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SAPHENOUS VEIN GRAFT BYPASS IN THE TREATMENT OF GIANT CAVERNOUS SINUS ANEURYSMS

REPORT OF TWO CASES

RICARDO RAMINA/**, MURILO S. MENESES* , ARI A PEDROZO*, WALTER O. ARRUDA*, GUILHERME BORGES***

ABSTRACT - Two cases of giant intracavernous aneurysms treated by high flow bypass with saphenous vein graft between the external carotid artery (ECA) and branches of the middle cerebral artery (MCA) are presented. Very often these aneurysms are unclippable because they are fusiform or have a large neck. Occlusion of the internal carotid artery (ICA) is the treatment of choice in many cases. This procedure has however a high risk of brain infarction. Revascularization of the brain by extra-intracranial anastomosis between the superficial temporal artery (STA) and branches of the MCA is frequently performed. This procedure provides however a low flow bypass and brain infarction may occur. We report two cases of giant cavernous sinus aneurysms treated by high flow bypass and endovascular balloon occlusion of the ICA. Immediate high flow revascularization of MCA branches was achieved and the patients showed no ischemic events. Follow-up of 8 and 14 months after operation shows patency of the venous graft and no neurological deficits. Angiographic control examination showed complete aneurysm occlusion in both cases.

KEY WORDS: giant intracavernous aneurysm, internal carotid artery aneurysm, saphenous vein graft, cerebral revascularization.

Anastomose intra-extracraniana com enxerto de veia safena no tratamento de aneurismas gigantes do seio cavernoso: relato de dois casos

RESUMO – Aneurismas gigantes da porção intracavernosa da artéria carótida interna frequentemente são inoperáveis por serem fusiformes ou apresentarem colo muito largo. Ligadura da artéria carótida interna é muitas vezes o tratamento de escolha para esses pacientes. Esse procedimento apresenta no entanto alta incidência de complicações isquêmicas agudas e tardias. Dois casos de aneurismas gigantes da porção intracavernosa são apresentados. Esses aneurismas foram tratados com cirurgia de "bypass"com enxerto de veia safena magna entre a artéria carótida externa e ramo M2 da artéria cerebral média e oclusão endovascular da artéria carótida interna. Revascularização com enxerto de alto fluxo sanguineo ocorreu nos dois pacientes não se observando nenhuma alteração isquêmica no período pós-operatório. O seguimento desses pacientes após 8 e 14 meses mostrou patência dos enxertos venosos e ausência de alteração no exame neurológico. A oclusão dos aneurismas e a patência dos enxertos foi confirmada com angiografias de controle.

PALAVRAS-CHAVE: aneurisma gigante intracavernoso, aneurisma da artéria carótida interna, enxerto venoso, revascularização cerebral.

Giant cavernous sinus aneurysms present a challenge for neurosurgeons. Direct neck clipping is frequently not desirable or feasible because these lesions have a large neck or are fusiform. Endovascular treatment may be not indicated due to aneurysm configuration or to intolerance to

*Instituto de Neurologia de Curitiba, Fundação Curitiba Pró-Base do Crânio,Curitiba, PR; **Disciplina de Neurocirurgia, Universidade Estadual de Campinas (UNICAMP), Campinas, SP. Aceite: 9-outubro-1999.

Dr. Ricardo Ramina - Rua Gonçalves Dias 713 - 80240/340 Curitiba PR - Brasil. E-mail: ramina@bsi.com.br

parent artery sacrifice. Occlusion of the internal carotid artery (ICA) is associated with high risk of cerebral infarction even when the patient tolerates the balloon test occlusion (BTO). Revascularization of the affected brain should be performed when the ICA must be sacrificed and ischemic episodes are expected to occur. Extra-intracranial bypasses have been used since long time. Anastomosis between the superficial temporal artery (STA) and branches of the middle cerebral artery (MCA) is the procedure more frequently performed. This surgery achieves however only low flow bypasses. Saphenous vein interposition grafts of varying lengths have been used in extracranial-intracranial bypasses for treatment of ischemic diseases, prior to surgical treatment of intracranial aneurysm, in skull base and cervical region tumors involving the ICA and traumatic occlusion of cervical or intracranial carotid arteries. The saphenous vein graft may be short when the anastomosis is performed between the petrous carotid artery and the intracranial ICA or MCA and long vein graft when the cervical ICA or ECA is used. Long saphenous vein bypass grafts were first performed in patients with advanced cerebroocclusive disease[1]. Long-term patency of these saphenous vein graft have been documented[2].

In this paper we present two cases of giant cavernous sinus aneurysms with large necks which could not be clipped and did not tolerate the balloon occlusion test.

METHODS

In the last 8 years 9 patients were treated in our clinic for cerebral revascularization with interposition of grafts. Cerebral revascularization with anastomosis between the STA and MCA and for the posterior fossa circulation with branches of ECA and the posterior inferior cerebellar artery were performed in a large number of cases. The cases treated by grafting were 6 giant aneurysms and 3 skull base tumors. Arterial graft was used in one case, short venous graft in two patients and in the remaining 6 cases (five giant aneurysms and one skull base tumor) a long saphenous vein graft was used. The grafts were patent with confirmation by angiography in 8 cases, and occluded postoperatively in one patient. We present two cases of giant intracavernous aneurysms treated with long saphenous vein graft between the ECA and braches of M2 and balloon occlusion of the aneurysms. Surgical indications were: unclippable giant aneurysms and benign skull base tumors with ICA infiltration in young patients (50 ≤ yr) with poor collateral circulation demonstrated by angiography, occlusion test or blood flow criteria.

Vein Grafting Technique

Mild hypertension (10 to 20% above the baseline) and metabolic brain protection (phenytoin, mannitol, barbiturates or propofol) were used in all cases. Heparin was given intravenously during the grafting procedure.

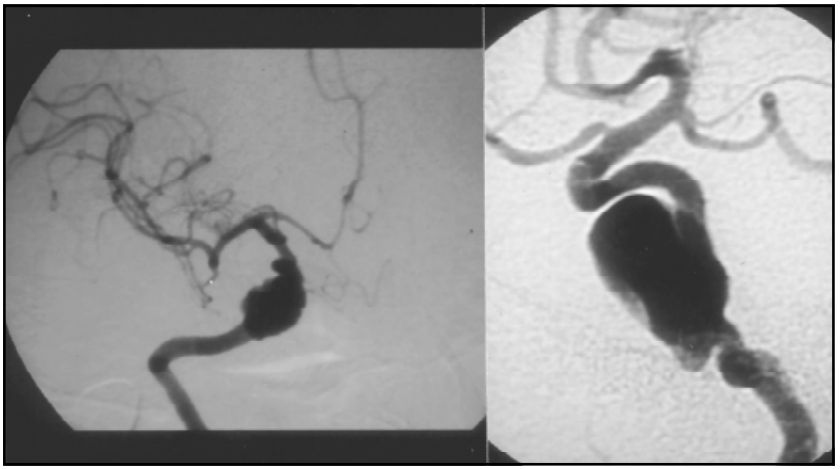

Fig 1. Case 1. Digital subtraction angiography (DSA) showing a giant aneurysm of the left ICA (cavernous and petrous portion) with a large neck.

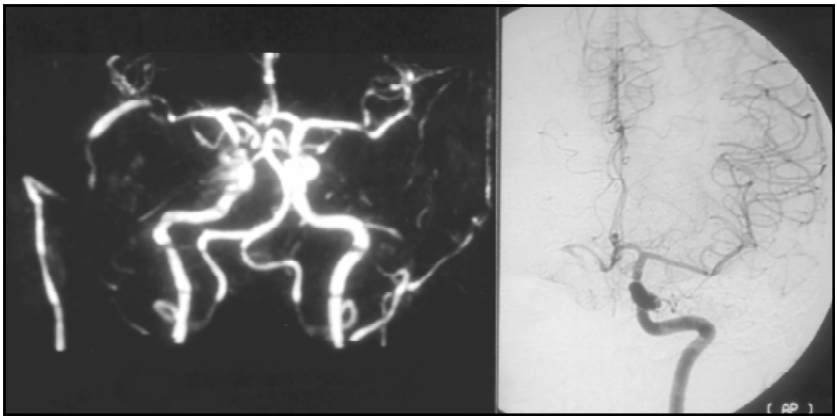

Fig 2. Case 1. Left- magnetic resonance angiography examination (MRA) after the surgery. The anastomosis between the ECA and MCA through the saphenous graft is observed. Right- DSA (right ICA) after embolization of the aneurysm and occlusion of ICA with balloons. Complete occlusion of the aneurysm was achieved.

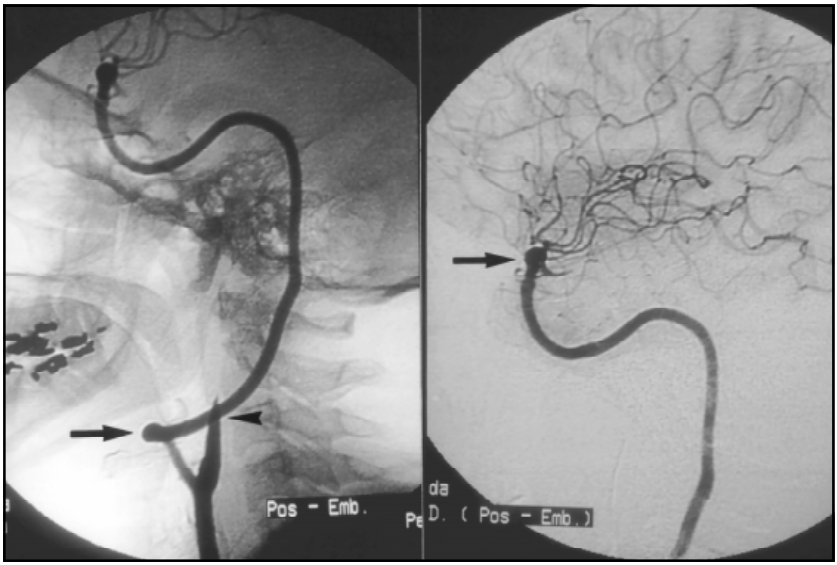

Fig 3. Case 1. Postoperative DSA (left ICA) showing occlusion of the ICA (arrow head) and the anastomosis site (arrows). A strong blood flow through the anastomosis and the MCA can be seen.

The greater saphenous vein was dissected in the thigh, its branches ligated with 4-0 prolene sutures and left in place until the grafting procedure started. A horizontal incision in the neck is performed at the level of common carotid (CC) bifurcation. The CC, ICA and ECA are identified. A fronto-temporal craniotomy is carried out and after opening of the silvian fissure the MCA (M1 and M2 braches) is identified. According to an anatomical study carried out in our department[3] the superior and inferior branches of the main division of the MCA have more than 2 mm of diameter and are suitable for the anastomosis. The superior trunk gives branches to the precentral and post-central giri therefore anastomosis with the inferior trunk presents lower risk of neurological deficits. A wide subcutaneous tunnel is created behind the ear to led the graft from the proximal vessel (ECA) to the M2 branch. The saphenous vein graft is placed into of a large bore suction tube and passed through the subcutaneous tunnel, thus avoiding torsion or kinking of the vein. This tunnel must be wide enough in order to

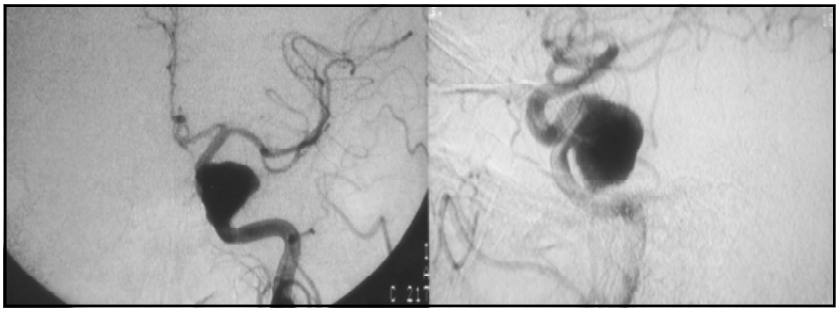

Fig 4. Case 2- DSA showing a giant aneurysm of the left cavernous ICA.

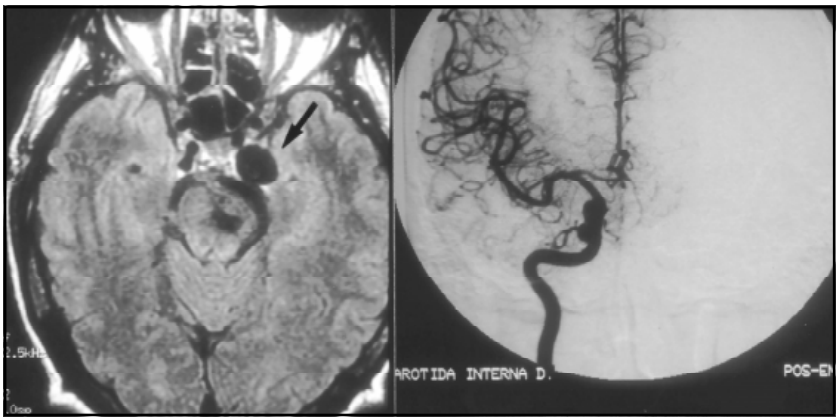

Fig 5. Case 2. Left- magnetic resonance examination (T1) showing the giant intracavenous aneurysm (arrow). Right- postoperative DSA of the right ICA after embolization of the aneurysm and occlusion of the left ICA. No filling of the aneurysm can be observed.

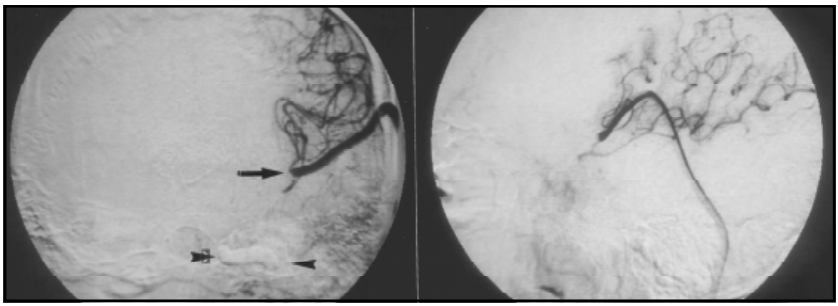

Fig 6. Case 2. Postoperative DSA (left ICA) showing the patency of the saphenous graft (arrow-site of anastomosis in the MCA) with good blood flow in the MCA territory. The ICA was occluded with a balloon (arrowheads).

avoid compression and stenosis of the graft. Grafting procedures are performed microsurgically with the proximal anastomosis first performed with 7-0 prolene sutures. The graft is temporarily occluded and the distal anastomosis is carried out with 9-0 or 10-0 prolene sutures. Suture line is secured with fibrin glue. After completion of the surgical procedure, the heparin effect is reversed. Three to five days after surgery the graft flow is confirmed using angiography and the ICA is occluded by endovascular placement of balloons.

Case reports

Case 1. This 42-year-old woman was admitted to our institute on May 11, 1998 with a 2 months history of right retroocular headaches. She complained of visual disturbances after beginning of symptoms. Computerized tomography (CT) showed a right cavernous sinus lesion. Four-vessel angiography revealead a giant carotid cavernous aneurysm with large neck (Fig.1). Colateral blood flow through anterior and posterior communicating arteries was poor. On examination, she exhibited no neurological deficits. Balloon test occlusion was not tolerated and a bypass procedure using a saphenous graft was indicated. On May 12,1998 the surgery was performed. The external carotid artery was exposed in the neck. A fronto-temporal craniotomy was carried on and the bifurcation of the MCA was dissected. A large branch of M2 was chosen for the anastomosis and the right saphenous was harvested from the thigh. This saphenous vein graft was placed from the ECA to the MCA-M2 segment. The postoperative course was uneventful. MRA (magnetic ressonance angiography) performed one week after operation confirmed patency of the shunt (Fig.2). On June 9,1998 the ICA and the aneurysm were successfully occluded. Control angiography revealed high flow through the vein graft to the MCA (Fig. 3). The patient was kept antiplatelet agents (aspirin) postoperatively. On control examination,14 months after operation, she remained asymptomatic with the presence of a strong pulsation over the saphenous vein graft.

Case 2. A 43-year-old man experienced diplopia due to left abducens palsy for three years before admission to our clinic. Ophthalmologic correction of the VI nerve palsy was undertaken with improvement of the symptoms. Four months before admission, he observed worsening of diplopia and started to complain of left fronto-orbital headache and progressive right hemiparesis. CT scan, MRI and DSA examinations disclosed a left giant sinus cavernous aneurysm. The lesion showed a large neck that was considered not suitable for surgical clipping or occlusion with coils (Fig.4). On examination, he presented a right hemiparesis and a left abducens nerve palsy. The patient was young and presented poor colateral circulation at angiography. A bypass procedure with interposition of a saphenous graft between the ECA and the MCA was indicated before occlusion of the ICA and the aneurysm. On October 26, 1998 the surgery was carried out. The CCA, ICA and ECA were exposed in the neck. A fronto-temporal craniotomy was performed and the segments M1 and M2 of the MCA were identified. The left greater saphenous vein was harvested from the thigh and used as graft for bypass between the ECA and the M2. The venous graft was placed behind the ear through a subcutaneous channel and the anastomosis was carried out. The postoperative course was uneventful and on October 31,1998 the ICA and the aneurysm were occluded (Fig 5). The control DSA showed patency of the saphenous graft (Fig 6). The patient was discharged without additional neurological deficits. On the last control examination in June 1999 he presented an improvement of hemiparesis and the graft showed a strong pulsation.

DISCUSSION

Yasargil[4,5] and Donaghy[6] initially described microsurgical treatment of cerebral ischemia due to cerebroocclusive disease through anastomosis between the STA and branches of the MCA. This surgery was also performed in cases of aneurysms that could not be clipped, prior to occlusion of the ICA. The blood flow through this kind of anastomosis was however insufficient in many cases when the ICA or the MCA had to be sacrificed and when the STA was small. For this reason arterial and venous grafts have been used[7-12]. Long saphenous vein bypass grafts between the extracranial vessels and the intracranial circulation were initially performed to achieve acute high-flow to the cerebral circulation in cases of cerebral infarction due to cerebroocclusive diseases[1]. Samson et al.[13] reported the use of saphenous vein interposition grafts since 1974 for occlusive disease, traumatic occlusion of the ICA and intracranial aneuryms. Iwabuchi et al.[14] in 1979 reported the first case of a giant ICA aneurysm treated with long vein bypass graft and trapping of ICA.

In spite of the development of modern microsurgery and new endovascular techniques which have considerably improved the treatment of giant aneurysms, some cases still need sacrifice of the ICA. Giant aneurysms of the intracavernous portion of the ICA are very difficult to be treated due to their location with involvement of several cranial nerves in the cavernous sinus and very often due to the absence of a clippable neck. In the series using long saphenous grafts, few cases of treatment of these aneurysms can be found in the literature[12,15-17]. Ligation of the ICA in young patients with long life expectancy is not acceptable, for there is a high risk of stroke. After ICA ligation during treatment of aneurysms or tumors, stroke occurred in 30 to 37% of cases[18,19]. Balloon test occlusion

(BTO) of the ICA is not a reliable parameter for selection of patients who could potentially tolerate ICA sacrifice[16]. Some patients may do well during the BTO but will develop a delayed stroke. Nevertheless, occlusion test is performed routinely in our clinic when the ICA is involved or infiltrated by intracavernous neoplasms in order to get further information about blood flow.

Venous grafting may be performed with a short graft between the petrous portion of the ICA and the intradural portion of ICA or MCA[15,17,20-22] or with a long venous graft between the CCA, ICA, ECA or subclavian artery and the intracranial ICA or MCA[12,23]. Short vein grafts have some disadvantages when compared with long vein grafts. The exposition of the petrous carotid artery is more difficult, the great petrosal nerve is cut, the anastomosis is technically difficult, the ICA blood flow has to be stopped for at least 30 minutes to one hour and the ICA is occluded before patency of the shunt is confirmed. For these reasons, we prefer the long venous graft technique in our cases. Early vein graft occlusion is usually related to surgical technical problems such as injury of the intima during vein extraction, kinking of the vein graft, disparity in size between arteries and the vein graft causing turbulence. Long term follow-up of patients with long saphenous vein grafts shows a very low rate of occlusion. In a recent study[2] 202 consecutive saphenous vein grafts performed at Mayo Clinic from 1979 to 1992 were reported. The indications were cerebrovascular disease in 63% of the cases, giant aneurysms in 37% and tumor in only one patient. Cumulative patency at 1 year was 86% ± 3%, at 5 years 82% ± 4% and at 13 years 73% ±19%. The majority of graft occlusion occurred during the first year after surgery (76%), and 42% occurred during the first 24 hs after the procedure. The average failure rate was 1% to 1.5% per year following the first year after operation. With the use of intraoperative angiography Sekhar et al.[16] reported a patency rate of 98% in patients with skull base tumors, giant aneurysms and occlusive cerebrovascular disease.

CONCLUSIONS

Long saphenous vein graft are effective and safe in providing high-flow bypass in the anterior circulation in cases of giant aneurysms of the intracavernous portion of the ICA. Occlusion of grafts occurs most frequently immediately after operation. Long-term patency of the venous graft is excellent when the correct surgical technique and perioperative management are applied. The use of intraoperative angiography may improve the results regarding patency of anastomosis.

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