

# Acute disseminated encephalomyelitis after SARS-CoV-2 infection

Giovanni Novi, MD, Tommaso Rossi, MD, Enrico Pedemonte, MD, Laura Saitta, MD, Claudia Rolla, MD, Luca Roccatagliata, MD, PhD, Matilde Inglese, MD, PhD, and Daniele Farinini, MD

## Correspondence

Dr. Novi  
giovanninovi@gmail.com

*Neurol Neuroimmunol Neuroinflamm* 2020;7:e797. doi:10.1212/NXI.0000000000000797

Acute disseminated encephalomyelitis (ADEM) is a rare autoimmune disease of the CNS that often after viral infections and mainly affecting children. ADEM is characterized by the onset of multifocal neurologic symptoms, encephalopathy, with brain MRI showing demyelinating abnormalities in the acute phase.<sup>1</sup> Coronavirus disease 2019 (COVID-19) is a novel entity caused by the pandemic severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2), which is characterized by influenza-like symptoms, pneumonia, and in severe cases respiratory insufficiency.<sup>2</sup> Many neurologic complications occurring in patients with COVID-19 have been described,<sup>3</sup> and it has been hypothesized that, in some cases, SARS-CoV-2 might exhibit a neurotropic behavior.<sup>4</sup>

## MORE ONLINE

### COVID-19 Resources

For the latest articles, invited commentaries, and blogs from physicians around the world

[NPub.org/COVID19](https://www.npub.org/COVID19)

## Results

We report on a 64-year-old woman with a history of vitiligo, hypertension, and monoclonal gammopathy of undetermined significance who developed an influenza-like syndrome in mid-March 2020 that lasted for 2 weeks. The patient also reported the development of smell and taste deficit that rapidly reached anosmia and ageusia. Starting from April 10, the patient developed bilateral vision impairment associated with sensory deficit on her right leg. She reached the emergency department of our hospital and was referred for ophthalmologic evaluation. Visual acuity was hand motion bilaterally, and relative afferent pupillary defect was detected. Ocular motility and fundus examination were unremarkable, whereas visual field test showed profound defects bilaterally. Neurologic examination, performed on hospitalization, showed mild behavioral abnormalities (irritability), headache, bilateral relative afferent pupillary defect, ageusia and anosmia, severe visual loss, right abdominal sensory level, and left-sided lower limb hyper-reflexia with the Babinski sign. The patient underwent a brain and spine MRI scan (figure), with evidence of multiple T1 post-Gd enhancing lesions of the brain, associated with a single spinal cord lesion at the T8 level and with bilateral optic nerve enhancement. A lumbar puncture was performed and showed lymphocytic pleocytosis with 22 cells/mm<sup>3</sup> (reference range: 0–5 cells/mm<sup>3</sup>), mainly represented by CD3<sup>+</sup>CD4<sup>+</sup> T-cells, with mild hyperproteinorrachia (452 mg/L, reference range: 150–450 mg/L), and identical immunoglobulin G oligoclonal bands were present in the CSF and serum (mirror pattern). PCR for SARS-CoV-2 tested negative on nasal swab and positive on CSF sample. The patient's serum tested positive for anti-SARS-CoV-2 immunoglobulin G and negative for aquaporin-4 (AQ4) antibody (ab) and antimyelin oligodendrocyte glycoprotein (MOG) ab; the levels of interleukins were not assessed in serum and CSF.

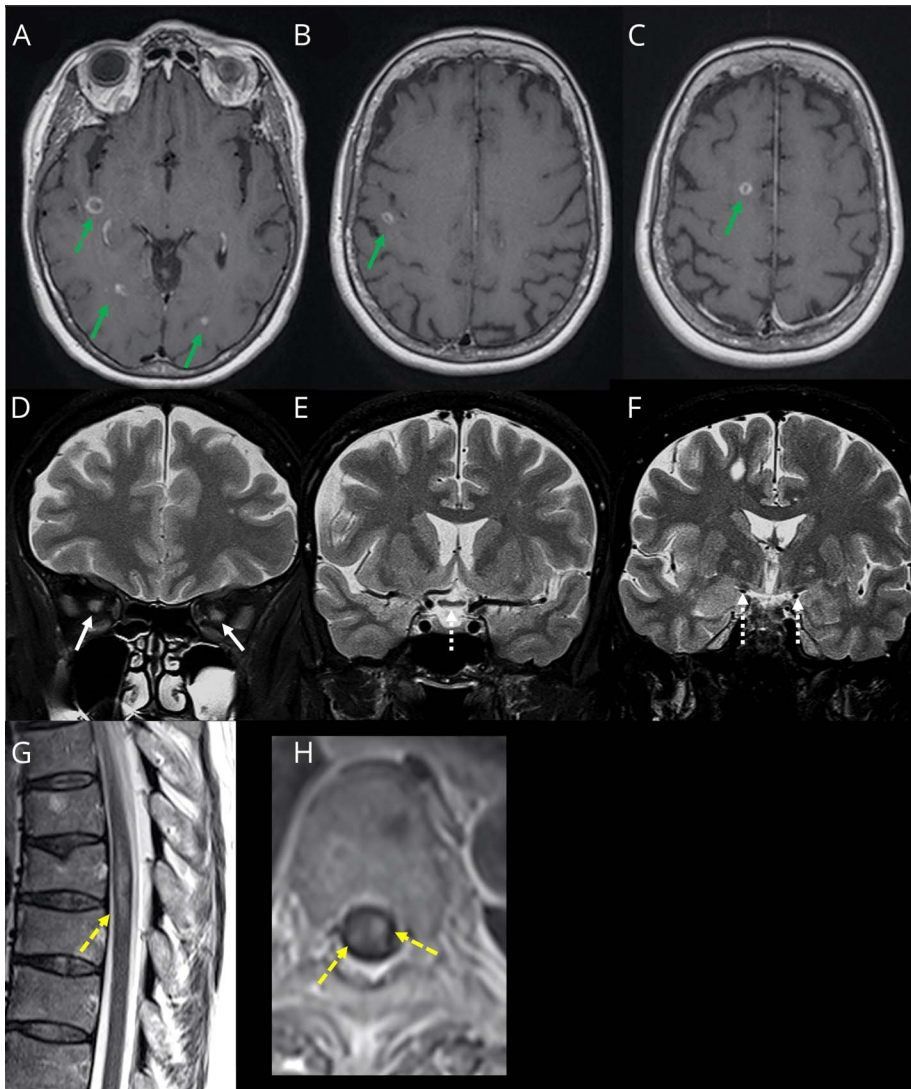
ADEM disease was suspected, and high-dose steroids (IV methylprednisolone 1 g/d for 5 days tapered with oral prednisone 75 mg/d) associated with IV immunoglobulins (2 g/kg in 5 days) were administered. The patient reported significant improvement in visual symptoms and progressive recovery of visual acuity. After 14 days of treatment, vision was 20/30 in the

From the Department of Neuroscience (G.N., E.P., D.F.), Ospedale Policlinico San Martino, IRCCS; Ospedale Policlinico San Martino (T.R., L.R., M.I.), IRCCS; Department of Neuro-radiology (L.S., C.R.), Ospedale Policlinico San Martino, IRCCS, Genova, Italy; Department of Health Sciences (DISSAL) (L.R.), University of Genova; and Department of Neuroscience (M.I.), Rehabilitation, Ophthalmology, Genetics, Maternal and Child Health (DINO GMI) and Center of Excellence for Biomedical Research (CEBR), University of Genova, Italy.

Go to [Neurology.org/NN](https://www.neurology.org/NN) for full disclosures. Funding information is provided at the end of the article.

The Article Processing Charge was funded by the authors.

This is an open access article distributed under the terms of the Creative Commons Attribution-NonCommercial-NoDerivatives License 4.0 (CC BY-NC-ND), which permits downloading and sharing the work provided it is properly cited. The work cannot be changed in any way or used commercially without permission from the journal.



(A–C) Postgadolinium (Gd) T1-weighted (T1w) sequence of the brain in the axial plane showing 6 enhancing lesions (green arrows), most of which with ring enhancement and some of which with nodular enhancement. Incomplete ring enhancement is shown about the right temporal lesion (dashed green arrow). (D–F) T2-weighted (T2w) fat saturated sequence in the coronal plane with evidence of (D) hyperintense signal of the optic nerves bilaterally (white arrows), which is best seen when compared with the normal signal within (E) the optic chiasm and (F) the optic tracts (dashed white arrows). (G) T2w sequence of the thoracic spine in the sagittal plane showing a hyperintense spindle-like T8 lesion, involving less than 2 metameric levels (dashed yellow arrow). (H) Post-Gd T1w sequence of the spine in the axial plane at the level of T8 showing eccentric areas of enhancement respectively located posteriorly to the right and anteriorly to the left (dashed yellow arrow).

right eye and 20/25 in the left eye. Visual-evoked potential showed increased latency in both eyes (p100 wave latency: 114 ms right eye, 120 ms left eye, reference: <100 ms). A follow-up brain MRI scan also showed a partial improvement with a reduction in the number of Gd-enhancing lesions. On April 27, the patient was discharged with oral prednisone tapering.

## Discussion

We report a rare case of an immune-mediated CNS disease that occurs after SARS-CoV-2 infection. Phenotypically, the disease resembled an atypical form of neuromyelitis optica spectrum disorder; however, (1) the hyperacute dynamic of the disease, (2) the presence of multiple, synchronous, enhancing brain lesions, (3) the lack of anti-AQ4 or anti-MOG abs, (4) the absence of longitudinally extended transverse myelitis, and (5) the presence of a viral infection preceding

the development of neurologic symptoms do not support this hypothesis, favoring ADEM diagnosis.

Since COVID-19 is currently a pandemic disease, neurologists should be aware that autoimmune neurologic complications involving the CNS might occur and should be promptly recognized and treated to reduce permanent neurologic disability.

## Study funding

No targeted funding reported.

## Disclosure

G. Novi: received speaker honoraria from Merck, Novartis, and Roche. T. Rossi: reports no disclosures relevant to the manuscript. Enrico Pedemonte: received speaker honoraria or consultation fees from Biogen and Merck-Serono. L. Saitta: reports no disclosures relevant to the manuscript. C. Rolla: reports no

disclosures relevant to the manuscript. L. Roccatagliata: reports no disclosures relevant to the manuscript. M. Inglese: received honoraria or consultation fees from Roche, Biogen, Merck-Serono, Novartis, and Genzyme and research grants from NIH, NMSS, FISM, and Teva Neuroscience. D. Farinini: reports no disclosures relevant to the manuscript. Go to [Neurology.org/NN](http://Neurology.org/NN) for full disclosures.

## Publication history

Received by *Neurology: Neuroimmunology & Neuroinflammation* May 4, 2020. Accepted in final form May 13, 2020.

## Appendix Author

Name	Location	Contribution
<b>Giovanni Novi, MD</b>	San Martino Hospital, Genova	Major role in the acquisition of data, interpreted the data, design and conceptualized study, analyzed the data, and drafted the manuscript
<b>Tommaso Rossi, MD</b>	San Martino Hospital, Genova	Major role in the acquisition of data
<b>Enrico Pedemonte, MD</b>	San Martino Hospital, Genova	Major role in the acquisition of data

## Appendix *(continued)*

Name	Location	Contribution
<b>Laura Saitta, MD</b>	San Martino Hospital, Genova	Major role in the acquisition of data
<b>Claudia Rolla, MD</b>	San Martino Hospital, Genova	Major role in the acquisition of data
<b>Luca Roccatagliata, MD, PhD</b>	University of Genova, Genova, Italy	Analyzed the data and revised the manuscript for intellectual content
<b>Matilde Inglese, MD, PhD</b>	University of Genova, Genova, Italy	Interpreted the data, design and conceptualized study, analyzed the data, and revised the manuscript for intellectual content
<b>Daniele Farinini, MD</b>	San Martino Hospital, Genova	Revised the manuscript for intellectual content

## References

1. Pohl D, Alper G, Van Haren K, et al. Acute disseminated encephalomyelitis: updates on an inflammatory CNS syndrome. *Neurology* 2016;87:S38–S45.
2. Guan W, Ni Z, Hu Y, et al. Clinical characteristics of coronavirus disease 2019 in China. *N Engl J Med* 2020;382:1708–1720.
3. Helms J, Kremer S, Merdji H, et al. Neurologic features in severe SARS-CoV-2 infection. *New Engl J Med Epub* 2020 April 15.
4. Li YC, Bai WZ, Hashikawa T. The neuroinvasive potential of SARS-CoV2 may play a role in the respiratory failure of COVID-19 patients. *J Med Virol Epub* 2020 Feb 27.