optical Coherence Tomography (OCT), AQP4/MOG antibody testing, and cerebrospinal fluid (CSF) oligoclonal band analysis. MRI findings were independently reviewed by two radiologists. A total of 111 patients (76.6% female, mean age 40.6 ± 13.2 years) were included. The most common diagnosis was MS (45.05%), followed by AQP4-NMO/NMOSD (19.82%), MOGAD (18.92%), and Chronic Relapsing Inflammatory Optic Neuropathy (CRION) (16.22%). MRI findings showed cerebral white matter lesions in 55.9% of cases. Optic chiasma involvement was prominent in AQP4-ON (76.9%), while MOG-ON showed optic nerve swelling (72.2%) and perineural inflammation (76.9%). CRION was significantly associated with age >50 years. Different MRI characteristics of the optic nerves aid in distinguishing ON subtypes. These findings enable early diagnosis and targeted immunotherapy, particularly in settings where antibody testing is not readily available.

Keywords. Optic Neuritis, Multiple Sclerosis, Neuromyelitis Optica Spectrum Disorder, MOG Antibody-Associated Disease, Magnetic Resonance Imaging

INTRODUCTION

Optic neuritis (ON) is typically characterised by visual loss together with painful movement of the eye as a result of the inflammation of the optic nerve (1). The annual incidence of optic neuritis is approximately 1–5 per 100,000 globally (2). Demyelinating optic neuritis is the most common cause of unilateral painful visual loss (3). It is caused by a group of diseases called inflammatory demyelinating diseases of the central nervous system, which include mainly Multiple sclerosis (MS), Neuromyelitis Optica (NMO) and Neuromyelitis Optica spectrum disorder (NMOSD). Optic neuritis commonly appears as the presenting symptom in 25% of patients or occurs during the course of the disease in up to 70% of patients diagnosed with MS (1).

Neuromyelitis Optica (NMO) and (NMOSD) are closely related demyelinating diseases that mainly affect the spinal cord and optic nerves, resulting in transverse myelitis and optic neuritis (ON), and are frequently accompanied by severe disability (4). Immunoglobulin G (IgG) antibodies targeting aquaporin-4 (AQP4 IgG) in patients with NMO or NMOSD have aided in differentiating this condition from MS (5).

A third category of patients who present with optic neuritis due to inflammatory demyelination has a clinical picture similar to NMO/NMOSD in adults and Acute Disseminated Encephalomyelitis (ADEM) in children (6). This is regarded as a separate

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entity and is known as Myelin oligodendrocyte glycoprotein antibody-associated disease (MOGAD). Unlike in anti-AQP4 antibody positivity in NMO/NMOSD, there is a different antibody (IgG) targeting the myelin oligodendrocyte glycoprotein (MOG) in these patients (7,8,9).

In another group of patients with isolated recurrent ON, no definite biomarker or underlying disorder can be found. They are categorised as Chronic Relapsing Inflammatory Optic Neuropathy (CRION). Some studies have suggested that patients with CRION may be MOG antibody positive, but a definite relationship between the two is not well established (7).

The initial diagnosis of ON is made clinically. Sub-acute onset, pain on eye movements, and severe papillitis on funduscopic examination favour an inflammatory demyelinating ON. The diagnosis is further aided by Visual evoked potential (VEP) testing, where an objective measurement of prolonged P100 latency will be seen in ON. Additionally, an Optical Coherence Tomography (OCT) will measure the retinal nerve fibre layer (RNFL) thickness, which will be thin in ON. One study found that the sensitivity of VEP after ON was 81% as compared to OCT RNFL thickness, where the sensitivity was only 60% (9). Furthermore, VEP identified 75% of all sub-clinically affected eyes, and OCT identified <20%, but neither of these methods can reliably find the cause for the ON.

It is of paramount importance to differentiate the cause of ON during the early stage of the disease course owing to the varied pathogenesis, therapy, and prognosis of MOGAD, NMO/NMOSD (anti-AQP4 antibody disease), MS and CRION (1). The distinction of the underlying cause in ON is crucial, especially since long-term disease-modifying therapy is dependent on it. Delays in initiating cause-specific treatment plans might sometimes end up in irreversible stages of the pathology, leading to optic atrophy.

The VEP, OCT, and CSF oligoclonal bands testing can be done within a couple of weeks, while antibody testing for AQP4 and MOG takes at least 6 weeks, as they are being sent to and tested in a Clinic in the USA. Hence, the role of the MRI becomes more important in differentiating the different types of ON, as there is the facility to perform an MRI early in the clinical work-up.

Thus, the fundamental role that Magnetic resonance imaging (MRI) of the brain and spinal cord plays in the diagnosis and management of patients with suspected demyelination cannot be overemphasised. Hence, in addition to other available investigations, MR imaging can be employed to distinguish the various causes that could be attributed to the development of ON.

Previous studies have shown that there are MR imaging findings that could be utilised to help in the differentiation of ON due to various above-mentioned causes. Bilateral optic nerve involvement and long-segment lesions are known to be more common in MOG- ON and AQP4-ON than in MS-ON (1). Optic chiasmal and bilateral optic tract involvement is mostly seen in AQP4-ON than in others (9-11). Hence, intracranial signal changes in the optic pathways are also common with this type (10–14). On the other hand, optic nerve head swelling and retrobulbar involvement are found more in MOG- ON than in other causes of ON (12,14,15). Perineural inflammatory changes are also a feature of MOG-ON.

A pattern of imaging appearances fitting into each cause of ON would be helpful to make a more accurate, early diagnosis of ON, which in turn could help clinicians to initiate appropriate therapy. This would also reduce the incidence of poor visual outcomes.

Thus, the findings of this study would enhance MRI differentiation of ON causes in Sri Lanka, aiding early diagnosis and tailored management.

METHODS

This retrospective descriptive cross-sectional study analysed secondary MRI imaging data available from April 2018 to December 2021 at the Institute of Neurology, National Hospital of Sri Lanka (NHSL). Ethical clearance was obtained from the NHSL Ethics Review Committee. Conducted in collaboration with neurology and radiology departments, it focused on patients with

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inflammatory demyelinating optic neuritis (ON) who had undergone dedicated MRI imaging of the orbits, brain, and spine.

Patients were selected from the Multiple Sclerosis and Related Disorders Clinic at NHSL. Optic Neuritis diagnosis was made clinically and confirmed using Visual Evoked Potential (VEP) testing, Optical Coherence Tomography (OCT), and antibody/cerebrospinal fluid (CSF) testing for AQP4, MOG, and oligoclonal bands. Patients with ischemic or infectious ON were excluded.

A total of 111 eligible patients were included. Two radiologists independently analysed MRI scans using a standardised data extraction sheet, with discrepancies resolved by consensus. Dedicated T1 weighted (T1W), T2 weighted (T2W), Short Tau Inversion Recovery (STIR) and post contrast T1W sequences of the orbits, T1W/T2W/Fluid Attenuated Inversion Recovery (FLAIR)/Diffusion weighted Imaging (DWI)/Apparent Diffusion Coefficient (ADC) / Susceptibility Weighted Imaging (SWI) and postcontrast T1W sequences of the brain and T1W/T2W/STIR and post contrast T1W sequences of the spine were analyzed in characterizing the inflammatory lesions. Data collection took place from February to April 2022, following the approval from NHSL authorities.

Descriptive statistics summarised demographic and MRI findings, with statistical analysis performed using R Studio. Data were securely stored in a password-protected database and anonymised.

RESULTS

A total of 111 patients were enrolled in the current study. The majority of the participants were female (76.6%). The age of the participants ranged from 12 to 76 years, with a mean age of 40.6 ±13.2 years. The diagnosis of MS was reported in 45.05%, while a diagnosis of AQP4 (NMO/NMOSD) (19.82 %), CRION (16.22 %), or MOG (18.92 %) was reported in less than 20.0% of the study subjects. According to Antibody and Oligoclonal band status, most of the participants were positive for CSF-OCB (54.26%), followed by AQP4-IgG (24.47%), and MOG-IgG (21.28%).

Most AQP4-IgG-positive patients (95.66%) had NMO/NMOS, with one MOG patient (4.35%) also testing positive. Among CSF-OCB-positive patients, 96.08% had MS, while 3.93% had NMO/NMOSD. All MOG-IgG-positive patients had MOG disease.

MRI outcome concerning the Brain and Spine

MRI findings showed that 31.5% of optic neuritis (ON) patients had no brain lesions, while 22.5% had lesions in periventricular, deep, and juxtacortical white matter, calloso-septal interface, and corpus callosum. The cerebral white matter (55.9%) was the most commonly affected area, followed by the calloso-septal interface (45.9%) and corpus callosum (32.4%).

Spinal involvement was observed in 35% of the patients, mostly as short-segment lesions (30.6%). Bilateral optic nerve involvement was common in MOG (37.9%). MS patients showed anterior intra-orbital involvement (56.5%), while AQP4 (NMO/NMOSD) often affected the posterior optic nerve (33.3%) and optic chiasma (76.9%). Optic nerve swelling (72.2%) and perineural inflammation (76.9%) were frequent in MOG patients.

MRI outcomes of the optic nerve

The right optic nerve involvement was the most common pattern seen (41.4%), while bilateral ON was seen in 26.1% of participants. Contrast enhancement, indicating active disease, was observed in 42.3% of patients. Most cases (75.6%) showed posterior segment involvement, often with intracanalicular or intracranial extensions.

Optic tract involvement was minimal, while 10% had optic chiasma and optic nerve head swelling. Perineural inflammation was found in 23.4% of cases, with higher right optic nerve involvement (13.5%). CRION-associated ON was significantly more common in patients over 50 years ($p < 0.001$), showing a strong age-related association (Table 1).

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Table 1. Association of different types of ON with age and sex

Characteristics	Type of ON				Total	Fisher's exact test	*p*
	AQP4 (NMO/NMOSD)	CRION	MOG	MS			
	n (%)	n (%)	n (%)	n (%)	n (%)		
Age (years)							
Less than 20	0 (0)	0 (0)	3 (100)	0 (0)	3 (100)	35.9	<0.001
20 to 50	15 (19.7)	4 (5.3)	18 (23.7)	39 (51.3)	76 (100)		
More than 50	7 (21.9)	14 (43.8)	0 (0)	11 (34.4)	32 (100)		
Sex							
Male	3 (11.5)	4 (15.4)	7 (26.9)	12 (46.2)	26 (100)		
Female	19 (22.4)	14 (16.5)	14 (16.5)	38 (44.7)	85 (100)	2.32	>0.05

Table 2. Association of laterality and segment of optic nerve involvement in ON with age and sex

Characteristics	MRI finding				Fisher's exact test	*p*
	Laterality of optic nerve involvement					
	Unilateral	Bilateral	Not seen	Total		
	n (%)	n (%)	n (%)	n (%)		
Age (years)						
Less than 20	1 (33.4)	2 (66.7)	0 (0)	3 (100)		
20 to 50	55 (72.4)	19 (25)	2 (2.6)	76 (100)	4.21	> 0.05
More than 50	8 (25)	24 (75)	0 (0)	32 (100)		
Sex						
Male	20 (76.9)	6 (23.1)	0 (0)	26 (100)	0.475	> 0.05
Female	60 (70.58)	23 (27.05)	2 (2.35)	85 (100)		
	Segment of optic nerve involvement					
	Only Anterior	Posterior & beyond	Not seen	Total		
Age (years)	n (%)	n (%)	n (%)	n (%)		
Less than 20	2 (66.7)	1 (33.3)	0 (0)	3 (100)		
20 to 50	15 (19.7)	57 (75)	4 (5.3)	76 (100)		
More than 50	6 (18.8)	26 (81.3)	0 (0)	32 (100)	5.349	> 0.05
Sex						
Male	4 (15.4)	21 (80)	1 (3.8)	26 (100)		
Female	19 (22.4)	63 (74.1)	3 (3.5)	85 (100)	0.707	> 0.05

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Table 3. Association of selected MRI findings of the optic nerve in ON with age and sex

	MRI findings Contrast enhancement			Fisher's exact test score	*p* value
	Yes n (%)	**No n (%)**	**Total n (%)**		
Age (years)					
Less than 20	3 (100)	0 (0)	3 (100)		
20 to 50	34 (44.7)	42 (55.3)	76 (100)	5.38	0.04
More than 50	10 (31.3)	22 (68.7)	32 (100)		
Sex					
Male	11 (42.3)	15 (57.7)	26 (100)	0	1
Female	36 (42.4)	49 (57.6)	85 (100)		
Age (years)	**Involvement of optic chiasma**				
Less than 20	0 (0)	3 (100)	3 (100)		
20 to 50	8 (10.5)	68 (89.5)	76 (100)	0.813	0.672
More than 50	5 (15.6)	27 (84.4)	32 (100)		
Sex					
Male	3 (11.5)	23 (88.5)	26 (100)	0.001	1
Female	10 (11.8)	75 (88.2)	85 (100)		
Age (years)	**Optic head swelling**				
Less than 20	2 (66.7)	1 (33.3)	3 (100)	5.42	0.054
20 to 50	63 (17.1)	13 (82.9)	76 (100)		
More than 50	3 (9.4)	29 (90.6)	32 (100)		
Sex					
Male	9 (34.6)	17 (65.4)	26 (100)	8.46	0.007
Female	9 (10.6)	76 (89.4)	85 (100)		
Age (years)	**Perineural inflammation**				
Less than 20	3 (100)	0 (0)	3 (100)	11.5	0.002
20 to 50	20 (26.3)	56 (73.7)	76 (100)		
More than 50	3 (9.4)	29 (90.6)	32 (100)		
Sex					
Male	7 (26.9)	19 (73.1)	26 (100)	0.232	0.792
Female	19 (22.4)	66 (77.6)	85 (100)		

The gender difference of the participants was not statistically significant (Fisher's exact test = 2.32, p >0.05) between the types of ON. Most of the male participants were in the MS (46.2%) category, while they were low in number in AQP4 disease (NMO/ NMOSD) (11.5 %). An equal number of participants were seen in both CRION and MOG (n=14, 16.5%) categories with regard to female participants. No statistically significant association was found between laterality and segment involvement of the optic nerve with age or sex ($p < 0.05$). Association of selected MRI findings of the optic nerve in ON with age and sex A significant association was found between age and contrast enhancement, optic head swelling, and perineural inflammation ($p < 0.05$), but post-hoc analysis confirmed significance was seen only for perineural inflammation, which was higher in patients under 20 years. Males had a significantly higher prevalence of optic head swelling ($p < 0.05$)

Association of spinal and brain MRI findings with different types of inflammatory demyelinating diseases

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There was a statistically significant association between MRI brain and MRI spine findings with different types of inflammatory diseases. However, the majority of MRI spine and MRI brain findings were found in MS, and the other three subtypes had very limited findings in MRI brain and MRI spine. Considering outcomes (Table 4.12) of the MRI findings of lesions, involvement of white matter was 79% (n=49, Fisher's exact test score=87.4, p < 0.001), Cerebellum 80% (n=8, fisher's exact test score = 6.648, p < 0.05) Corpus callosum was reported as 94.4% (n=34, fisher's exact test score = 55.3, p < 0.001) and Calloso-spatial interface was 98% (n=50, fisher's exact test score =, p < 0.001) for MS as the type of inflammatory demyelinating disease. Half of the participants categorized under had a lesion in Brainstem as the MRI finding for AQP4 (NMO/NMOSD) (n=7, Fisher's exact test score = 7.55, p < 0.05) inflammatory demyelinating disease.

Contrast enhancement, optic nerve head swelling, optic chiasma involvement, and perineural inflammation showed significant associations with optic neuritis causes, while T2 hyperintensity and right optic tract involvement were not statistically significant.

Table 4. Association of spinal and brain MRI findings with different types of inflammatory demyelinating diseases

MRI findings	Types of inflammatory demyelinating diseases					Fisher's exact test score	*p*
	AQP4 (NMO/NMOSD) (%)	CRION (%)	MOG (%)	MS (%)	Total (%)		
Segment of spinal cord involvement							
Long	10 (62.5)	0 (0)	3 (18.8)	3 (18.8)	16 (100)		
Short	4 (11.8)	0 (0)	1 (2.9)	29 (85.3)	34 (100)		
No	8 (13.6)	16 (27.1)	17 (28.8)	18 (30.5)	59 (100)		
Not seen	0 (0)	2 (100)	0 (0)	0 (0)	2 (100)	55.7	< 0.001
Involvement of white matter							
Yes	3 (4.8)	9 (14.5)	1 (1.6)	49 (79)	62 (100)	87.4	< 0.001
No	19 (38.8)	9 (18.4)	20 (40.8	1 (2)	49 (100)		
Cerebellum							
Yes	0 (0)	2 (20)	0 (0)	8 (80)	10 (100)	6.648	< 0.05
No	22 (21.8)	16 (15.8	21 (20.8	42 (41.6)	101 (100)		
Brainstem							
Yes	7 (50)	1 (7.1)	1 (7.1)	5 (35.7)	14 (100)		
No	15 (15.5)	17 (17.5	20 (20.6	45 (46.4)	97 (100)	7.55	< 0.05
Corpus callosum							
Yes	0 (0)	1 (2.8)	1 (2.8)	34 (94.4)	36 (100)		
No	22 (29.3)	17 (22.7	20 (26.7	16 (21.3)	75 (100)	55.3	< 0.001
Callso-spatial interface							
Yes	0 (0)	1 (2)	0 (0)	50 (98)	51 (100)		
No	22 (36.7)	17 (28.3	21 (35)	0 (0)	60 (100)	132.65	< 0.001

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Table 5. Variation of optic nerve MRI findings with different types of inflammatory demyelinating disease

		Diagnosis						
		AQP4 (NMO/ NMOSD) (%)	**CRION (%)**	**MOG (%)**	**MS (%)**	**Total (%)**	**Likelihood Ratio**	**p**
Right side optic nerve	T2 hyper intensity	17 (22.36)	11 (14.47)	17 (22.36)	31 (40.78)	76 (100)	3.874	>0.05
	Contrast enhance	7 (19.44)	2 (5.55)	15 (41.66)	12 (33.33)	36 (100)	19.564	<0.05
	Head swelling	1 (8.33)	2 (16.66)	8 (66.66)	1 (8.33)	12 (100)	17.636	<0.001
	Optic chiasma	8 (88.88)	1 (11.11)	0 (0)	0 (0)	9 (100)	25.906	<0.001
	Optic tract	3 (75)	1 (25)	0 (0)	0 (0)	4 (100)	9.19	<0.05
	Peri neural	2 (10.52)	1 (5.26)	14 (73.68)	2 (10.52)	19 (100)	36.962	<0.001
Left side optic nerve	T2 hyperintensity	11 (18.64)	11 (18.64)	14 (23.72)	23 (38.98)	59 (100)	3.154	>0.05
	Contrast enhance	5 (25)	1 (5)	10 (50)	4 (20)	20 (100)	16.462	<0.05
	Head swelling	2 (15.38)	2 (15.38)	9 (69.23)	0 (0)	13 (100)	25.522	<0.001
	Optic chiasma	9 (75)	1 (8.33)	2 (16.66)	0 (0)	12 (100)	25.344	<0.001
	Optic tract	1 (100)	0 (0)	0 (0)	0 (0)	1 (100)	3.274099	>0.05
	Peri neural	0 (0)	0 (0)	11 (100)	0 (0)	11 (100)	42.663	<0.001

DISCUSSION

MRI plays a crucial role in diagnosing optic neuritis (ON) and differentiating between multiple sclerosis (MS), neuromyelitis Optica (NMO), myelin oligodendrocyte glycoprotein antibody-associated disease (MOGAD), and chronic relapsing inflammatory optic neuropathy (CRION). Brain MRI is a standard component in ON workups and helps predict the progression to clinically definite MS. Spinal cord MRI provides additional diagnostic insights, distinguishing MS from NMO, MOGAD, and other inflammatory disorders.

According to Youl BD et al., MRI with gadolinium contrast enhancement and fat-suppressed orbital imaging is the preferred protocol for assessing inflammatory CNS lesions in ON, including the optic nerve, chiasm, and retrochiasmal pathways. Contrast enhancement of the optic nerve is a highly specific marker for ON, differentiating it from non-inflammatory optic neuropathies (16). Kupersmith et al. found that 94% of acute ON cases showed abnormal optic nerve enhancement. The present study reported contrast enhancement in 42.3% of patients, with 24.3% having enhancement on the right side, 9.1% on the left, and 8.1% bilaterally. T2 hypersensitivity was observed in 94.6% of cases, with 26.1% bilateral, 41.4% right-sided, and 27% left-sided enhancement (17). The predominant involvement of the right optic nerve in the current study has not been described in previous studies.

Studies on ON in MS, NMO, and MOGAD indicate that bilateral ON is uncommon in MS, occurring in only 0.42% of cases. However, NMO and MOGAD show higher bilateral involvement, with literature reporting cases ranging from none to over 80% (18). The present study aligns with these findings, showing bilateral ON in 17.2% of MS and CRION patients while bilateral ON was seen in 27.6% and 36.9% of NMO and MOGAD patients, respectively.

MRI findings in ON also include optic nerve swelling. Studies have shown that MOGAD exhibits the most prominent optic nerve swelling, with rates between 61.9% and 95%. Chen JJ et al. reported moderate-to-severe optic nerve swelling in over 50% of MOG patients, while Akaishi T et al. found severe swelling in 94.1% of MOG cases (19,20). NMO patients show optic nerve sheath thickening and dilation, with 49% of cases

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exhibiting swelling. Ramanathan et al. reported that MOG and NMO have a higher incidence of radiological optic nerve thickening than MS. The present study highlights similar findings, emphasizing the importance of optic nerve swelling in diagnosing ON subtypes (12).

Optic nerve head swelling, usually assessed through funduscopic examination, can also be detected radiographically. In the present study, 16.21% of patients exhibited optic nerve head swelling, with the highest proportion (72.2%) in MOG cases. Studies by Zhao et al. found no significant difference in optic nerve head elevation among ON subtypes, though Ramanathan et al. and Y. Zhao et al. reported significantly higher rates in MOG (79–80%) compared to NMO (20–27%) and MS (15%). Khanna et al. found no radiographic optic nerve head swelling in MS or NMO patients (21).

ON can affect different anatomical segments of the optic nerve. MS-related ON tends to be more localized, while NMO and MOGAD exhibit more extensive involvement. Several studies suggest that MOGAD preferentially affects anterior optic nerve segments, whereas NMO more commonly involves posterior segments, including the optic chiasm and tract (21). The present study found anterior intra-orbital involvement in 56.5% of MS patients and 30.4% of MOG cases. Posterior intra-orbital, intracanalicular, and intracranial involvement was observed in 37.83% of the study population, with NMO (33.3%) being the most affected, followed by MOG (26.2%).

Chiasmal involvement is significantly more frequent in NMO than in MS or MOGAD. Studies report that 60–75% of NMO patients have chiasmal lesions, compared to 5–25% of MOG cases and 0–15% of MS cases (12). The present study aligns with these findings, showing chiasmal involvement in 76.9% of NMO patients, with no MS cases affected. Optic tract involvement is uncommon but occurs more frequently in NMO (7–18%) than in MOG (2–13%) or MS (13%).

MRI findings in ON have diagnostic implications. The extent and location of optic nerve lesions correlate with disease etiology. Both NMO and MOGAD frequently exhibit longitudinally extensive optic nerve lesions (LEON), which are rare in MS. Perineural enhancement, often seen in MOGAD, is less common in NMO or MS.

Brain MRI findings also aid in distinguishing ON subtypes. White matter lesions are most common in MS (79%), followed by NMOSD (4.8%) and CRION (14.5%). While white matter lesions are characteristic of MS, they can also appear in NMOSD and ischemia. The present study found that 55.9% of brain lesions occurred in the cerebral white matter, followed by the calloso-septal interface and corpus callosum. These findings are consistent with the literature, which reports periventricular or deep white matter lesions in 63% of MS cases (22).

Brainstem lesions, particularly in the dorsal brainstem adjacent to the fourth ventricle, are characteristic of NMOSD and appear in 7–46% of patients (23). The present study found that 50% of brainstem lesions occurred in NMOSD patients, supporting the diagnostic value of these lesions in differentiating ON subtypes.

In conclusion, MRI findings are critical in differentiating MS, NMO, MOGAD, and CRION as the causative pathology in patients with ON. Bilateral ON is more common in NMO and MOGAD than in MS. MOGAD is associated with significant optic nerve swelling, while NMO frequently affects the optic chiasm and posterior optic nerve segments. Brain MRI findings, such as white matter lesions and brainstem involvement, provide further diagnostic clues. Understanding these MRI characteristics aids in early diagnosis and appropriate management of ON-related demyelinating diseases.

CONCLUSION

MRI characteristics help differentiate NMO/NMOSD, MOG-AD, and MS-related optic neuritis by assessing lesion laterality, morphology, location, length, and perineural/orbital enhancement. These radiological features aid in differentiating typical from atypical ON, enabling early immunotherapy initiation, especially at the

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initial presentation, where antibody confirmation is unavailable.

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