Embolization of a traumatic arteriovenous fistula of the scalp with radiopaque Gelfoam pledgets

Case report and technical note

DAVID L. KASDON, M.D., L. REED ALTEMUS, M.D., AND BENNETT M. STEIN, M.D.
Departments of Radiology and Neurosurgery, Tufts University School of Medicine and The Boston Veterans Administration Hospital, Boston, Massachusetts

A large traumatic arteriovenous malformation of the scalp was embolized with Pantopaque-saturated Gelfoam pledgets, which made fluoroscopic monitoring of the radiopaque emboli possible. Postembolization angiography demonstrated complete occlusion of the malformation. There is still no clinical or physical evidence of recurrence after an 8-month follow-up period.

KEY WORDS • embolization • arteriovenous malformation • traumatic fistula

The embolization of arteriovenous malformations (AVM's) has proved effective both as a preoperative adjuvant to surgical resection and as a definitive method of treatment.\textsuperscript{1,7,8} In extracranial malformations perfused entirely by branches of the external carotid artery, a contraindication to embolization is a large direct arteriovenous fistula. When they are voluminous, such communications permit injected emboli either to arrest on the venous side of the lesion or to migrate to the pulmonary circulation. We embolized a large traumatic arteriovenous fistula of the scalp with large sterile radiopaque Gelfoam pledgets introduced by cutdown catheterization and injected under direct fluoroscopic control. These emboli were saturated with Pantopaque to render them radiopaque. This technique has not previously been described.

Case Report

A 52-year old man sustained a severe scalp laceration 3 years prior to admission. Shortly after the trauma, he noted progressive enlargement of a tender, pulsatile mass involving the right frontal region. He also was disturbed by the unsightly dilatation of forehead veins, a bruit in the right ear, and severe headaches. The persistence of these signs and symptoms led to his hospitalization.

Examination. The general physical and neurological examinations were normal. Large vascular channels were visible beneath the skin of the right frontal area with dis-
tended draining veins present over both frontal and parietal regions. A bounding, superficial temporal artery pulse was palpable on both sides, more so on the right. There was a loud bruit audible over the entire scalp and associated with a strong thrill over the right frontal area. Several defects in the galea were present at the regions of greatest thrill. Digital compression of the right superficial temporal artery diminished but did not obliterate the bruit, thrill, or pulsatile mass. Compression of both superficial temporal arteries reduced the pulsatile mass incompletely. On March 17, 1975, a percutaneous transfemoral cerebral angiogram was performed with selective catheterization of both right and left internal and external carotid arteries. Serial filming of the right internal carotid injection established the absence of any contribution from the intracranial circulation. The right external carotid study opacified a huge AVM of the scalp supplied by branches of the superficial temporal artery and the right posterior occipital artery, but with no contributions from the meningeal circulation (Fig. 1 upper left). A voluminous draining vein was also promptly opacified; it drained into the superficial temporal vein, preauricular vein, and subsequently the external jugular vein. Other large venous channels drained anteriorly into the facial, angular, and ophthalmic veins on the right. Dural veins or sinuses were not opacified. A left common carotid injection

FIG. 1. Upper Left: Pre-embolization selective right external carotid angiogram. The traumatic arteriovenous fistula (arrow) is fed primarily by anterior (a) and posterior (p) branches of the superficial temporal artery, and drained by the superficial temporal vein (v). Lower Left: Postembolization selective right external carotid angiogram. Multiple radiopaque Gelfoam pledgets (arrows) totally occlude anterior and posterior superficial temporal artery branches. Note three metallic clips localizing initially injected emboli within the venous side of the fistula. Lower Right: Postembolization film without angiography showing positions of radiopaque Gelfoam pledgets within superficial temporal artery branches. Those within proximal common trunk (arrow) subsequently migrated to distal branches.
Embolization of AV scalp fistula

FIG. 2. Left: Pre-embolization left carotid angiogram demonstrating contributions from the left superficial temporal artery (arrowhead). Direction of flow indicated by wavy arrow. Right: Post-embolization selective left external carotid angiogram. Dilated contributions from left external carotid artery have returned to normal caliber (arrowhead).

disclosed a few arterial contributions from the left superficial temporal artery (Fig. 2 left).

Embolization Technique. On March 27, 1975, venous extension tubing with an outside diameter of 0.123 in. was threaded into the right external carotid artery until the tip was distal to the origin of the superior thyroid artery. Using sterile technique, we introduced individual strips of Gelfoam averaging $3 \times 3 \times 20$ mm through a three-way stopcock and a glass syringe. Both stopcock and syringe had been previously redrilled to accept a larger pledget than the standard bore would accommodate. The initial non-saturated emboli were tagged with silver clips and three were injected. Radiographs localized these emboli within the venous side of the circulation (Fig. 1 lower left and right). In order to monitor the appropriate size and progress of subsequent emboli to be injected, the strips were rendered opaque by saturating them with Pantopaque. As a result, it was possible to follow the progress and final position of the individually injected pledgets all of which remained on the arterial side of the malformation. Fifteen pledgets were necessary to occlude the fistula and all feeding vessels from the right external carotid artery. Embolization was discontinued when flow to the malformation ceased. The catheter was then removed and the right external carotid artery doubly ligated.

Postoperative Course. A dramatic reduction in the size of the pulsatile mass was immediately apparent without evidence of blanching, coolness, or other signs of skin ischemia. Over the next 4 days all bruits disappeared and the pulsatile mass completely regressed. The patient tolerated the procedure well, complaining only of mild discomfort of the right scalp. He was discharged 10 days after embolization. On April 19, 1975, he was readmitted for reevaluation. Physical examination demonstrated regression of the lesion and no masses or dilated vascular channels were seen. A follow-up selective left external carotid angiogram demonstrated no opacification of the malformation (Fig. 2 right). The most recent follow-up visit, approximately 8 months after embolization, confirmed the continued obliteration of the lesion both subjectively and on clinical examination.

Discussion

Transcatheter embolization of both intracranial and extracranial cerebral AVM’s is currently a recognized method of treatment,
Materials used for embolization include opaque plastic spheres, muscle, metallic beads, Teflon balls, Spongostan, china beads, and gelatin sponge (Gelfoam). Studies and clinical experience have established the non-antigenic and non-irritating qualities of Gelfoam. Light and Prentice recognized both the thrombotic effect of this material as well as the ability of phagocytes to eventually absorb it. In addition, it is easy to inject and may be readily tailored to appropriate size. Gelatin sponge is radiolucent, however, and requires angiography to monitor both the effect and position of emboli. Metallic clips and gold film have been attached to Gelfoam emboli to render them opaque, but to our knowledge Pantopaque saturation has not been described. The ability to inject and immediately follow the progress of large radiopaque pledgets is extremely useful for a number of reasons. The appropriate size necessary to arrest an embolus on the arterial side of the fistula can be quickly determined without multiple contrast injections and serial angiography. Also, the progress of emboli inadvertently entering the venous side of the circulation can be monitored. Furthermore, even voluminous lesions can be embolized with less fear of failure or complications. Finally, since the ultimate goal is the production of permanent thrombosis of the fistulous communications, perhaps the added cellular reaction of intravascular Pantopaque supplements the occlusive process. This is speculative, for the exact mechanism of intravascular toxicity of Pantopaque is not known. Emulsification of Pantopaque by blood is thought to account for its cellular reaction, which theoretically might enhance thrombosis of these lesions.

References

Address reprint requests to: L. Reed Altemus, M.D., Department of Radiology, Maine Medical Center, Portland, Maine 04102.