Migration of detachable mini-balloon from the ICA causing occlusion of the MCA

Case report

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This patient had an aneurysm on the internal carotid artery that was responsible for episodes of severe hemorrhage through the nose. During occlusion of the aneurysm by a detachable balloon, the balloon became dislodged and migrated, obstructing the middle cerebral artery territory and causing a life-threatening situation. This was treated promptly and successfully by removal of the balloon and repair of the artery. Attention is drawn to the risk of such migration occurring, and the possible causes.

KEY WORDS - cerebral aneurysm - carotid artery - balloon occlusion - middle cerebral artery occlusion - embolectomy complication

IN 1978, Debrun, et al., introduced the technique of detachable-balloon catheterization to the western world for the treatment of carotid-cavernous sinus fistulas. Prior to this, Serbinenko described in 1974 the use of balloon catheters to selectively occlude intracranial cerebral vessels either temporarily or permanently. These methods have been used at our institution with gratifying results. The purpose of this communication is to report an unusual complication that developed when we attempted to occlude a traumatic internal carotid artery (ICA) aneurysm with a detachable mini-balloon. The complication was managed successfully.

Case Report

This right-handed 33-year-old man received a blow to the head from a billiard cue in October, 1981. He was rendered unconscious for a short period of time and, upon regaining consciousness, was discovered to be blind in his left eye. Several weeks after the injury, he began to have episodes of ferocious pulsatile left-sided epistaxis. Over this period of time he received 22 replacement units of blood. Because of these episodes he was referred to the University Hospital Neurosurgery Service in January, 1982. He presented with another episode of pulsatile epistaxis from the left nostril, accompanied by a severe headache. Physical examination revealed an amaurotic left eye with optic atrophy. The neurological examination was otherwise unremarkable. Plain radiographs of the skull revealed fractures through the frontal bone on the left side.

Serial angiography revealed an aneurysm of the cavernous segment of the left ICA (Fig. 1 left). A second smaller aneurysm was also visualized more distally, at the origin of the left ophthalmic artery. While in the hospital, the patient continued to have episodic epistaxis. Treatment alternatives considered included Crutchfield clamp occlusion of the ICA in the neck, an ICA occlusion in the neck combined with an intracranial procedure to trap the aneurysm, or detachable-balloon occlusion of the ICA in the region of the aneurysm neck.

Repeat cerebral angiography 11 days after admission showed no changes in the size or configuration of the aneurysms (Fig. 1 right). Right ICA injection and vertebral artery injection with compression of the left ICA revealed excellent collateral supply of the left anterior and middle cerebral arteries and posterior communicating arteries. Therefore, the decision was made to occlude the left ICA at the level of the ophthalmic artery and its aneurysm, using the detachable-balloon technique. Occlusion at this level would
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![Image](https://example.com/image1)

**FIG. 1.** *Left:* Left common carotid arteriogram, anteroposterior view, on January 8, 1982. The traumatic aneurysm is indicated by black arrows. The curved arrow points to the segment of the artery where the mini-balloon was placed. *Right:* Lateral left internal carotid arteriogram on January 19, 1982. The traumatic aneurysm is indicated by two short arrows. A second traumatic aneurysm on the ophthalmic artery is shown by a long arrow. The curved arrow points to the segment of the artery where the mini-balloon was placed.

oblitrate the ophthalmic artery aneurysm and, by retrograde thrombosis of the ICA, would also obliterate the more proximal aneurysm of the cavernous segment projecting into the sphenoid sinus.

**Operation.** On January 27, 1982, a mini-balloon was introduced as planned under local anesthesia. First, a trial occlusion of the ICA was performed by inflating the balloon in place for 7 minutes (Fig. 2 left). The patient suffered no ill effects and developed no neurological deficit. Accordingly, the balloon was detached at the level of the ophthalmic artery and its aneurysm, and the ICA was completely occluded. The patient remained well for 15 minutes after occlusion of the artery. He then suddenly became agitated and lethargic, and developed a right hemiplegia and aphasia. A lateral skull radiograph revealed that the balloon had become dislodged and migrated into the left middle cerebral artery (MCA) (Fig. 2 right). Upon this discovery, airway and ventilatory control was immediately established, and steroids and barbiturates were administered intravenously. Preparations were made for emergency craniotomy and MCA embolectomy. Despite our best efforts, however, the time from embolization and blockage of the MCA until release of the balloon amounted to 5 hours.

Figure 3 depicts the arterial anatomy and the position of the balloon as it was found at operation. The balloon filled the MCA from just distal to its point of origin from the ICA and was held by the trifurcation of the MCA into its branches. Not only were the trifurcation vessels occluded, but the lenticulostriate vessels arising from the MCA were also compromised.

The surgical procedure consisted of a routine left frontotemporal craniotomy with removal of the outer sphenoid wing and opening of the Sylvian fissure. This allowed excellent exposure of the entire carotid artery and the middle and anterior cerebral arteries with minimal retraction of the frontal and temporal lobes. Under magnification, the site of the balloon was identified. Temporary clamps were placed on the ICA, the anterior cerebral artery, and the trifurcation vessels (Fig. 3 right). A small arteriotomy was made in the MCA proximal to the trifurcation. The balloon was expelled by the column of blood behind it. There was weak retrograde bleeding from the trifurcation vessels, but no significant back-bleeding was noted from the perforating vessels of the main trunk of the MCA. The arteriotomy was closed with running 10-0 Prolene sutures. The clamps were released and patency restored to the vessel.

**Postoperative Course.** For the first 24 hours postoperatively, the patient was maintained in barbiturate coma. As he slowly regained consciousness, it was apparent that he had a dense right hemiparesis and marked dysphasia. These deficits slowly resolved over the next few weeks. Computerized tomography revealed a small low-density lesion in the anterior limb of the left internal capsule. On February 12, 1982, a repeat cerebral angiogram revealed patency of the left MCA and its distal branches (Fig. 4). The lenticulostriate vessels also filled. Remarkably, the ICA aneurysm was no longer seen. Follow-up examination 2 months later revealed total resolution of the patient's
**FIG. 2.** Left: Lateral left common carotid arteriogram, 8 seconds after the injection and after placement of the mini-balloon. The stagnant contrast material in the internal carotid artery is indicated by the two open arrows, the mini-balloon by the curved arrow, and the attached catheter by the arrowheads. The ophthalmic artery, indicated by the two small arrows, has been opacified through the external carotid artery. Right: Arteriogram after the mini-balloon became dislodged. The loose mini-balloon is shown embolized into the origin of the left middle cerebral artery (curved black arrow). A curved open arrow points to the position where the mini-balloon had been placed (dotted line).

**FIG. 3.** Drawings made at the time of surgery. Left and Inset: The balloon is seen distending the middle cerebral artery (MCA) and completely blocking it and its branches. Right: Temporary clamps were placed, and the balloon was expelled through an incision in the MCA. ACA = anterior cerebral artery.
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Fig. 4. Follow-up left common carotid arteriogram on February 12, 1982. The white open arrow shows the location of the mini-balloon after being dislodged. The black curved arrow shows its location at the time of placement. The traumatic aneurysm is no longer opacified, and its site is marked by the short arrow.

Discussion

This case is presented as an example of an unusual complication of the detachable-balloon technique for vascular occlusion. It should be recognized that the balloon can become dislodged and migrate. Temporary MCA occlusion in the sub-human primate has been used as an experimental model of transient ischemic attack in the laboratory. It is clear from these studies that only a short period of ischemia can be tolerated without permanent nerve tissue damage. However, this time interval varies from subject to subject because of differential potential for development of collateral blood supply. This patient suffered only a small internal capsule infarct, and survived with no neurological deficit even with complete occlusion of his MCA for approximately 5 hours. This is a tribute to his collateral flow via the anterior and posterior cerebral anastomosis. Also the use of barbiturates may have added some protection to the ischemic brain. We believed that reestablishment of flow in the left MCA was mandatory. Permanent and catastrophic consequences would have been the result of a conservative course. If detachable-balloon procedures are planned, the facilities and expertise required for MCA embolectomy should be available.

An interesting sidelight to this case is the fact that the offending aneurysm was found to be thrombosed on the postoperative angiogram. We postulate that the brief period of ICA occlusion that occurred with the initial placement of the balloon was sufficient to produce thrombosis within this aneurysm. This would agree with the experience described by Kessler and Wholey.

The reason for migration of the balloon is unclear. A possible explanation is that the balloon became partially deflated and dislodged from its initial position, producing embolization. For this patient, a 1-mm self-detachable balloon catheter system, inflatable to widths of 4 to 5 mm, was selected. We considered that this size of balloon would be sufficient to occlude the distal portion of the ICA. Whatever the cause of the balloon migration in our case, it would be less likely to occur if a larger balloon or the double-balloon technique had been used. When a second balloon is lodged below the first, the arterial pressure head is prevented from reaching the distal balloon and thus the chance of its becoming dislodged is reduced.

To our knowledge, this is the first report of embolization with a detachable balloon producing severe neurological deficits and requiring MCA embolectomy. In a recent article by Barrow, et al, concerning the complications of the detachable-balloon technique and the treatment of carotid-cavernous sinus fistulas, a complication was reported that was thought to be the result of a thromboembolism lodged in the MCA. However, in that case the occlusion of the artery was incomplete and the patient remained neurologically intact.

Conclusions

The detachable-balloon technique is useful for the occlusion of intracranial vessels, but is not without risk. The inflatable size of a balloon intended for occlusion of a large vessel with strong flow, such as the ICA, should be at least 1½ times the diameter of that vessel. This should prevent migration of the balloon. However, if embolization by the balloon does occur, urgent surgical removal is necessary.

References


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