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COVID-19-associated Acute Hemorrhagic Necrotizing Encephalopathy: Imaging Features

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REVIEWS AND COMMENTARY • IMAGES IN *RADIOLOGY*

COVID-19–associated Acute Hemorrhagic Necrotizing Encephalopathy: Imaging Features

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Conflicts of interest are listed at the end of this article.

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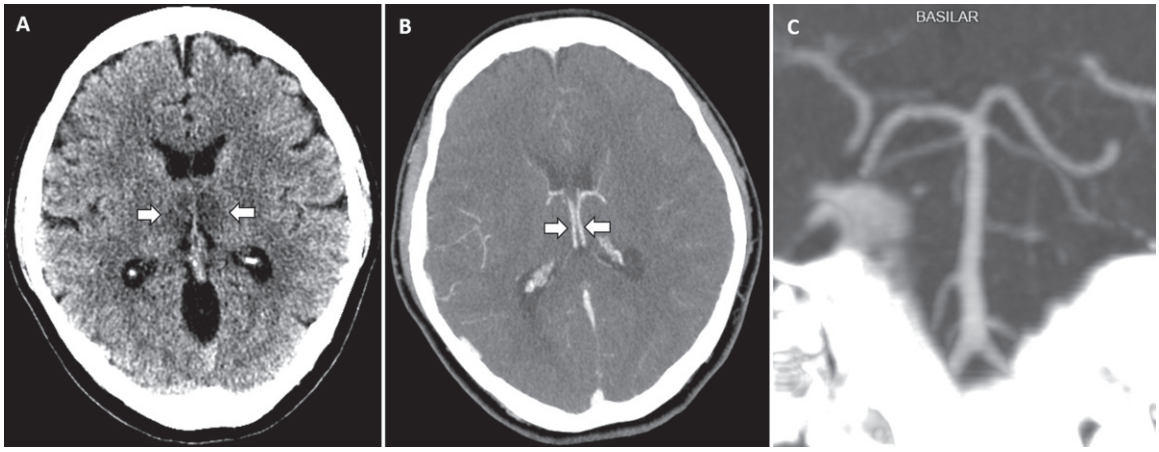

Figure 1: *A*, Unenhanced CT scan of head demonstrates symmetric low attenuation within the bilateral medial thalami (arrows). *B*, Axial CT venogram demonstrates patency of the cerebral venous vasculature, including the internal cerebral veins (arrows). *C*, Coronal reformation of CT angiogram demonstrates normal appearance of the basilar artery and proximal posterior cerebral arteries.

Since its introduction to the human population in December 2019, the coronavirus disease 2019 (COVID-19) pandemic has spread across the world with more than 330 000 reported cases in 190 countries, areas, or territories (1). While patients typically present with fever, shortness of breath, and cough, neurologic manifestations have been reported, although to a much lesser extent (2). Herein, we report on the first presumptive case of COVID-19–associated acute necrotizing hemorrhagic encephalopathy, a rare encephalopathy that has been associated with other viral infections but has yet to be demonstrated as a result of COVID-19 infection.

A 58-year-old female airline worker presented with a 3-day history of cough, fever, and altered mental status. The initial laboratory work-up was negative for influenza, with the diagnosis of COVID-19 made by detection of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) viral nucleic acid in a nasopharyngeal swab specimen using the U.S. Centers for Disease Control and Prevention 2019 novel coronavirus real-time reverse-transcription polymerase chain reaction assay. The assay was performed using a Cobas Z 480 analyzer (Roche, Basel, Switzerland) at our institution following emergency use authorization from the U.S. Centers for Disease Control and Prevention. Cerebrospinal fluid analysis was limited due to a traumatic lumbar puncture. However, cerebrospinal fluid bacterial culture showed no growth after 3 days, and tests for herpes simplex virus 1 and 2, varicella zoster virus, and West Nile virus were negative. Testing for the presence of SARS-CoV-2 in the cerebrospinal fluid was unable to be performed. Unenhanced CT of the head demonstrated symmetric low attenuation within the bilateral medial thalami with a normal CT angiogram and CT venogram (Fig 1). Brain MRI demonstrated hemorrhagic rim-enhancing lesions within the bilateral thalami, medial temporal lobes, and subinsular regions (Fig 2). The patient was started on intravenous immunoglobulin. High-dose steroids were not initiated due to concern for respiratory compromise.

Acute necrotizing encephalopathy is a rare complication of influenza and other viral infections and has been related to intracranial cytokine storms, which result in blood-brain barrier breakdown but without direct viral invasion or parainfectious demyelination (3). Accumulating evidence suggests that a subgroup of patients with severe COVID-19 might have cytokine storm syndrome (4). Although predominantly described in the pediatric population, acute necrotizing encephalopathy is known to occur in adults as well. The most characteristic imaging feature includes symmetric, multifocal lesions with invariable thalamic involvement (5). Other commonly involved locations include the brainstem, cerebral white matter, and cerebellum (5). Lesions appear hypoattenuating on CT images, and MRI demonstrates T2-weighted fluid-attenuated inversion recovery hyperintense signal with internal hemorrhage. Contrast material–enhanced images may demonstrate a ring of contrast enhancement (5).

To our knowledge, this is the first reported case of COVID-19–associated acute necrotizing hemorrhagic encephalopathy. As the number of patients with COVID-19 increases

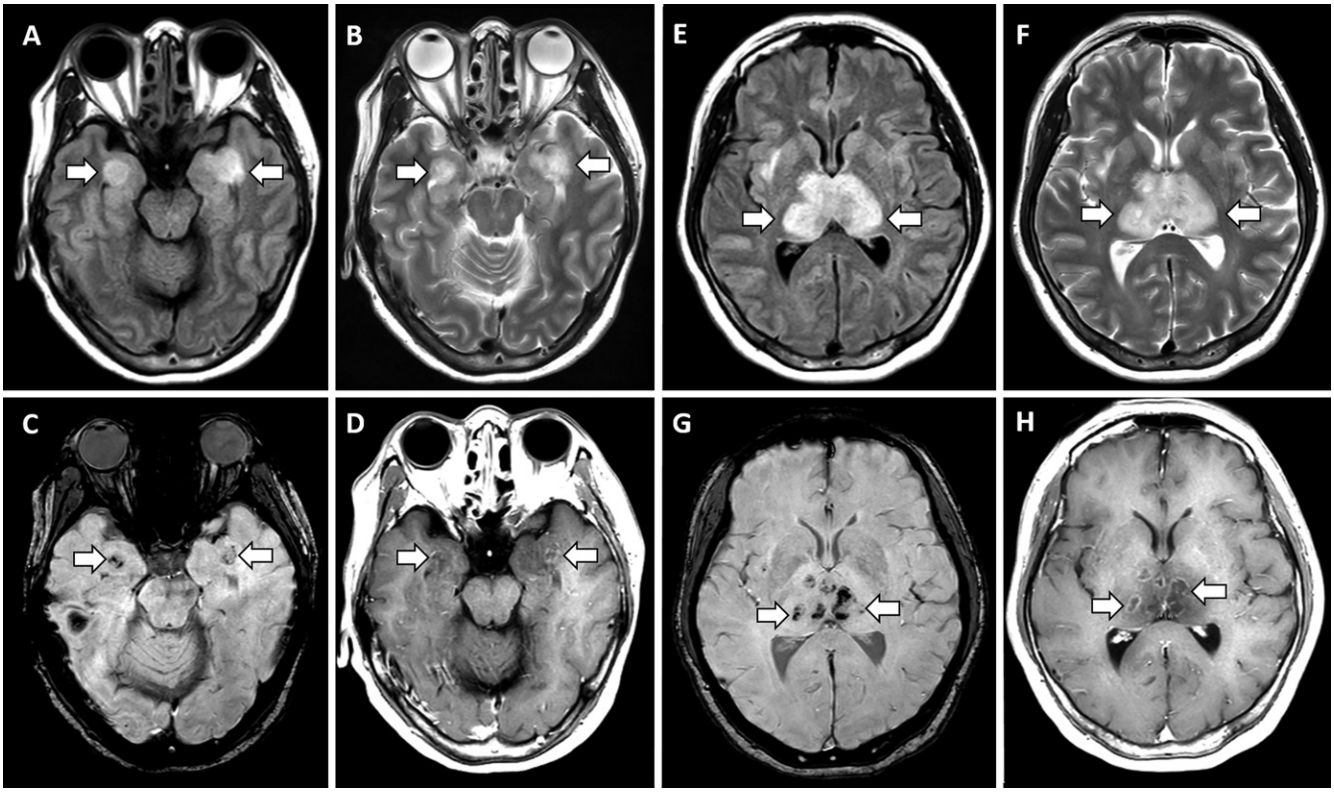

Figure 2: *A, B, E, F,* T2-weighted fluid-attenuated inversion recovery MRI scans demonstrate hyperintensity within the bilateral medial temporal lobes and thalami (arrows), with evidence of hemorrhage indicated by, *C, G,* hypointense signal (arrows) on susceptibility-weighted images and, *D, H,* rim enhancement (arrows) on contrast material–enhanced images.

worldwide, clinicians and radiologists should watch for these findings among patients presenting with COVID-19 and altered mental status.

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