



# Neuroimaging Abnormalities in Severe Acute Respiratory Syndrome Coronavirus 2 Infected are More Diverse than Previously Thought and Depend on the Methods Used

Josef Finsterer<sup>1</sup>

<sup>1</sup>Neurology and Neurophysiology Center, Vienna, Austria

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Address for correspondence Josef Finsterer, MD, PhD, Postfach 20, 1180 Vienna, Austria (e-mail: ffigs1@yahoo.de).

We read with interest the article by Tiwari et al who reported on a retrospective study of 180 severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2)-infected patients who underwent neuroimaging in a single Indian center between March 2020 and May 2021.<sup>1</sup> The most frequently detected neuroimaging abnormality was ischemic stroke ( $n = 77$ ), followed by bleeding ( $n = 22$ ), hypoxic lesions ( $n = 5$ ), cerebellitis ( $n = 3$ ), demyelination ( $n = 1$ ), encephalitis ( $n = 1$ ), acute hemorrhagic necrotizing encephalitis ( $n = 1$ ), transverse myelitis ( $n = 1$ ), cytotoxic lesion of the corpus callosum ( $n = 1$ ), Guillain–Barre syndrome ( $n = 1$ ), and microbleeds ( $n = 1$ ).<sup>1</sup> The study is excellent but has limitations that should be discussed.

The first constraint is the inclusion criterion. According to the method part, patients with polymerase chain reaction (PCR)-positive SARS-CoV-2 or coronavirus disease 2019 (COVID-19) pneumonia were included.<sup>1</sup> Accordingly, also patients with a negative PCR but COVID-19 pneumonia on imaging were included. However, according to the exclusion criteria, patients with a negative PCR or negative lung imaging were excluded. This discrepancy should be resolved. In addition, we should know if COVID-19 pneumonia was diagnosed by X-ray or lung computed tomography (CT) or both. In cases with negative PCR but imaging suggestive of pneumonia, how were false-positive diagnoses ruled out?

A second limitation is that the majority of included patients had only cerebral CT (CCT,  $n = 169$ ) and only 28 had cerebral magnetic resonance imaging (cMRI).<sup>1</sup> Disadvantages of CCT are the low resolution and the fact that small or embolic ischemic lesions can be missed. It is also unreported how many who underwent CCT or cMRI also received contrast

medium. Immune/infectious meningitis or encephalitis can easily be overlooked if no contrast medium has been administered. According to the results, an MRI was only performed if the CCT was not explanatory.<sup>1</sup> However, only 17 had both, CCT and cMRI. This discrepancy should be explained.

A third limitation is that comorbidities were not reported. In particular, we should know how many had cardiovascular risk factors such as smoking, arterial hypertension, diabetes, hyperlipidemia, or atrial fibrillation. How many of those with ischemic stroke attributed to SARS-CoV-2 also had cardiovascular risk factors that could explain the brain/nerve damage?

A fourth limitation is that in the 66 patients in whom neuroimaging provided no explanation, no explanation was given for the neurological deficits. We should therefore know the clinical neurologic findings of these 66 patients with negative neuroimaging and what other tests were performed to clarify the underlying pathology.

A fifth limitation is that the number of included patients was small.<sup>1</sup> This could explain why the number of imaging abnormalities was limited to 11.<sup>1</sup> However, the number of imaging abnormalities in SARS-CoV-2-infected patients is much larger and also includes posterior reversible encephalopathy syndrome, infections/immune encephalitis, infections/immune meningitis, acute disseminated encephalomyelitis, acute hemorrhagic leukoencephalitis, multiple sclerosis, neuromyelitis optica spectrum disorder, cerebral vasculitis, reversible cerebral vasoconstriction syndrome, giant cell arteritis, ventriculitis, pontine myelinolysis, Wernicke encephalopathy, pseudotumor cerebri, subarachnoid bleeding, hypophysitis, and rhabdomyolysis.<sup>2</sup>

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There is a discrepancy regarding the study period between the methods (March 2020 to May 2021) and the results (May 2020 to May 2021).<sup>1</sup> This discrepancy should be resolved.

Overall, addressing these limitations would strengthen the conclusions and could improve the status of the study.

#### Statement of Ethics

(1) The study was approved by the institutional review board (responsible: Finsterer J.) at the 4th November 2022.

(2) Written informed consent was obtained from the patient for publication of the details of their medical cases and any accompanying images.

#### Author Contribution

J.F. contributed to design, literature search, discussion, first draft, critical comments, and final approval.

#### Disclosures

The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

#### Note

This article is based on previously conducted studies and does not contain any new studies with human participants or animals performed by any of the authors.

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#### Conflict of Interest

None declared.

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