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Topical Review

Thrombectomy for Acute Stroke in Childhood: A Case Report, Literature Review, and Recommendations

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ABSTRACT

The updated American Heart Association/American Stroke Association guidelines include recommendation for thrombectomy in certain adult stroke cases. The safety and efficacy of thrombectomy in children are unknown. An 8-year-old girl experienced acute stroke symptoms on two occasions while therapeutically anticoagulated on Novalung. Computed tomography scans showed proximal vessel thrombi, which were retrieved using a Trevo device without hemorrhagic complications. Postprocedural assessment found respective decreases in the National Institutes of Health Stroke Scale score from 10 to 4 and 12 to 7. The indications for treatment and early benefits observed in our case are consistent with other pediatric thrombectomy cases reported. However, publication bias and the heterogeneity of reported cases prevent drawing conclusions about the safety and efficacy of thrombectomy in children. Anticipating that updates to adult stroke guidelines would likely incite stroke providers to consider thrombectomy in children, our institution developed guidelines for thrombectomy before the index patient. Establishing institutional guidelines before considering thrombectomy in children may optimize patient safety.

Keywords: pediatric stroke, stroke, treatment, mechanical thrombectomy, embolectomy, endovascular procedures, interventional lung-assist device, oxygenators

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Introduction

Endovascular options for treating acute arterial ischemic stroke (AIS) have significantly advanced in the last decade. While thrombolysis with tissue-type plasminogen activator (tPA) remains the cornerstone of adult stroke care, mechanical clot retrieval has shown recent compelling evidence of its benefit to clinical outcomes. Supported by class

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What this paper adds:

- A comprehensive compilation of published pediatric thrombectomy cases.
- A proposed approach to selecting and managing pediatric thrombectomy candidates.

1, level A evidence, in 2015, the American Heart Association/American Stroke Association (AHA/ASA) amended their stroke guidelines to include the recommendation that endovascular therapy with stent retrieval be pursued in adults with AIS (National Institutes of Health Stroke Scale [NIHSS] $\geq$ 6, Alberta Stroke Program Early CT Scores [ASPECTS] $\geq$ 6) and causative internal carotid (ICA) or proximal middle cerebral artery (MCA) occlusions within six hours of symptom onset. While the recent amendment to the AHA/ASA guidelines advises that stent retrieval may be reasonable for similar patients under age 18 years, it does so with the caveat that the benefits have not been well established in this group.[1] To date, there are no published guidelines, clinical trials, or prospective studies investigating acute endovascular intervention strategies in children. Evidence pertaining to mechanical thrombectomy in children consists of case reports and small case series.

Here, we present a child who experienced two acute AIS events while on extracorporeal lung support and was treated on both occasions with mechanical thrombectomy. In addition, we review relevant literature and present our institutional guidelines for mechanical thrombectomy.

Patient Description

This eight-year-old girl with end-stage pulmonary hypertension was transferred to our institution for lung transplantation. The patient required intubation and venoarterial extracorporeal membrane oxygenation because of progressive respiratory failure and right ventricular dysfunction while septic. She was later transitioned to extracorporeal lung support with an interventional lung-assist device (Novalung, Xenios) placed in the pumpless configuration from the pulmonary artery to the left atrium as a bridge to lung transplantation. The carotid artery and jugular veins were reconstructed. The patient was subsequently extubated and maintained on supratherapeutic levels of unfractionated heparin to prevent fibrin deposits in the device. After three months, she developed severe headaches unresponsive to analgesia. Because the transthoracic cannulas used were not magnetic resonance imaging compatible, computed tomography (CT) was performed and identified remote AIS involving the right head of the caudate nucleus and putamen.

Two weeks later, she presented with acute aphasia, right facial palsy, and right arm weakness. Upon assessment by the stroke team 20 minutes after the onset of symptoms, her speech had recovered and she had a Pediatric National Institutes of Health Stroke Scale (PedNIHSS) score of 7. A CT completed 76 minutes after symptom onset demonstrated acute AIS in the left caudate nucleus and putamen. Within the left caudate, there was a focal hyperdensity thought to represent either petechial hemorrhage or dystrophic calcification. There were also two areas of gyriform hyperdensity in the left parietal lobe, thought likely to represent subacute infarcts with laminar necrosis. CT angiogram showed a linear filling defect extending from the A1 segment of the left anterior cerebral artery to the proximal M1 segment of left MCA (Fig 1A). The patient proceeded to mechanical thrombectomy with an interval of 300 minutes from symptom onset to groin puncture.

Catheter angiography confirmed a nonocclusive thrombus in the left carotid bifurcation, extending into the A1 and M1 segment, and the anterior temporal branch (Fig 1B). The extent and size of the clot were larger than that on the CT angiogram. A Trevo (Stryker, Fremont, CA) 3 $\times$ 20–mm device was then deployed through the Trevo 14

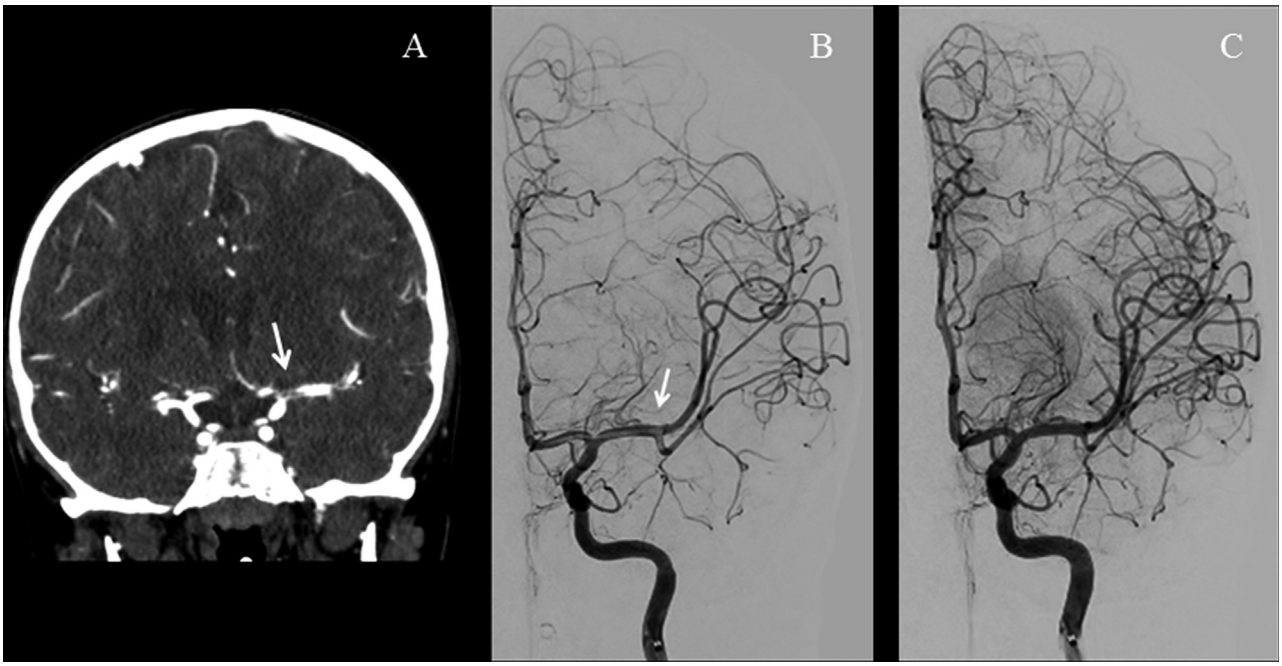

FIGURE 1.
(A) Computed tomography (CT) angiogram: thin linear filling defect extending from the A1 segment of the left anterior cerebral artery to the proximal M1 segment of left middle cerebral artery (arrow). (B) Catheter angiography: nonocclusive thrombus in the middle cerebral artery bifurcation, extending into the A1 segment of the anterior cerebral, the M1 segment of the middle cerebral arteries, and the anterior temporal branch (arrow). (C) The catheter angiogram after clot removal shows no residual thrombus.