Bypass combined with embolization via a venous graft in a patient with a giant aneurysm in the posterior communicating artery and bilateral idiopathic occlusion of the internal carotid artery in the neck

Case report

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The authors describe the case of a patient with a symptomatic giant aneurysm of the posterior communicating artery (PCoA) associated with bilateral idiopathic occlusion of the internal carotid artery (ICA). The presence of severe tortuosity of the vertebral arteries (VAs), both at their origin from the subclavian artery and at the level of the third segment, impeded navigation of the catheter for embolization of the aneurysm with Guglielmi detachable coils (GDCs).

A direct surgical approach was considered to be a high-risk procedure because of the bilateral occlusion of the ICAs and the size of the aneurysm. The following therapeutic strategy was therefore adopted: 1) balloon occlusion test of the left VA; 2) vertebro–vertebral bypass with saphenous vein graft to provide a pathway for subsequent embolization; 3) ICA–left middle cerebral artery bypass to ensure blood flow in the event that embolization resulted in closure of the PCoA; and 4) GDC embolization of the aneurysm via the posterior circulation graft to ensure complete exclusion of the lesion from the arterial circulation and preservation of the PCoA. At 3-month follow-up review the patient did not present with any neurological deficits; at 1-year control examination, magnetic resonance (MR) imaging and MR angiography both confirmed complete exclusion of the aneurysm and patency of the two bypasses.

KEY WORDS • posterior communicating artery aneurysm • long saphenous graft • vertebral artery • Guglielmi detachable coil • angiography

Case Report

History. This 54-year-old woman had presented with sudden onset of headache and visual field impairment in 1994. A cerebral computerized tomography scan demonstrated the presence of an aneurysm that seemed to originate from the posterior cerebral artery. Subsequent cerebral angiography confirmed the presence of the aneurysm (Fig. 1) and also documented bilateral occlusion of the ICA in the neck, although there was no typical radiological picture of moyamoya disease. The patient refused surgery and was discharged in good general condition. The patient’s neurological condition remained stable until November 1999 when the bouts of headache from which she continued to suffer began to worsen, in terms of both duration and intensity; these were accompanied by further visual field limitation and difficulty in walking. She was therefore admitted to the Neurosurgical Division of the Department of Neurosciences of Rome’s “La Sapienza” University.

Examination. On admission, neurological examination
revealed the following: bitemporal hemianopsia; initial binasal hemianopsia, prevalent in right eye; and a positive Romberg sign. Cranial MR imaging and subsequent MR angiography demonstrated an increase in the size of the aneurysm, which had a diameter of 3.5 cm and appeared partially thrombosed. Cerebral angiography confirmed the increased size of the aneurysm originating from the PCoA (Fig. 2), and it also confirmed bilateral carotid artery occlusion.

Treatment. Embolization of the aneurysm by using GDCs was attempted, but passage of the catheter was impeded by marked tortuosity of the VAs in both the first and third segments. Consequently, the neuroradiologists and neurosurgeons treating the patient agreed on the following strategy: 1) balloon occlusion test of the left VA; 2) replacement of the left VA with a saphenous vein graft to eliminate the two tortuous segments that impeded advancement of the catheter; 3) bypass graft between the stump of the right ICA in the neck and the MCA to maintain blood flow in the perforating arteries originating from the initial segment of the PCoA, in case it was necessary to let the coils protrude from the lumen of the artery to close the aneurysm completely; and 4) closure of the aneurysm by using GDCs immediately after performing the anterior circulation bypass to avoid possible rupture of the lesion resulting from increased intraaneurysm pressures developing after an extracranial–intracranial bypass.

Because the patient tolerated the occlusion test of the left VA without the onset of either neurological deficits or alterations of electroencephalographic readings or evoked brainstem potentials, we went ahead with the rest of the program.

First Operation. In March 2000 the first operation was performed with the patient placed supine with her head turned to the right and slightly extended. The saphenous vein was exposed in her right leg from the malleolus to the knee. Via a presternocleidomastoid approach, the first and third segments of the VA were then exposed according to the technique described by George and Laurian. The vein was harvested and kept hydrodistended at a constant pressure of 150 mm Hg by using a pressure transducer throughout the entire procedure. After applying a temporary clip to the VA at the point where it entered the dura mater, the superior anastomosis was performed by means of a continuous suture with 8.0 prolene thread; following this the inferior anastomosis was completed between the saphenous vein and the VA at its origin from the subclavian vein. Antiplatelet therapy with aspirin (400 mg/day) was begun, which the patient continues to receive. An MR angiography study performed the next day confirmed the patency of the bypass.

Second Operation. One month after venous grafting, a period judged sufficient for endothelialization to occur, once a control angiography study with superselective catheterization of the aneurysm via the venous graft had been performed (Fig. 3), the anterior circulation bypass was made between the temporal branch of the right MCA and the stump of the ICA in the neck: the procedure used was the one described in detail in previous papers. Once patency of the bypass had been ascertained, the aneurysm was embolized using GDCs: a No. 6 French guide Envoy catheter (Cordis Endovascular, Miami, FL) was placed in the distal cervical vertebro–vertebral venous graft and a Tracker 18 microcatheter with a Dasher 14 microguide (Target Therapeutics/Boston Scientific Corp., Fremont, CA) was navigated into the BA, the right PCoA, and then into the aneurysm sac. A total of 18 GDCs (Target Therapeutics/Boston Scientific) of different sizes and characteristics were progressively detached within the aneurysm sac, obtaining a more than satisfactory occlusion of the lesion. Control angiography documented complete exclusion of the aneurysm from the anterior circulation (Fig. 4).

Postoperative Course. This second postoperative period was also uneventful, with total resolution of the neurological deficits present before operation. Two months postsurgery, results of the visual field examination were normal. At the 10-month follow-up examination, both MR
imaging and MR angiography confirmed complete exclusion of the aneurysm and patency of both bypasses.

Discussion

True PCoA aneurysms are rare; they account for between 0% and 3.3% of all intracranial aneurysms, and few of them are giant.2,19,31,35,39 In the largest series, published in 1990, Kudo19 reviewed 27 cases of true PCoA aneurysms. The PCoA gives rise to many important branches that supply the optic chiasm, oculomotor nerve, mammillary body, tuber cinereum, cerebral crura, ventral thalamus, and the rostral portion of the caudate nucleus.22 Thus, preservation of the perforating vessels seems to be the key to successful treatment of these aneurysms.23,37 Standard treatment for giant aneurysms is occlusion by clipping the neck of the lesion, although in some cases endovascular treatment with GDCs is possible.11,13,16,26

The association of an intracranial aneurysm with bilateral occlusion of the ICA in the neck, as described in our case, is very unusual. In fact, it is extremely rare for a PCoA aneurysm to be associated with occlusion of a major intracranial vessel that has no relation to moyamoya disease.3,17,24 whereas moyamoya disease accompanying posterior circulation aneurysms is well documented.4,8,18,36,38 In our case the hemodynamic anomaly associated with bilateral occlusion of the ICA with consequent increased flow at the level of the BA, may be considered partially responsible for the formation of the aneurysm and the increase in its size.

The complex therapeutic strategy devised to treat our case was derived from several considerations. Although clipping of the aneurysm, eventually associated with cardiac arrest, remains the ideal treatment, a direct surgical approach in a patient with a giant aneurysm of the PCoA and bilateral occlusion of the ICA would have been extremely dangerous. Besides the possibility of ischemic complications resulting from accidental closure of the perforating arteries,21 accidental closure of the PCoA19 might have produced an ischemic lesion due to interruption of compensatory flow in the posterior circulation. The absence of patent bilateral ICAs, as in our case, with the entire cerebral blood flow provided by the PCoAs, made it impossible to occlude the parent artery.21 On the other hand, the presence of severe tortuosity in the VAs, both at their origin and in the transverse segment, did not permit navigation of the catheter, which was required for embolization. Because surgical exposure of the VAs to allow passage of the microcatheter was judged inappropriate because of the presence of bilateral tortuosity at the level of the first and third seg-

Fig. 3. Upper: Angiogram of the left vertebro–vertebral bypass confirming its patency. Lower: Oblique base view angiogram obtained via catheterization of the venous graft, demonstrating the proximal marker of the microcatheter (arrow) in the right P1 segment, and the distal marker (curved arrow) through the right PCoA, inside the aneurysm.

Fig. 4. Follow-up angiogram of the left vertebro–vertebral bypass, oblique base view, demonstrating the BA (curved arrow), right and left PCoA (small arrows), right and left P1 segments (large arrows), and complete occlusion of the aneurysm with GDC (asterisk).
ments, a graft was applied to the posterior circulation for the sole purpose of permitting navigation of the catheter, and, therefore, superselective angiography of the aneurysm and its consequent embolization. We also considered it necessary to perform another bypass at the level of the anterior circulation because accidental closure of the PCoA with GDCs during embolization of the aneurysm might have caused ischemic lesions due to interruption of the compensatory flow originating from the posterior circulation.

Resolution of the preoperative symptoms caused by the mass effect of the aneurysm, despite treatment with GDCs, was probably due to the disappearance of the pulsing effect. Modern endovascular techniques allow treatment of intracranial aneurysms in many situations in which surgical treatment is associated with significant morbidity. Occasionally, when embolization is unsuccessful or incomplete, surgical management is required.7,16

One pitfall related to the use of a long graft is late occlusion, which has an incidence ranging from 66 to 95%.20

Our patients who undergo extracranial–intracranial bypass surgery of both the anterior and posterior circulation are treated with antiplatelets from then on. As reported in our previously published study,3 we observed no cases of long-term occlusion after an average follow-up period of 3.7 years. In a more recent series that has yet to be published, the incidence of late occlusion of the long graft was 10.8% after an average follow-up period of 5.2 years.

Conclusions

To treat particularly complex aneurysms it is sometimes necessary to combine endovascular and surgical methods.7,16,20 In the cases described in the literature, this combination consists of either positioning a clip on the remnant of the aneurysm after embolization,7,22 postclipping endovascular treatment, or the creation of a cerebral bypass.16

The presence of significant vascular anatomical anomalies3 may impede navigation of the catheter, making embolization with GDCs impossible. Application of a venous graft can eliminate these anomalies so that passage of the catheter is possible. Our case, the first reported in the literature, is another example of the results that can be achieved by collaboration between neurosurgeons and endovascular neuroradiologists.

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