Late paraophthalmic aneurysm rupture following endovascular treatment

Case report

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✓ A fatal rupture of a large paraophthalmic aneurysm 11 months following treatment with detachable balloons is described. This case illustrates the potential consequences of incomplete aneurysm obliteration with endovascular techniques and emphasizes the need for adequate posttreatment evaluation when this method is used for aneurysm therapy.

KEY WORDS • aneurysm • endovascular techniques • detachable balloon

DURING the last several years, there has been significant progress in development of the capabilities for the percutaneous endovascular treatment of intracranial vascular abnormalities. Important among these advances are detachable balloon techniques which allow obliteration of some intracranial aneurysms with preservation of the parent artery. Publications describing adequate long-term follow-up monitoring after such treatment are lacking, however, as are descriptions of the consequences of incomplete aneurysm obliteration using endovascular techniques. Although aneurysm persistence, regrowth, and rupture are well-described events following inadequate surgical clipping, this is, to our knowledge, the first report describing aneurysm enlargement and rupture following incomplete treatment with intra-aneurysmal balloons.

Case Report

This 28-year-old right-handed woman was in good health until June, 1986, when she began to notice decreasing vision in her left eye. Examination at that time revealed marked pallor of the left optic disc and visual acuity of 20/400. A computerized tomography (CT) scan disclosed a left-sided homogeneously enhancing parasellar mass. Angiography the following day showed a 12 × 15-mm aneurysm originating from the dorsal wall of the internal carotid artery (ICA), just distal to the origin of the left ophthalmic artery (Fig. 1). Other angiographic findings of importance were hypoplasia of the A1 segment of the right anterior cerebral artery (ACA) and a very small aneurysm located symmetrically on the opposite ICA. There was no evidence of thrombosis within the left ICA aneurysm on CT, angiography, or magnetic resonance (MR) imaging.

First Admission. On July 22, a left frontotemporal craniotomy was performed and an attempt was made to clip the left paraophthalmic aneurysm. Despite removal of the anterior clinoid process and entrance into the cavernous sinus, the neck of the aneurysm could not be visualized completely, and attempts at clipping were abandoned. The exposed portion of the aneurysm was wrapped with shredded cotton fibers, and the procedure was terminated. Except for transient third nerve palsy the postoperative course was uneventful.

Second Admission. On August 25, the aneurysm was treated with detachable balloons. Because of the presence of the contralateral aneurysm and the hypoplastic A1 segment of the right ACA, no attempt was
made to treat the aneurysm using parent artery occlusion. During treatment, one latex balloon, inflated to a diameter of approximately 3 mm, became detached prematurely. This resulted in blockage of the left ICA bifurcation and was associated with the immediate development of stupor, aphasia, and right-sided hemiparesis. Following intubation and institution of supportive measures, a nondetachable balloon was employed to force the balloon embolus out of the carotid bifurcation and into the A1 segment of the left ACA, thereby relieving obstruction of the left middle cerebral artery. These maneuvers required approximately 45 minutes.

Treatment was then continued using Hieshima silicone rubber detachable balloons. Since no single balloon would either occlude the aneurysm neck or fill the entire volume of the aneurysm lumen, three balloons were sequentially positioned, filled with 5-hydroxyethyl methacrylate, and detached within the aneurysm. These assumed a cloverleaf configuration and, on the final posttreatment angiogram, were judged to occupy more than 90% of the aneurysm volume. The left ICA was patent. In spite of nearly total obliteration of the aneurysm cavity, late venous phase films showed some persistent contrast medium layering along the dependent portion of the aneurysm lumen (Fig. 2).

Following treatment, the patient had an expressive aphasia and a right hemiparesis involving the arm more than the leg. These deficits improved substantially over the course of the next 8 months. During this interval, despite being informed that her aneurysm was likely not completely treated, the patient refused to submit to either repeat CT or angiography. Because of the recurrence of frequent rather severe headaches, however, she again sought medical attention on April 1, 1987.

Third Admission. Examination revealed a normal gait but significant persistent distal right upper extremity paresis and a mild expressive dysphasia. Ophthalmological examination now showed only mild pallor of the left optic disc and a visual acuity of 20/70. The patient related a history of recurrent headaches, occurring several times each week. She again refused to have repeat angiography, but did consent to a repeat CT scan. This revealed a slight enlargement of the aneurysm as well as some change in the position of the balloons within the aneurysm (Fig. 3 left and center). A small frontal lobe infarct was also present. She refused to submit to further examination and treatment.

On May 24, 1987, she was found comatose. A CT scan revealed massive subarachnoid and intraventricular hemorrhage (Fig. 3 right). She died on the following day.

Pathological Findings. At necropsy, there was evidence of recent massive subarachnoid and intraventricular hemorrhage. To facilitate examination of the arterial system, the left cavernous sinus was opened and the ICA was cut below the origin of the aneurysm. The arteries at the base of the brain were removed from the cerebral hemispheres and were examined separately. The left paraophthalmic aneurysm measured 15 mm at its greatest diameter. Its base and neck were thick and broad; through the opening from the ICA, balloons were seen within the aneurysm cavity. Although these were flush with the lumen of the ICA, space was present between the periphery of the aneurysm and the surface of the balloons. Rupture seemed to have occurred at the dome of the aneurysm along its posterior inferior wall.

Microscopic examination revealed that most of the aneurysmal lumen not occupied by balloons was filled with recent and old thrombus; the majority of this was attached to the aneurysm wall. The recent thrombus...
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Consisted of platelet and fibrin layers while the older thrombus showed evidence of partially collagenized fibrin. In one area, there was evidence of disruption (that is, dissection between the margin of an organized portion of the thrombus and along and into the aneurysm wall).

The thickness of the aneurysm wall varied from less than one 1 mm to 2.5 mm. In most areas, along its inner surface, the wall of the aneurysm was made up of a zone of tissue composed of an inner layer of fibrous tissue containing some small capillaries and a few hemosiderin-laden macrophages and a more peripheral, thinner layer of hyalinized collagenous acellular tissue. In some areas this latter zone comprised the entire wall of the aneurysm. No inflammatory reaction was present in the wall of the aneurysm adjacent to the balloons (Fig. 4).

Discussion

Persistence, expansion, and not infrequent rupture are well-recognized consequences of incomplete surgical clipping of intracranial aneurysms. Although published facts are lacking regarding the incidence and significance of incomplete aneurysm treatment by endovascular techniques, there is concern that some aneurysms treated by intravascular balloon embolization may not be completely obliterated.

To our knowledge, this is the first reported case of aneurysm growth and rupture following incomplete treatment with balloon embolization.

Angiography following placement and detachment of three balloons within this aneurysm revealed that, although the balloons occupied greater than 90% of the volume of the aneurysm and were flush with the origin of the aneurysm from the ICA, there was still a small amount of contrast medium within the aneurysm cavity, as seen on late venous phase films. Additional treatment was not undertaken at this point because, due to the marked degree of stasis present, it was considered that further thrombosis was likely to occur after anticoagulation procedures were discontinued and that this could then cause complete obliteration of the aneurysm.

The unfortunate lack of short-term follow-up examination with angiography leaves us uncertain as to the extent of thrombus formation following treatment. The failure to visualize any thrombus within the aneurysm on pretreatment MR imaging and the presence at pathological examination of well-organized thrombus in portions of the aneurysm not filled by balloons indicate, however, that some posttreatment thrombus did occur. It is speculative whether there was complete obliteration of the aneurysm and subsequent thrombolysis or whether there was never complete thrombosis of the aneurysm lumen. The rather marked improvement in the optic nerve function indicates clearly, however, that some significant change occurred in the local pressure effects caused by this large aneurysm.

Balloons partially filling an aneurysm cavity have an undetermined and, to our understanding, unpredictable effect on intra-aneurysmal pressure and hemodynamics. On a theoretical basis, both obliteration of large portions of an aneurysm cavity and changes in the relationship and size of the origin of an aneurysm to its parent artery could, through reduction of intra-aneurysmal pressure and promotion of reduced flow, be beneficial.
Promotion of turbulent flow by changing intra-aneurysm hemodynamics also could unpredictably either be beneficial by favoring thrombosis or be threatening by inducing added hemodynamic stress on the aneurysm wall.5,8,12 In our pathological examination, there was no evidence that the balloons within this aneurysm had caused any mechanical effects on the adjacent aneurysm wall.

The difficulties of completely obliterating most aneurysm cavities with any single balloon or combination of balloons and the obvious potential consequences of leaving even a small portion of an aneurysm intact, indicate to us that additional techniques must be employed if the results obtained with endovascular methods are to be optimized. The uncommon but well-documented spontaneous thrombosis and complete obliteration of intracranial aneurysms and the even more uncommon thrombosis, disappearance, and then reappearance, combined with the frequent observation in aneurysms of hemodynamic and pathological states which favor thrombosis (stasis, turbulent flow, and endothelial damage), in our opinion indicate that one key to realization of the full potential of the endovascular approach lies in a better understanding of, and the ability to precisely control and regulate, intravascular thrombosis and thrombolysis.8,9,11,13

This case provides clear warning of the seriousness of incomplete aneurysm treatment with balloon techniques. It is essential that caution and concern be used in selection of patients to be treated with this technique; when treatment is carried out, an aggressive posttreatment follow-up as suggested by Hieshima and Higashida9 is mandatory.

References

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