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CASE REPORT

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Pediatric internal carotid artery dissection and stroke after minor head injury

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Abstract

Pediatric arterial ischemic stroke (AIS) is an important cause of juvenile brain injury. There are no well-established guidelines for universal management of childhood stroke. Although cerebral arteriopathies are the most common cause of pediatric AIS, head or neck trauma is an established risk factor.[1] We report the case of a 6-year-old African American male who presented to the pediatric emergency department with aphasia and right-sided hemiparesis 4 days after a fall in gym class. Magnetic resonance angiography showed tandem occlusion of the left internal carotid artery (ICA) and middle cerebral artery. During endovascular exploration for thrombectomy, a dissection of the ICA also was discovered and recanalized. Following neurointerventional embolectomy, the patient sustained full neurologic recovery without recurrence at 2 years. The safety and efficacy of therapeutic embolectomy in children is not well documented and warrants additional discussion for establishing novel protocols.

KEYWORDS
internal carotid artery dissection, ischemic stroke, medical thrombectomy, pediatrics

1 | INTRODUCTION

The benefit of endovascular thrombectomy in management of acute ischemic stroke has been extensively studied in adults but not in children. No thrombectomy trials have included individuals <18 years of age, and the role of endovascular therapies remains inconclusive in pediatric populations.[2] Pediatric stroke is a rare condition that affects ≈2–8 per 100,000 children each year.[3] Unfortunately, 30% to 50% of pediatric arterial ischemic stroke (AIS) patients suffer persistent neurologic deficits, including cognitive deterioration, speech impairment, and recurrent seizures.[4] Hyperacute stroke therapies for management of pediatric AIS remain controversial. The American Heart Association statement on management of stroke in children suggested thrombectomy be used based on adult parameters, yet the knowledge gap increases with younger or smaller individuals.[5] The treatment modality of mechanical thrombectomy in pediatric AIS is rarely reported in the literature, particularly in younger children.

2 | CASE REPORT

Mr. WJ is a 6-year-old African American male who presented to the emergency department with right-sided paralysis and aphasia. Four days before the presentation, the patient had a fall from standing position in gym class. The patient did not lose consciousness nor did he experience any immediate nausea, vomiting, or neurological changes per patient's mother. The day before admission, he had a headache and 1 episode of emesis. On the day of presentation, he went to school at 8:00 am without any deficits or complaints. After the patient's mother picked him up from school, he complained of right leg weakness but was able to walk to the car. While en route to the hospital at 5:30 pm, the

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FIGURE 1 Magnetic Resonance Angiogram comparison

child was reporting increased leg pain. He soon transitioned to being unable to move the right arm and right leg and became aphasic. He presented to the pediatric ED with National Institutes of Health Stroke Scale (NIHSS) of 17. Points were given for global aphasia, left gaze deviation, and right hemiplegia including face, arm, and leg. He also had decreased sensation to the right side. In the ED, the patient had a non-contrast brain computed tomography that showed a hyperdense internal carotid artery (ICA) sign and subsequently underwent magnetic resonance imaging (MRI) that showed a small infarct in the deep white matter structures in the periventricular region. Magnetic resonance angiography (MRA) showed tandem occlusion of the ICA and middle cerebral artery (MCA). Laboratory evaluation including thyroid studies, CBC, comprehensive metabolic panel, coagulation panel, and magnesium were grossly normal and clinically insignificant. After discussion by neurointerventional specialist with family the decision was made to proceed with intervention. Patient was brought emergently to the catheterization laboratory where he was intubated by anesthesia. The interventionist performed a thrombectomy that resulted in thrombolysis in cerebral infarction (TICI) 2a, thrombolysis in myocardial infarction 2, and flow in the left ICA and left MCA. After first pass, the lumen of the left ICA showed irregularity and a dissection flap consistent with the history of traumatic head injury. The vessel was recanalized and the patient was monitored overnight in the pediatric ICU. The next morning follow-up MRI showed evolution of stroke with no changes to overall volume of infarct from previous. MRA showed recanalization of the ICA and MCA respectively (Figure 1). An echocardiogram was performed, which showed no abnormalities. On follow-up exam postoperative day 1, the patient was squeezing with his right hand and moving his right leg. Shortly after this he was extubated. The patient remained in the hospital for 3 more days and ultimately was evaluated by physical medicine and rehabilitation for residual right arm weakness. The patient was started on half of an 81 mg aspirin daily. The patient was discharged 5 days after admission with only residual right-handed weakness giving him an NIHSS of 1. He was able to jump, play video games, and interact with peers. Since the initial admission on reevaluation 1 month later the child was back to baseline with the exception of minor right hand weakness. Per mother's report he still used the hand fully but felt like it was slightly weaker. Four months later the child was improved with only minor hand weakness noted per his mother.

3 | DISCUSSION

We report a case of ICA thrombosis in a pediatric patient successfully treated with neurointerventional embolectomy. Upon arrival to the ED, his NIHSS score was 17. At 24 hours post-thrombectomy, the patient demonstrated neurologic improvement with an NIHSS score of 1. Neurologic function was sustained at 2 years with only residual subjective minor right hand weakness noted.

Endovascular embolectomy is a rarely reported treatment for pediatric AIS that needs to be considered for standard of care. Mechanical thrombectomy has been extensively studied only in adult populations. The DAWN (DWI or CTP Assessment with Clinical Mismatch in the Triage of Wake-Up and Late Presenting Strokes Undergoing Neurointervention with Trevo) trial demonstrated improved rates of functionality and decreased disability in adults with AIS who underwent thrombectomy within 6–24 hours of stroke onset.[6] The DEFUSE 3 (Endovascular Therapy Following Imaging Evaluation for Ischemic Stroke) trial showed similar benefit when thrombectomy was performed in a more extensive patient population within 6–16 hours following stroke onset.[7] Such trials have led to adult stroke guidelines that recommend thrombectomy up to 24 hours of stroke onset in patients who meet certain criteria.[5]

Despite extensive research in adults, pediatric AIS studies are limited by the heterogeneous nature of childhood stroke, delay in diagnosis, and low participant enrollment. The 2010 Thrombolysis in Pediatric Stroke (TIPS) study was the first prospective trial for childhood stroke treatment funded by the National Institutes of Health but had to shut down due to lack of patient recruitment.[8] No clinical trials have been conducted to examine the safety and efficacy of thrombectomy in children. Data of thrombectomy in pediatric AIS are largely limited to case reports and retrospective analyses.

To our knowledge, existing data more commonly includes older children > 10 years of age. A national sample of 3184 pediatric cases of AIS found only 38 were treated with endovascular therapy.[9] The study found patients treated with endovascular therapy were older, with an average age of 10.2 years versus 4.5 years in the group treated with other therapy ($P < 0.001$).[9] A separate recent case report described an 11-year-old female who suffered MCA dissection with large vessel occlusion after a fall on a trampoline.[10] Following clot removal, the treatment team attained a TICI 2b 8.5 hours following symptom onset.[10] On literature review, the researchers found only 20 pediatric patients with anterior AIS treated via thrombectomy with stent retrievers, with mean age of 10.6 years.[10] Of these patients, 14 achieved a TICI of 2b or better, with dramatic improvements presumably owing to superior collateral circulation and neuroplasticity of the pediatric population.[10] A recent retrospective analysis demonstrated improved angiographic outcomes following thrombectomy in 12 children with large-vessel occlusion.[3] Most patients demonstrated improved neurologic function, with mean NIHSS score of 12.5 on

admission and 3.5 on day 7 post-thrombectomy.[3] The median age in this study was 14 years.[3] A second review found only 22 cases of pediatric AIS treated with mechanical thrombectomy using modern technology, with an average age of 10 years.[11] Of these 22 cases, 91% had favorable clinical outcomes, defined as asymptomatic, an NIHSS score of 0–4, and modified Rankin score of 0–2.[11]

Although these retrospective studies and case reports are limited by small study numbers and lack of standardization for assessing outcomes, the data aid in evidence for pursuing recanalization therapies when developing global hyperacute pediatric stroke therapies. Current recommendations for pediatric AIS focus on supportive care measures in an intensive care setting for a minimum of 24 hours, including monitoring of blood pressure and metabolic derangements.[5] Children without contraindications are administered antithrombotic therapies, such as aspirin, low-molecular weight, or unfractionated heparin.[5] Long-term antithrombotic medications are continued for at least 2 years to prevent recurrent stroke.[5] Hyperacute therapies may be considered if certain criteria are met: pediatric NIHSS score ≥6, larger sized children, availability of endovascular surgeon with appropriate expertise, and a large artery occlusion confirmed on imaging.[5] Management largely varies in a case-by-case basis. We report a case of a 6-year-old male with AIS successfully treated with embolectomy, resulting in sustained neurologic improvement. Given the paucity of pediatric stroke cases and scarce use of endovascular thrombectomy particularly in children < age 10, our case report is unique and adds to growing evidence of treatment success. We suggest mechanical thrombectomy should be considered as primary intervention in pediatric AIS with large vessel occlusion and warrants systematic exploration of safety and efficacy in age ranges 1–18 years of age.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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