Giant serpentine middle cerebral artery aneurysm treated by extracranial-intracranial bypass

Case report

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Giant intracranial aneurysms often pose difficult management issues. Such aneurysms may not be amenable to direct surgical attack because of their size, location, or lack of a clear aneurysmal neck. In such cases, a combination of strategies may provide a means of proximal aneurysm occlusion and distal cerebral revascularization.

The authors report the successful treatment of a giant (186.8-ml) serpentine aneurysm of the left middle cerebral artery (MCA) in a 14-year-old boy. The aneurysm was managed in a two-stage procedure in which the MCA branches distal to the aneurysm were anastomosed first with branches of the left superficial temporal artery. After the bypass procedure, direct occlusion of the MCA was performed at the proximal base of the aneurysm at its site of dilatation. The patient had no intraoperative or postoperative complications and was intact neurologically 6 months following the procedures.

Key words • giant serpentine aneurysm • cerebral revascularization • extracranial-intracranial bypass • middle cerebral artery

The treatment of giant aneurysms of the cerebral vessels can pose difficult management issues. Aneurysms of the cerebral circulation with a clear neck are typically treated by conventional aneurysm clipping; however, some giant aneurysms of the cerebral circulation are not amenable to a direct surgical approach because of their location or size. The development and refinement of cerebral revascularization techniques have added a new dimension to the treatment of giant intracranial aneurysms.

We report a patient with a fusiform aneurysm of the left middle cerebral artery (MCA). This case is noteworthy because of the exceptionally large size of the aneurysm, which occupied about 20% of the cranial vault and was successfully treated in two stages. An extracranial-intracranial (EC-IC) bypass to the blood vessels at the distal end of the aneurysm was followed by direct clip occlusion of the MCA at the proximal base of the aneurysm.

Case Report

This 14-year-old right-handed boy was admitted to our neurosurgical service with a history of intermittent headaches. Four weeks before admission, he was examined at another facility for fever and possible sinusitis. Plain skull films revealed areas of intracranial calcification. Computerized tomography (CT) of the head, with and without contrast enhancement, showed a large mass in the distribution of the left MCA. The mass extended frontally and laterally to involve the right frontal region (Fig. 1).

Examination. On admission, the patient was neurologically intact and had no evidence of language dysfunction. Mild papilledema was evident on funduscopic examination. The patient had no gait abnormalities. Cerebral angiography revealed a partially thrombosed giant aneurysm that arose from the left MCA. The medial portion of the aneurysm filled, and a serpiginous lumen of contrast medium coursed through the largely thrombosed portion of the aneurysm (Fig. 2 left). This lumen filled slowly and supplied blood to two distal left MCA branches arising directly from the lateral aspect of the giant aneurysm (Fig. 2 right).

Because the aneurysm was so large, additional preoperative evaluation was performed. Magnetic resonance (MR) imaging studies were obtained, including MR angiography. These studies confirmed the presence of a giant, partially thrombosed aneurysm with residual
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FIG. 1. Contrast-enhanced axial computerized tomography scan demonstrating an extremely large irregular-shaped mass within the left frontotemporal region. The mass extends across the midline to the right side with marked distortion of the surrounding brain parenchyma and ventricular system.

Flow through a serpiginous lumen within the thrombosed portion of the aneurysm (Fig. 3 left); MR angiography also demonstrated flow through the lumen supplying the two distal MCA branches that arose from the lateral aspect of the aneurysm (Fig. 3 right). Data from CT and MR imaging were entered into an Allegro work station* for three-dimensional display and volumetric analysis. The volume of the aneurysm was calculated to be 186.8 ml.

Operations. In the first of the two planned operations, a large pterional-type craniotomy was performed while the patient was under barbiturate electroencephalography burst suppression following dissection of the superficial temporal artery (STA) and two of its distal branches. After the dura was opened, the aneurysm could be seen in the expanded sylvian fissure. Careful microsurgical dissection around the lateral aspect of the aneurysm exposed the two distal MCA branches arising from the distal end of the aneurysmal lumen. The outflow of these two vessels was occluded with aneurysm clips. The vessels were transected, and the distal ends were anastomosed in an end-to-end fashion with the two branches of the STA. During this operation, no attempt was made to expose the proximal partial medial portion of the aneurysm or to open it for thrombectomy. At the end of the procedure, an ipsilateral external ventricular drain was placed in the parieto-occipital region.

Postoperatively, the patient had no complications and remained in the intensive care unit for 7 days.

During this period, his intracranial pressure remained normal. A postoperative cerebral angiogram revealed slow but persistent opacification of the residual medial portion of the large aneurysm near its origin. No residual flow through the serpiginous lumen was visible, however, indicating complete thrombosis of that portion of the aneurysm (Fig. 4 left). The STA-MCA anastomoses were patent, and external carotid angiography showed improved distal filling of the MCA branches (Fig. 4 right).

On the 8th postoperative day, the patient underwent the second stage of surgical treatment through the same craniotomy. The two aneurysm clips previously placed at the distal outflow sites were removed. The aneurysm was then opened at its lateral portion, and intraluminal thrombus was removed with a Cavitron ultrasonic surgical aspirator† and small pituitary rongeurs. This partial decompression improved retraction for continued subfrontal and sylvian dissection. The proximal carotid artery and carotid bifurcation were exposed. The bifurcation was displaced medially, as seen on the preoperative angiograms (Fig. 2). The superomedially oriented proximal MCA was followed distally to its origin in the aneurysm. Two lenticulostriate branches originated just proximal to the aneurysm and were carefully preserved. The MCA was occluded as it enlarged into the aneurysm. After MCA occlusion, the aneurysm was opened widely and additional extensive thrombectomy was performed to decompress the surrounding brain. The aneurysmal sac was then closed.

Postoperative Course. The patient again did well postoperatively. Three days after surgery no evidence of aneurysm filling was seen on cerebral angiography, although mass effect was still present (Fig. 5). The left

* Allegro work station manufactured by ISG Technologies, Toronto, Ontario, Canada.

† Aspirator manufactured by Valleylab, Inc., Boulder, Colorado.
STA-MCA bypass regions were patent and showed good filling of the distal distribution of the MCA. The patient's intracranial pressure remained low and the ventriculostomy was removed. He recuperated from surgery without incident and was discharged from the hospital 7 days later. At a 6-month follow-up examination, the patient was neurologically intact and no daily activities were compromised.

**Discussion**

The surgical treatment of giant aneurysms of the anterior circulation may involve direct clipping (if a neck is present and amenable to clip placement), proximal parent feeding-vessel occlusion, or a combination of proximal ligation with EC-IC bypass for revascularization of distal vessels. In some cases, giant aneu-
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**Fig. 5.** Angiograms, anteroposterior (left) and lateral (right) views, obtained after the second operative procedure demonstrating complete obliteration of the aneurysmal lumen with preserved flow to the lenticulostriate branches arising from the proximal middle cerebral artery.

Aneurysms may be amenable to direct aneurysmorrhaphy. Because of their unusual morphology, many aneurysms larger than 2.5 cm in diameter cannot be clipped. Only 67 of the 174 giant aneurysms treated by Drake were amenable to direct occlusion of the neck. Ischemic complications limit the utility of proximal artery occlusion alone. In cases of giant cerebral aneurysms that are not amenable to direct clipping, the treatment of choice is a combination of proximal occlusion with distal revascularization. In such cases, proximal occlusion must be complete and there should be no postoperative filling of the aneurysm to avoid the possibility of postoperative aneurysm rupture.

After review of several major series of surgically treated giant aneurysms, Spetzler and Carter noted that these aneurysms involved the MCA in 11% of cases. The anterior cerebral artery was the least frequent location of giant aneurysms (9%). Surgical treatment of giant aneurysms of the anterior circulation typically results in a good outcome. However, cases exist in which exceptionally large aneurysms of the anterior circulation, which are not thought to be amenable to surgical treatment, cause occlusion of parent arteries and death.

Aneurysms larger than 2.5 cm were originally referred to as unusually large, but are now commonly considered to be giant. The aneurysm described in this report can be thought of as a giant serpentine aneurysm. Such aneurysms reveal tortuous vascular channels within the body of an otherwise largely thrombosed aneurysm, with associated slow circulation. These aneurysms have accounted for as many as 17.6% of giant aneurysms in a recent series. Giant serpentine aneurysms are most commonly found on the MCA. The tortuous vascular pathways created within the aneurysm are thought to result from "jet-flow" phenomena. The MCA distribution appears to be well suited for producing conditions in which jet flow can cause the appropriate stagnation of blood flow because there are fewer surrounding structures to prevent the growth of aneurysms.

Unlike the case described by Sutherland, complete organization of the thrombus within the giant aneurysm was not present in our case. It was not thought necessary to perform a complete thrombectomy, as the mass effect present did not confer neurological deficits. Although the methods used in this patient's treatment have been described previously, the case is of interest because of the exceptionally massive size of the aneurysm and the successful outcome achieved after treatment.

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