Pediatric Acute Ischemic Cerebral Vascular Accidents: A Case Report

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Abstract: An 8-year-old girl presented to the pediatric emergency department (ED) with left-sided weakness. Workup consisted of labs and imaging including magnetic resonance imaging showing an acute ischemic stroke. Literature regarding pediatric acute ischemic stroke is minimal, and there are few protocols guiding care in the pediatric population. Current recommendations include treatment with unfractionated heparin or low-molecular-weight heparin (LMWH) with subsequent daily aspirin prophylaxis. Further large scale studies are needed to produce protocols and generalizable treatment plans.

Key Words: CVA, stroke, hemiparesis, cerebrovascular accident, acute ischemic stroke

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CASE

An 8-year-old Hispanic girl was brought to the pediatric emergency department (ED) by ambulance at 4:20 A.M. for left-sided weakness. The patient was in her usual state of health until the morning of presentation when she awoke crying in pain. On evaluation by the mother, it appeared that the patient was unable to move her left arm, left leg, had left-sided facial droop and slurred speech. The mother reported that the patient was last seen without deficit at 10 P.M., approximately 6 hours before presentation.

The family denied any preceding illness, recent trauma, and fever and had no previous medical history. She was a full-term baby, born via normal spontaneous vaginal delivery without any complications and had primary care follow-up with multiple documented well-child visits. She had no previous surgical history. Family history was negative for cerebral vascular accidents (CVA), coagulation disorders, mitochondrial disorders, or sickle cell disease.

On examination, she was in mild distress, complaining of a headache and an inability to move her left arm and leg. Initial vital signs were temperature 98.3 F, blood pressure 121/95 mm Hg, pulse rate of 142 beats per minute and regular, respiratory rate of 24 breaths per minute, and oxygen saturation of 100% on room air. She was alert and oriented appropriately for an 8 year old, but did have obvious slurred speech. She had a left-sided facial droop with difficulty fully closing her mouth and left eye. She was unable to move her left arm completely (0/5 strength), was areflexic, and did not have any sensation to blood draws or pain. She was able to flex her left hip against gravity but with poor control. She has no left leg reflexes or sensation. Her right upper extremity and right lower extremity had 5/5 strength, normal reflexes, and intact sensation. The remainder of the physical examination was unremarkable. Basic laboratory studies, including coagulation profile, were within normal limits.

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An emergent non-contrast computed tomography (CT) of the brain done at 4:40 A.M. did not show any acute abnormalities. Pediatric neurologist was consulted. They recommended further imaging studies emergently. Diffusion-weighted magnetic resonance imaging (MRI) of the brain showed abnormal signal within the right side of the pons characterized by increased T2 and FLAIR signal that was consistent with an acute ischemic infarct. Further testing included magnetic resonance angiography/magnetic resonance venography (MRV/MRA) of the brain, which were both negative. A 2-dimensional echocardiogram was positive for trace tricuspid valve regurgitation, without evidence of atrial or ventricular septal defect. Carotid ultrasound was also negative for obstruction. The patient was subsequently admitted to the pediatric intensive care unit (PICU) and started on aspirin. In the PICU, additional coagulation studies including protein C, protein S, anticardiolipin IgG, and factor 5 were found to be within normal limits. Ultimately, no obvious source of thromboembolic disease was identified despite a thorough workup. Intensive physical therapy in the PICU allowed the patient to regain some function of her left upper and left lower extremity with residual deficits.

DISCUSSION

Arterial ischemic stroke (AIS) is extremely rare in the pediatric population, with an incidence of less than 2 to 3 per 100,000.[1] In comparison with adults, the presentation is often variable leading to delays in recognition and care. These delays, often greater than 24 hours, can lead to increased morbidity and mortality with up to 85% of patients experiencing long-term neurologic sequelae.[2–4] There is also a significant difference in underlying risk factors in children. Many of the known adult risk factors including hypertension, smoking, atherosclerosis, and oral contraceptive use are not present in pediatric patients. As in our case, the majority of pediatric AIS cases are idiopathic. However, known causes include varicella infection, anticoagulation deficiency, coagulopathy, congenital heart disease, and arteriovenous malformations. In addition, neonates and young children have been shown to have variable levels of clotting factors, adding to the complexity of both the underlying cause and definitive treatment.[5]

In pediatric patients presenting with concern for acute stroke, the differential diagnosis is broad and includes migraine, seizure, Todd paralysis, infection, brain mass, or hemorrhage. In adults, the management of transient ischemic attacks and cerebrovascular accidents has become well protocolized, yet there is no definitive standard in pediatric patients.[6] Although non-contrast brain CT scan has a poor sensitivity for AIS, it continues to be recommended as the first-line imaging in pediatric patients because of its ability to quickly rule out hemorrhage or space-occupying lesions as the cause of the patient's symptoms. Magnetic resonance imaging has been proven to have the highest sensitivity and accuracy for identifying AIS in the pediatric population.[7] In addition, MRA and MRV continue to be recommended as part of the workup to detect underlying ateriopathy.[8]

Even once an AIS is appropriately identified, there continues to be confusion in management given the dearth of

literature guiding care for these patients. To date, the only definitive anticoagulation therapy recommended is from the 2013 American Heart Association citation of Monagle et al.[9] Their current class 2C recommendations include supportive care for neonates with first AIS in the absence of documented cardioembolic source and unfractionated heparin (UH) or LMWH for neonates with AIS from a cardioembolic source. Aspirin therapy is recommended for recurrent AIS in neonates. For children, the current grade 1C initial therapy is UH or LMWH with subsequent daily aspirin until embolic causes have been excluded. Their grade 2C recommendation is daily aspirin prophylaxis for 2 years given the 10% to 35% rate of recurrence.[10] The reasoning behind this measure is to optimize cerebral oxygenation and perfusion pressures by preventing further ischemic clot formation until hypercoagulable states can be excluded.

For patients with known ischemic clots, thrombolysis has been considered an option, but to date, there are no randomized control trials judging its efficacy. The largest pediatric tissue plasminogen activator (tPA) study to date reviewed a total of 2904 pediatric ischemic strokes over a 3-year period. Of this total, only 46 patients (<2%) received tPA. Although there was a small sample size, the authors concluded that the length of hospitalization and complications were greater for the tPA group without reported benefit. It was unclear if this was due to selection bias or the adverse effects of thrombolytic therapy.[1] In addition, a review of thrombectomy for treatment of AIS is also poorly studied with only a handful of case reports yielding variable outcomes. Thus, given the lack of large-scale clinical trials on antithrombotic therapy, current literature generally recommends against tPA or mechanical thrombectomy.[5,11]

While there continues to be no absolute consensus on management, multiple studies have called for more rapid identification of AIS as there is often a significant delay to diagnosis.[12,13] This is a multifactorial issue stemming from both the lack of education on pediatric stroke along with the variability of symptoms compared with adult CVA. Most adult EDs have systems in place to quickly identify and treat AIS based on published literature guiding care. This is not true in the pediatrics where challenges remain because of both the rarity of disease and the absence of consensus upon treatment strategies. Few pediatric emergency departments have protocolized pathways to expedite imaging and blood work on patients who present with concern for stroke.[2] In addition, institutional review boards are hesitant to approve randomized control trials in pediatric patients with serious neurological pathology without evidence justifying changes in practice.

Ultimately, without large-scale definitive trials showing improved outcomes, no agreed upon, generalizable recommendations can be made for treatment of pediatric AIS. Owing to the heterogeneity in pediatric patient age, weight, and sex, detailed clinical trials evaluating the efficacy of different anticoagulants is challenging. For these reasons, it is important that pediatric patients with symptoms concerning for AIS be taken to a comprehensive stroke center. Once there, it is imperative that immediate imaging take place and pediatric neurology be consulted emergently for recommendations. Given the variability of symptoms, individualized, custom treatment plans may be the most beneficial option for each patient until more large-scale clinical trials reveal better treatment options. Once better studied, it is the hope that these patients can be rapidly triaged, imaged, and treated with appropriate therapy as in adult patients.

CONCLUSIONS

Pediatric arterial ischemic stroke is extremely rare in the pediatric population. Variable presentation coupled with delays in diagnosis can lead to increased morbidity and mortality. Current recommendations include non-contrast CT brain along with MRI. For children, the initial grade 1C therapy is unfractionated heparin or LMWH with aspirin prophylaxis until embolic causes have been excluded. In addition, tPA is not generally recommended due to lack of large-scale clinical trials. Further research needs to be done in this field to yield more definitive answers.

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