

Traumatic Internal Carotid Artery Dissection

Pooya Ganjali, BS; Richard B. Towbin, MD; Carrie M. Schaefer, MD; Alexander J. Towbin, MD

Abstract

Traumatic internal carotid artery dissection represents a tear within the arterial wall after a traumatic event. It is associated with an increased risk of stroke in children since it can compromise blood flow through the formation of thrombosis and/or stenosis of the blood vessels. A definitive diagnosis can be achieved by CTA, MRI/MRA, or cerebral angiography. The lack of clear treatment guidelines makes management a case-by-case decision.

Keywords: trauma, vascular, head and neck

Case Summary

A teenaged boy was involved in a high-speed motor vehicle accident. Upon presentation to the emergency department, he underwent multiple imaging studies, including a CTA of the head and neck owing to the mechanism of injury. CTA demonstrated a narrowed but patent right internal carotid artery concerning for a traumatic arterial dissection. Subsequent catheter angiography confirmed abnormal narrowing and residual flow within the right internal carotid artery.

Imaging Findings

See Figures 1, 2.

Diagnosis

Traumatic internal carotid artery dissection (TICAD).

Other causes of an internal carotid artery dissection include sport-related injuries, trauma, connective

tissue disorders like Ehlers-Danlos syndrome, Marfan syndrome, chiropractic manipulation, and alpha-1 antitrypsin deficiency.

Discussion

Internal carotid artery dissection is the causative factor in 7.5-20% of children with ischemic stroke.^{1,2} It occurs when there is a sudden tear of the layers of the wall of the internal carotid artery. The tear allows for blood to enter the layer between the intima and media of the artery, separating the layers of the vessel wall and creating a false lumen.³ As more blood enters the false lumen, the true lumen becomes increasingly narrowed by compressive force of the intramural hematoma, causing significant stenosis.⁴ Stroke can occur from a thrombus formed at the site of dissection or from a distant embolus leading to intracranial embolic infarction.¹

Internal carotid artery dissection may occur spontaneously, affecting patients with connective tissue disorders such as Marfan syndrome or after a traumatic

event.³ Spontaneous internal carotid artery dissection is more often associated with intracranial vessels, while TICAD is more commonly seen in extracranial segments.¹ In children, the most common inciting factors in TICAD are direct blunt or penetrating injury to the distal cervical segment of the internal carotid artery and/or excessive neck rotation and extension.⁴ These injuries in children are most commonly reported as a result of motor vehicle accidents; however, sport-related injuries, fights, and falls can also injure the internal carotid artery.⁵ Children are more vulnerable to developing TICAD than adults due to their weaker neck muscles and larger head-to-neck ratio.⁴ These mechanical differences can lead to abnormal neck flexion and rotation.⁴

Children with TICAD can present with variable symptoms. Thus, a high index of suspicion is required.⁶ In fact, in pediatric TICAD, neurological signs can be delayed for weeks after trauma.² When neurological symptoms occur, children may present with hemiparesis, headaches, aphasia, altered level of consciousness, and seizures.² In addition to these symptoms, intracranial dissections can present with cranial nerve abnormalities as a result of mass effect and compression of adjacent cranial nerves.⁷ Compared with adults, warning signs indicating an arterial ischemic stroke are rarely present in children.⁸ The lack of warning signs

Affiliations: California Health Sciences University College of Osteopathic Medicine, Clovis, California (Ganjali); Department of Radiology, Phoenix Children's Hospital, Phoenix, Arizona (RB Towbin, Schaefer); Department of Radiology, Cincinnati Children's Hospital, University of Cincinnati College of Medicine, Cincinnati, Ohio (AJ Towbin).

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Figure 1. Axial image from CTA showing diffuse narrowing of the right cavernous carotid artery and dissection (arrow) and a dissection (arrowhead).

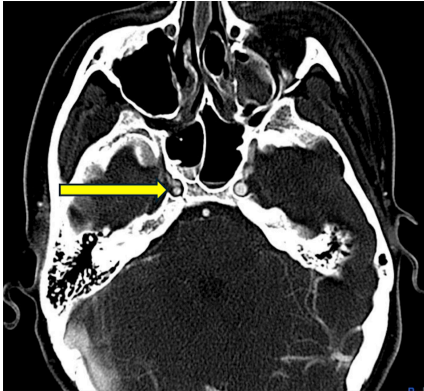
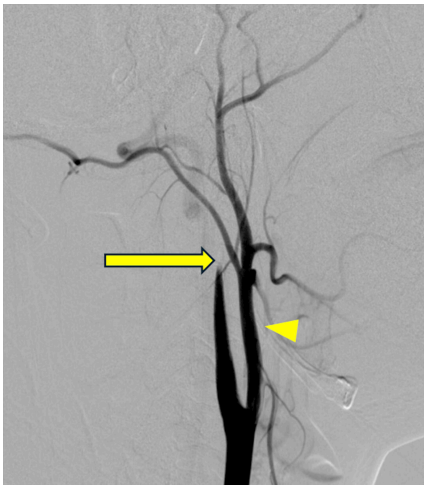


Figure 2. Lateral digital subtraction angiogram injection into the common carotid artery showing opacification of the normal external carotid and branches (arrowhead) and tapering with occlusion of the internal carotid artery (arrow).



poses a challenge in diagnosing pediatric internal carotid artery dissection before neurological deficits occur.⁸

Noncontrast CT is often the first-line imaging study to diagnose an ischemic stroke. Findings related to internal carotid artery dissection include loss of differentiation of the gray matter and white matter in the anterior and/or middle cerebral artery distribution, edema, and, in some cases, a hyperdense, thrombosed vessel that is an early sign of an ischemic

stroke. While noncontrast CT can diagnose stroke, it is unable to identify the internal carotid artery dissection. CTA is the initial diagnostic modality for this diagnosis due to its rapid imaging acquisition, high spatial resolution, and wide accessibility in most hospitals.⁶ CTA is helpful in detecting the intimal flap indicative of arterial dissection.⁶

Diffusion-weighted MRI is the most sensitive and specific test for early detection of an ischemic stroke. MRI/MRA allows for diagnosis of stroke and carotid dissection. It has been shown to be as sensitive and specific as conventional angiography.⁴ MRI can show decreased or absent flow within the affected vessels. A “crescent sign” within the internal carotid artery indicates the presence of an intramural hematoma.⁴ While MRI/MRA can provide useful diagnosis, it is less sensitive for the detection of intracranial dissections, and catheter angiography remains the standard in such cases.⁴

While catheter angiography is the gold standard for the evaluation of carotid artery dissections in adults, in the past, it has been less often used in children due to limited access to pediatric interventionalists and neurointerventionalists.^{2,4} However, the availability of trained angiographers has increased, especially in children's hospitals and academic medical centers. The most common finding associated with dissection is the “flame sign,” which represents an abnormally shaped vessel with significant narrowing due to stenosis/compression.⁶ The “double lumen sign” is pathognomonic for arterial dissection and represents flow within both the true and false lumens. While this finding is highly specific, it is one of the least reported findings in children.⁶ The “pearl and string” highlights narrowing and proximal dilatation within the dissected vessel.⁶

Treatment of pediatric TICAD is controversial. Currently, no treatment guidelines exist.⁷ Therapy usually focuses on antithrombotic drugs, anticoagulation,

and, if necessary, endovascular or surgical treatment. Due to the pathophysiology of internal carotid artery dissection and the formation of fibrin-rich thrombus, anticoagulation is likely the best treatment option for traumatic extracranial dissection.⁶ However, cases of intracranial dissections are more complicated since anticoagulation may increase the risk of intracranial hemorrhage.¹ With this risk in mind, treatment decisions for intracranial dissections should be made on a case-by-case basis.¹ Furthermore, while few studies have shown promising results with neurointerventional procedures such as mechanical thrombectomy, they are rarely used in children due to a lack of pediatric clinical trials on these procedures.⁹

Conclusion

TICAD represents a tear within the arterial wall after a traumatic event. It is associated with an increased risk of stroke in children since it can compromise blood flow through the formation of thrombosis and/or stenosis of the blood vessels. A definitive diagnosis can be achieved by CTA, MRI/MRA, or cerebral angiography. The lack of clear treatment guidelines makes management a case-by-case decision.

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