Direct carotid sinus approach to treatment of bilateral carotid-cavernous fistulas

Case report

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The authors present a patient with a complex vascular malformation composed of bilateral spontaneous carotid-cavernous fistulas (CCF’s). The abnormality was supplied on the right side by the right external carotid artery (ECA) and the right internal carotid artery (ICA), and on the left side only by the left ICA. There was also an arteriovenous communication between the right ECA and the lateral sinus. Surgical embolization of both cavernous sinuses with oxidized cellulose was achieved on one side by direct puncture and on the other through one of its venous affluents, successfully occluding both CCF’s and preserving the patency of both ICA’s without any neurological deficit. The arteriovenous communication between the right ECA and the lateral sinus was occluded by embolization of the occipital artery and ligation of the right ECA.

KEY WORDS • carotid-cavernous fistula • bilateral treatment • arteriovenous malformation • embolization

Spontaneous bilateral carotid-cavernous fistulas (CCF’s) supplied by the internal carotid artery (ICA) are quite unusual. Their surgical management represents a challenge to the neurosurgeon, who must occlude the fistulas while preserving carotid artery patency, bilaterally if possible. In 1985, Yamamoto, et al., reviewed the literature on this subject and found only five surgically treated cases. In two of these the fistula was approached bilaterally, and the results were poor in both. One of the cases was treated with the Hamby method combined with external carotid artery (ECA)-ICA anastomosis; but the patient died. In the other case both fistulas were treated with detachable-balloon embolization, and the patient suffered permanent unilateral blindness and sixth-nerve palsy.

We have successfully treated a case of spontaneous bilateral CCF’s and describe our experience in the management of this difficult neurosurgical problem in the following case report.

Case Report

This 64-year-old woman was admitted to our department in January, 1981. For over 8 years she had complained of an annoying buzzing in her right ear, which had become bilateral in the year before admission. Two months prior to admission she suffered from continuous frontal headaches that prevented her from sleeping, and she became aware of progressive conjunctival injection as well as blurred vision. The rest of her medical history was unremarkable.

Examination. On admission, there was slight bilateral exophthalmos, conjunctival hyperemia with marked chemosis, left abducens palsy, and bilateral engorgement of the optic disc. A bruit was heard over the right mastoid process and orbit. Visual acuity was 10/20 in both eyes, and there was peripheral constriction of the visual fields with enlargement of the blind spots. The remaining neurological and general findings were normal.

Computerized tomography scans of both orbits showed dilated superior ophthalmic veins. Four-vessel angiographic studies, with selective views for both ECA’s and both ICA’s, demonstrated the presence of bilateral CCF’s and a fistulous communication between the right ECA and the lateral sinus. In the frontal views, during compression of the left ICA, both cavernous sinuses were immediately filled. The right ECA-lateral sinus fistula was fed by the occipital artery. The right
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CCF was filled during both selective ECA and ICA angiograms, while the left CCF was supplied only by the left ICA (Fig. 1). Vertebral angiography was normal.

Operations. On February 5, 1981, the right ECA-lateral sinus fistula was occluded by embolization and ligation of the occipital artery and by ligation of the ECA beyond the emergence of the lingual artery. Postoperative carotid angiograms showed occlusion of the fistula to the lateral sinus but the CCF on that side remained. Although buzzing in the right ear disappeared, the ocular symptoms persisted.

On February 24, 1981, surgery was performed on the left CCF. The common carotid artery was dissected at the neck and a band was passed around it to permit temporary occlusion. An arteriographic catheter was left in place for intraoperative angiography. A left pterional craniotomy was performed, exposing the external wall of the sinus, into which three large veins bearing arterialized blood led from the undersurface of the temporal lobe. The wall of the sinus protruded, with a strikingly convex surface. A square piece of oxidized cellulose (Surgicel), about 7 × 7 cm in size, was cut into fine pieces of less than 2 × 2 mm and mixed with 10 cc of angiographic contrast fluid (Uro-angiographin). This resulted in a moderately dense solution that was injected into the sinus through a No. 16 venipuncture cannula which had previously been introduced into the cavernous sinus by direct puncture of its external wall. The solution was injected in 2-cc consecutive boluses until resistance to further injection prevented the introduction of more embolizing substance and blood did not flow from the sinus through the catheter. In total, 6 cc of embolizing substance was injected. Intraoperative angiograms showed the disappearance of the fistula with functional and morphological preservation of the ICA.

Ten days later, the right CCF was approached with a similar technique. On this side, catheterization of one of the large veins that led from the temporal lobe to the sinus was possible with a No. 16 venipuncture cannula. Injection of contrast medium showed the catheter to be located in the markedly dilated superior ophthalmic vein. As on the left side, obliteration of the CCF was achieved by embolization with 7 cc of the same embolizing substance. Intraoperative angiograms showed patency of the ICA.

Postoperative Course. The postoperative course was unremarkable, except for an initial increase in ocular chemosis which subsided progressively. There were no ocular palsies. During the 6-year follow-up period there has been gradual improvement of visual acuity, complete clearance of visual field constriction, and no recurrence of the symptoms. Control angiograms 6 months after surgery demonstrated the disappearance of both fistulas and patency with morphological integrity of both ICA's (Fig. 2).

Discussion

Techniques to occlude the ICA by trapping with or without embolization carry the high price of sacrificing this artery, an event which is not always well tolerated and frequently causes blindness of an eye if the ophthalmic artery is occluded. These techniques cannot be applied if the malformation is bilateral. More recent techniques are aimed not only at the successful obliteration of the CCF but also at preservation of carotid blood flow. The direct repair of the fistula with hypothermia, circulatory bypass, and arrest of blood flow, as proposed by Parkinson, 6,7 is usually not practical. Electrothrombosis of the cavernous sinus, as described by Hosubuchi and coworkers, 1,3 requires complex equipment, unavailable to most neurosurgeons. Mullan 3 reported successful results with thrombosis of the sinus by introducing hemostatic material through a venous pathway, depending on the location of the fistula.

At this time, the intra-arterial or intravenous catheterization techniques with detachable balloons initiated
in 1974 by Serbinenko\(^4\) and perfected by Debrun, \textit{et al.},\(^2,10\) attract the most attention. Unfortunately, these methods are not always successful, because in a large number of cases patency of the carotid artery is not maintained; when patency is achieved it is usually associated with abnormalities of the lumen, false aneurysms, or sequelae such as oculomotor palsy.

On two occasions, Viñuela, \textit{et al.},\(^10\) were able to obliterate CCF's and achieve carotid artery patency by introducing balloons into the cavernous sinus using a direct approach. Uflacker, \textit{et al.},\(^9\) achieved thrombosis of the cavernous sinus by antegrade catheterization of the superior ophthalmic vein and direct embolization, a method that we have employed successfully in two cases, the first time in 1983. Recently, Isamat, \textit{et al.},\(^4\) has reported the obliteration of four CCF's by introducing muscle and/or fibrin sealant directly into the cavernous sinus.

Unilateral fistulas can be treated by one of several different surgical options; however, this is not the case with bilateral fistulas, since in such cases it is essential to preserve carotid blood flow. Therefore, procedures that occlude carotid arteries or carry a high risk of thrombosis of the vessels should be avoided. We believe occlusion of the cavernous sinus, either by a direct or by an intravascular approach, should be made with embolizing substances capable of adapting to the tortuous, multiple-compartment cavity. Detachable balloons obviously do not meet these requirements, since they do not adjust to the irregular structure of the sinus but rather act as compressive elements to the carotid siphon and the cranial nerves. For these reasons we treated a CCF in 1971 with bone wax mixed with an oily iodized contrast medium (Ethiodol), injected by direct puncture of the cavernous sinus (unpublished data). In six other patients, we also embolized the venous portion of the fistula, either through the superior ophthalmic vein, by direct puncture of the sinus, or by catheterization of one of the veins flowing into the sinus from the temporal lobe, but always using pliable substances such as fibrin sealant or oxidized cellulose.

References


Manuscript received July 17, 1987. Accepted in final form May 19, 1988.
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