Successful Management with Glue Injection of Arterial Rupture Seen during Embolization of an Arteriovenous Malformation Using a Flow-Directed Catheter: A Case Report

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We present a case in which an arterial rupture occurring during embolization of an arteriovenous malformation of the left occipital lobe with a flow-directed microcatheter, was successfully sealed with a small amount of glue. We navigated a 1.8-Fr Magic catheter through the posterior cerebral artery, and during superselective test injection, extravasation was observed at the parieto-occipital branch. The catheter was not removed and the perforation site was successfully sealed with a small amount of glue injected through the same catheter. Prompt recognition and closure of the perforation site is essential for good prognosis.

Index terms:
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To achieve effective and permanent obliteration of a cerebral arteriovenous malformation (AVM), a liquid embolic agent such as *N*-butyl cyanoacrylate (Histoacryl; Braun, Melsungen, Germany) should be injected within the nidus, or in feeders as close to the nidus as possible, via a microcatheter (1). Two types of microcatheters are available for this purpose: the over-the-wire system (e.g. Tracker, Transit, Jetstream), and the flow-directed system (e.g. Magic, Zephyr, Mini-Torquer). The former requires considerable wire/catheter manipulation, and this can stretch and potentially damage the intima of tortuous vessels. A prime example of the latter system is the Magic catheter (4), which is flow-directed and consistently allows rapid, less traumatic, and distal access to high-flow AVMs. Several reports have described the vascular perforation that can occur during neurointerventional procedures. Rupture of a vessel is usually related to guidewire manipulation and the use of a steerable microcatheter such as the Tracker (2, 3). The over-the-wire system has, however, gradually been replaced by one using very floppy, flow-directed catheters (4), and in recent years, the use of microcatheters of this type for endovascular embolization has undergone considerable technical evolution. The frequency with which periembolic complications arise during AVM-related procedures has thus decreased. Even so, during endovascular embolization using flow-directed microcatheters, perforation of a vessel may occur at vessel angulations - or in associated congenital, flow-related feeder, or intranidal aneurysms - as a result of the greater stiffness of the wire as compared with the microcatheter (5). It is therefore important that before undertaking embolization procedures, the practicioner is aware of the possibility of iatrogenic rupture. We describe a case in which arterial rupture occurred during AVM embolization with a flow-directed catheter, and was treated by the injection of glue through the same catheter.

CASE REPORT

A 42-year-old man, who had complained of seizure and headache, was admitted to another hospital, where angiography and CT revealed an AVM in the left occipital lobe, with hematoma (Fig. 1A). He was referred to our hospital for preoperative embolization. Preembolic cerebral angiography revealed a left-sided occipital AVM fed by the left posterior parietal artery and branches of the left posterior cerebral artery (Fig. 1B).

After local anesthesia, a 6-Fr guiding catheter was positioned in the high cervical internal carotid artery using the femoral approach and the Seldinger method. To prevent systemic coagulation, 5000 units of heparin was used, and to ensure that the anticoagulative effect was adequate, an activated clotting time of greater than 300 seconds was employed. Throughout the procedure, all catheters were continuously flushed with saline. Using a flow-directed 1.8-Fr Magic catheter (Balt, Montmorency, France) and a hydrophilic Terumo 0.010 wire (Terumo, Tokyo, Japan), selective catheterization was performed. The tip of the Magic catheter was J-shaped, with steaming, and initial embolization was attempted via the left posterior parietal artery; for assessment of this vessel, a 1.8-Fr Magic catheter combined with a Terumo 0.010 wire was employed. Using a mixture of 1 ml of histoacryl and 3 mL of lipiodol, embolization was successfully performed.

A second embolization was then attempted. Guided by a Terumo 0.010 wire, a 1.8-Fr Magic microcatheter was advanced by flow control through the left vertebral artery into a branch of the posterior cerebral artery. The wire did not extend beyond the tip of the catheter, as commonly occurs in the standard microcatheter/wire system, and the microcatheter was subsequently advanced into a turn approximately 1.5 cm from the nidus, at which point it failed to progress. At this juncture, superselective test injections were carried out. A lateral injection demonstrated no evidence of extravasation, but an anteroposterior injection revealed the extravasation of contrast medium at the point at which the parieto-occipital branch changed direction, at the a site of the microcatheter tip, approximately 1.5 cm from the nidus (Fig. 1C). The patient immediately complained of a slight headache. The position of the Magic microcatheter was not changed and angiography was again performed; this time neither occlusion of the parieto-occipital branch nor contrast medium extravasation at the rupture site was seen. Anticoagulative measures were not reversed.

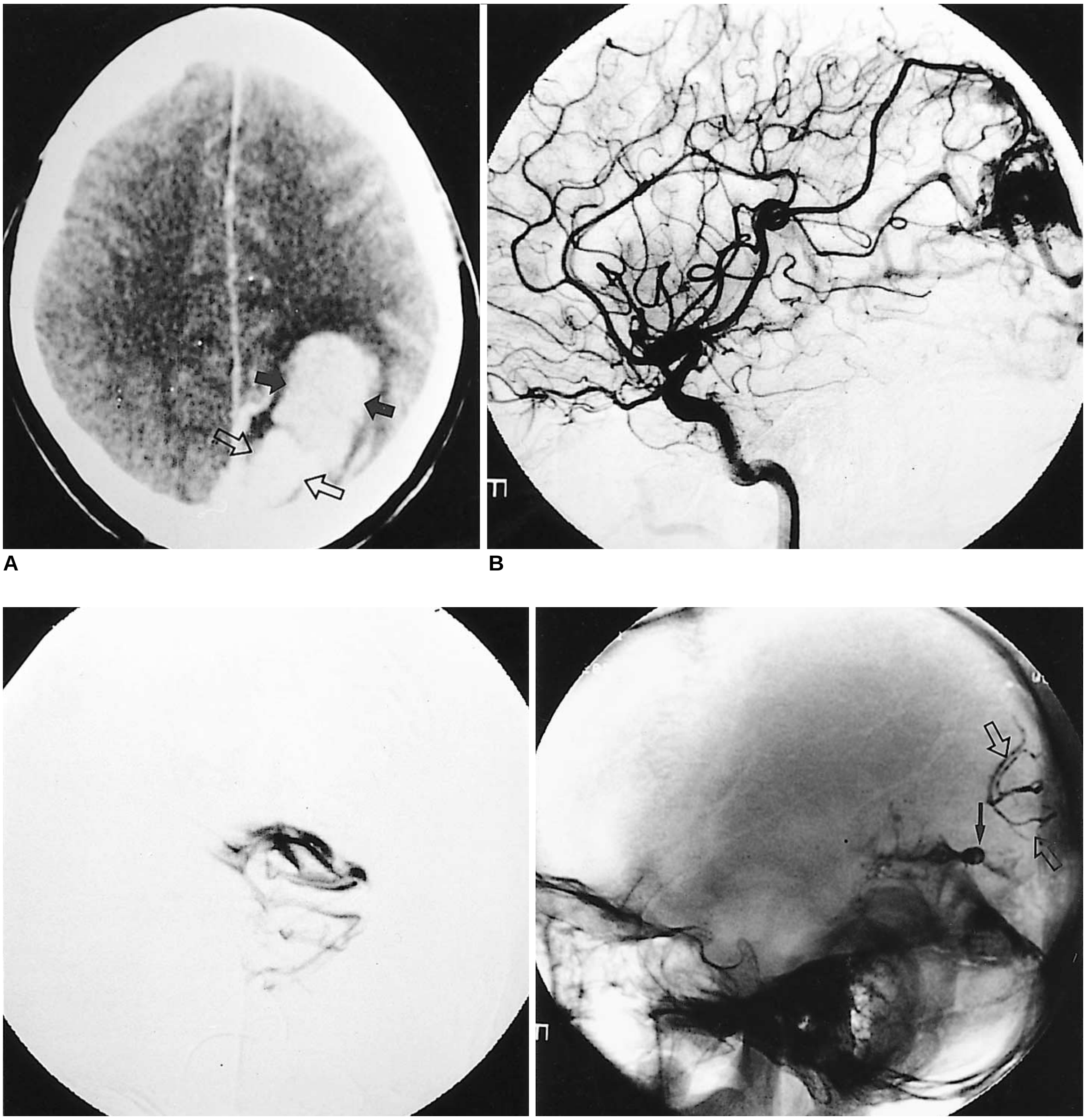
We believe that arterial rupture had occurred at the point at which the parieto-occipital branch turned sharply, approximately 1.5 cm from the nidus. Because no changes had been made to the microcatheter or position of the wire, the reason for perforation was thought to be over-injection rather than catheter wedging. The tip of the Magic catheter was located extravascularly, so in order to occlude the site of arterial rupture, the distal portion of the microcatheter was positioned at the perforation site. The extravascular compartment were sealed with a small amount of a 40% mixture of histoacryl and lipiodol, injected through the same Magic catheter (Fig. 1D), then the patient's headache disappeared completely. Control vertebral angiography revealed occlusion of the perforation site, with subtle narrowing at the point at which the parieto-occipital branch changed direction. This vessel was reselected and the feeder, including the sealed perforation site, was occluded. The remaining feeders of the posterior cerebral artery were occluded with a 25% mixture of histoacryl and lipiodol. Control angiography of the vertebral artery after embolization revealed complete anatomic cure of the AVM. Extravasation of the contrast medium was no longer evident (Fig. 1E). After embolization and surgery, two days later, the patient no longer complained of neurologic symptoms or headache.

DISCUSSION

Although several reports have dealt with the vascular perforation that can occur during neurointerventional procedures, none has -to our knowledge- described vessel perforation by a flow-directed microcatheter itself and management of the perforation using this same microcatheter. The outcome of vascular perforation has ranged from asymptomatic to massive hemorrhage and death (2, 3).

Rupture of a vessel is usually related to guidewire manipulation and the use of steerable microcatheters such as the Tracker catheter (2, 3). For the embolization of brain AVMs, the variable, stiff, guidewire-guided microcatheter has thus been gradually replaced by the very floppy, flow-directed catheter (4). Since January 1996, we have used the hydrophilic Terumo 0.010 wire in conjunction with the 1.8-Fr Magic microcatheter for superselective catheterization of the nidus of AVMs. The wire does not extend beyond the catheter tip, as is commonly seen in standard microcatheter/wire systems. Endovascular embolization using flow-directed microcatheters has undergone considerable technical evolution in recent years, and during AVM-related procedures, periembolic complications are now less frequent than before. Even so, during endovascular embolization using flow-directed microcatheters, perforation of a vessel may occur at vessel angulations or in associated aneurysms -whether congenital, flow-related feeder, or intranidal -due to the fact that the wire is stiffer than the microcatheter (5).

The mechanisms involved in arterial perforation during neurointerventional procedures have been described in several reports (2, 6) and fall into three groups: mechanical



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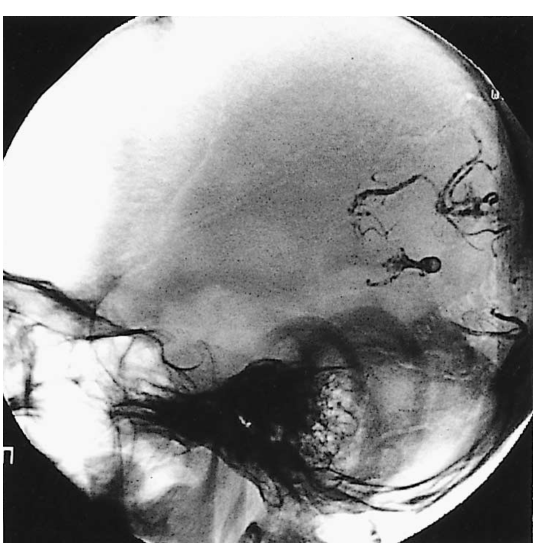

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Fig. 1. A. Axial enhanced CT reveals a left occipital arteriovenous malformation (open arrows). A hematoma (arrows) is seen in the left parietal lobe. No feeding artery appears in this section.
B. Lateral angiograms of the left internal carotid artery disclose an occipital arteriovenous malformation fed by the left posterior parietal artery and branches of the posterior cerebral artery.
C. Anteroposterior test injection shows contrast extravasation into the subarachnoid space at the point at which the parieto-occipital branch changes direction, the site of the microcatheter tip, approximately 1.5 cm from the nidus.
D. Plain lateral view shows a mixture of histoacryl and lipiodol after occlusion of the arterial rupture with glue (arrow), and change in the position and shape of the initial extravasation of contrast medium is seen. Note the presence of glue cast arising from initial embolization of the left posterior parietal artery (open arrows).
E. Plain lateral view obtained 139 minutes after initial contrast extravasation shows no evidence of further extravasation.

perforation of a normal vessel, mechanical disruption of a dysplastic vessel or aneurysm, and fluid overinjection (2). We consider that in our case, perforation occurred due to the overinjection of contrast medium at a sharp angulation.

The management of arterial rupture occurring during embolization has included surgical closure of the perforation, closure with various embolic materials, or conservative management(2). We believe that the most expeditious treatment is occlusion of the perforation by embolization via the offending catheter.

Despite new developments in the field of flow-directed microcatheters and associated techniques, arterial rupture may occur during the embolization of AVMs. For good prognosis, prompt recognition and closure of the perforation site by embolization via the offending catheter are essential.

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