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AJNR Am J Neuroradiol 2012, 33 (3) E36-E37
doi: https://doi.org/10.3174/ajnr.A2424
http://www.ajnr.org/content/33/3/E36

TECHNICAL NOTE

Superselective Indocyanine Green Angiography for Selective Revascularization in the Management of Peripheral Cerebral Aneurysms

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SUMMARY: This report describes the management of a fusiform peripheral middle cerebral artery aneurysm by endovascular parent artery occlusion under bypass protection. Localization of the recipient cortical artery was accomplished after craniotomy by superselective injection of diluted ICG dye via a microcatheter positioned proximal to the aneurysm. This report demonstrates that superselective ICG angiography can be a beneficial alternative technique to identify the best anastomosis site intraoperatively.

ABBREVIATIONS: DSA = digital subtraction angiography; ICG = indocyanine green; MCA = middle cerebral artery; PAO = parent artery occlusion

Intracranial fusiform aneurysms occurring beyond the circle of Willis are rare and challenging lesions.[1-5] Possible therapeutic strategies include deconstructive techniques such as trapping and endovascular PAO as well as reconstructive techniques such as direct clipping and stent reconstruction.[1,4,6-11] Deconstructive procedures are often performed under bypass protection to preserve cerebral perfusion distal to the occluded aneurysm.[3-5] Correct localization of the cortical recipient artery distal to the aneurysm is of importance for selective revascularization. Identification of this branch is possible by surgical dissection, neuronavigation, and stereotactic techniques as well as intraoperative DSA.[12-15]

In this technical case report, we describe the management of a fusiform peripheral MCA aneurysm by endovascular PAO under bypass protection. Localization of the recipient cortical artery was accomplished after craniotomy by superselective injection of diluted ICG dye via a microcatheter positioned proximal to the aneurysm.[1,16] Fluorescent activity in the corresponding distal cortical artery was detected under the operation microscope.

Case Report/Technique

A 21-year-old woman was admitted with the incidental MR imaging finding of a 10-mm vascular lesion in the posterior limb of the left insular cistern (Fig 1*A*). DSA disclosed a fusiform peripheral MCA aneurysm (Fig 1*B*). In view of the eloquence of the dependent distal vascular territory, surgical trapping and endovascular PAO were considered impracticable. Stent reconstruction of the aneurysm was considered but deferred because of the tortuosity of the aneurysm and the caliber mismatch between the proximal and distal parent arteries. The decision was made to occlude the aneurysm under bypass protection. Because the team of vascular neurosurgeons involved in the management of cerebral aneurysms at our center is cross-experienced in the surgical and endovascular management of cerebrovascular lesions, a strategy of endovascular PAO immediately after bypass surgery was developed.

A 5F sheath was placed at the right groin and a 5F macrocatheter was advanced into the left common carotid artery. The frontal branch of the superficial temporal artery was of sufficient size and was used as the donor vessel for an arterial low-flow bypass. After microsurgical dissection of this branch, craniotomy, and dural opening, an SL 10 microcatheter (Boston Scientific, Fremont, California) was coaxially advanced through the macrocatheter into the left MCA and navigated under fluoroscopic road-mapping control to a superselective position proximal to the aneurysm. Thereafter, selective angiograms were obtained, and the position and morphology of the distal cortical recipient artery were assessed (Fig 1*C*). ICG dye (ICG-PULSION; PULSION Medical Systems, Munich, Germany) was then applied via a peripheral vein (25 mg), and the morphology of the cortical vasculature at the craniotomy site was studied under an operation microscope (Zeiss Pentero; Carl Zeiss, Oberkochen, Germany; Fig 1*D, -E*). After 10 minutes, 2 mL of ICG dye diluted to 0.1 mg/ml was injected superselectively via the microcatheter into the parent artery of the aneurysm. Under the operation microscope, fluoroscopic activity could be detected selectively in the vascular territory supplied by the injected artery and a suitable cortical recipient artery could be identified easily (Fig 1*F*). After withdrawal of the microcatheter, bypass surgery was completed (Fig 1*G*). At the end of the operation, another microcatheter access to the aneurysm was performed, and endovascular PAO was accomplished by using detachable coils (Fig 1*H*). The correct localization of the anastomosis was verified by selective intraoperative DSA of the external carotid artery territory (Fig 1*I*).

Discussion

In this article, we describe the intraoperative identification of a cortical recipient artery for selective revascularization of a peripheral vascular territory. The technique described may not be necessary in all cases of small peripheral aneurysms, where the distal recipient artery may easily be identified by surgical dissection. However, when selective revascularization of a distal vascular territory is required in the management of larger or more complex peripheral aneurysms and endovascular expertise is available, this technique can be a reasonable alternative. Intraoperative microcatheter manipulations were easily possible, and monoplane imaging quality was comparable to that of standard endovascular angiography

Received August 26, 2010; accepted September 29.

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http://dx.doi.org/10.3174/ajnr.A2424

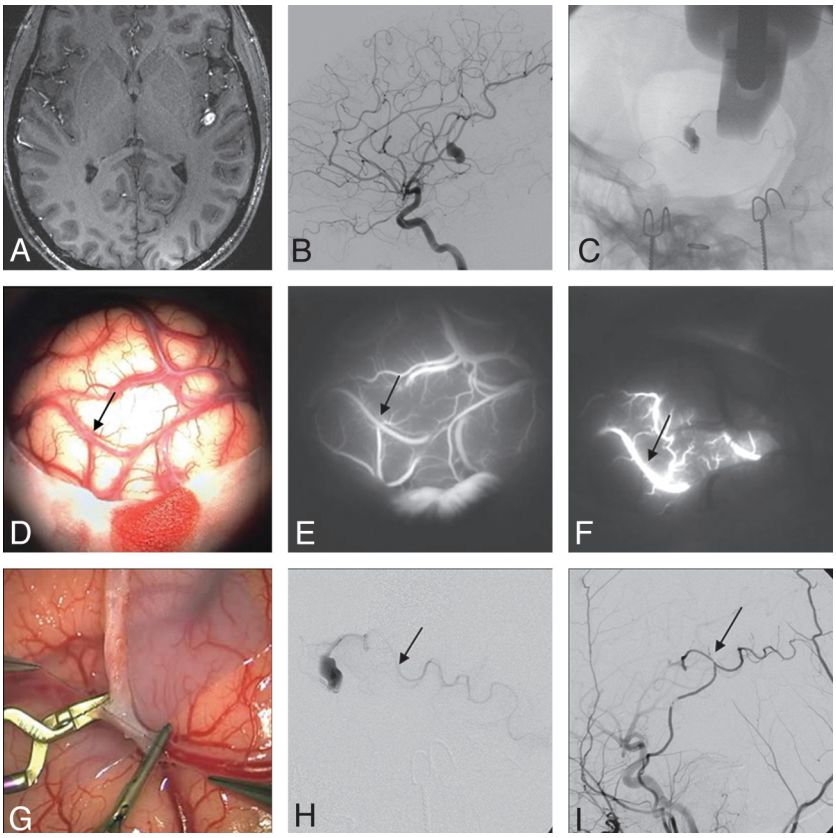

Fig 1. *A* and *B*, MR imaging and DSA detecting a fusiform peripheral left MCA aneurysm. *C*, Intraoperative superselective microangiography demonstrating the aneurysm and the distal cortical recipient artery for selective revascularization. *D* and *E*, Microsurgical exploration and intravenous ICG angiography showing the cerebral vasculature at the craniotomy site. *F*, Microcatheter ICG injection (0.1 mg/ml) selectively opacifies the vascular territory distal to the aneurysm. *G*, Selective revascularization via a monopedicle arterial low-flow bypass is performed with the anastomosis site within the previously identified vascular territory. *H* and *I*, Control angiograms before and after aneurysm occlusion demonstrating bypass patency and correct selective peripheral revascularization. Arrows indicate later anastomosis site.

suites. Permanent flushing of all catheter systems with heparinized saline is mandatory to avoid thromboembolic complications and did not adversely affect coagulation intraoperatively. The concentration of the ICG dye for intra-arterial injection was adjusted to simulate arterial ICG concentrations after intravenous bolus injections. Because the operation room setup allowed for endovascular interventions and the catheter systems were already in place, the aneurysm was obliterated via the endovascular route. The most suitable surgical or endovascular technique to obliterate such aneurysms is usually chosen individually on a case-by-case basis, and it is not the purpose of this report to advocate either technique.

Conclusions

Peripheral intracranial aneurysms can be managed effectively by surgical or endovascular PAO under bypass protection.[3-5] When selective revascularization of a vascular territory distal to the aneurysm is required, localization of the correct cortical recipient vessel is of importance. Superselective ICG angiography as described in this report can be a beneficial alternative technique to identify the best anastomosis site intraoperatively.

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