Treatment of a Giant Aneurysm of the Right Middle Cerebral Artery with GDCs after Extracranial to Intracranial Bypass

A Technical Case Report

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Summary

A case of a giant aneurysm of the right middle cerebral artery treated with Guglielmi detachable coils is reported. Extracranial to intracranial bypass had previously been performed and surgical trapping had been attempted.

During the endovascular procedure, balloon test occlusion of the middle cerebral artery was performed in order to demonstrate clinical and angiographic tolerance to parent vessel occlusion. A previous occlusion test in the right common carotid artery did not show sufficient flow through the bypass to perform safe parent vessel occlusion.

Diagnostic imaging, the endovascular procedure, and haemodynamic aspects in cases in which parent vessel occlusion is required after extracranial-intracranial bypass are described and the literature is reviewed.

Case Report

A 17-year-old man who presented after two episodes of disturbed consciousness was admitted to hospital after an MR study demonstrated a large mass in the right Sylvian fissure void of signal indicative of flowing blood (figure 1).

Cerebral angiography showed a large giant aneurysm of the right middle cerebral artery

(MCA). Cortical branches of the MCA arose from the posterior aspect of the aneurysm and the lateral M1 segment was also involved (figure 1).

During vertebral contrast injection there was no filling of the right MCA territory or ipsilateral carotid compression.

A superficial temporal artery (STA) MCA bypass was performed in an attempt at surgical trapping. Intra-operative angiography was performed immediately to determine the integrity of the arterial bypass.

Surgical trapping was then attempted, but left-side hemiparesis developed during clipping of the lateral M1 segment with the patient awake. Surgical trapping was therefore ruled out as an option, and the patient was referred to our hospital for endovascular treatment.

Embolisation was performed under neuroleptic analgesia that allowed close clinical and electroencephalographic monitoring. Systemic anticoagulation was achieved by means of an intravenous bolus of 5000 IU of heparin administered at the beginning of the procedure followed by 1000 IU every hour. A bifemoral arterial approach was used to assess bypass flow during a temporary balloon occlusion performed to demonstrate angiographic tolerance to MCA occlusion.

Figure 1 A) T2-weighted MR axial image showing a large mass void of signal in the right Sylvian fissure, indicative of flowing blood. B) Angiogram (anteroposterior view) of the right internal carotid showing a giant aneurysm of the right middle cerebral artery (MCA). C) Cortical branches of the MCA arising from the aneurysm.

In order to verify bypass patency, balloon test occlusion (BTO) of the right common carotid artery (CCA) was performed using a ZEPPELIN double lumen balloon catheter (Micro Interventional Systems, CA, USA) with placement of a second catheter coaxially in the proximal portion of the right external carotid artery (ECA). A right ECA angiogram during the right CCA occlusion demonstrated filling of one branch of the posterior division of the right MCA through the bypass (figure 2).

A second BTO was performed in the lateral right M1 segment adjacent to the origin of the aneurysm (GRAPEVINE 10 catheter, Micro Interventional Systems, CA, USA) for 30 min

with systemic heparinization while the patient was awake, in order to confirm clinical tolerance to parent vessel occlusion. Tests did not show any neurological deficit. Injection of the right ECA during right MCA occlusion revealed good filling of the cortical right MCA territory through the bypass without retrograde filling of the aneurysm (figure 3).

The aneurysm was catheterized with a TRACKER 18 microcatheter (Target Therapeutics, CA, USA) and endosaccular occlusion of the aneurysm was performed with MCA sacrifice using GDCs of an appropriate size (figure 4).

The patient was closely monitored in the

intensive care unit for 48 h with continued administration of heparin. The patient was discharged 3 d after the procedure under a regimen of antiplatelet therapy.

During clinical follow-up the patient remained asymptomatic at 12 months.

Discussion

Giant aneurysms account for approximately 5% of all intracranial aneurysms. Most giant aneurysms result from the growth of smaller saccular aneurysms. In the rarer fusiform variant of giant aneurysm, the beginning of the aneurysm is not related to the origin of a branch artery. When fusiform aneurysms reach giant size, they are in many cases indistinguishable from giant saccular aneurysms¹.

A common feature of giant aneurysms is the difficulty of therapeutic management, which often requires a combination of techniques. Optimal treatment comprises complete exclusion of the aneurysm from cerebral circulation by surgical or endovascular methods or a combination of the two procedures.

Drake et al² reported their experience in the treatment of 335 giant aneurysms of the anterior circulation. In all, 55 of these aneurysms were located in the MCA. In 26 cases, neck clipping was performed, but in another 29 cases clipping was considered impossible and different treatment techniques were used: wrapping, excision, reconstruction, trapping, and proximal occlusion with or without preliminary bypass. However, surgical dissection of the M1 segment may be problematical in cases of giant aneurysms, and poor outcomes were achieved in 20% of patients who underwent Drake tourniquets for proximal occlusion².

The same authors also reported on their experience in 120 patients with giant fusiform intracranial aneurysms treated surgically.

Thirteen of these aneurysms were located in the MCA. Good or excellent outcomes were reported in 62% of the cases. The operative morbidity rate was 23%, including a single death from rupture of a previously intact aneurysm¹.

Endovascular treatment has now attained an important place in the therapeutic arsenal for treating giant intracranial aneurysms. Most giant aneurysms can be treated safely by means of parent vessel occlusion or endovascular trapping using GDCs or balloons without having to

Figure 2 A) Balloon occlusion of the right common carotid artery (CCA). B) During CCA occlusion, injection of the right external carotid artery (ECA) showed poor filling of the cortical branches of the right MCA through the bypass.

fill the lumen of the aneurysm, achieving contraction of the aneurysm. In opposition to surgery, the endovascular approach allows pre-embolisation testing of tolerance by means of an Amytal test or balloon test occlusion in a fully conscious patient. Cortical flow and lenticulostriate circulation must be verified in cases in which MCA sacrifice is required^{3,4,5,6}.

Leptomeningeal anastomoses are almost always sufficient to revascularize the distal anterior cerebral, posterior cerebral, and even middle cerebral artery. If the occlusion test is

Figure 3 Angiogram (lateral view) of the right external carotid artery (ECA) performed during MCA balloon occlusion showing complete filling of right cortical MCA territory through the bypass and demonstrating angiographic tolerance to occlusion. The angiogram shows stagnation of contrast medium in the aneurysm (arrow) because 1 cc was injected through the balloon-tipped microcatheter in order to verify complete occlusion of the right MCA during the clinical BTO.

clinically well tolerated, and if angiography performed during occlusion shows adequate vascularization of the MCA via leptomeningeal anastomosis and retrograde filling of the branches, occlusion of the parent artery is relatively safe.

The greatest risk in the treatment of giant or fusiform aneurysms of the M1 segment is the integrity of the lenticulostriate circulation, which is occluded at the origin. Subselective injections of amobarbital into the aneurysm with temporary occlusion at the neck may provide information complementary to that provided by BTO with functional evaluation of the brain parenchyma supplied by branches coming from the aneurysm or the parent vessel. Retrograde flow into the aneurysm from peripheral branches or, as in our case, from the bypass, may occur during trial parent vessel occlusion, and development of lenticulostriate infarction remains a possibility in spite of clinical tolerance during the test. Extracranial-intracranial bypass is considered by most experienced authors to be useful in all MCA occlusions^{1,2,6,7,8}.

Certain haemodynamic questions need to be considered in order to elucidate the protocol in

cases in which clinical tolerance to MCA occlusion after ECA-ICA bypass is required and angiographic tolerance has to be demonstrated.

In our case, angiographic tolerance was evaluated by right CCA occlusion with simultaneous injection of contrast medium into the right ECA. The bypass was patent, but there was poor filling of the cortical MCA territory. No leptomeningeal anastomosis or retrograde filling of MCA branches was seen.

Clinical tolerance was then evaluated by BTO in the lateral right M1 segment adjacent to the origin of the aneurysm. The test did not show any neurological deficit. During MCA occlusion simultaneous injection into the right ECA was performed, and good filling of the right cortical MCA territory through the bypass was demonstrated.

A fuller consideration of the ECA-ICA bypass treatment modality selected lies outside the scope of this case report, but in low-flow STA-MCA bypasses patency of the bypass must be demonstrated and, additionally, complete filling of the cortical MCA territory must be verified angiographically in most cases before safe parent vessel occlusion can be performed. However, in high-flow vein bypasses, angiographic evidence of patency of the bypass may very well be enough to consider parent vessel occlusion safe without angiographic evidence of complete filling of the cortical MCA territory⁸.

In our case, parent vessel occlusion was ruled out in order to avoid unnecessary occlusion of the normal artery proximal to the M1 segment from perhaps compromising the lenticulostriate vessels. Therefore, in spite of the danger posed by the possibility of the increased mass effect after treatment, endosaccular occlusion of the lumen of the aneurysm with Guglielmi detachable coils with MCA sacrifice, was carried out to preclude retrograde flow into the aneurysm, with the subsequent risk of acute haemodynamic changes turning the lesion into a terminal aneurysm and possible rupture. Aneurysms must always be isolated from the circulation because if even the slightest filling remains after treatment, the patient will be at risk of haemorrhage^{5,9,10,11}.

Another concern in cases of parent vessel occlusion is retrograde thrombosis of the next large proximal branch vessel, which may also occur after surgical occlusion¹. In MCA sacrifice, this may result in occlusion of the lenticu-

Figure 4 Anteroposterior (A) and lateral (B) angiographic views of the right internal carotid obtained after endovascular occlusion demonstrating complete embolisation of the aneurysm following GDC treatment. C) Right external carotid injection showing complete filling of the right cortical MCA territory after the procedure without any retrograde filling of the aneurysm.

lostriate branches. In order to reduce that risk, heparin was administered for 48 h and antiplatelet therapy was continued after the patient was discharged.

Even though mid-term clinical results in patients treated with GDCs have tended to be encouraging, outcomes have been less satisfactory in cases involving giant lesions, and further follow-up review is necessary to establish the long-term durability of GDC embolisation as a treatment modality¹².

Conclusions

GDCs are a therapeutic alternative for treatment of giant aneurysms when the best treatment option is isolation from the cerebral

circulation. When a functional bypass is indicated and the aneurysm is considered inoperable, endosaccular occlusion of the aneurysm can be performed in order to minimize retrograde filling and the subsequent risk of rupture.

Clinical tolerance may in most cases be enough to perform safe parent vessel occlusion, but if angiographic tolerance needs to be demonstrated, BTO must be performed at an appropriate level in order to avoid misleading results.

Despite angiographic evidence of a patent STA-MCA bypass with minimal MCA filling of the cortical MCA territory, flow through the bypass may become very robust after parent vessel occlusion.

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