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Case Report

Endovascular stenting of an extracranial–intracranial saphenous vein high-flow bypass graft: Technical case report

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Abstract

Background: The authors describe a case of endovascular stenting of an extracranial–intracranial saphenous vein high-flow bypass graft in the management of a complex bilateral carotid aneurysm case.

Case Description: A 43-year-old woman was admitted with progressive visual field restriction and headache. Imaging studies revealed bilateral supraclinoid carotid aneurysms. The right carotid aneurysm was clipped and the left one was treated by an endovascular procedure, after performing an internal carotid artery–middle cerebral artery (ICA-MCA) saphenous vein bypass graft. A few months following the bypass procedure, a 70–80% stenosis of the graft was discovered and treated endovascularly with a stenting procedure. Follow-up at 36 months after the first operation showed the patency of the venous graft and no neurological deficits.

Conclusions: Endovascular stenting of the extracranial–intracranial saphenous vein high-flow bypass graft is technically feasible when postoperative graft occlusion is discovered.

Key Words: Aneurysm, bypass, graft, saphenous vein, stenting

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INTRODUCTION

Extracranial–intracranial (EC-IC) bypass surgery is a complex, technically demanding revascularization procedure that plays a key role in the management of complex aneurysms.[1]

Graft failures are described in literature and surgical treatment algorithms for diagnosis and troubleshooting acute graft occlusion are provided.[14,19]

In this report, we describe a case of endovascular stenting in the management of a saphenous vein bypass graft stenosis discovered a few months after the surgical procedure.

CASE REPORT

A previously healthy 43-year-old woman complained of progressive visual field restriction, with a bitemporal hemianopsia and headache.

On admittance, the patient presented also extraocular movements within normal limits and double vision in the right gaze. The bitemporal hemianopsia was confirmed by visual field analysis.

Magnetic resonance imaging and magnetic resonance angiography revealed two spherical formations in the right and left carotid siphon.

The patient underwent to a cerebral angiography [Figures 1 and 2]. There were two aneurysms. A right supraclinoid one measuring 3 cm in maximum diameter and a left one, also supraclinoid and measuring a maximum diameter of 10 mm.

We decided to clip the right carotid aneurysm microsurgically. A right pterional route was performed and the right carotid aneurysm was approached during temporary endovascular occlusion of the right internal carotid artery (ICA). This allowed careful dissection of the aneurysm sac from the surrounding structures.

Preoperatively, a balloon occlusion test of right ICA was performed for 20 minutes; the test confirmed the counter lateral compensate by the anterior communicating artery.

During the procedure, however, the aneurysm ruptured at the neck and, as surgical clipping could not be achieved, the neck of the aneurysm was sutured and then reinforced with a Yasargil clip. The patient was then transferred to the Intensive Care Unit for postoperative monitoring.

Angiographic control demonstrated the complete exclusion of the right ICA giant aneurysm, but a right ICA occlusion was discovered [Figure 3]. Right intracerebral vascularization was compensated by the left circulation. The left carotid aneurysm remained unchanged [Figure 4]. At discharge, the patient presented a right third cranial nerve palsy and hypoesthesia in the right V_1 and V_2 nervous branches that recovered within 1 month. After 3 months, the patient returned to our institution to undergo treatment for the left ICA aneurysm for which an endovascular approach was selected.

The wide neck of the left ICA aneurysm suggested the possibility of a stent-assisted coiling, instead of a simple

Figure 1: Presence of a giant aneurysm from the supraclinoid tract of the right carotid siphon, digital subtraction angiogram in anterior–posterior craniocervical view

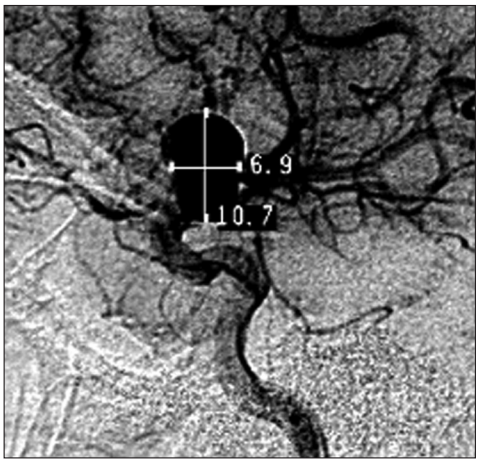

Figure 2: Presence of a large aneurysm from the supraclinoid tract of the left carotid siphon

Figure 3: Right internal carotid artery occluded

Figure 4: Right intracerebral vascularization vicariated by the left circulation, digital subtraction angiogram after first intervention

coiling. A right EC-IC bypass was proposed mainly due to the possible risk of a left ICA occlusion during the endovascular procedure. EC–IC bypass has been proposed by Donaghy[3] and Yasargil[15] to bypass an occlusive process in the arteries supplying the brain that is not accessible surgically in another way.

It was our opinion that a stent-assisted coiling procedure of the left ICA aneurysm could increase the risk of thrombotic complications. Therefore, a right ICA-MCA bypass was planned and a saphenous vein graft was chosen because radial artery was not available as a suitable vessel (Allen test negative).The bypass was performed under electroencephalographic confirmed burst suppression. A frontal branch of the MCA-M2 was chosen as a recipient vessel without perforators. The right ICA was isolated and sectioned 1 cm above the common carotid artery bifurcation and, after removal of the thrombus, a proximal end-to-end anastomosis of the saphenous vein graft to the right ICA and a distal end-to-side anastomosis of distal end of the graft to the MCA-M2 branch was performed. An interrupted 8-0 Prolene suture was utilized both at the proximal and distal end of the graft. The patency of the bypass was assessed intraoperatively by an intraoperative indocyanine green angiography and Doppler ultrasound.

The patient did well postoperatively and magnetic resonance angiography demonstrated the patency of the bypass despite a kinking at the level of the proximal anastomosis [Figure 5].

Two months later, following an intracranial angiography, endovascular treatment for exclusion of the left carotid aneurysm was performed. Before undergoing the procedure, the patient was pharmacologically treated for 7 days with antiplatelet drugs (ASA 300 mg + ticlopidine 300 mg per QD). During the procedure, an intracranial carotid stent was placed to cover the aneurysm neck (Neuroform, Boston Scientific). A microcatheter was then passed through the stent and GDCs (Guglielmi Detachable Coils) were used to fill the aneurysm sac. The procedure was well-tolerated with no further neurological deficits or complications [Figure 6].

Three months later, the patient underwent an angiographic study confirming a complete aneurysm occlusion, and demonstrating an area of segmental narrowing at the level of the previously revealed kinking of the proximal portion of the graft.The narrowing was graded 75% (NASCET method) [Figure 7]. The endovascular team then proceeded with an angioplasty and stenting of the graft [Figure 8]. The procedure was well-tolerated and followed by a regular clinical course and immediate mobilization.

Antiplatelet agents (ASA 300 mg + ticlopidine 300 mg per QD) were continued after the procedure.

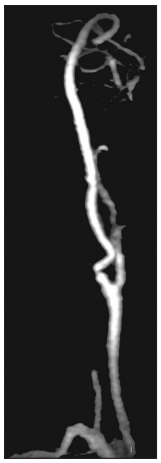

Figure 5: Proximal kinking of the right internal carotid artery–middle cerebral artery bypass, magnetic resonance angiography

Figure 6: Endovascular exclusion of the left carotid siphon aneurysm, digital subtraction angiography in lateral view

Figure 7: Area of segmental narrowing of the extracranial–intracranial high-flow bypass graft

Figure 8: Intraoperative angiography imaging showing the endovascular stenting of segmental narrowing of the Extracranial–intracranial high-flow bypass graft

Figure 9:Angiographic follow-up showing the patency of graft and robust flow to the middle cerebral artery territory

One year after the first surgical procedure, the patient presented visual field loss improvement and no other neurological deficits. A follow-up angiogram performed 36 months later showed a widely patent graft and robust flow to the MCA territory [Figure 9]. The patient remained asymptomatic.

DISCUSSION

Yasargil first described EC-IC bypass procedures.[25] These procedures were used with increasing frequency in the 1970s. However, since the EC-IC Bypass Study results were reported,[24] popularity of the procedure waned. More recently, limitations of the EC-IC Bypass Study have been recognized, and indications for intracranial revascularization are being re-evaluated.[3,6,10,21]

Furthermore, as endovascular techniques of coil and stent implantation are being used more liberally, aneurysms still requiring surgical intervention are likely to be more complex or giant aneurysms, or both[14,20] – circumstances for which bypass techniques are more frequently indicated.

The use of bypass for the management of difficult intracranial aneurysms is now being accepted by cerebrovascular surgeons.[3,5,9,11,14,16,18,21,22]

In the reported case, the patient presented bilateral carotid aneurysms. The left ICA aneurysm was large and was considered treatable via an endovascular approach, while the right giant aneurysm had to be treated surgically because of both its dome–neck ratio and mass effect. The rupturing of the aneurysm neck complicated the procedure and was followed by a complete thrombosis of the right ICA.

As expected from the balloon occlusion test results, the circulation from the counter lateral side adequately compensated the one on the right. The postoperative course was uneventful. The re-organization of the cerebral circulation increased the risk of the left ICA aneurysm growth.

The endovascular team considered an endovascular treatment of the left ICA aneurysm too dangerous given the absence of a collateral circulation; in our opinion, a stent-assisted coiling could have increased the risk of thrombosis compared to a simple coiling. So, we decided to perform a right ICA-MCA procedure. The bypass was done from the ICA to MCA-M2 because we had an occluded right ICA. As the radial artery could not be harvested, a saphenous graft was used.

The patency of the bypass was demonstrated and, subsequently, the stent-assisted coiling of the left ICA aneurysm could be obtained. The patient did well and her symptoms improved.

Despite intraoperative assessment of its patency, occlusion of the graft after a bypass procedure may occur. One of the current critical issues in successful EC-IC bypass surgery is the intraoperative assessment of graft patency. Unfortunately, direct intraoperative inspection may fail to reliably predict EC-IC bypass patency. Consequently, the postoperative bypass patency rate is reported to be only between 90% and 96%.[8,17,22,23]

In the presented case, an area of proximal kinking of the bypass was discovered immediately postoperatively by magnetic resonance angiography. However, the stenosis was not so severe as to suggest counter-indications for the endovascular treatment of the left aneurysm.

A few months later, the stenosis was graded 75% and had to be treated endovascularly. A balloon angioplasty was not considered safe enough, neither in short or in long terms, due to the risk of dissection or elastic recoil during

the procedure, or re-stenosis at follow–up.

We therefore decided to stent the stenosis area in order to obtain a good refilling of the graft and a reduction in the proximal kinking of the bypass. The procedure was discussed and deemed to be safely achievable. The major concern in the use of a stent was the strength of the proximal suture. The procedure was well-tolerated and no complications arose. The patency of the bypass has been documented.

Direct stenting is considered an alternative treatment to percutaneous intervention with a distal protection device for selected saphenous vein graft lesions in cardiac bypasses.[13]

The stent procedure after occlusion or kinking of a bypass has been extensively described in the cardiology literature,[4,7] but, to our knowledge, its feasibility in EC–IC bypass has not been reported.

In the presented case, using the endovascular stent to bridge the area of segmental narrowing of the EC-IC high-flow bypass graft has proven to be an effective procedure. Therefore, we highly recommend this procedure as a valid technique in managing similar conditions.

CONCLUSIONS

Endovascular stent of stenting of EC-IC saphenous vein high-flow bypass graft is an important tool for the management of graft stenosis after cerebral revascularization.

To prevent possible complications, diligent preoperative patient evaluation is paramount. To avoid occlusions, in particular, the patient's coagulation status must be attentively studied.

In the reported case, the ICA occlusion was managed by a bypass procedure that was further complicated by a proximal stenosis. Management of shunt stenosis with a stent was achieved without complications.

It is our opinion that endovascular stenting of EC-IC saphenous vein high-flow bypass graft can be performed in cases when an occlusion occurs postoperatively. The technology and technique need to evolve, and clinical studies are necessary to assess its efficacy and role for endovascular approaches in graft management.

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