



## Cerebrovascular lesions and brain vascular abnormalities in children infected with the Omicron variant of SARS-CoV-2 (MRI study) | 1

Prior studies have found neurological involvement and abnormal neuroimaging findings in pediatric patients infected with earlier variants of the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). These abnormal neuroimaging findings included acute disseminated encephalomyelitis, lesions of the *corpus callosum*, *cauda equina* nerve root enhancement, bilateral changes of thalamic signal, micro-hemorrhages, and leukoencephalopathy. In this retrospective study, the researchers from Taiwan evaluated brain magnetic resonance imaging (MRI) and MR angiography (MRA) findings in hospitalized children with severe neurological manifestations of infection with the Omicron variant of SARS-CoV-2. The focus was on cerebrovascular lesions and vascular abnormalities. The authors noted that the incidence of pediatric hospitalizations has increased significantly with the spread of the Omicron variant.

### **About the study**

This retrospective study included children diagnosed with COVID-19 who underwent brain MRI and MRA for neurological symptoms. All patients tested positive for SARS-CoV-2 by reverse transcriptase polymerase chain reaction (rt-PCR). Demographics and clinical and laboratory data were also collected.

Two pediatric neurologists and one pediatric radiologist reviewed the MRI images. They evaluated the presence of signal abnormalities, the locations of lesions, and the cerebral vascular changes. The researchers noted that MRI was done only in children with severe neurological manifestations, not children with milder symptoms.

### **Results**

A total of 31 pediatric patients, 11 females, and 20 males, underwent MRI due to neurological symptoms resulting from the COVID-19 infection. All patients presented with fever and/or upper respiratory symptoms. None of them had acute severe pulmonary disease, respiratory distress syndrome, or other severe non-neurological manifestations. One patient had hepatitis, possibly as an adverse effect of remdesivir treatment. Approximately 50% of the children infected with earlier SARS-CoV-2 strains who developed neurological complications met the criteria for a multisystemic inflammatory syndrome in children (MIS-C), in this study, however, no case met the MIS-C criteria.



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The median age was six years (three months to 13 years).

The median time from diagnosis of COVID-19 to MRI examination was 26 days (0-97 days). The median time from the onset of neurological manifestations to MRI examinations was 20 days (0-97 days) for all patients and 11 days (0-97 days) for patients with abnormal MRI findings.

Most pediatric patients had seizures as a neurological symptom (35.5%). This result is consistent with a recent Japanese nationwide epidemiological study which has found that seizures, impaired consciousness, and abnormal speech and behavior were the first symptoms of acute encephalopathy associated with Omicron infection in more than 90% of unvaccinated pediatric cases.

<https://discovermednews.com/acute-encephalopathy-associated-with-sars-cov-2-infection-in-children-during-the-omicron-period/>

Other neurological symptoms included visual hallucinations (19.4%), altered mental status (16.1%), headaches (9.7%), myoclonus (9.7%), hemiplegia (3.2%), tics (3.2%), gait disturbance (3.2%), and parasomnia (3.2%).

### ***MRI findings***

Out of 31 patients, MRI abnormalities were found in 48.4% (15 patients).

73.3% of patients with abnormal findings on MRI had encephalitis/encephalopathy. Other MRI abnormalities included hemorrhages in 13.3%, Alice in Wonderland syndrome in 6.7%, and ischemic stroke in 3.2% of pediatric cases.

### *The analysis of the lesion location*

Two patients had diffuse cortical T2 and/or DWI hyperintensity. Focal lesions were detected in the cerebral cortex and thalamus in one patient, the medulla in one patient, the pons in two patients, the cerebellum in one patient, the *splenium* of the *corpus callosum* in one patient, and *globus pallidus*, subthalamic regions, and cerebral peduncles in one patient.

Neurological symptoms, such as a decreased level of consciousness, central apnea, and loss

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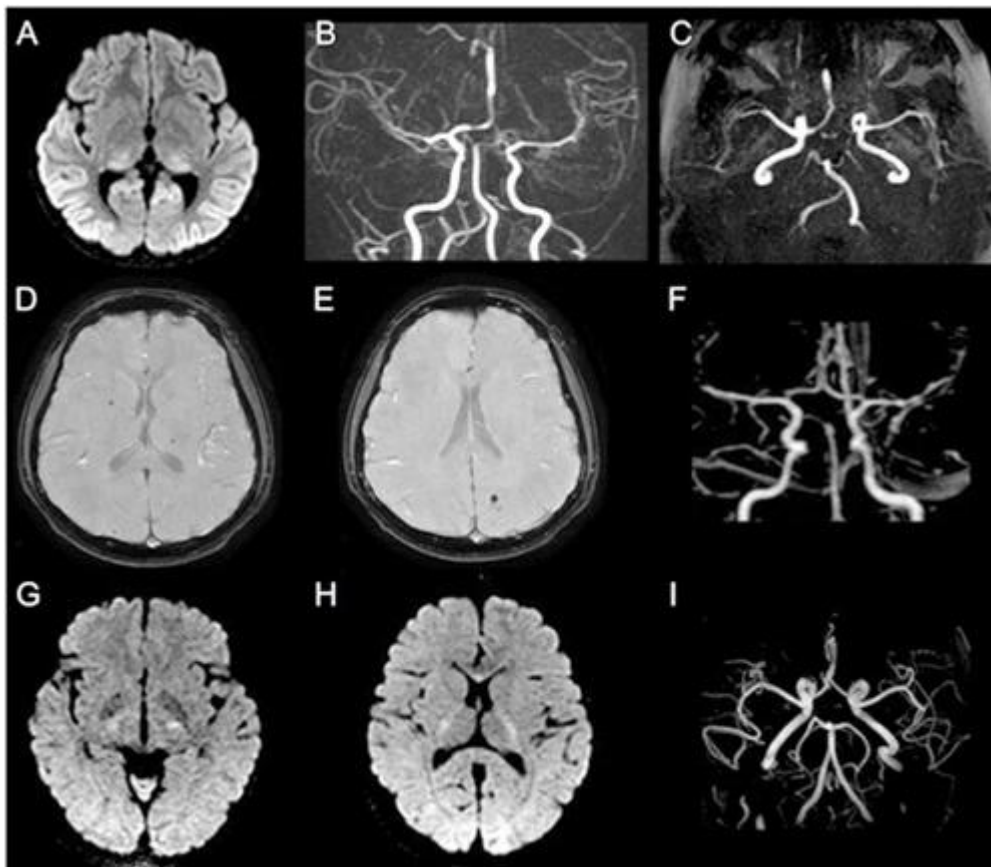
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of oculocephalic reflex accompanied the MR findings in the brainstem (the pons and medulla).

Three children with SARS-CoV-2 Omicron infection developed ischemic strokes, an eight-year-old boy with seizures and impaired consciousness, a twelve-year-old boy with abrupt onset of hemiplegia, and a four-year-old girl with *epilepsia partialis continua*.

Four patients had poor neurological outcomes, all had abnormal MRI findings, and two of them had vascular abnormalities.

Importantly, a high proportion of patients (80%) had abnormal MRA findings in medium or large intracerebral vessels. Infarction in small vessels was found only in 8.8% of patients. Two patients had abnormal MRA findings in the anterior cerebral arteries (ACA), seven patients in the middle cerebral arteries (MCA), two patients in the posterior cerebral arteries (PCA), and three patients in the internal carotid arteries (ICA).



Original figure from the article of Yen-Ju Chu et al. 2024. (A-C) 7-year-old girl with encephalitis and myoclonic status epilepticus.



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Restricted diffusion at the bilateral thalami and parietal, occipital, and temporal cortex. MRA showing narrowing of bilateral MCA and proximal right ACA. (D-F) A 10-year-old female with surgically corrected tetralogy of Fallot and new-onset seizure. Multiple petechial hemorrhages on susceptibility-weighted imaging. MRA showing narrowing and beading of left MCA. (G-I) 12-year-old boy with hemiplegia. Restricted diffusion at left thalamus and rostrum of corpus callosum. Interrupted flow signal at left distal MCA.

### *Conclusion*

This study has shown cerebrovascular lesions and vascular abnormalities in a high proportion (48.4%) of children with SARS-CoV-2 Omicron infection and severe neurological manifestations.

Importantly, a high proportion of patients (80%) had abnormal MRA findings in medium or large intracerebral vessels, whereas infarction in small vessels was found in 8.8%. According to the authors, some of the MRI findings in these patients demonstrate brain damage related to vasculitis. However, the underlying mechanisms and pathophysiology of large cerebral vessel occlusion observed in children with SARS-CoV-2 Omicron infection remain unknown.

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### ***Journal Reference***

Yen-Ju Chu, Lee-Chin Wong, Wen-Chin Weng, et al. High incidence of cerebrovascular lesions on magnetic resonance imaging in pediatric COVID-19 during omicron outbreak - A retrospective case series. Journal of the Formosan Medical Association, 2024. (Open Access) <https://doi.org/10.1016/j.jfma.2024.02.015>



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