

## Vision Loss Secondary to COVID-19 Associated Bilateral Cerebral Venous Sinus Thromboses

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**Abstract:** A young, morbidly obese woman with recent SARS-CoV-2 infection requiring hospitalization presented with visual and neurologic complications secondary to bilateral cerebral venous sinus thromboses. With elevated intracranial pressure and severe papilledema, she rapidly progressed to complete bilateral vision loss despite anticoagulation, therapeutic lumbar punctures with lumbar drain, bilateral optic nerve sheath fenestrations, and endovascular thrombectomy. It is possible that obese patients with a SARS-CoV-2 infection may be at greater risk of hypercoagulable cerebrovascular complications. It is impossible to know if an even more rapid response would have led to a different outcome, but we report this case in the hope that publishing this and similar cases may result in improved treatment protocols to preserve vision.

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), a novel strain of coronavirus, has led to a global pandemic with an associated disease (COVID-19) causing multiorgan complications. Currently, some of the documented manifestations include acute respiratory distress syndrome and a hypercoagulable state causing events such as pulmonary embolism,<sup>1</sup> central nervous system vasculitis,<sup>2</sup> myocarditis,<sup>3</sup> large vessel ischemic strokes,<sup>4</sup> and cerebral venous sinus thromboses.<sup>5</sup>

Important ophthalmic manifestations include nonvision threatening conditions such as conjunctivitis or subconjunctival hemorrhage,<sup>1</sup> as well as more severe conditions such as orbital apex syndrome,<sup>6</sup> branch retinal vein occlusions,<sup>2</sup> ophthalmic artery occlusion,<sup>3</sup> and papilledema.<sup>7,8</sup> We report a case of a patient with complete vision loss secondary to recalcitrant cerebral venous sinus thrombosis (CVST) in the setting of a recent SARS-CoV-2 infection. This case highlights a devastating visual complication related to COVID-19-associated hypercoagulable state. Despite intervention, the patient lost all vision in OU. However, her care proceeded in a serial fashion over the course of several weeks, and a better understanding of the severity and aggressiveness of this condition may have improved the clinical outcome. We report this case in the hope that the communication of such cases will hasten the development of optimal treatment protocols. The information provided is compliant with the Health Insurance Portability and Accountability Act and adheres to the tenets of the Declaration of Helsinki.

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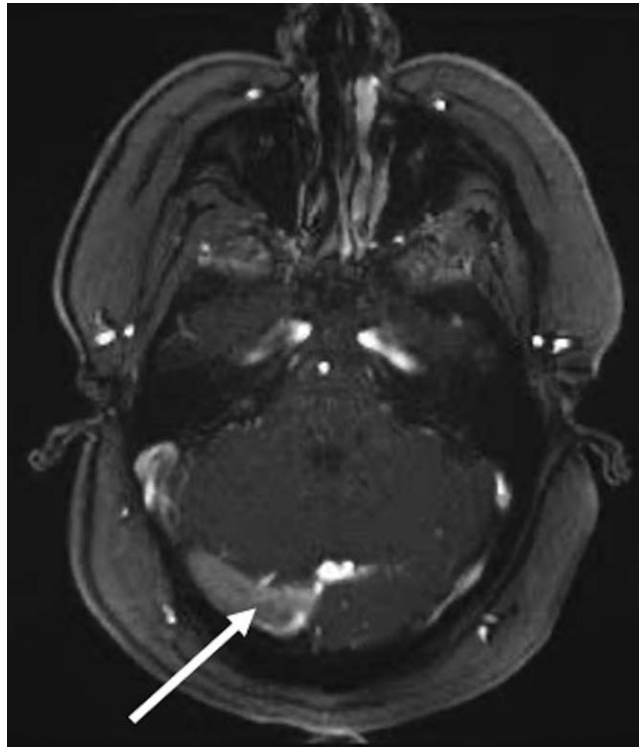
## CASE PRESENTATION

A 23-year-old woman with a past medical history of morbid obesity (body mass index of 79.8 kg/m<sup>2</sup>) and hypothyroidism presented as a hospital transfer for evaluation of bilateral blurry vision, pulsatile tinnitus, and severe headache. She was admitted to the hospital 1 month prior for SARS-CoV-2 infection, with a subsequent hospitalization 2 weeks later for bilateral pulmonary emboli and deep venous thromboses presumed secondary to coronavirus disease 19 (COVID-19) and negative hypercoagulopathy panel. MRI and venography obtained revealed venous sinus thromboses involving the right transverse sinus, sigmoid sinus, and torcula (Figs. 1 and 2). There was also focal narrowing of the transverse sinus on the left side. There were no masses or cavernous sinus thromboses.

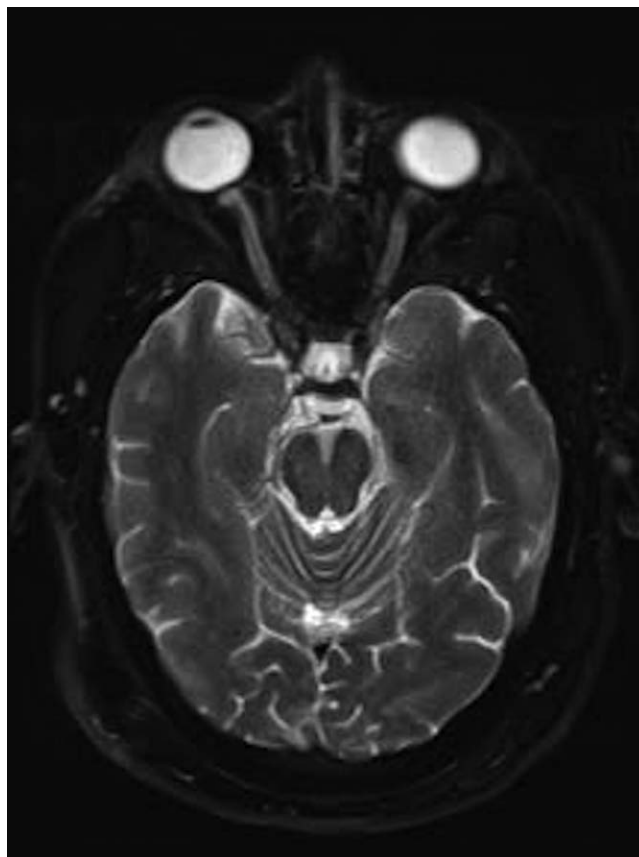
Her presenting ophthalmic examination was relevant for visual acuity of 20/200 on the right and 20/40 on the left, a right-side relative afferent pupillary defect, and partial right third nerve and bilateral sixth nerve palsies. Her fundoscopic exam was remarkable for grade 4 bilateral disc edema and right disc pallor. Her opening pressure was greater than 60 mmHg, and cerebrospinal fluid evaluation was negative for infection or inflammation. She was treated with acetazolamide and heparin, but her visual acuity declined to light perception on the right and 20/100 on the left. Neurosurgery were consulted to consider an urgent ventriculoperitoneal shunt, but intervention was determined to be too high risk due to the patient's morbid obesity and stenotic sinuses with a high risk of failure. An urgent optic nerve sheath fenestration (ONSF) was performed on the right, followed a week later with ONSF on the left. Her procedures were both well tolerated with initial improvement in visual acuity to 20/200 on the right (from light perception) and to 20/40 on the left (from 20/100). The optic disc edema appeared improved as well postoperatively. However, despite improvement in optic disc edema, she experienced recurrent decline in visual acuity and developed bilateral disc pallor. An endovascular transverse sinus thrombectomy was performed under fluoroscopic guidance. However, she experienced continued decline in vision to no light perception bilaterally. She otherwise maintained mental, motor, and sensory function. On clinic follow up 3 months postdischarge, she continued to demonstrate no light perception bilaterally.

## DISCUSSION

This is the first report of bilateral vision loss secondary to a thrombotic complication of COVID-19. The outcomes of other cases of extensive CVST attributed to COVID-19 have resulted in seizures and patient mortality.<sup>5,8</sup> The recalcitrant nature and severity of this condition prompts further evaluation. We suspect that, in our patient, the duration of optic nerve edema and congestion with persistent cerebral venous thromboses culminated in atrophy of both optic nerves. Her clinical treatment course with maximal medical therapy, bilateral ONSF, and endovascular transverse sinus thrombectomy, were ultimately unsuccessful in preventing vision loss. However, she maintained her mental, motor, and sensory function. Although it is impossible to know whether a more rapid response would have led to a different outcome, we report this case in the hope that it may help develop better treatment protocols to improve the clinical outcomes in patients with ophthalmic complications of COVID-19. One limitation of the report is that we cannot definitively rule out idiopathic intracranial hypertension (IIH) with underlying sinus stenosis that predisposed to CVST. However, according to the modified



**FIG. 1.** MRV brain with gadolinium. This is an axial image showing a filling defect within the right transverse sinus (white arrow), consistent with an intraluminal thrombus.



**FIG. 2.** T2-weighted MRI brain with gadolinium. This is an axial image illustrating posterior globe and optic disc flattening (right worse than left) consistent with elevated intracranial pressure.

Dandy criteria for diagnosis of IIH, an absence of obstruction of the ventricular system and no other cause for elevated intracranial pressure are required.<sup>9</sup> Additionally, Virchow's triad for thrombosis overlaps with characteristics of IIH, where her morbid obesity and illness directly affected her prolonged hospital period of immobility.<sup>10</sup> The hypercoagulable state known to be associated with COVID-19 infection additionally predisposes the patient to an elevated risk of thrombotic event. With the patient's MRI/MRV denoting CVST in the setting of immobility and underlying COVID-19 infection, CVST is the favored diagnosis, and a clinically separate diagnosis of IIH is less likely. The partial cranial nerve 3 palsy accompanying the bilateral 6th nerve palsies may also be explained by CVST. It has been reported in multiple cases of CVST<sup>11</sup> and is most likely due to a vascular pressure gradient that leads to edema and dysfunction of multiple cranial nerves.

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## Orbital Inflammation Following COVID-19 Vaccination

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**Abstract:** Three patients presented with periorbital swelling, pain with extraocular movements, and binocular diplopia 1–4 days after receiving an mRNA Coronavirus Infectious Disease-19 (COVID-19) vaccine (BNT162b2, Pfizer/BioNTech; mRNA-1273, Moderna). All patients had a normal afferent function, unilateral limitation of extraocular motility, proptosis, and periorbital inflammation. Neuroimaging of the orbits with contrast revealed inflammation and enlargement of extraocular muscles in 2 cases and the lacrimal gland in 1 case. In all 3 cases, an extensive infectious and inflammatory laboratory work-up was unremarkable and signs and symptoms of orbital inflammation rapidly improved to complete resolution after treatment with high-dose oral prednisone. This is the first reported series of orbital inflammation occurring shortly after administration of the COVID-19 vaccine. Clinicians may consider an inflammatory postvaccine etiology as an alternative to presumed idiopathic diagnosis in such cases.

Ophthalmic sequelae associated with Coronavirus Infectious Disease-19 (COVID-19) infection have been well described, with the most commonly reported findings consisting of conjunctivitis, neuroretinitis, uveitis, and fungal orbital cellulitis and few reports of COVID-19-associated orbital inflammation. Ocular adverse events following COVID-19 vaccination are less common, with 4 reports of orbital disease: 2 cases of superior ophthalmic vein thrombosis, 1 case of Tolosa-Hunt syndrome, and 1 case of acute thyroid eye disease.<sup>1,2</sup> The authors report 3 cases of orbital inflammation occurring within days of the BNT162b2 mRNA (Pfizer/BioNTech) or mRNA-1273 (Moderna) COVID-19 vaccine which is suggestive of an association. This case series was performed in compliance with the Declaration of Helsinki and Health Insurance Portability and Accountability Act regulations.

## CASE PRESENTATION

### Case 1

A 68-year-old man with no known autoimmune or rheumatologic history presented with binocular diplopia, pain with extraocular movements, and periorbital swelling 4 days after receiving the second dose of COVID-19 vaccine (BNT162b2 mRNA, Pfizer/BioNTech). He denied any other systemic infectious or inflammatory symptoms. On presentation, his visual acuity was 20/20 in each eye and intraocular pressures (IOP) were normal. There was no relative afferent pupillary defect (rAPD) or dyschromatopsia. The OS was noted to have marked limitation in supraduction and 3 mm of relative proptosis (Fig. 1A). The remainder of his ophthalmic examination was unremarkable. Orbital CT with contrast revealed inflammation of the left superior oblique muscle (Fig. 1B). A laboratory workup including complete blood count (CBC), basic metabolic panel (BMP), erythrocyte sedimentation rate (ESR), C-reactive protein (CRP), angiotensin-converting enzyme (ACE), lysozyme, IgG subclass, antinuclear antibody (ANA), antineutrophil cytoplasmic antibody (ANCA), double-stranded DNA antibody (DS-DNA), thyroid-stimulating hormone (TSH) with reflex, Sjogren's antibodies (SS-A/SS-B), rheumatoid factor (RF), quantiferon-gold, fluorescent treponemal antibody-absorption (FTA-ABS), rapid plasma reagin (RPR), and Epstein Barr virus antibodies (EBV) was unremarkable.

### Case 2

A 33-year-old woman presented with binocular diplopia, periorbital swelling, and pain with extraocular movements, as