Acta Neurologica Belgica
https://doi.org/10.1007/s13760-024-02717-4

IMAGE

The combination of central vein sign, cortical lesions, and paramagnetic rim lesions for differentiating MOGAD from MS: a case report

Serena Borrelli[1,2] · **Pietro Maggi**[1,3]

Received: 14 August 2024 / Accepted: 28 December 2024

Keywords Central vein sign · Paramagnetic rims · Cortical lesions · MOGAD · MS · Differential diagnosis

A 45-year-old male was admitted to the neurology department due to photophobia, blurred vision, and painful ocular movements. Two months prior to hospital admission, the patient experienced hypoesthesia in his right leg, but did not seek medical attention at that time. On current examination, visual acuity (VA) was notably reduced in the left eye (7/10 left eye, 10/10 right eye), with altered color vision and visual field defects in both eyes. Fundoscopy revealed bilateral optic disc swelling. Visual evoked potentials demonstrated delays in both eyes, leading to an initial diagnosis of bilateral optic neuritis (ON).

Brain-MRI revealed multiple nodular hyperintense lesions on T2-weighted(w) and fluid attenuated inversion recovery (FLAIR) images, located in the periventricular, subcortical, cerebellum, and brainstem regions. The majority of these lesions showed enhancement on T1-w imaging following gadolinium injection. Spinal cord MRI similarly demonstrated multiple T2 hyperintense lesions, all measuring less than three vertebral segments in length, with most lesions also enhancing on post-gadolinium T1-w images. The dissemination in space and time MRI criteria for multiple sclerosis (MS) were fulfilled (Figure, panel A) [1], suggesting an initial diagnosis of MS. However, given the clinical presentation atypical for MS (bilateral ON with disc swelling), additional testing was needed.

Cerebrospinal fluid (CSF) analysis showed mild pleocytosis (2 cells/μL), a slightly elevated protein level (0.78 g/L; 0.15–0.45), and an increased albumin CSF/serum ratio (1.11; <0.8). CSF glucose, lactate, and IgG index were within normal limits. Isoelectric focusing identified two CSF-restricted oligoclonal bands. Subsequent serum fixed cell-based assay revealed the presence of myelin oligodendrocyte glycoprotein (MOG)-IgG in two separate samples (titer not available).

The patient received high-dose intravenous corticosteroid treatment for 5 days, which led to significant recovery of VA.

Given the atypical presentation for MS and the positive MOG-IgG test, a follow-up brain-MRI was performed, incorporating the assessment of 3 advanced imaging biomarkers which have been recently shown to improve the accuracy of MS diagnosis: central vein sign (CVS), paramagnetic rim lesions (PRL), and cortical lesions (CL) [2]. Only two brain lesions met the North American Imaging in MS Cooperative (NAIMS) eligibility criteria for CVS assessment [3], one of these two lesions being clearly perivenular on 3T 3D-high-resolution susceptibility based images (FLAIR* contrast generated by coregistration of T2*-w echo-planar imaging (EPI) magnitude and FLAIR; Figure, panel B) [4]. Among the 8 lesions not fulfilling the NAIMS criteria for CVS assessment, 4 exhibited multiple venous structures and 4 others were less than 3 mm in diameter and without a clearly visible vein. Notably, the PRL and CL assessments did not reveal any hypointense rim lesions on T2*-EPI phase nor focal hypointensities relative to the

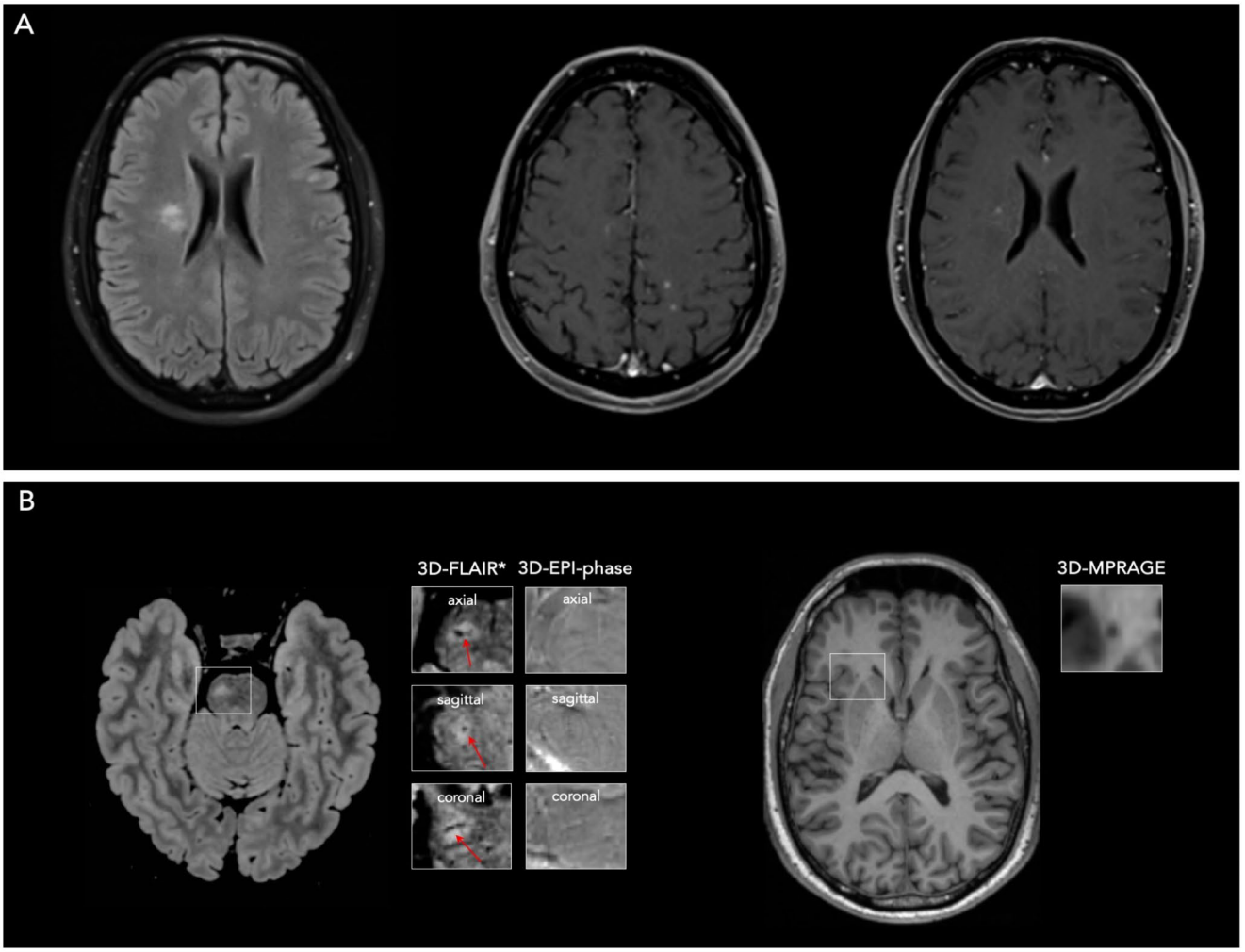
✉ Serena Borrelli
serena.borrelli@uclouvain.be

1 Neuroinflammation Imaging Lab (NIL), Institute of NeuroScience, Université catholique de Louvain, Brussels, Belgium

2 Department of Neurology, Hôpital Erasme, Hôpital Universitaire de Bruxelles, Université libre de Bruxelles, Brussels, Belgium

3 Department of Neurology, Cliniques Universitaires Saint-Luc, Université catholique de Louvain, Brussels, Belgium

Published online: 18 January 2025



Brain-MRI incorporating advanced sequences to assess central vein sign (CVS), paramagnetic rim lesions (PRL), and cortical lesions (CL)

surrounding normal cortex on magnetization prepared rapid gradient echo (MPRAGE) images (Figure, panel B).

This case underscores the diagnostic challenge of differentiating MOG antibody-associated disease (MOGAD) from MS. The patient's clinical presentation with bilateral ON and the presence of MOG-IgG strongly supported a diagnosis of MOGAD [5], despite initial MRI findings compatible with an MS diagnosis. In this context, the advanced imaging biomarker assessment combining CVS, PRL, and CL provided additional insights. Indeed, while the presence of perivenular pathology generally suggests an MS diagnosis – one out of the two lesions eligible for CVS rating in this case was perivenular – [3] the absence of any PRL and/or CL argued against MS and further corroborated the MOGAD diagnosis, in line with the clinical and laboratory work-up. Even tough CL sensitivity detection remains low even at ultra-high field strength [6], this case is in line with recent evidences from the literature [2, 7] and suggests that the combination of these biomarkers clearly improves MS differential diagnosis, offering greater diagnostic accuracy than using a single biomarker alone.

This report underscores the importance of incorporating advanced MRI biomarkers into the diagnostic workup of MS. The absence of PRL and CL, despite CVS positivity, should prompt consideration of alternative diagnoses such as MOGAD, especially when supported by other clinical and paraclinical findings. Further research and larger studies are warranted to validate the diagnostic value of these MRI biomarkers in distinguishing MOGAD from MS.

(A) On the left, axial 3D-FLAIR image showing a periventricular lesion with ill-defined borders. In the middle and on the right, post-gadolinium T1-weighted images revealing multiple enhancing lesions.
(B) On the left, axial 3D-FLAIR image showing, in the magnified box, one of the two eligible lesions for the CVS assessment. The FLAIR* sequence reveals the CVS (indicated by the red arrow), while unwrapped

EPI-phase images do not display a typical perilesional hypointense rim, consistent with the absence of PRL. On the right, axial 3D-MPRAGE sequence demonstrating a subcortical lesion that does not extend to the cortex (magnified box), consistent with the absence of visible CL in this patient's scan.

Author contributions S.B. contributed to the study design, collected and analyzed the data, interpreted the results, and drafted the manuscript.P.M. conceived the study, assisted with data interpretation, critically revised the manuscript for important intellectual content, and provided final approval of the version to be published.Both authors have read and approved the final manuscript.

Data availability No datasets were generated or analysed during the current study.

Declarations

Competing interests The authors declare no competing interests.

References

1. Thompson AJ, Banwell BL, Barkhof F et al (2018) Diagnosis of multiple sclerosis: 2017 revisions of the McDonald criteria. Lancet Neurol 17(2):162–173. https://doi.org/10.1016/S1474-4422(17)30470-2
2. Borrelli S, Martire MS, Stölting A et al (2024) Central Vein Sign, Cortical Lesions, and Paramagnetic Rim Lesions for the Diagnostic and Prognostic Workup of multiple sclerosis. Neurol Neuroimmunol Neuroinflammation 11(4):e200253. https://doi.org/10.1212/NXI.0000000000200253
3. on behalf of the NAIMS Cooperative, Sati P, Oh J et al (2016) The central vein sign and its clinical evaluation for the diagnosis of multiple sclerosis: a consensus statement from the North American Imaging in multiple sclerosis Cooperative. Nat Rev Neurol 12(12):714–722. https://doi.org/10.1038/nrneurol.2016.166
4. Sati P, George IC, Shea CD, Gaitán MI, Reich DS, FLAIR*: (2012) A combined MR contrast technique for visualizing White Matter lesions and Parenchymal veins. Radiology 265(3):926–932. https://doi.org/10.1148/radiol.12120208
5. Banwell B, Bennett JL, Marignier R et al (2023) Diagnosis of myelin oligodendrocyte glycoprotein antibody-associated disease: International MOGAD Panel proposed criteria. Lancet Neurol 22(3):268–282. https://doi.org/10.1016/S1474-4422(22)00431-8
6. Kilsdonk ID, Jonkman LE, Klaver R et al (2016) Increased cortical grey matter lesion detection in multiple sclerosis with 7 T MRI: a post-mortem verification study. Brain 139(5):1472–1481. https://doi.org/10.1093/brain/aww037
7. Cagol A, Cortese R, Barakovic M et al (2023) Diagnostic performance of Cortical Lesions and the Central Vein sign in multiple sclerosis. JAMA Neurol Published Online Dec 11. https://doi.org/10.1001/jamaneurol.2023.4737