Deflation of metrizamide-filled balloon used to occlude a carotid-cavernous fistula

Case report

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A carotid-cavernous fistula was occluded by a detachable latex balloon. Because of technical problems, the contrast-filled balloon was left in a precarious position in the ostium of the fistula. Premature deflation of the balloon would have resulted in intra-arterial migration of the device. Approximately 1 week is required for the balloon to become secured in place by fibrous attachment to the vascular wall. For success, if the ligature is adequate, a detachable Debrun balloon should remain inflated for this period of time. The deflation process was monitored radiographically in this patient. The balloon remained inflated for at least 2 weeks. A short summary of the experience with deflation of various contrast-containing balloon devices in the treatment of carotid-cavernous fistulas is given. Metrizamide may be the best contrast agent for use in these devices.

KEY WORDS □ carotid-cavernous fistula □ detachable latex balloon □ metrizamide □ fibrosis □ embolization

THE standard treatment of carotid-cavernous fistulas has been surgical, however, in certain cases, intravascular balloon devices may provide an effective alternative. These balloons must seal the fistula directly or occlude the carotid lumen until a stable thrombogenic plug develops. Information is lacking on the amount of time these balloons remain fully inflated with contrast material. The present study monitors an Amipaque (metrizamide)-filled balloon by serial radiographs during the successful obliteration of a carotid-cavernous fistula.

Case Report

This 31-year-old male truck driver sustained severe multiple injuries, including a right temporal skull fracture, in a serious automobile accident. He was comatose for 5 days but made a good recovery except for the insidious development of a right carotid-cavernous fistula. He declined treatment for 5 months until the vision in the right eye deteriorated.

Examination. The right eye was markedly protrusice, with reddened swollen conjunctiva. A right sixth nerve palsy was present, and the eye could only distinguish flashes of light. Vision on the left was 20/25. A bruit was audible in both temporal areas and over the right frontal region. Carotid pulsation was strong and he could tolerate right carotid artery compression. Hearing on the right was significantly decreased. The orthopedic injuries were in various stages of mending, and he appeared somewhat slowed mentally.

Right internal carotid angiography demonstrated a large carotid-cavernous fistula (Fig. 1). Left internal carotid angiography was normal, with cross-filling to the right anterior cerebral and middle cerebral arteries. There was no opacification of the cavernous sinuses. Bilateral external carotid angiography was normal. The site of the fistula was localized at the posterior part of the cavernous portion of the right internal carotid artery (Fig. 2).

We decided to attempt obliteration of the fistula by floating an intracarotid Debrun balloon into the cavernous sinus. If the balloon failed to enter the sinus, we planned to proceed with direct operative closure rather than electively block the carotid artery.

Embolization Procedure. Through a percutaneous groin approach, a No. 10 catheter was inserted into the right common carotid artery. A No. 12 Debrun balloon was guided to the region of the fistula by a system of coaxial catheters. From the angiograms it was known that the carotid artery was wide up to the area of the fistula and was narrow distally (Figs. 1 and 2).
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The balloon engaged the ostium but would not enter the fistula. Distention of the balloon occluded the carotid artery as well as the fistula. On several occasions the balloon was deflated, withdrawn into the neck, and floated again into the vertical limb of the carotid artery. At the last attempt, the balloon was distended with metrizamide and was demonstrated to lie against the ostium and protrude into the cavernous sinus. At this point, efforts to withdraw the metrizamide failed. The balloon could accept another small amount of contrast material and was distended with a total volume of approximately 0.35 ml. Presumably, a loop of latex thread must have slipped down the neck of the balloon distal to the orifice of the catheter and turned the free neck into a one-way valve (see Fig. 3).

Three options were considered: 1) overdistend and rupture the balloon with the possibility of arterial damage; 2) add Silastic material with the risk of its escape should the balloon burst; or 3) withdraw the catheter and leave the balloon in its existing position with the chance of rapid deflation and unintentional embolization. The last option was taken, and the introducing system was withdrawn without incident. The patient awoke after the procedure neurologically intact without the subjective bruit that had been present for 3 months.

Postembolization Course. The proptosis and chemosis resolved early. After 4 days the patient began to recognize forms and distinguish male from female faces with his right eye. Serial skull x-ray films were used to monitor the balloon’s status, which did not change during the 1st week after occlusion of the fistula (Fig. 4). By the 14th day, the balloon had changed shape. It was no longer bilobular, but there was no evidence of a decrease in size (Fig. 5).

At 1 month, the right eye appeared normal with full extraocular movements. Vision returned to 20/200 and he appeared more alert. Skull x-ray films demonstrated the markedly deflated balloon remaining in the cavernous sinus. Repeat radiographs 3 months later were similar (Fig. 6).

Fig. 1. Right internal carotid angiogram, lateral view. The carotid-cavernous fistula is filling the enlarged anterior and superior orbital veins. The middle cerebral vein and its tributaries fill in a retrograde manner to the superior sagittal sinus. The basal vein of Rosenthal is also well demonstrated. The right inferior petrosal sinus opacifies to the internal jugular vein. Note that the right middle cerebral arterial branches are barely opacified.

Fig. 2. Left vertebral angiogram, lateral view, during right internal carotid compression. The site of the fistulous rent at the posterior part of the cavernous portion of the carotid (arrow) is well demonstrated by this maneuver.

Fig. 3. Diagram of the distal end of a detachable Debrun balloon. A: The balloon is tied onto the tip of the catheter by latex thread. A second coaxial catheter is used to detach the inflated balloon. B: A band of latex thread slipping over the edge of the catheter would function as a one-way valve. Further contrast material could be forced into the balloon, but any attempts to withdraw fluid failed.
Fig. 4. Skull films, anteroposterior (left) and lateral (right) views. The bilobulated metrizamide-filled balloon is seen in the cavernous portion of the right internal carotid artery. The size, shape, and position of the balloon were unchanged in serial radiographs obtained during the 1st week after occlusion of the fistula. The neck of the smaller lobule (arrow) is in the ostium of the fistula.

Discussion

The precise location of a carotid-cavernous fistula can be determined by regional injection of contrast material via an intracarotid balloon device. The rent may also be identified by Huber's technique of vertebral angiography performed during compression of the ipsilateral cervical carotid artery. Based on this procedure, the average size of these fistulas is 3 mm. Ideally then, the intracavernous placement of a single Debrun balloon may obliterate the fistula while preserving the carotid blood flow. A less desirable alternative involves the simultaneous occlusion of the fistula and internal carotid artery with either the Prolo catheter or the unsuitably rigid Fogarty catheter. Premature deflation of detachable balloons contain-

Fig. 5. Skull films, anteroposterior (left) and lateral (right) views. This film was taken 14 days after the occlusion procedure. The configuration of the balloon has changed; it is now spherical. However, there is no definite loss in volume.
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Fig. 6. Skull films, anteroposterior (left) and lateral (right) views. These films taken 3½ months and those taken 6 weeks after the occlusion are identical. The balloon (arrow) has greatly diminished in size but remains in the cavernous portion of the right internal carotid artery.

ing contrast material, and their subsequent intraarterial migration, is quite worrisome. Technical problems, as in our case, or the problem of dead-space replacement do not always allow for the use of a polymerizing agent which could prevent balloon deflation.21,23 The stability of the contrast-inflated balloon and the time required for its fibrotic encasement are the important considerations in assessing the possibility of embolization.

Several investigators have monitored the deflation of various balloon devices filled with different contrast media. Markham13 observed ex vivo and in vivo the deflation of Fogarty balloons filled with 50% Hypaque (diatrizoate sodium). Sitting alone at normal room temperature and pressure, these balloons deflated within 24 to 48 hours. In treating patients with carotid-cavernous fistulas, Markham saw a No. 2 Fogarty balloon containing 0.2 ml contrast material and a No. 4 Fogarty balloon containing 0.75 ml contrast material deflate over an 18-day and a 2-month period, respectively. Prolo and Hanbery19 used Fogarty devices in seven patients. In three, the catheter had to be externalized at the chest so that the balloon could be reinflated with contrast medium over the course of 1 week. In a fourth patient, the balloon slowly deflated, with partial return of the fistula. Debrun, et al.,3-7 noted that the Debrun detachable latex balloons remained inflated for 2 to 4 weeks, although one apparently deflated within 5 days. When these balloons did deflate rapidly, venous pouches or false aneurysms frequently formed. Fortunately, such complications tended to remain asymptomatic and required no further therapy.7 Mullan, et al.,15 observed the spontaneous decompression of a latex balloon filled with 0.2 ml of Conray over a 60-hour period. They also noted deflation of an intracavernous Debrun balloon containing 0.5 ml of Conray at the end of 3 weeks, but no radiographs were taken in the interval.

Presumably, the vascular obstruction and irritation caused by a balloon initiates the clotting process. The hemostatic plug which forms may develop into a thrombus. As this clot organizes over several days, it is transformed into a scar attached to the vascular wall.16,22 This ultimately anchors the balloon in place. Prolo and Hanbery19 believed that an inflated intra-arterial balloon would thrombose the cavernous segment of the internal carotid artery within 1 week.18 It is crucial that the balloon remain inflated during this period.

Keeping in mind the time required for fibrosis, we resolved to monitor the deflation process radiographically. We decided to use metrizamide in our Debrun Type II balloon, anticipating possible difficulties in replacing the contrast material with polymer. Metriza-
mide is considered to be the ideal contrast agent for use in Silastic balloons because of its low permeability.1 Although no information is available on the permeability of the various contrast agents in latex balloons, we believe that metrizamide might extend the life span of our detachable balloon. Indeed, the balloon retained its size and shape for approximately 2 weeks, providing adequate time for its fibrous attachment to the vascular wall.

With the presently available Debrun detachable balloons, the security of the latex thread ligature is essential for maintenance of the balloon’s volume. Technical modifications in the sealing mechanism of the detachable balloons have not been completely satisfactory.5,11 Debrun, et al.,7 believe that a double-lumen catheter will provide a reliable method for replacement of the full volume of iodine contrast agents by polymer.7

Conclusions

One attractive alternative to the direct surgical approach in the treatment of carotid-cavernous fistulas is the intracavernous placement of a detachable Debrun balloon with preservation of carotid blood flow. However, with any new technique, technical problems arise. Premature deflation of a detachable balloon, especially one that is precariously positioned, may result in intraradial migration with disastrous consequences. The balloon must remain inflated for approximately 1 week to guarantee its fibrous attachment to the vascular wall. Provided the ligature is secure, these contrast-containing latex balloons should remain inflated for this length of time. Metrizamide may be the best contrast agent to select for use in these devices.

References


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