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Intravascular Balloon Embolization of a Carotid-Ophthalmic Artery Aneurysm with Preservation of the Parent Vessel

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It is now technically possible to treat intracranial aneurysms from a transvascular approach by balloon embolization therapy. If the aneurysm has a neck, a detachable silicone balloon can be guided into the aneurysm, inflated to occlude the neck and dome, and detached. We are thus able to exclude the aneurysm from the circulation and preserve the parent vessel. In patients who have failed standard neurosurgical approaches to clipping, this may provide an alternative therapeutic technique.

Case Report

A 57-year-old woman presented with severe bifrontal headaches, vomiting, and diplopia. She was diagnosed by CT as having a large right-sided subarachnoid hemorrhage. Cerebral angiography showed bilateral large carotid-ophthalmic artery aneurysms. A craniotomy was performed for clipping of the right-sided aneurysm, but during the procedure the aneurysm ruptured and both the internal carotid artery and the aneurysm were clipped.

A postoperative left internal carotid artery angiogram showed occlusion of the right internal carotid artery by the surgical clip and cross-filling of the right cerebral hemisphere across the anterior communicating artery. The large, left-sided carotid-ophthalmic artery aneurysm measured 20 mm × 12 mm × 10 mm (Figs. 1A and 1B). The vertebral angiogram showed no significant blood supply across either of the posterior communicating arteries.

Since the patient was still at risk of bleeding from the left-sided aneurysm and was developing progressive ophthalmoplegia with decreasing visual acuity over the ensuing months, a second neurosurgical procedure was attempted. A craniotomy was performed, and clipping of the left-sided aneurysm was attempted. While exposing the aneurysm neck, which was infraclinoid in location, the aneurysm ruptured and started to bleed. The neck and dome of the aneurysm was wrapped with surgical gauze to prevent further bleeding and the operation was terminated. Surgical reexploration of the aneurysm was considered but thought to be too risky.

The patient was referred for intravascular detachable balloon embolization of her aneurysm. Since the right internal carotid artery was clipped, it was imperative to preserve flow through the left internal carotid artery. The patient was given local anesthesia. From a transfemoral approach, selective catheterization of the left proximal internal carotid artery with a 7.3-French nontapered polyethylene catheter was performed. Five thousand units of heparin was then given intravenously to prevent thrombus formation.

A Hieshima (Patent pending, American V. Mueller, Division of American Hospital Corp., 6600 Touhy Ave., Chicago, IL) detachable silicone balloon [1], which measures 1.5 mm × 4.0 mm uninflated, and 8.0 mm × 13.0 mm inflated, was then attached to a 2.0-French polyethylene microcatheter, placed through the 7.3-French catheter, and, by flow, guided up the petrous and cavernous carotid artery. The balloon was then directed into the aneurysm (Figs. 1C and 1D). The balloon was then filled with precatalyzed 5-hydroxyethyl methacrylate (HEMA) (Patent pending, American V. Mueller, Division of American Hospital Corp., 6600 Touhy Ave., Chicago, IL), a liquid hydrophilic polymer that solidifies and hardens within 60–90 min [2] and remains permanently solidified within the balloon. The balloon was inflated to occlude the neck and dome of the aneurysm and then, by gentle traction, detached after allowing the HEMA to harden for 70 min (Fig. 1E).

After the balloon was detached, the patient was reassessed neurologically and found to be in good condition. The heparin was reversed with protamine sulfate. A postembolization angiogram was performed, which demonstrated the balloon in good position within the aneurysm (Fig. 1F). The dome and body of the aneurysm were excluded by the balloon, and preservation of the carotid artery with good flow to both cerebral hemispheres was apparent. After 24 hr of observation, the patient was discharged in stable condition, with no further complications.

Follow-up angiography at 1 month showed the balloon in continued good position with occlusion of the aneurysm and preservation of the parent vessel. Clinically, at 6 and 8 months postembolization therapy, the patient continues to do well with no further progression of visual symptoms.

Discussion

Intravascular balloon embolization therapy for intracranial aneurysms with preservation of the parent artery is now being performed in selected cases. This was first reported by Serbinenko [3] and later by Romodinov and Shcheglov [4], and Debrun et al. [5]. The largest series was by Romodinov and Shcheglov from the Kiev Research Institute [4]. They reported

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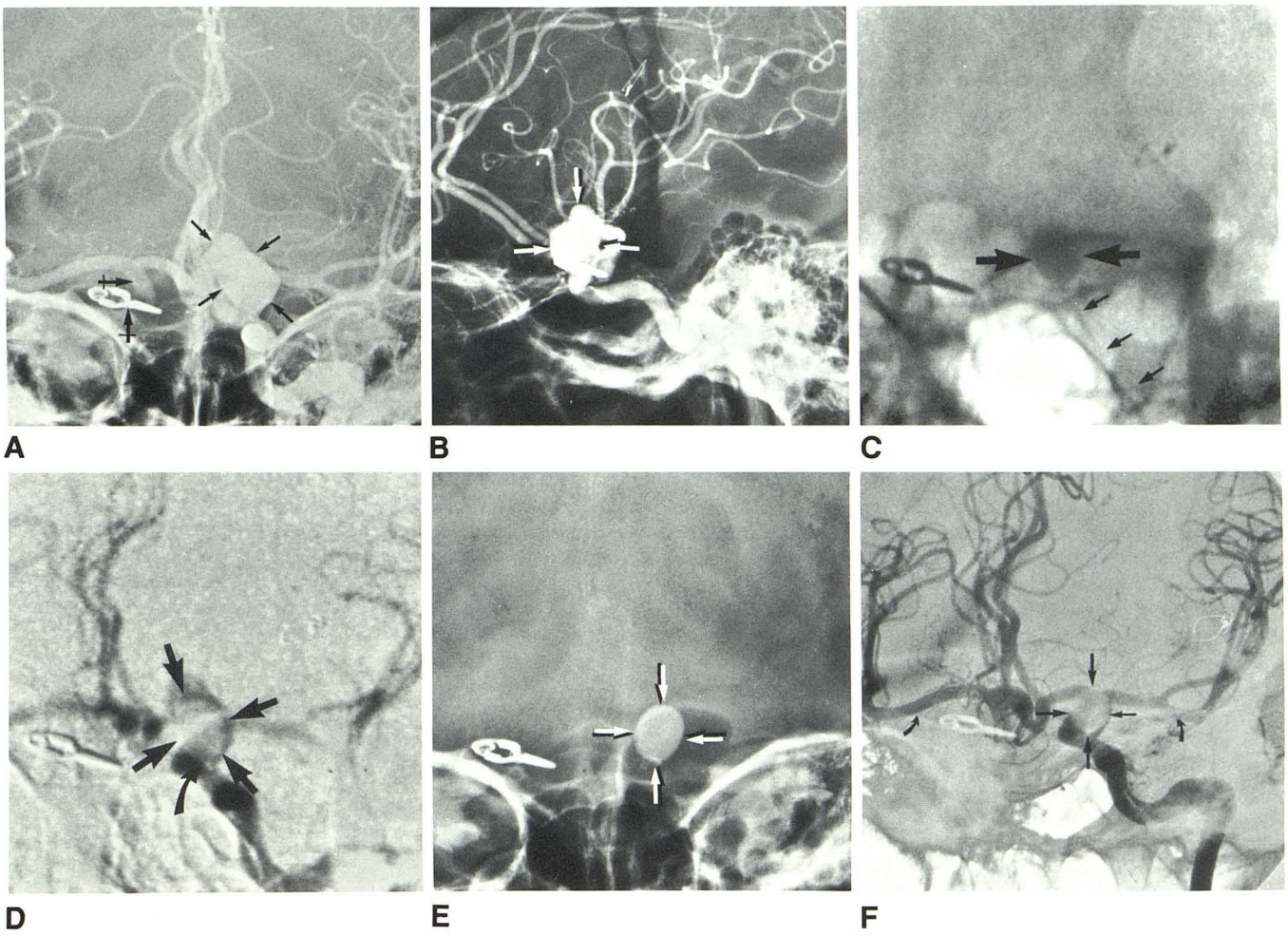

Fig. 1.—Selective left internal carotid artery angiogram anteroposterior (**A**) and lateral (**B**) views show large left-sided carotid-ophthalmic artery aneurysm measuring 20 mm × 12 mm × 10 mm (*arrows*). Right internal carotid artery was surgically clipped (*crossed arrows*) for right carotid-ophthalmic artery aneurysm that ruptured intraoperatively. Right cerebral hemisphere is perfused via anterior communicating artery from left carotid artery. **C**, Silicone balloon (*large arrows*) is within aneurysm and still attached to microcatheter (*small arrows*). **D**, Digital subtraction angiogram shows balloon within aneurysm (*straight arrows*) and preservation of carotid blood flow. Some filling of aneurysm remains around balloon. *Curved arrow* points to base of balloon, which is at aneurysm neck. **E**, Silicone balloon is detached within large carotid-ophthalmic artery aneurysm (*arrows*). **F**, Postembolization subtraction angiogram, in mild oblique position, shows exclusion of aneurysm by balloon (*straight arrows*) and preservation of internal carotid and intracranial circulation. There is some trace filling along lateral aspect of aneurysm, and normal filling of left and right cerebral hemispheres (*curved arrows*) from left internal carotid injection.

on 119 cases, of which they were able to successfully occlude the aneurysm in 93 (78%). In this series, they reported on three carotid-ophthalmic artery aneurysms, of which two were successfully occluded with preservation of the parent artery. In one case, both the aneurysm and carotid artery were obliterated.

Recently, several other authors have reported on the treatment of intracranial aneurysms by detachable balloon embolization therapy [6, 7]. This has, however, involved proximal ligation or trapping of the aneurysm after test occlusion of the parent artery is performed. Primary surgical ligation or the use of clamping the carotid artery has also been used to treat large and giant unclippable aneurysms [8–11]. In these cases, the parent artery is not preserved, and thus would not have been acceptable.

At our institution, intravascular balloon embolization therapy has been used only in patients who have failed standard neurosurgical clipping procedures or are high-risk surgical candidates because of poor medical condition. The procedure is performed with local anesthesia from a transfemoral approach. Thus, aneurysms in both the anterior and posterior circulation can be treated. Constant neurologic function can be monitored since patients are fully awake. If transient ischemia develops owing to balloon encroachment on the parent artery during the procedure, the balloon can be immediately deflated and cerebral perfusion restored. The balloon can then be repositioned. The only disadvantage to this technique is that systemic heparinization is required during the procedure so thrombus does not develop on the catheters or the balloon. The procedure is similar to a cerebral angiogram in discomfort and usually requires 1–2 hr to perform.

Because there is a risk of the balloon deflating or deterio-

rating with time, the balloon is filled with HEMA, a permanent solidification agent that is inert, nontoxic, and stable. It will not deteriorate or produce inflammatory or endothelial changes, as demonstrated in previous animal studies [2, 12].

We now believe that in those cases where an aneurysm neck can be identified, the parent artery can be preserved. Long-term follow-up is required in all these patients because intravascular balloon embolization is still considered a new method of therapy. As more clinical and technical experience is gained in intravascular embolization techniques for treating intracranial aneurysms, the indications for treatment may also expand.

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