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**Case Report**

# Management of a Rare Complication of Endovascular Treatment of Direct Carotid Cavernous Fistula

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**Summary: A 30-year-old woman with direct carotid cavernous fistula underwent endovascular treatment with detachable balloons via a transarterial route. The patient returned with diplopia 1 year after therapy. On cranial MR imaging, one of the balloons was detected in the proximal portion of the superior ophthalmic vein and was deflated percutaneously with a 22-gauge Chiba needle under CT guidance. The patient's symptoms resolved after balloon deflation. This case report presents a unique complication of endovascular treatment of direct carotid cavernous fistula and its management.**

A direct carotid cavernous fistula (CCF) is a high-flow shunt between the internal carotid artery (ICA) and the cavernous sinus caused by trauma or rupture of a preexisting cavernous aneurysm (1, 2). The presenting ocular signs may develop days to weeks after injury (3). Transarterial balloon embolization is the treatment of choice for direct CCFs, and complications associated with endovascular therapy (eg, thromboembolic and ischemic events, pseudoaneurysm formation, and alteration of arterial flow resulting in hemorrhage, edema, or worsening of ocular symtpoms) are not frequent (4). To our knowledge, diplopia associated with balloon migration on the venous side has not yet been reported.

## Case Report

A 30-year-old woman presented with proptosis, conjunctival injection, left eye pain, and left sixth-cranial-nerve palsy. She also complained of decreased acuteness of vision. Seven months earlier, she suffered head trauma from falling. She had been treated at an outside hospital at the time of injury. Previous imaging studies showed a mid skull base fracture and multiple cerebral contusions.

Cerebral angiography revealed a left-sided direct CCF draining mostly by the superior and inferior ophthalmic veins and into the contralateral cavernous sinus through the circoid sinus (Fig 1). Left vertebral artery injection during compression of the left ICA showed a high-flow shunt, presumably through a large tear in the ICA at the C3–C4 segment. The fistula was occluded totally by way of a transarterial approach with multiple, detachable, silicone balloons. A repeat session had to be performed because of fistula recurrence within 2 days. Ipsilateral ICA had to be closed after test occlusion during the last session because of the large tear in the ICA, making definitive fistula closure by transarterial and transvenous approaches difficult (Fig 2).

One year after endovascular therapy, the patient was readmitted with diplopia that had started a few weeks earlier and worsened over time. Oscultation revealed no symptoms related to CCF or bruit over the eyes. The patient's lateral gaze was limited in the left eye.

The balloons in the cavernous sinus and ICA's cervical and cavernous segments appeared intact on plain radiographs of the skull. Orbital CT and MR imaging showed mild, residual proptosis of the left globe and a slightly enlarged left superior ophthalmic vein. One of the balloons was detected in the proximal portion of the left superior ophthalmic vein, and was impinging on the muscle cone. The ipsilateral superior ophthalmic fissure was also enlarged slightly (Fig 3).

After obtaining the patient's consent, a percutaneous intervention was planned. Under CT guidance, a 20-gauge Chiba needle was introduced into the left orbit, 1 centimeter below the left lateral canthus and parallel to the inferolateral orbital wall. Upon accession of the appropriate location, balloon ingredient was aspirated and control imaging showed deflation of the balloon obstructing the vein (Fig 4 and 5). The patient's symptoms resolved immediately.

## Discussion

The treatment of traumatic CCF is an elective procedure unless there is an emergency situation involving loss of vision, acute hemiplegia with intracerebral hematoma, massive epistaxis, recruitment of cortical venous drainage, or an intraocular pressure higher than 40 mm Hg (5). Endovascular therapy by way of a transarterial or transvenous approach is the treatment of choice for CCF, yielding the best definitive results with limited morbidity and the least damage to cranial nerves (3). Transarterial and transvenous therapy may fail to treat large-tear fistulas, as occurred in this case, and the ICA may have to be sacrificed. In our patient, excellent outcome regarding vision salvage and relief of annoying ocular symptoms occurred, although the left ICA had to be sacrificed.

The diplopia often associated with direct CCFs may be attributable to edema of orbital contents from orbital, venous congestion, limiting extraocular muscle movement. It can also be a direct result of a mass-effect cavernous syndrome caused by the fistula (5). In our patient, all ocular signs had resolved after treatment of the CCF. As documented by orbital CT and MR imaging, there was mechanical compression of the lateral rectus muscle caused by the balloon. During initial endovascular treatment, fistula occlusion by way of an arterial approach had failed because of a large tear of the

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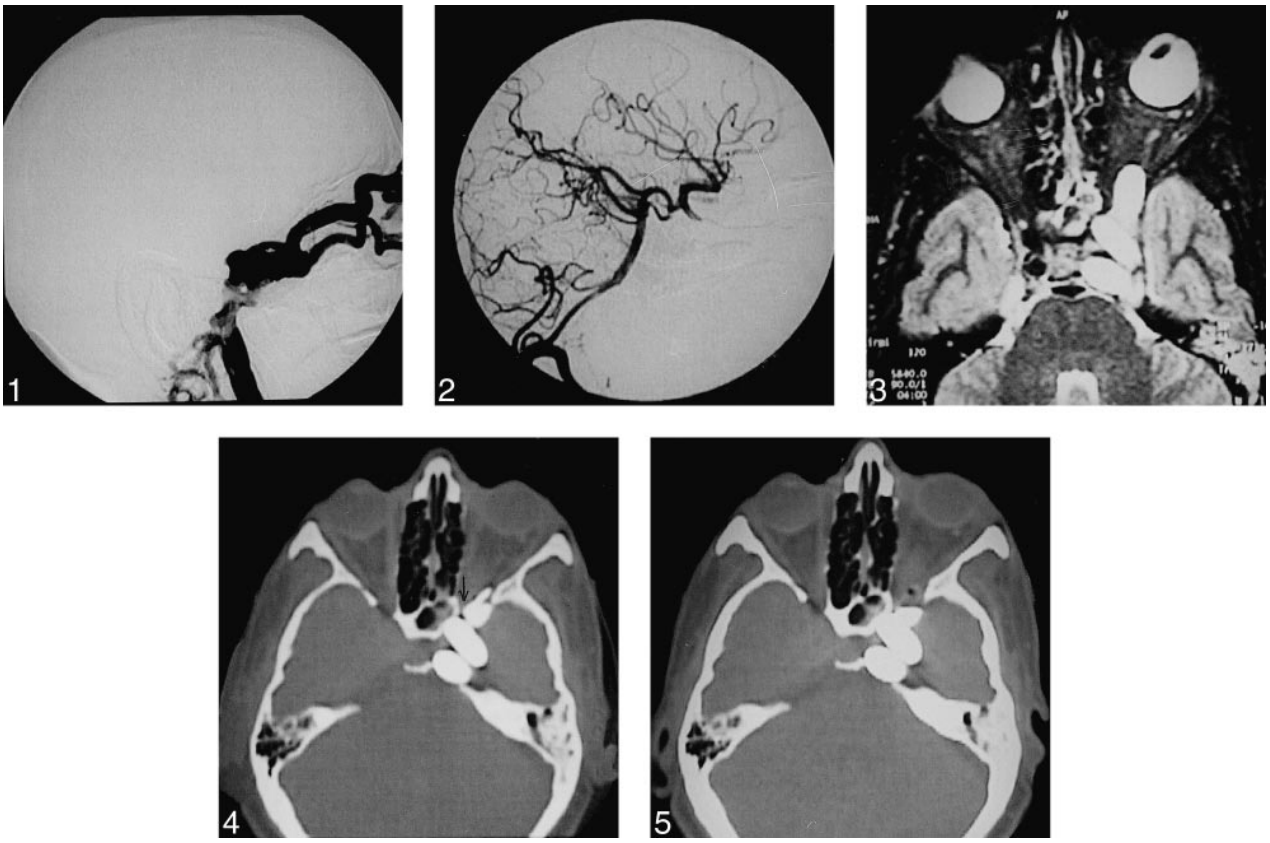

FIG 1. Lateral projection of the left ICA injection shows CCF draining by the superior and inferior ophthalmic veins.

FIG 2. Left vertebral artery injection in the lateral projection shows complete closure of the CCF and patent posterior communicating artery supplying the supraclinoid ICA and middle cerebral artery branches.

FIG 3. Axial short tau inversion recovery MR image shows mild proptosis and a balloon protruding into the left orbit.

FIG 4. Axial CT scan in bone algorithm shows tip of the needle inside the balloon. The position of the needle tip is indicated by the arrow.

FIG 5. CT scan performed at the same level after aspiration shows deflation of the balloon.

ICA, and the artery had to be closed. Fistula recurrence from external carotid branches was a remote possibility; however, there were no additional eye symptoms such as proptosis, conjuctival injection, or bruit revealed by oscultation that would suggest fistula recurrence. Therefore, diplopia was presumed to be a purely mechanical process caused by migration of a balloon to the venous side of the treated fistula. A possible cause for balloon migration may be gradual loss of volume in one or more of the balloons detached in the cavernous sinus.

The balloon was deflated using CT guidance and meticulous technique. The needle type and trajectory have been carefully chosen to avoid injury to the optic nerve, globe, and the close extraocular muscles. Patient coordination was kept at the maximum, and globe movement was minimized throughout the procedure. A surgical approach for the same result would have been more invasive than the procedure that we used.

Delayed balloon migration on the venous side of a treated CCF or diplopia associated with compression of a detachable balloon to our knowledge has not been reported in the literature despite the wide use of detachable balloons for the treatment of direct CCFs. This complication has been managed successfully percutaneously without introducing any new moribidity or risk of surgical intervention to the patient.

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