Intravascular balloon embolization of a large mid-basilar artery aneurysm

Case report

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A patient who presented with multiple episodes of subarachnoid hemorrhage was diagnosed as having a large mid-basilar artery aneurysm that had no definable surgical neck. Balloon embolization was performed utilizing two detachable silicone balloons to occlude the mid-basilar artery and the aneurysm. The procedure was carried out with the patient fully awake and alert. One day after the procedure, the patient developed pontine and cerebellar ischemia which completely resolved after 5 days on heparin therapy. A follow-up angiogram performed immediately after the procedure and at 3 months demonstrated complete occlusion of the mid-basilar artery and the aneurysm. The patient was intact neurologically upon discharge 5 days after the embolization procedure and has since resumed his normal activities. Balloon embolization therapy may offer some advantages over surgical methods for the treatment of such therapeutically challenging aneurysms.

KEY WORDS • interventional neuroradiology • embolization • basilar artery aneurysm

INTRAVASCULAR balloon embolization therapy for treating neurovascular lesions was first described in 1974. With improved techniques including development of detachable balloons, mini-catheters, permanent solidification agents, and real-time digital subtraction angiography, the use of detachable balloons for the treatment of aneurysms is now possible. The treatment of choice is to occlude the aneurysm while preserving the parent vessel.

The patient described here had a large mid-basilar artery aneurysm with no definable neck. Thus, the parent artery could not be preserved, and the mid-basilar artery had to be occluded to obliterate and treat the aneurysm. The aneurysm arose just above the anterior inferior cerebellar arteries (AICA's) and at the level of important pontine perforating branches. The procedure was carried out with the patient fully awake, so that close neurological monitoring could be performed. This is the first reported case of intravascular detachable balloon embolization therapy for a large mid-basilar artery aneurysm.

Case Report

This 23-year-old man had a history of intermittent severe headaches for 18 months. The first headache lasted 6 weeks; it occurred in the lower occipital and upper cervical region and was exacerbated by lateral movement of the head and neck. He also had one episode of sudden loss of consciousness lasting 20 minutes, not associated with a seizure. Several weeks prior to admission, his headaches began increasing in severity and intensity. The headaches spread to both occipital and temporal regions and were associated with a moderately stiff neck. Clinically, it was thought that the patient was having multiple episodes of subarachnoid hemorrhage.

A computerized tomography brain scan demonstrated a large contrast-enhancing mass lesion anterior to the brain stem. A cerebral angiogram confirmed the presence of a large mid-basilar artery aneurysm measuring 8 × 15 × 17 mm, arising just superior to the AICA's (Fig. 1). The aneurysm had no well-defined
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FIG. 1. Vertebral angiogram, Towne's projection, showing a large irregular mid-basilar artery aneurysm arising just above the anterior inferior cerebellar arteries. Multiple projections demonstrate no definable neck for surgical attack. Both posterior communicating arteries filled well from the carotid artery injections. The patient was referred to our institution for further evaluation and treatment. After consultation with personnel from neurosurgery, neurology, and neuroradiology, the patient was advised to have the aneurysm treated by intravascular balloon embolization therapy.

A baseline clinical examination showed that the patient was neurologically intact. Using local anesthesia, a femoral artery puncture was performed followed by selective placement of a No. 7.3 French catheter into the proximal left vertebral artery. A Hieshima detachable balloon occluder system, partially inflated so as to be carried along by flowing blood, was advanced from the vertebral artery into the basilar artery.

The first test occlusion was performed at the base of the basilar artery aneurysm (Fig. 2 left). The balloon was inflated to cause occlusion of the aneurysm neck and mid-basilar artery. Within 10 to 15 seconds of the start of the test occlusion, the patient noted distortion of hearing and the onset of severe occipital headaches. At 3 minutes, he complained of a loud "roaring noise" and then hearing loss. The balloon was deflated and his sense of hearing returned to normal after 5 to 7 minutes. These symptoms were attributed to transient occlusion at the level of the AICA's.

The balloon was then advanced beyond the aneurysm and placed into the distal basilar artery (Fig. 2 left). A second test occlusion was performed. Within 20 to 30 seconds, the patient developed coarse lateral gaze nystagmus, slurred speech, and skewed deviation of the eyes. At 1 minute, a right central facial palsy developed, followed by lethargy and then unresponsiveness to loud verbal stimuli or deep pain. The balloon was deflated and he slowly recovered over 15 minutes. His rapid deterioration was attributed to transient occlusion of perforating vessels to the pons and midbrain.

The balloon was then placed within the aneurysm and inflated. The patient developed mild vertical and horizontal nystagmus with upward and lateral gaze. No other focal changes were noted after 15 minutes. The balloon was deflated and filled with 2-hydroxyethyl methacrylate (a liquid hydrophilic polymer that solidifies within the balloon over 60 to 90 minutes) and detached (Fig. 2 right). The polymer is used in case the...
silicone balloon deteriorates over time. Neurologically, the patient was alert and oriented and only had a mild right central seventh nerve palsy, minimal left horizontal gaze nystagmus, and a positive right Babinski sign. A repeat angiogram demonstrated the balloon in the superior aspect of the aneurysm with subtotal occlusion at its base (Fig. 3). The basilar artery was still patent. The patient was discharged home the next day in good condition.

Since the aneurysm was not completely occluded by the first balloon and the patient continued to have severe headaches, he was readmitted 5 weeks later for a second detachable balloon embolization procedure. This time, the balloon was placed so as to completely occlude the basilar artery and aneurysm above the level of the AICA’s. Test occlusion for 15 minutes was well tolerated and the balloon was detached (Fig. 2 right). The patient left the neuroangiography area in stable neurological condition.

The next day he developed mild slurred speech, weakness of his right arm and leg, and dysmetria on finger-to-nose testing. A repeat cerebral angiogram demonstrated complete occlusion of the mid-basilar artery and the aneurysm. In addition, there was thrombus identified just distal to the balloon which could potentially occlude pontine and mid-brain perforating vessels. Both AICA’s filled well from the vertebral artery injection, and both posterior cerebral and superior cerebellar arteries filled well from the carotid artery injections. Magnetic resonance imaging confirmed pontine and cerebellar ischemia. The patient was started on a course of intravenous heparin and observed. Over 5 days, he recovered coordination and strength in his right upper and lower extremities and his speech returned to normal. His medication was changed to oral coumadin and he was discharged with only a subtle right hemiparesis.

At 3 months, a repeat cerebral angiogram was performed. Both balloons were intact without change in size or position. The angiogram demonstrated continued complete occlusion of the mid-basilar artery and the aneurysm. There was good filling of both AICA’s (Fig. 4). The patient was neurologically normal. The coumadin was discontinued and he was started on a course of aspirin, 5 grains/day. He has since returned to his normal activities and continues to do well 18 months following embolization therapy.

**Discussion**

Intravascular balloon embolization for occlusion of major cerebral vessels was first reported by Serbinenko in 1974. Serbinenko utilized both fixed and detachable balloons for temporary and permanent occlusion of intracranial vessels to treat carotid-cavernous sinus fistulas and aneurysms associated with arteriovenous malformations, and for investigations of collateral blood flow. At our institution, we have been performing balloon embolization of intracranial aneurysms since 1982. If possible, we prefer to directly enter and occlude the aneurysm, while preserving the parent vessel. This is not possible for large and giant ectatic aneurysms that have no well-defined neck as in the case presented here. All of our procedures are carried out with the patient

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**Fig. 3.** Single detachable balloon (1, *arrows*) in dome of aneurysm. Subtotal occlusion with filling of the lower aspect of the aneurysm (*crossed arrow*).

**Fig. 4.** Vertebral angiogram 3 months postembolization of mid-basilar artery and aneurysm. Both silicone detachable balloons (1 and 2) are in a good position (*arrows*). There is complete occlusion of the aneurysm and normal filling of the anterior inferior cerebellar arteries (*crossed arrows*).
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fully awake so that constant neurological testing can be performed. This is an extremely important technical aspect, especially in procedures involving the vertebro-basilar system. If the patient cannot tolerate test occlusion, the balloon can be deflated, perfusion restored, and the balloon repositioned. In this case, the patient did not tolerate occlusion of the basilar artery either inferior or superior to the aneurysm. The balloons had to be placed directly into the aneurysm to perform occlusion.

Giant intracranial aneurysms have been defined as those exceeding 2.5 cm in diameter and large aneurysms are between 12 and 25 mm. It is postulated that these aneurysms arise from smaller saccular aneurysms which gradually enlarge. Eventually the neck also enlarges in a spherical fashion, and later becomes bulbous and ectatic and incorporates the artery wall at the neck base. As the aneurysm enlarges, the parent artery is splayed out into the neck to the point of entering and leaving the aneurysm from separate locations. In these instances, the parent vessel can no longer be preserved if the aneurysm is to be obliterated.

The largest surgical experience for treatment of basilar artery aneurysms is that of Peerless and Drake. In their initial experience with direct basilar artery occlusion for seven patients with giant aneurysms, two patients worsened and two died when the aneurysm was trapped by ligation of the parent vessel. They have since modified their procedure by utilizing a tourniquet around the parent vessel. A Prolene suture is placed around the basilar artery just below the aneurysm and left protruding from the head. The patient is then awakened from anesthesia and catheterization of the vertebral artery is performed. The tourniquet is tightened by hand to occlude the basilar artery and checked by serial angiography, and the patient is monitored clinically. This method was applied in 13 subsequent patients, of whom six had poor results and seven had good results in the mid-basilar artery territory below the superior cerebellar artery. Complications developed from spontaneous dissection of the parent vessel due to the suture, premature thrombosis due to surgical manipulation, and the necessity to change the position of the tourniquet if the initial occlusion site was not tolerated.

The technique we utilize is essentially a modification of this technique using detachable balloons. A balloon can be placed in the desired site under direct fluoroscopic control and inflated. The patient is neurologically evaluated, and if occlusion is tolerated, the balloon is detached. The entire procedure is carried out under local anesthesia. The patient is observed overnight and is discharged to his home the next day if no neurological symptoms develop. If a good site for detachable balloon occlusion cannot be found, other options such as extracranial to intracranial bypass may be performed prior to vessel occlusion by balloon embolization.

In conclusion, balloon embolization therapy may be useful in certain cases of surgically difficult or inaccessible intracranial aneurysms. It offers the advantages of local anesthesia and direct, immediate neurological evaluation during occlusion of an aneurysm and/or parent vessel.

References


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