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Successful Endovascular Therapy in COVID-19 Associated Pediatric Ischemic Stroke

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Cerebrovascular diseases attributed to coronavirus disease 2019 (COVID-19) are uncommon but can result in devastating outcomes. Pediatric acute ischemic strokes are themselves rare and with very few large vessel occlusion related acute ischemic strokes attributed to COVID-19 described in the literature as of date. COVID-19 pandemic has contributed to acute stroke care delays across the world and with pediatric endovascular therapy still in its infancy, it poses a great challenge in facilitating good outcomes in children presenting with acute ischemic strokes in the setting of COVID-19. We present a pediatric patient who underwent endovascular therapy for an internal carotid artery occlusion related acute ischemic stroke in the setting of active COVID-19 and had an excellent outcome thanks to a streamlined stroke pathway involving the vascular neurology, neuro-interventional, neurocritical care, and anesthesiology teams.

Key Words: Stroke in children—COVID-19—COVID-19 in children—Pediatric stroke—Stroke therapy—Endovascular therapy—Hypercoagulable state
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Manuscript

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devastating outcomes¹. The incidence of ischemic stroke in adult patients with COVID-19 ranges from 1-3% but with a high mortality rate of over 30%.^{1,2} The yearly incidence of childhood arterial ischemic stroke is low at 1.6 per 100,000 and pediatric ischemic stroke attributed to COVID-19 is exceedingly rare.^{3,4} In this setting, prompt identification of COVID-19 associated strokes in children and targeted therapy to facilitate good outcomes can be very challenging. Herein we present a pediatric patient who underwent endovascular therapy for an acute ischemic stroke in the setting of active COVID-19 with an excellent outcome.

Case report

A 12-year-old male patient with a medical history of asthma presented to an outside emergency department (ED) approximately 20.5 h after developing a syncopal episode in the setting of fever and malaise and no reported focal deficits at the time but followed later by language impairment, and right-sided weakness on the

morning of the day of presentation. On initial examination, the patient was noted to have dysarthria, aphasia, and right hemiparesis. Imaging with computed tomography (CT) of the head was unremarkable and a CT angiography showed an occlusion of the left supra-clinoid internal carotid artery (ICA). A referral was initiated to our institution with the involvement of the vascular neurologist and the neuro-interventionalist. A rapid COVID-19 test (Abbott Laboratories, Abbott Park, Illinois) was positive. The patient was transferred by helicopter to our institution approximately 4 h from focal symptom onset, where NIHSS on arrival was 17 for global aphasia and dense right-sided hemiplegia suggestive of clinical worsening from the outside ED presentation. A repeat CT head showed an Alberta Stroke Program Early CT Score of a 9 and hence was deemed favorable for endovascular clot retrieval. The patient was intubated and placed under general anesthesia. Angiography confirmed a thrombus in the left supraclinoid ICA and the use of a 4mm diameter stent retriever combined with .070" contact aspiration resulted in complete reperfusion (Fig. 1A and B). Post-procedure the patient was extubated and had an NIHSS of 5 with points for level of consciousness (1), right facial droop (1), right arm drift (1), right leg drift (1), and dysarthria (1).

Magnetic Resonance Imaging of the brain showed a small acute border-zone infarction in the left middle cerebral artery territory (Fig. 1C and D). Cardiac evaluation for an etiology of the ischemic stroke showed no arrhythmias and normal transthoracic echocardiography. A CRP was less than 0.1 (normal <0.5mg/dL), but no D-dimer was obtained. Extensive evaluation for inherited or acquired hypercoagulable states following this presentation that included Antithrombin assay, Factor V Leiden, Prothrombin G20210A mutation, Lupus anticoagulant testing with dilute Russell's viper venom time, Anticardiolipin antibody, Beta-2 Glycoprotein, Protein C and S activity, and Homocysteine testing were all normal. No other etiology for the stroke was identified.

NIHSS at 24 h post thrombectomy was a 2 for right facial weakness and right arm drift. At discharge, five days from initial presentation, the patient had subtle right facial droop, subtle hand dexterity impairment with no drift and no functional limitation, and a discharge modified Rankin scale score of 1. He was discharged on antiplatelet therapy with aspirin 81 mg for secondary stroke prevention. Vaccination for COVID-19 wasn't approved in this age category at the time of his presentation, but approximately 4 months post-presentation, the patient was vaccinated as per the latest recommendations.

Discussion

We describe one of the first reported cases of successful mechanical thrombectomy in a pediatric patient with acute ischemic stroke due to an ICA occlusion presenting

with active COVID-19. Endovascular therapy in pediatric acute ischemic stroke is based on limited observational data with diagnostic delays being the primary impediment for early therapy initiation and patient recruitment to clinical trials.⁵ The COVID-19 pandemic by itself has led to delays in the care of acute ischemic stroke across the world.⁶⁻⁸ Taken together, only a streamlined process during the pandemic could facilitate good outcomes in acute stroke management. The current case is illustrative of such a scenario where prompt initiation of the stroke systems of care by the vascular neurologist led to the prompt mobilization of neuro-interventional, neurocritical care, and anesthesiology teams with the transition of care to the children's hospital after the procedure, leading to an excellent outcome.

Hypercoagulability stemming from COVID-19 termed COVID-19 associated coagulopathy has been postulated to be a major pathophysiological mechanism in thrombotic complications of COVID-19 including stroke.^{9,10} This is especially true in pediatric patients without obvious cerebrovascular risk factors such as our patient who on comprehensive evaluation was not identified to have any risk factors. A few other pathophysiological mechanisms have been implicated with respect to stroke and COVID-19 in children with two reports showing strokes related to focal cerebral arteriopathy and a large study by LaRovere et al. reporting the role of multisystemic inflammatory response due to COVID-19 contributing to systemic as well as focal neurological diseases including ischemic stroke due to large vessel occlusion, cerebral venous sinus thrombosis, and focal cerebral arteriopathy.¹¹⁻¹³

At the time of this report, only 1 other case of endovascular therapy in COVID-19 associated pediatric ischemic stroke has been described but with this patient having a medical condition - severe anemia with a hemoglobin of 2.8 gm/dl needing blood transfusion that could have confounded the clinical presentation. The COVID-19 infection also preceded the stroke presentation by 3 weeks while our patient had an active infection.¹⁴

Pediatric acute ischemic strokes are themselves rare and with few large vessel occlusion related acute ischemic strokes attributed to COVID-19 described in the literature as of date, although with recent increases noted in the setting of increasing COVID-19 cases in children.¹⁵ The role of COVID-19 vaccination could not be ascertained since vaccinations were not approved for patients in this age category at the time of our patient's presentation, but considering their approval recently, it might be prudent to ensure vaccination in the approved pediatric age groups to hopefully prevent such debilitating complications. The patient was treated with antiplatelet therapy for secondary stroke prevention. Anticoagulation was considered, but due to the lack of clear evidence with regards to the use of anticoagulation in the setting acute ischemic stroke secondary to

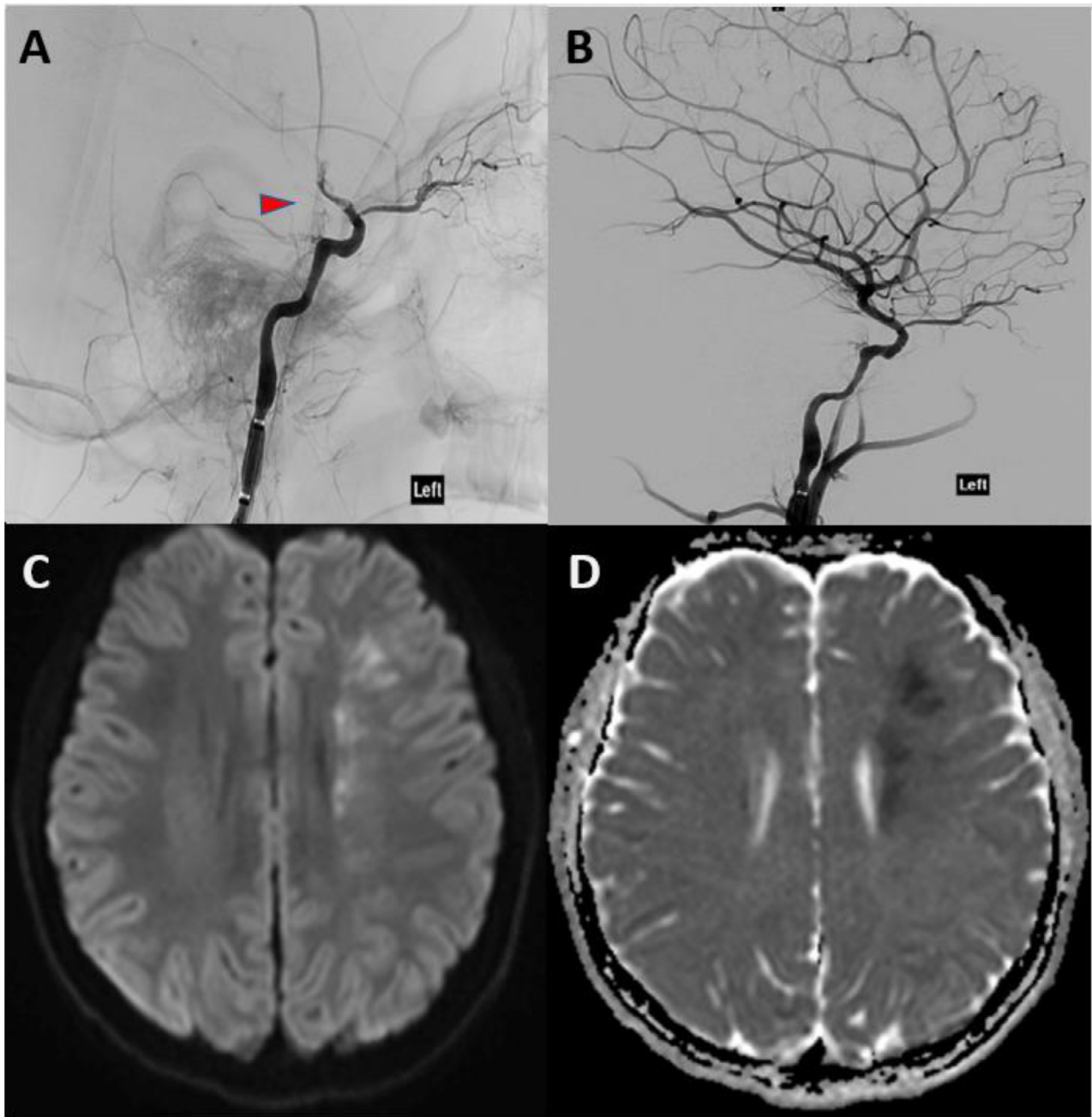


Fig. 1. A: Lateral angiography showing a left internal carotid artery occlusion in the supra-clinoid segment. B: Lateral angiography showing complete reperfusion of the internal carotid artery post-endovascular procedure. C: MRI brain – Diffusion-weighted sequence showing restricted diffusion correlating with a small acute border-zone infarction in the left middle cerebral artery territory. D: MRI brain – Apparent diffusion coefficient sequence showing a hypointense area correlating with a small acute border-zone infarction in the left middle cerebral artery territory.

COVID-19 especially in the pediatric category without other obvious indications for its use and the potential for a higher bleed risk, it was deferred. Our case illustrates that proximal large vessel occlusions can be treated safely and effectively in the pediatric population even in the setting of scenarios such as the COVID-19 pandemic that have been associated with therapeutic delays, via appropriate streamlining of stroke pathways.

Declaration of Competing Interest

The authors report no conflicts of interest.

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