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Deflation of Detachable Balloons in the Cavernous Sinus by Percutaneous Puncture

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Summary: The authors show that percutaneous puncture of balloons within the cavernous sinus is technically feasible and allows further access to the cavernous sinus after balloon detachment. Complete closure of a large carotid cavernous fistula was achieved in the 37-year-old trauma victim they treated using this technique.

Index terms: Fistula, carotid-cavernous; Fistula, therapeutic blockade; Catheters and catheterization, balloons

Closure of traumatic carotid cavernous fistulae using detachable balloons is well described (1-6) in the literature. Occasionally, despite initial closure of the fistula, it may reopen after balloon detachment due to slight movement or shifting of the balloon. Gaining further access to the cavernous sinus through the fistula can be problematic due to partial occlusion by the detached balloon(s).

We describe a case where a high-flow traumatic carotid cavernous fistula recurred on two separate occasions after balloon detachment. Subsequent puncture of inflated, detached balloons in the cavernous sinus by a percutaneous approach through foramen ovale allowed further access to the cavernous sinus through the fistula.

Case Report

A 37-year-old man sustained severe head injury during a motor vehicle accident. Five weeks later he developed symptoms of a carotid cavernous fistula. His intraocular pressure was raised (28 cmH₂O).

Selective left internal carotid arteriography demonstrated a direct carotid cavernous fistula of the C5 segment of the cavernous carotid artery (Figs. 1A and 1B).

During an initial transarterial endovascular approach, three #9 Debrun detachable latex balloons (Ingenor, Paris, France) were placed through the traumatic carotid cavernous fistula (TCCF) into the cavernous sinus. The angiogram obtained just prior to detachment of the third balloon showed that the fistula was occluded (Fig. 1C). Immediately after detachment, a small leak developed, due to slight shifting of the balloons (Fig. 1D). After 48 hours, there was no evidence of spontaneous thrombosis.

An additional balloon could not be passed through the fistula on the second attempt due to the in situ balloons obstructing the fistula. The inferior petrosal sinus was occluded on the ipsilateral side; therefore, the only other potential endovascular therapeutic options included occlusion of the internal carotid artery or retrograde transvenous approach through the superior ophthalmic vein, which can be technically difficult.

To improve access through the fistula into the cavernous sinus, two of the balloons were punctured percutaneously via the foramen ovale using a 21-G spinal needle without complication (Fig. 1E). Three additional Debrun balloons were then introduced into the cavernous sinus (total of four inflated balloons) with complete closure of the fistula. Approximately 24 hours later, a small leak was again evident on examination.

This leak also failed to thrombose spontaneously, and further percutaneous puncture of three of the balloons was performed before allowing an additional balloon to be introduced. On this occasion an 18-G needle was inserted into the foramen ovale. This needle was used as an introducer for a second, slightly bent, 21-G Chiba needle, which could be guided into the cavernous sinus to puncture the three balloons. The inferior aspect of the cavernous sinus was now thrombosed, and the last balloon was wedged at the fistula orifice. The final balloon resulted in complete closure of the fistula with preservation of the internal carotid artery (Fig. 1F). Both the immediate postdetachment and a follow-up angiogram 4 days later confirmed satisfactory results. In both instances the latex Debrun balloons were punctured without difficulty. It is possible that the more elastic silicone balloons would be harder to puncture by this technique.

Discussion

Traumatic carotid cavernous fistulae are due to laceration of the internal carotid artery in the cavernous sinus or rupture of C4 or C5 intracav-
Fig. 1. A, Early arterial phase of internal carotid arteriogram (lateral projection) showing fistula site (arrow).
B, Later phase showing aneurysmal dilation of the cavernous sinus (CS) and retrograde filling of the dilated superior ophthalmic vein and numerous cortical veins.
C, Appearance just prior to detachment of the third Debrun 49 latex balloon (B) showing occlusion of the fistula with preservation of the internal carotid artery.
D, Angiogram obtained 48 hours later showing leakage around the balloons, which have migrated.
E, Fluoroscopic image showing needle placed percutaneously into cavernous sinus through foramen ovale (open arrow).
F, Final internal carotid arteriogram showing occlusion of the fistula and preservation of the carotid artery. Metal clips mark deflated balloons (arrows). There are two remaining inflated balloons (B).

Cerebral dural branches. Balloon occlusion is the established method of choice for treatment of these lesions when caused by carotid laceration (1–6). Although the literature indicates that the lesion may thrombose spontaneously when only minimal filling of the fistula persists after embolization (1), this did not occur in our case.

The technique of percutaneous puncture of Meckel’s cave via foramen ovale is well described in the neurosurgical literature (7) for the treatment of trigeminal neuralgia by glycerol injection and for biopsy of cavernous masses. This technique requires fluoroscopic guidance with the patient positioned in a submentovertex projection with
15–20 degrees of contralateral rotation. The needle is inserted 2 cm lateral to the corner of the mouth and advanced submucosally in the sidewall of the oral cavity, medial to the ascending ramus of the mandible. Once Meckel's cave is entered, the needle need only be advanced a few millimeters with lateral fluoroscopic guidance to reach the cavernous sinus. Although it is possible that cranial nerves might be injured by this technique, in large series in which this technique was used for glycerol injection of the trigeminal nerve, other cranial nerve injury is exceedingly rare and usually temporary. Since ophthalmoplegia is commonly associated with traumatic carotid cavernous fistula, detection of additional injury to cranial nerves may be difficult. No complications occurred in this patient following percutaneous puncture of balloons on two separate occasions by this method. The deflated balloons remained in the cavernous sinus and contributed to the volume of thrombogenic material present. Interestingly, upon removal of the needle stillet in the cavernous sinus, brisk arterial bleeding as one might expect from a cavernous sinus in fistulous communication with the internal carotid artery was not noted. Rather, the bleeding was of a slow venous nature. This is probably because the cavernous sinus is actually a septated structure. Potentially, puncture of a cavernous sinus in direct communication with the internal carotid artery could result in life-threatening arterial bleeding. For this reason, we had an uninflated detachable balloon immediately available to occlude the internal carotid artery at the fistula if it became necessary.

There are philosophical differences among practitioners as to whether contrast medium or a polymer such as HEMA (hydroxyethylmethacrylate) is the best agent to be placed inside a detachable balloon. Had HEMA or a similar polymer been used in this instance, the deflation technique described would not have been suitable, since these polymers are semisolid. In any event, it is unlikely that the agent used to fill the balloons had any impact on the recurrence of the fistula. In serial skull films, the balloons did not show evidence of deflation, but rather had migrated or shifted within a very patulous cavernous sinus. We attribute this effect to the presence of soft thrombus within the cavernous sinus, which yielded to the pulsatile mass effect of the balloons in contact with the carotid artery.

Percutaneous puncture through foramen ovale for trigeminal neurolysis is an established and safe neurosurgical technique. Others have reported this approach for deflation of detached silicone balloon(s) in the cavernous sinus when there is chronic pain associated with treatment of TCCFs (8), or for biopsy of masses in the cavernous region. Percutaneous puncture of nonideally placed balloons within the cavernous sinus was technically feasible in this case and allowed further access to the cavernous sinus after balloon detachment, ultimately allowing complete closure of this large TCCF with presentation of the parent artery.

References

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