Internal carotid artery dissection following wooden arrow injury to the posterior pharynx

Case report

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In this report the authors describe a case of internal carotid artery (ICA) dissection following a blunt posterior pharynx injury and review current literature on the identification and treatment of such disorders. An ICA dissection developed in a 6-year-old boy who had suffered blunt injury to the posterior pharynx and who was followed up via computed tomography (CT) angiography and clinic visits for 6 months. The ICA dissection healed with pseudoaneurysm development and was treated with anticoagulation therapy.

The authors searched the January 1996 through March 2007 MEDLINE database by using the Ovid search engine. They requested all English-language articles with the term “carotid dissection.” Reference lists from these articles were retrieved and searched for additional relevant sources. The authors found that given its availability and speed of acquisition, CT angiography typically is the preferred initial diagnostic method. Magnetic resonance angiography is usually recommended for follow-up examination especially in pediatric cases. According to the available literature, the current preferred treatment for ICA dissection is anticoagulation. (DOI: 10.3171/PED/2008/1/4/334)

KEY WORDS • anticoagulation • internal carotid artery dissection • pseudoaneurysm • stent • string sign

In this paper we offer an interesting insight into ICA dissection in children as a result of oropharyngeal trauma. Children who place objects in their mouths and then fall are often victims of such trauma. We believe this injury mechanism and its diagnostic and treatment modalities as described here are important to pediatricians, radiologists, and neurosurgeons involved in the care of such children.

Case Report

History and Examination. This 6-year-old boy presented with a history of pharyngeal trauma. Per his mother, the child fell while chewing on a wooden arrow (the arrow had no metal parts). After this fall, the child stood up with minimal bleeding emanating from his mouth. He then lost consciousness, assumed a decorticate posture, and ceased breathing for ~10 seconds. He was urgently transported to our tertiary care children’s hospital. On presentation to the pediatric emergency department, a 1-cm-diameter penetrating wound was identified in the left posterolateral pharynx. An emergent CT angiogram of the head and neck was immediately requested, and both neurological and neurosurgical consultations were urgently obtained.

Computed tomography angiography studies (Fig. 1) of the neck revealed bilateral S-shaped hairpin turns of the cervical ICAs, centered at the C-2 level. Abrupt stenosis of the left ICA was noted, centered at the C-1 arch level, producing a characteristic string sign and smooth narrowing consistent with ICA dissection.9 Proximal to the stenosis of the left ICA, a 6-mm saccular dilation of the ICA was noted and was suspicious for pseudoaneurysm formation. A continuation of contrast-enhanced imaging of the head demonstrated absent opacification of contrast material at the left ICA within the foramen lacerum. In contradistinction, normal contrast opacification of the right ICA foramen was noted.

Computed tomography angiography also demonstrated asymmetric parapharyngeal soft tissue enlargement, greater on the left than on the right, with airway narrowing to ~3.5 mm. Multiple foci of air tracked from the oropharynx at the site of injury to the posterior parapharyngeal space, consistent with posttraumatic emphysema. No drainable collection or osseous injury was identified. No evidence of an acute intracranial process was revealed on the initial CT an-
giogram; in particular, no acute intracranial hemorrhage or infarction was demonstrated. The remainder of the examination was unremarkable. Magnetic resonance imaging was deferred in the acute setting because the child was so ill, and he was transferred to the pediatric intensive care unit. Acute (given the clinical history) cervical ICA dissection and pseudoaneurysm formation (presumably also acute) proximal to the dissected area were diagnosed.

**Treatment.** The child was initially treated with intravenous anticoagulation in the form of heparin. His neurological symptoms vastly improved. Following a consultation with vascular surgery and neurosurgery personnel it was agreed that the best course of action in this patient would be nonoperative, with follow-up CT angiography in 1 and 3 months and discharge on low-molecular-weight heparin anticoagulation therapy.

**Posttreatment Course.** At a 2-month follow-up visit the child had no neurological symptoms or sequelae, and the CT angiography study demonstrated recanalization of the left ICA. It was then decided to switch the boy to baby aspirin (1 tablet/day) and to discontinue the heparin. At the 6-month follow-up the pseudoaneurysm size remained stable with patency of the ICA. The patient was continued on the aspirin regimen.

**Discussion**

Internal carotid artery dissection after pharyngeal wall injury is a known pathological entity with ~29 cases reported in the literature since 1935.\(^6\) The injury often occurs in young children carrying household objects such as a toothbrush or a pen in their mouth and falling.\(^8\) The object is driven into the child’s pharyngeal wall. Based on literature reviews\(^7\)^8 ICA injuries most often occur with lateral oropharyngeal injury. Internal carotid artery dissection typically carries a 20% mortality rate.\(^7\)

**Pathophysiological Features**

Internal carotid artery dissection most likely is caused by intimal tearing from blunt trauma.\(^9\) It has been postulated that congenital kinking (deviation of 90–145°) or coiling (loop of 360° visible) of the cervical ICA predisposes a patient to ICA dissection.\(^10\) Looping of the ICA leads to medial displacement that situates the artery in proximity to the pharyngeal soft tissues. A postmortem study of 265 random cadavers revealed 17 cases of kinking (12 cases) or coiling (5 cases) of the ICAs. The ICA was in direct contact with the tonsillar fossa in 6 of the kinking and 2 of the coiling cases. A common complication of dissection is pseudoaneurysm formation and subsequent thrombosis within 48 hours. Without anticoagulation, cerebral infarction can occur due to embolization.\(^3\)

**Imaging and Diagnosis**

For diagnostic purposes in cases of suspected BCIs, arteriography still appears to be the gold standard.\(^12\) In a 2002 study of 23 patients authors compared arteriography with CT angiography and MR angiography; however, both angiography methods (CT: sensitivity 68% and specificity 67%; and MR: sensitivity 75% and specificity 68%) failed to detect BCIs at a satisfactory rate.\(^1\) Nonetheless, given CT angiography’s availability and fast acquisition in the emergency room setting, it is often the first recommended study of choice.\(^11\) Noninvasive MR angiography may be the preferred imaging modality for follow-up evaluation of an ICA injury in the pediatric patient population by reducing the ra-

![Fig. 1. Left: Coronal contrast-enhanced CT angiograms of the head and neck obtained on hospital Day 1, showing bilateral hairpin loops within the ICA 3 cm above the bifurcations (solid arrow). Abrupt narrowing of the left ICA is noted 5 cm above the common carotid artery bifurcation, producing the characteristic string sign (dotted arrow). In addition, pseudoaneurysmal outpouching (arrowhead) appears proximal to the narrowing of the ICA. Right: Axial contrast-enhanced CT angiogram obtained at the level of the ICA foramen on hospital Day 1, demonstrating no contrast in the left ICA foramen (solid white arrow). Contrast is observed in the right ICA foramen (dashed white arrow).](image1)

![Fig. 2. Contrast-enhanced coronal CT angiograms of the head and neck obtained at the 3-month follow-up, revealing bilateral hairpin loops within the ICA (solid arrows, left). A 1-cm pseudoaneurysm is present as well (arrowhead, left and right). The left ICA is patent above the injury site (dashed arrow, right).](image2)
diation exposure associated with CT angiography.\textsuperscript{8,11} Flexible oropharyngeal laryngoscopy evaluation of the soft tissues is typically recommended if physical findings suggest a penetrating injury.

\textbf{Anticoagulation Therapy}

A study of 114 angiograms confirming BCIs in adults has shown that cerebral ischemia occurred in 0 of 73 anticoagulated cases and in 19 of 41 nonanticoagulated cases.\textsuperscript{3} These results indicate that early diagnosis and prompt treatment significantly reduce the incidence of cerebral ischemic events and disability resulting from BCI. In a 110-patient, 10-year, retrospective cohort study, Edwards et al.\textsuperscript{2} compared outcomes in patients with BCIs and concluded that there was no statistical difference between the use of anticoagulation (heparin followed by warfarin) or antiplatelet agents (aspirin with or without clopidogrel) in survival and neurological sequelae. Two of the patients had bleeding complications caused by anticoagulation, whereas none of the patients suffered complications from antiplatelet therapy. The preferred method of anticoagulation has yet to be determined.

\textbf{Carotid Artery Stents}

In a 46-patient prospective study of ICA stent placement combined with anticoagulation or antiplatelet agents for Grade III BCIs (Grade III denotes pseudoaneurysm formation in the injured area), 21\% complication and 45\% ICA occlusion rates at the 72-day angiography follow-up were reported.\textsuperscript{4} In contrast, patients treated with antithrombotic agents alone had a 5\% ICA occlusion rate. Hence, the authors in that study did not recommend the use of ICA stents as a first-line treatment in patients with BCIs.\textsuperscript{4} In a previously mentioned retrospective study Edwards et al. evaluated the placement of endovascular stents in a group of 18 patients with Grade III or higher BCIs (out of a total cohort of 110 patients). In this group no peri- or postprocedural complications were recorded, cerebral infarction occurred in 1 of 18 patients before discharge, and there was no stent occlusion on follow-up among the 14 patients who had undergone angiographic follow-up. Finally, in a separate 3-patient study of BCI with documented evidence of ischemia (diffusion-perfusion MR imaging mismatches and/or evidence of cerebral ischemia on angiography) and no response to anticoagulation, endovascular stenting was shown to be beneficial.\textsuperscript{2}

\textbf{Patient Presentation}

We postulate that our patient’s transient decorticate posturing was caused by transient brainstem and cerebral ischemia due to acute left ICA occlusion with resulting redistribution of the blood supply to the brain via a patent circle of Willis, which was documented on imaging. This posturing could represent seizure-like activity; however, we do not have electroencephalographic recordings to support this claim.

Although an interval increase in the pseudoaneurysm was noted at the 3-month follow-up, its size remained stable at the 6-month follow-up, and the patient continued to take low-dose aspirin.

\textbf{Conclusions}

Internal carotid artery dissection due to pharyngeal injury is a known pathological entity in pediatric patients, and its risk increases with congenital ICA variants such as kinking or coiling. Knowledge about this constellation of findings is useful in optimizing diagnosis and treatment in these patients. Given its resolution, availability, relative safety (as opposed to conventional catheter angiography), and speed of acquisition, CT angiography appears to be the initial diagnostic method preferred in patients with no contraindications to this type of examination. Magnetic resonance angiography may be of interest for follow-up examination given its lack of ionizing radiation. According to the available literature the currently preferred treatment for ICA dissections is anticoagulation therapy.

\textbf{References}