Thrombosis and spontaneous recanalization of a giant intracranial aneurysm: diagnostic and management pearls in a pediatric patient

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The authors present the case of a boy who was successfully managed through the spontaneous thrombosis of a cavernous internal carotid artery (ICA) aneurysm, the subsequent occlusion of the ICA, its recanalization, and ultimate endovascular sacrifice, using only two angiograms because of the diagnostic capability of CT angiography. Spontaneous recanalization of the ICA following occlusion in the setting of a giant aneurysm has not been previously reported.

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PEDIATRIC aneurysms pose unique diagnostic and management challenges. In this case, spontaneous recanalization of the internal carotid artery (ICA) following thrombosis of a giant aneurysm presented a unique clinical and radiological learning opportunity. Ultimately, CT angiography proved to be an invaluable tool in the management of this patient.

Case Report

History and Examination

A 12-year-old boy with no medical history presented to his pediatrician with 5 days of progressive headache and double vision. He was examined by an ophthalmologist, who noted a left sixth cranial nerve palsy and ordered MRI/MR angiography that showed a large mass adjacent to his left ICA that was suspicious for a cerebral aneurysm. The boy was sent to the Emergency Department at Children's Hospital of Pittsburgh, where a CT scan and CT angiography were performed, which showed no evidence of intracranial hemorrhage and the presence of a partially thrombosed giant left cavernous ICA aneurysm measuring 3.8 × 3.7 cm (Fig. 1). The patient was admitted to the intensive care unit (ICU), and scheduled for an elective cerebral angiogram. On the morning of the angiogram, he developed worsening of his sixth cranial nerve palsy, and

a new complete third cranial nerve palsy. An emergency head CT scan demonstrated no subarachnoid hemorrhage and increased hyperdensity within the lumen of the aneurysm. Following the CT scan, the patient underwent a cerebral angiogram that revealed spontaneous occlusion of the left ICA, with no filling past the petrous segment and no filling of the giant aneurysm. The patient supplied his left middle cerebral artery (MCA) and anterior cerebral artery (ACA) through a patent circle of Willis via a large left posterior communicating artery (PCoA) and a patent anterior communicating artery. He was returned to the ICU after angiography, and immediately started on aspirin and a heparin drip with a goal partial thromboplastin time of 80 to 90 seconds. His neurological examination was unchanged in comparison with just prior to the angiogram (Fig. 2A and B).

The next day a routine CT angiogram verified the findings of the angiogram (Fig. 2C), with spontaneous thrombosis of the aneurysm and the left ICA from the skull base to the supraclinoid segment. There was reconstitution of flow at the supraclinoid segment with filling of the left MCA, ACA, and PCoA. That afternoon the patient developed slurring of his speech and right hemiparesis. Emergency MRI and MR perfusion showed multifocal restricted diffusion in the left M₃ territory on both diffusion-weighted imaging and on the perfusion scan, most con-

ABBREVIATIONS ACA = anterior cerebral artery; DSA = digital subtraction angiography; ICA = internal carotid artery; ICU = intensive care unit; MCA = middle cerebral artery; PCoA = posterior communicating artery.

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FIG. 1. **Left:** Initial coronal CT angiogram showing filling of the ICA and partial filling of the aneurysm (arrow). **Right:** Axial CT angiogram showing complete thrombosis of the aneurysm and ICA (arrow); the hyper-density in the posterior fossa is an artifact.

sistent with embolic infarction and not hypoperfusion, as the infarcts were not simply in a watershed distribution (Fig. 3). An aggressive mean arterial pressure floor of 90 mm Hg and anticoagulation with heparin and aspirin were continued. Over the next 2 weeks, the patient's right hemiparesis completely resolved. During the remainder of his hospitalization, 3 more CT angiograms were obtained to monitor for progression of the intracranial thrombosis as the heparin drip was weaned (Fig. 4). Repeat MR images

FIG. 3. **A:** Axial MR image obtained the same day as CT angiography showing diffusion-weighted imaging infarction (with apparent diffusion coefficient correlate not shown) after ICA occlusion. **B:** Axial MR perfusion image showing decreased cerebral blood flow in the left MCA territory. **C:** Follow-up coronal CT angiogram obtained 24 hours later showing progression of subocclusive thrombus to the ICA bifurcation (arrow). Figure is available in color online only.

FIG. 2. **A and B:** Digital subtraction angiograms showing thrombosis of the ICA (A; arrow) and left MCA filling via the PCoA (B). **C:** Coronal CT angiogram obtained the following day verifying the findings of DSA and showing the lack of left ICA filling (arrow).

during the heparin weaning indicated no new infarctions. The patient was discharged home on hospital Day 21. At discharge, the patient had complete left third and sixth cranial nerve palsies, but had no weakness on examination or other neurological deficits. His only discharge medication was 325 mg of aspirin per day.

Operation and Postoperative Course

One month following his hospitalization, CT angiography revealed recanalization of the left ICA to the ophthalmic segment, and the patient was referred for endovascular balloon test occlusion and left ICA coil embolization (Fig. 5A and B). He underwent this procedure exactly 3 months after his initial presentation, and tolerated it without complication. The patient underwent genetic testing for connective tissue disorders, and was found to have a mutation in the *MYH11* gene. He was diagnosed with a thoracic abdominal aneurysms and dissection spectrum disorder. Both his mother and sister were diagnosed with the same disorder after genetic testing. He underwent a normal echocardiogram, and was referred to the Cardiology Department for monitoring for the development of aortic dissection. Nine months after the ictus, he has regained full horizontal eye movements and some downward gaze. He has decreased ptosis, and nystagmus with downward

FIG. 4. Coronal CT angiograms showing regression of subocclusive thrombus after anticoagulation therapy (left; arrow) and stable ICA thrombosis 2 weeks after ictus (right; arrow).

gaze. The aneurysm is significantly smaller on repeat CT angiography (Fig. 5C).

Discussion

Pediatric cerebral aneurysms occur at a frequency between 0.17% to 6.8% among all patients treated for intracranial aneurysms.^{14,17–21,24} Estimates regarding the percentage of pediatric cerebral aneurysms that are giant (diameter ≥ 25 mm) range from 14% to 54%.^{7–10} Pediatric cerebral aneurysms are most often found in the posterior circulation or the ICA bifurcation.^{22,26}

Spontaneous thrombosis of giant intracranial aneurysms is a well-documented phenomenon, although spontaneous occlusion of the parent artery is uncommon.^{1,2,11–14} The volume-to-neck ratio has been reported as a possible predictor of aneurysmal thrombosis, with values greater than 25 being favorable for thrombosis.³ In this case, the ratio was approximately 90. Recanalization of the ICA following occlusion secondary to spontaneous thrombosis of a giant aneurysm has not been previously reported. Lee et al. reported a case of spontaneous recanalization of a completely thrombosed giant aneurysm of the posterior cerebral artery.¹⁵ The ICA thrombosis and embolic strokes that this patient suffered presented a challenging management dilemma. The progression of the thrombosis required frequent monitoring. In this case, the correlation between CT angiography and digital subtraction angiography (DSA) was excellent. CT angiography provided reliable and informative data regarding the thrombosed aneurysm, the extent of ICA thrombosis, and the distal blood flow provided by collateral circulation through the circle of Willis comparable to DSA with high sensitivity and specificity.^{5,27} The use of CT angiography enabled the patient to be monitored without invasive testing. The risk of embolic complications in children due to DSA is extremely low,^{4,6,23,28} but the use of CTA for serial examinations decreases the risk of hypotensive strokes by obviating the need for general anesthesia. In patients younger than 16 years of age, general anesthesia is used at our institution to eliminate procedural pain and eliminate motion degrada-

FIG. 5. A: Coronal CT angiogram showing recanalization of the ICA (arrow) noted at the 1-month follow-up examination. B: Angiogram showing endovascular sacrifice of the recanalized ICA as the final intervention. C: Nine-month follow-up coronal CT angiogram showing a decrease in aneurysm size and normalization of the position of the MCA (arrow).

tion of imaging. The effective dose for CT angiographic assessment of cerebral vessels is approximately one-fifth (17 mGy) the dose compared with DSA (75 mGy), and studies have shown that the estimated lifetime risk of developing radiation-related brain cancer relative to nonexposed children is increased by 2%–10% when the average absorbed dose to the brain is 17 mGy (for CT angiography) and 163 mGy (for DSA).^{16,25} In this specific patient, who was at high risk of thoracic aortic dissection, the use of CT angiography allowed the risk of iatrogenic dissection to be minimized. CT angiography allowed for reliable noninvasive monitoring for recanalization as an outpatient, identified recanalization when it occurred, and led to the patient being referred for endovascular ICA sacrifice. Over a 3-month period of time the patient underwent a total of 5 CT angiograms, 1 diagnostic angiogram, and 1 interventional cerebral angiogram.

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