Case Report

Traumatic carotid-cavernous fistula: A case report

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ABSTRACT

Direct carotid-cavernous fistulas are a rare complication of craniofacial trauma that often presents with proptosis, chemosis, and other visual symptoms. Disruption of blood flow from a carotid-cavernous fistula can cause cortical and cranial nerve ischemia which requires emergent intervention. Upon clinical suspicion of a carotid-cavernous fistula, patients should undergo computed tomography angiography (CTA) or magnetic resonance angiography (MRA), and digital subtraction angiography (DSA) if no other etiology is suspected. We present a case of a middle-aged patient with a gunshot wound to the posterior pharynx that resulted in a direct carotid-cavernous fistula of the left internal carotid artery.

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Introduction

Only 0.3% of craniofacial traumas are associated with carotid-cavernous fistulas (CCFs), forming arterio-venous (AV) shunts from the internal or external carotid arteries (ICA, ECA) into the cavernous sinus (CS) [1-3]. Fistulas with a direct connection between the ICA and CS with a high rate of flow account for approximately 75% of CCFs and are most often the result of trauma (70%-90%) [2-5]. AV shunting may disrupt normal cerebral or ocular venous drainage routes. This can lead to cerebral hemorrhage, venous congestion, or deterioration of ocular symptoms. Therefore, emergent intervention is required [2,6]. We present a case of a middle-aged patient with a gunshot wound in the posterior pharynx that resulted in a direct CCF of the left ICA.

Case report

A middle-aged patient presented to the emergency department with a gunshot wound to the posterior pharynx. On physical exam, pupils were bilaterally non–reactive and dilated to about 6-mm. Epistaxis and hemoptysis were active from the nares bilaterally and oral mucosa. Respirations were irregular and coarse bilaterally during manual ventilation. The patient was unresponsive to command and highly agitated, thrashing all 4 extremities requiring physical restraints, with some decreased motion noted on the right side.

In preparation for a head and neck computed tomography (CT) scan, the patient was intubated, and an orogastric tube was placed. Although no intracranial injury was visualized, the CT angiography (CTA) revealed metallic fragments along the upper c-spine and posterior neck, a complex fracture of...
the left midface, including the base of the skull, sphenoid and ethmoid sinuses, and a disrupted left lateral mass of C1, including the foramen (Figs. 1 and 2). The proximal aspect of the left vertebral artery was dominant compared to the right, which suggested an acute dissection. The left sigmoid sinus was asymmetrically small with an abrupt caliber change of the left cervical jugular vein at the skull base. There was also asymmetric opacification of the left cavernous sinus with subtle asymmetric enlargement of the left superior ophthalmic vein posteriorly (Figs. 3 and 4).
Given the vascular trauma, a CCF could not be excluded and diagnostic cerebral angiogram was pursued. Digital subtraction angiography (DSA) demonstrated a complex left CCF with rapid and early AV shunting. On injection of the left ICA, a dissection was observed in the cervical segment with no significant intracranial flow secondary to the CCF. The immediate filling of the left cavernous sinus on arterial phase as well as early filling of transverse and sigmoid sinus on the left was consistent with a direct AV fistula (Fig. 5). The CS was draining in a retrograde fashion into the cortical veins and petrosal sinus leading to significant venous congestion. Injection of the right ICA demonstrated significant collateral flow to the left cerebral hemisphere via the anterior communicating artery and slightly delayed perfusion of the cortical segments of the left middle cerebral artery territory (Fig. 6). The left vertebral artery showed evidence of occlusion from the V2 to V4 segments secondary to dissection.

After confirming the presence of a CCF on DSA, the patient was scheduled for endovascular intervention the following day. Attempts were made to access to the fistula from both the transarterial and transvenous approaches, but were unsuccessful. For this reason, the decision was made to ligate the internal carotid artery with endovascular coiling (Fig. 7). After ligation, the left cerebral hemisphere demonstrated continued perfusion via collateralization from the right ICA, and right vertebral artery (Fig. 8).

Two weeks later, the patient regained some cognition, indicated by head nodding to questioning and some movement and intentional hand squeezing on the left side. The patient had no withdrawal to pain in the right upper or lower extremity. There was a leftward gaze with intermittent tracking and ignoring of the right visual field. The left pupil was 4 mm and fixed and the right was reactive and 3 mm. Residual edema and ecchymosis was present in he left periorbital region at this time.

Fig. 5 – DSA of the left ICA demonstrating early arteriovenous shunting and opacification of the dural venous sinuses, more so on the left. Note the lack of intracranial perfusion.

Fig. 6 – DSA of the right ICA in the arterial phase, for comparison, demonstrating no AV shunting, and collateral flow to the left cerebral hemisphere via the anterior communicating artery.

Fig. 7 – Angiogram of the left common carotid artery post embolization with coils occluding the cervical left ICA, with no evidence of the CC fistula. Opacification of external carotid branches only. Arrows show the 2 coil masses.
Fig. 8 – DSA of the right ICA in the arterial phase after left ICA coil occlusion demonstrating collateralization of flow to the left hemisphere via the Circle of Willis.

Discussion

A CCF may be readily identifiable in the outpatient setting by clinical presentation with sudden development of the classic triad of pulsatile exophthalmos, bruit, and chemosis. Additional symptoms may include arterialization of conjunctival veins, diplopia, retroorbital headache, elevated intraocular pressure, and decreased visual acuity [2]. Patients that fit the clinical presentation of a CCF should undergo neuroimaging with a CTA or magnetic resonance angiography (MRA). Contrast enhancement can provide valuable information regarding the size and location of the fistula and vascular changes with high sensitivity, 87% and 80% for CTA and MRA respectively, and may influence treatment decisions [7]. The gold standard for diagnosis in patients with a suspected CCF is DSA because it can provide detailed information about the size, location, rate of flow, and drainage or congestion. Contrast enhanced CTA was essential in initially identifying possible CCF in this patient and follow up with DSA was diagnostic.

Endovascular embolization is the preferred treatment modality, offering a high rate of cure and low rate of complications [2]. Transient complications are more frequent and may include hematoma, facial pain, and cranial nerve palsies. Serious complications are infrequent, but include stroke, pseudoaneurysm, hemiparesis, and peripheral nerve injury [6,8]. The cure rate of endovascular treatment approaches 90%-100% [6]. Post-procedure DSA confirms fistula occlusion and patency of remaining vessels. Symptoms of increased ocular pressure typically resolve within hours to days. Cranial nerve palsies may recover over several weeks and is dependent on the severity and duration of hemodynamic disruption [2]. In this case, ligation of the left ICA was necessary, and the left cerebral hemisphere was perfused via collateralization of the right ICA and right vertebral artery through the anterior and posterior communicating arteries respectively.

Patient consent

Written consent has been obtained.

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REFERENCES

[1] Moralis BA, Yamaki VN, Caldas JGMP, Paiva SW, Matushita H, Teixeira MJ. Post-traumatic carotid-cavernous fistula in a pediatric patient: a case-based literature review. Childs Nerv Syst 2018;34:577–80.
[2] Ellis JA, Goldstein H, Connoly ES, Meyers PM. Carotid-cavernous fistulas. Neurosurg Focus 2012;32(5):E9.
[3] Millman B, Giddings NA. Traumatic carotid-cavernous sinus fistula with delayed epistaxis. Ear Nose Throat J 1994;73(6):408–11.
[4] Debrun G, Viñuela F, Fox A, Davis K, Ahn HS. Indications for treatment and classification of 132 carotid-cavernous fistulas. Neurosurgery 1988;22(2):285–9.
[5] Chaudry IA, Elkhamry SM, Al-Rashed W, Bosley TM. Carotid cavernous fistula: ophthalmological implications. Middle East Afr J Ophthalmol. 2009;16(2):57–63.
[6] Henderson AD, Miller NR. Carotid-cavernous fistula: current concepts in aetiology, investigation, and management. Eye 2018;32:164–72.
[7] Chen CC, Chang PC, Shy C, Chen W, Hung H. CT angiography and MR angiography in the evaluation of carotid cavernous sinus fistula prior to embolization: a comparison of techniques. Am J Neuroradiol 2005;26:2349–56.
[8] Higashida R, Halbach V, Tsai F, Norman D, Pribram H, Mahringer CM, et al. Interventional neurovascular treatment of traumatic carotid and vertebral artery lesions: results in 234 cases. AJR 1989;153:577–82.