Transfemoral embolization of an external carotid-cavernous fistula

Case report

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The authors report a case of spontaneous carotid-cavernous fistula in which transfemoral arterial embolization under fluoroscopic control resulted in immediate occlusion of the fistula and dramatic resolution of the patient's signs and symptoms.

KEY WORDS  •  carotid-cavernous fistula  •  embolization  •  internal maxillary artery  •  external carotid artery

We are reporting a case in which an external carotid artery-cavernous sinus fistula was successfully treated by selective embolization of branches of the internal maxillary artery through a percutaneous femoral approach.

Case Report

A 25-year-old woman had noticed swelling and injection of the right eye since the last trimester of her first pregnancy, approximately 4 months prior to admission; no other symptoms had been present. She immediately sought medical attention. Physical examination revealed a bruit over the right eye, exophthalmos on the right, distension of the retinal veins, and engorgement of the conjunctival veins. There were no extraocular palsies. A presumptive diagnosis of internal carotid artery-cavernous sinus fistula was made, and the patient was referred to our department for selective carotid angiography. A right internal carotid angiogram was unremarkable with the exception of minimal inferior displacement of the ophthalmic artery. The injection of the right external carotid artery, however, revealed a fistula between branches of the internal maxillary artery and the cavernous sinus (Fig. 1). A left common carotid injection revealed no blood supply to the lesion. We decided to embolize selectively the arteriovenous fistula utilizing Silastic emboli. Postembolization angiography showed disappearance of the lesion (Fig. 2); the bruit had also disappeared, and within 24 hours the exophthalmos and engorgement of the retinal and conjunctival veins had markedly decreased.

Discussion

In 1963, Hayes first described three patients who had persistent symptoms following the trap operation for internal carotid artery-cavernous sinus fistulas. Postoperative angiography in these patients showed arteriovenous fistulas between terminal
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**Fig. 1.** Right external carotid arteriogram demonstrating carotid-cavernous fistula (*large arrow*) supplied by the accessory meningeal (a) and vidian (b) branches of the internal maxillary artery. Note the large superior ophthalmic vein (s).

**Fig. 2.** Right external carotid arteriogram, postembolization, demonstrating occlusion of the accessory meningeal and vidian arteries with no opacification of the fistula. There is faint opacification of the internal carotid artery due to reflux of contrast material.
branches of the external carotid (accessory meningeal, vidian, ascending pharyngeal, and infraorbital arteries) and the cavernous sinus. Ligation of the external carotid arteries apparently had not been successful.

Since this initial report, other accounts of external carotid-cavernous sinus fistulas have appeared.1,2,4,11-18 The treatment of choice in most of these cases was ligation of the external carotid artery.1,2,6,12,15,18 This form of treatment was successful only in the case of Mingrino and Moro.12 Embolization of the external carotid artery after surgical exposure has been attempted in two cases, but was successful only in the case of Mahaley and Boone.11,15

Newton and Hoyt19 in reviewing 30 cases of carotid-cavernous fistula found three cases in which the total arterial blood supply came from meningeal branches of the external carotid. No mention is made of therapy in any of their cases, although spontaneous closure was noted in five patients.

The development of a congenital or non-traumatic fistula between the external carotid artery branches and the cavernous sinus depends on the specific anatomy of the branches of the external carotid artery and the internal maxillary artery. Each of the vessels derived from these arteries coursing in the region of the cavernous sinus is capable of forming an arteriovenous fistula.16

The internal maxillary artery is one of the direct continuations of the external carotid artery. It is anatomically divided into three portions. The first, or mandibular, portion is the origin of both the middle and the accessory meningeal arteries. These two arteries enter the skull through the foramen spinosum and foramen ovale, respectively, and supply the dura in the region of the cavernous sinus. They anastomose freely with branches from the other side as well as the dorsal meningeal and the tentorial branches of the meningohypophyseal trunk of the cavernous carotid artery. The second, or pterygoid, portion of the internal maxillary artery primarily supplies the musculature of the face and to our knowledge has not been shown to supply the cavernous sinus region.

The third, or pterygopalatine, portion of the vessel supplies the deep midline structures of the face. It has multiple connections with the cavernous sinus. Studies on the human fetus have shown that the vidian artery, or artery of the pterygoid canal, directly supplies the region of the cavernous sinus. This vessel is felt to be the remnant of the primitive maxillary artery which serves as a direct communication between the internal carotid artery and the internal maxillary artery in the embryo. Potential routes of blood supply through the infraorbital artery to the cavernous sinus have also been shown in cases of internal carotid occlusion.

Furthermore, the ascending pharyngeal branch of the external carotid has anastomotic channels with the dura in the region of the cavernous sinus. Thus, it is not surprising that all of the above-mentioned vessels have been shown angiographically to supply fistulas in the region of the cavernous sinus.

The fistula in our patient afforded a unique opportunity for selective embolization since the two feeding arteries were both branches of the internal maxillary artery. Standard neuroradiological techniques permit the selective catheterization of the external carotid artery after a percutaneous femoral artery puncture. The introduction of the emboli can then be carried out under fluoroscopy with maximal control if the catheter can be situated close to the fistula.20

Luessenhop, et al.,19 pioneered the embolization of cerebral arteriovenous malformations utilizing Silastic spheroids. The technique has subsequently been applied to the treatment of cavernous-carotid fistulas utilizing porcelain beads, muscle fragments, gelfoam, and steel balls.7-9,11,17,19 We used barium-impregnated silicone spheres obtainable in 0.5, 1.0, and 2.0 mm diameters.21 They are easily sterilized and can be introduced into catheters singly if desired. The radiopacity of the spheres allows their progress to be monitored easily after their introduction into the selected artery. The spheres may either be injected from a saline-filled syringe, or be introduced singly into the mouth of the catheter and then propelled up with an inner catheter. We elected to use the latter method, believing this provided us with the maximal control. The outer diameter of the outer catheter was 2.8 mm, and the inner diameter was 2.1 mm. The outer diameter of the inner catheter was 1.67 mm, and the inner

*Barium-impregnated silicone spheres manufactured by Heyer-Schulte Corporation, 600 Pine Avenue, Goleta, California 93017.
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diameter was 1.25 mm. The catheters were
introduced coaxially, utilizing the percutaneous
Seldinger method after a femoral puncture. A
total of 11 silicone beads of 2 mm diameter
were introduced. After they were seen to
lodge in the middle meningeal and ptery-
gopalatine arteries, a postembolization angi-
ographic series was obtained which
demonstrated nonopacification of the fistula.

Apparently, two previous cases of external
carotid-cavernous fistula have been
successfully treated. In the first the blood
supply was from a branch of the internal
maxillary artery. Ligation of the external
carotid resulted in clinical improvement, but
a postoperative angiogram was not obtained;
radiographic confirmation was, therefore, not
available. The second case was reported
recently by Mahaley and Boone, the first to
describe successful treatment of a fistula by
embolization with radiographic confirmation.
They gave several reasons for not attempting
a percutaneous approach and did their
procedure via surgical exposure of the exter-
nal carotid in the neck. With the exception of
these two cases, the treatment of external
carotid artery-cavernous sinus fistula ap-
parently has met with extremely poor results.

We feel that the fistula in our patient
afforded a unique opportunity for selective
embolization of the feeding arteries. When
the procedure is carried out by experienced
angiographers there should be no higher mor-

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