

Bipallidal Lesions in a COVID-19 Patient: A Case Report and Brief Review of Literature

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Case Report

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Abstract

Background

Altered mentation in COVID-19 patients can be a function of any number of metabolic abnormalities associated with the infection. Here we present the case of an encephalopathic COVID-19 patient with bilateral globus pallidus lesions. While imaging abnormalities involving basal ganglia have been reported in encephalitis caused by neuroinvasive flaviviruses, the bipallidal lesions noted here likely resulted from hypoxic-ischemic brain injury.

Case Presentation

A 51-year-old African American woman was found unresponsive at home by her fiancé. She had been complaining of shortness of breath and cough for three days. She is a former smoker with past medical history of hypertension, nephropathy, and bipolar disorder. Upon examination, she was alert but nonverbal, following commands inconsistently, and unable to move extremities against gravity. After several minutes, she was able to state her name but kept repeating it in response to all questions. Chest radiograph revealed bilateral lung infiltrates. CT of the head showed hypodensities in bilateral globus pallidi. A non-contrast MRI of the brain showed symmetric restricted diffusion and FLAIR hyperintense signal changes in bilateral globus pallidi. Abnormal SWI signal seen in bilateral globus pallidi likely represents mineralization or hemosiderin. There were no striatal or thalamic lesions. Major intracranial arteries were widely patent.

The patient later tested positive for 2019-nCoV using real-time PCR assay, and was transferred to our COVID-19 designated hospital campus. Thereafter, she had waxing and waning mentation. Repeat CT imaging 11 days after the first scan demonstrated resolution of the bipallidal hypodensities. The patient was recently discharged to a subacute rehab facility but is still experiencing confusion.

Conclusions

As we come across neurological manifestations of COVID-19, we believe neuroimaging is likely to play an important role in establishing if central nervous system involvement is invariably due to indirect mechanisms such as metabolic or hypoxic-ischemic brain injury or if direct neuroinvasive disease is a possibility, as with certain viruses.

Background

COVID-19 is a respiratory disease caused by a novel virus strain, SARS-CoV-2, an enveloped, positive-sense, single-stranded RNA beta-coronavirus. Infection can result in acute respiratory distress syndrome and pneumonia, but increasingly, multi-organ complications are being recognized. As the COVID-19 pandemic rages on, a wide variety of neurologic presentations, including headache, dizziness, encephalopathy, stroke, and encephalitis are being reported.^{1,2} Perhaps due to limitations imposed by infection control protocols, relatively few reports of neuroimaging abnormalities in COVID-19 patients have emerged.³ The entire array of neurologic manifestations and neuroimaging abnormalities associated with COVID-19 is yet to be established, and will likely unfold as we continue to encounter more cases with neurological presentations.

Altered mentation in COVID-19 patients can be a function of any number of metabolic abnormalities associated with the infection. Here we present the case of an encephalopathic COVID-19 patient with bilateral globus

pallidus lesions. While imaging abnormalities involving basal ganglia have been reported in encephalitis caused by neuroinvasive flaviviruses,^{4,5} the bipallidal lesions here likely resulted from hypoxic-ischemic brain injury.

Case Presentation

A 51-year-old African American woman was found unresponsive at home by her fiancé. She had been complaining of shortness of breath and cough for three days. She is a former smoker with past medical history of hypertension, nephropathy, and bipolar disorder. On scene, paramedics found her oxygen saturation level was 70%, which improved to over 95% with oxygenation by nasal cannula. Presenting vital signs in the emergency department were notable for temperature of 100.2 F and respiratory rate of 26 per breaths minute. Initial laboratory results showed WBC count 13,100 with 15% lymphocytes, BUN 73, creatinine 5.15, glucose 115, ALT 121, AST 293, D-dimer 4053, and CPK 4500. Upon examination, she was alert but nonverbal, following commands inconsistently, and unable to move extremities against gravity. After several minutes, she was able to state her name but kept repeating it in response to all questions. Chest radiograph revealed bilateral lung infiltrates. CT of the head showed hypodensities in bilateral globus pallidi (Figure 1A). Her level of alertness improved the following day but she remained confused. Her extremity weakness resolved, and there were no other focal neurological deficits. A non-contrast MRI of the brain (Figure 1 C-F) showed symmetric restricted diffusion and FLAIR hyperintense signal changes in bilateral globus pallidi. Abnormal SWI signal seen in bilateral globus pallidi likely represents mineralization or hemosiderin. There were no striatal or thalamic lesions. Major intracranial arteries were widely patent (not shown in Figure).

The patient later tested positive for 2019-nCoV using real-time PCR assay, and was transferred to our COVID-19 designated hospital campus. Thereafter, she had waxing and waning mentation. Repeat CT imaging 11 days after the first scan demonstrated resolution of the bipallidal hypodensities (Figure 1B). The patient was recently discharged to a subacute rehab facility but is still experiencing confusion.

Discussion And Conclusion

In this report, we present the case of a 51-year-old female with altered mental status and respiratory insufficiency who tested positive for COVID-19. Neuroimaging revealed bilateral globus pallidus lesions. Due to their high metabolic activity, these mitochondria- and neurotransmitter-rich nuclei utilize oxygen and glucose at an increased rate compared to other brain structures, rendering them particularly vulnerable to hypoxic-ischemic injury.⁶ Similar lesions have been noted in hypoxic-ischemic encephalopathy following cardiac arrest and acute poisoning by cellular respiratory toxins such as carbon monoxide.⁵ It is important to note that our patient did not suffer cardiac arrest, rather presented with worsening acute hypoxic respiratory failure. A wide differential exists for bilateral lesions involving basal ganglia and thalami including viral encephalitis by flaviviruses, such as West Nile virus and Japanese encephalitis (see Table 1 for summary).⁵

There is no indication that the encephalopathy and/or neuroimaging abnormalities in our patient represent encephalitis by the novel coronavirus. The evidence we present points to reversible hypoxic-ischemic brain injury as a consequence of respiratory compromise due to COVID-19 ARDS/pneumonia. However, growing recognition of neurologic symptoms such as headache, seizure, stroke, altered mentation, and loss of smell/taste in COVID-19 patients, sometimes as the primary presentation, calls for investigation of the possibility of neuroinvasive disease,⁷ as much is unknown about the basis of neurologic involvement in these patients.

A presumption of indirect involvement of the central nervous system via metabolic or hypoxic-ischemic etiologies may not be appropriate in every case. When possible, it is prudent to judiciously employ neuroimaging to determine the cause of neurologic deficits in COVID–19 patients and in turn, advance our understanding of the entire array of neurologic manifestations and neuroimaging abnormalities associated with COVID–19.

Abbreviations

COVID–19: Coronavirus Disease 2019

SARS-Cov–2: Severe acute respiratory syndrome coronavirus 2

CT: Computerized tomography

MRI: Magnetic resonance imaging

ARDS: Acute respiratory distress syndrome

WBC: White blood cells

BUN: Blood urea nitrogen

ALT: Alanine Aminotransferase

AST: Aspartate Aminotransferase

CPK: Creatine phosphokinase

FLAIR: Fluid-attenuated inversion recovery

SWI: Susceptibility weighted imaging

Declarations

Ethics approval and consent to participate

Not applicable.

Consent for publication

Written informed consent was obtained from the patient for publication of this report. A copy of the written consent is available for review by the editor of this journal.

Availability of data and materials

All data generated or analyzed during this study are included in this manuscript.

Competing interests

The authors report no competing interests.

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Authors' contributions

Name	Contribution
Sudhat Ashok, MPhil	Designed and conceptualized the study; drafted the manuscript for intellectual content; revised and submitted the manuscript
Kalyan Shastri, MD, MS	Conceptualized the study; interpreted the data; drafted and revised the manuscript for intellectual content, treating physician
L. Beryl Guterman, MPH	Major role in extraction of the data; drafted and revised the manuscript for intellectual content
Lee R. Guterman, PhD, MD	Drafted and conceptualized the study; interpreted the data; and drafted and revised the manuscript for intellectual content

All authors read and approved the final manuscript.

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Not applicable.

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Table 1

Table 1. Differential Diagnosis of Bilateral Basal Ganglia Lesions

Diagnosis	Clinical and Laboratory Findings	MR Imaging Features
<i>Toxic poisoning</i>		
Carbon monoxide poisoning	Suicide attempt, elevated serum level of carboxyhemoglobin	T2 hyperintensity and diffusion restriction (acutely) and T1 hyperintensity (delayed); propensity for GP
Heroin, MDMA, cocaine	Drug abuse and overdose, positive toxicology	Similar imaging findings as above acutely
<i>Metabolic diseases</i>		
Hepatic cirrhosis	Spontaneous or iatrogenic portosystemic shunts	T1 hyperintensity in GP and SN (due to manganese deposition).
Hyperammonemia	Acute hepatic encephalopathy, coma, elevated ammonia	T2 hyperintensity and restricted diffusion in BG, insular cortex and cingulate gyrus.
Hypoxic ischemic encephalopathy	Cardiac arrest, asphyxia, near drowning	Variable, T2 hyperintensity and diffusion restriction in BG, thalamus, cortical rim, watershed zones, or diffusely.
Hypoglycemia	Seizures, focal neurologic deficits, and coma	Variable, T2 hyperintensity and restricted diffusion in BG, hippocampi, cortical rim, splenium, internal capsules, or diffusely
Nonketotic Hyperglycemia	Diabetic patients with chorea, ballismus, elevated blood glucose level	Unilateral or bilateral T1 hyperintensity in putamen and caudate.
Wilson Disease	Liver dysfunction, Kayser-Fleisher rings, neuropsychiatric manifestations, low serum level of ceruloplasmin.	T2 hyperintensity in BG and ventrolateral thalami.
<i>Neurodegenerative</i>		
CJD	Myoclonus, rapid progressive dementia, , CSF protein 14-3-3, generalized periodic sharp wave complexes on EEG	T2 hyperintensity and restricted diffusion in BG and thalamus.
Neurodegeneration with Brain Iron Accumulation	Pyramidal or extrapyramidal signs, PANK2 gene mutation.	Central T2 hyperintensity and surrounding hypointensity in GP (“Eye of the Tiger” sign).
<i>Inflammatory and infectious diseases</i>		

Flavivirus encephalitis (Japanese encephalitis, West Nile fever)	Fever, headache, focal neurological deficits, altered sensorium, coma	T2 hyperintensity, restricted diffusion, and hemorrhagic changes in BG and thalamus
Cerebral Toxoplasmosis	Fever, headache, focal neurologic deficits, seizures, altered sensorium, coma; immunocompromised.	T2 hypo- to isointense lesions in BG and thalamus with prominent mass effect and vasogenic edema.

Figures

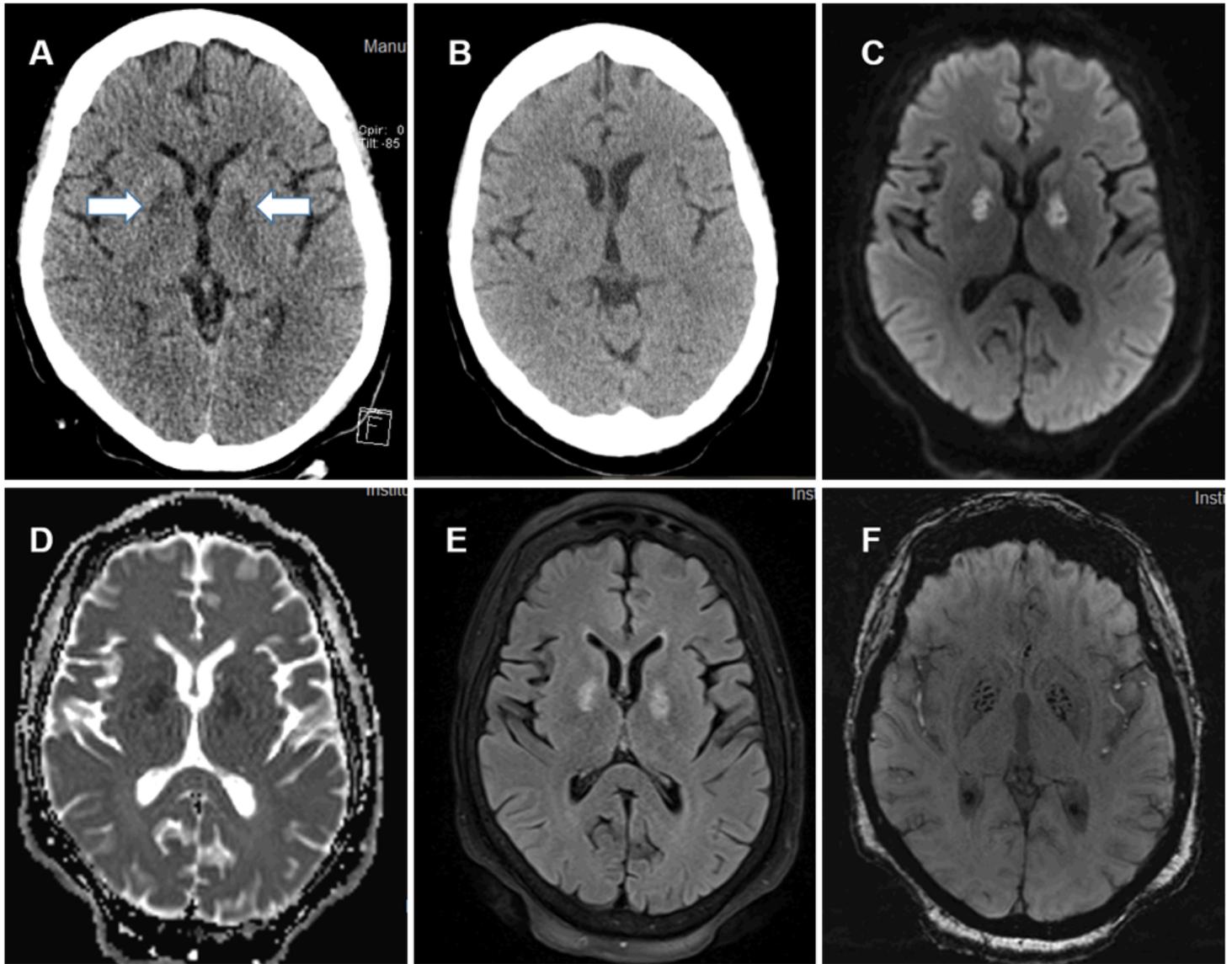


Figure 1

Neuroimaging findings. Non-contrast CT of the head on Day 1 (A) demonstrating bipallidal hypodensities (white arrows), and repeat CT on Day 12 (B) demonstrating resolution of the hypodensities. MRI of the brain demonstrating abnormal signal changes in bilateral globus pallidus on DWI (C), ADC (D), FLAIR (E), and SWI(F) sequences.