Stent-Supported Coil Embolization for Carotid Artery Pseudoaneurysm as a Complication of Endovascular Surgery
—Case Report—

Masaomi KOYANAGI, Shogo NISHI*, Itaro HATTORI, Fumihiko HORIKAWA, and Koichi IWASAKI

Department of Neurosurgery, Himeji Medical Center, Himeji, Hyogo; *Department of Neurosurgery, Takatsuki Red Cross Hospital, Takatsuki, Osaka

Abstract

A 57-year-old male presented with right amaurosis fugax and left transient ischemic attack caused by stenosis of the intracranial segment of the right internal carotid artery (ICA). Percutaneous transluminal angioplasty with stenting was successfully performed to dilate the stenosis. However, serial angiography revealed the development of a large pseudoaneurysm in the cervical ICA, probably as a result of carotid wall injury caused by the guiding catheter during the procedures. The patient underwent a second endovascular angioplasty. A Palmaz stent was placed across the aneurysm neck to stabilize the carotid wall. Guglielmi detachable coils were then inserted into the aneurysm cavity through the stent struts to successfully obliterate the aneurysm. Both the angiographical results and the patient’s outcome were favorable. Stent-supported coil embolization is an effective and safe technique for medically refractory pseudoaneurysms, and may be a useful alternative to direct surgery.

Key words: pseudoaneurysm, carotid artery, endovascular therapy, stent

Introduction

Arterial dissection or pseudoaneurysm are among the complications of endovascular surgery with the highest mortality and morbidity, and are potential causes of thromboembolic stroke or spontaneous rupture.7,8,14) Several therapeutic strategies are available, including medical therapy, direct surgery, and endovascular treatment.5,7,9,17–20) Medical therapy may be only palliative, and direct surgical treatment may require sacrifice of the parent vessel or artery reconstruction with bypass grafting. The optimum strategy would occlude the aneurysm and preserve the patency of the parent vessel. Pseudoaneurysms have been successfully treated by coil embolization with stenting, enabling preservation of the patency of the parent vessels as well as obliteration of the aneurysm.4,8,10,12,13) Most of these pseudoaneurysms were idiopathic,10) or secondary to trauma or direct neurosurgical procedures.4,8,12,13) Two cases of pseudoaneurysms of the vertebral arteries secondary to endovascular procedures were treated by coil embolization combined with stenting.13) We treated a patient with a carotid pseudoaneurysm subsequent to an endovascular procedure, which was successfully obliterated by the stent-supported coil embolization technique.

Case Report

A 57-year-old male presented with a 2-year history of recurrent transient blindness of the right eye, and a 6-month history of transient motor weakness in the left lower limb. Neurological and ophthalmological examinations on admission revealed no other deficits. Magnetic resonance imaging showed multiple small infarctions in the bilateral cerebral hemispheres. Cerebral angiography demonstrated complete occlusion of the left internal carotid artery (ICA) at its origin, and 60% stenosis of the right ICA at the intracranial C4 portion. Collateral blood flow to the left cerebral hemisphere was well developed from the posterior circulation and the contralateral
anterior cerebral artery. Single photon emission computed tomography revealed decreased cerebral blood flow (CBF) in the right cerebral hemisphere. On the basis of these neuroradiological findings, the diagnosis was monocular ischemia and left transient ischemic attack (TIA) caused by right ICA stenosis. Extracranial-intracranial (EC-IC) bypass surgery and endovascular surgery were considered for the treatment. The neurological symptoms of the present patient included transient right motor weakness and transient right blindness as a symptom of ocular ischemia. EC-IC bypass might be insufficient to reverse the decreased ophthalmic artery flow. Therefore, to treat the ischemia in the ocular area as well as the cerebral hemisphere, endovascular treatment to dilate the narrowed right ICA was undertaken.

This lesion was treated by percutaneous transluminal angioplasty (PTA) with stenting, as reported in detail elsewhere. First, a guiding catheter (Envoy; Cordis Neurovascular, Miami, Fla., U.S.A.) was introduced into the right ICA just distal to the carotid bifurcation via a femoral route. Then, a 4-mm-diameter and 12-mm-length balloon expandable stent (S670; Medtronic, Inc., Minneapolis, Minn., U.S.A.) was positioned in the right ICA to cover the stenotic lesion, although navigation of the stent and the delivery system was difficult because
of severe atherosclerotic changes of the entire carotid artery. The ICA stenosis resolved completely with no perioperative neurological deficit. However, angiography shortly after the treatment revealed a small arterial dissection in the cervical ICA 2 cm distal to the bifurcation (Fig. 1B). The tip of the guiding catheter may have injured the wall of the ICA resulting in a small dissection during the procedure. Postoperatively, the patient was medically treated with anticoagulant agents, and remained asymptomatic.

Repeat angiography performed 4 months later demonstrated growth of a large pseudoaneurysm in the right ICA at the site of the previous small dissection (Fig. 1C). This de novo lesion was treated by endovascular coil embolization with stenting. A 4-mm-diameter and 20-mm-length Palmaz stent (Cordis Neurovascular, Warren, N.J., U.S.A.) was positioned in the right ICA to cross the neck of the aneurysm. Then, a microcatheter was advanced through the stent struts into the cavity of aneurysm, and Guglielmi detachable coils (Boston Scientific/Target, Fremont, Calif., U.S.A.), measuring 103 cm in total length, were detached to pack the aneurysm cavity (Fig. 2A). Subsequent right carotid angiography showed obliteration of the aneurysm with preservation of the blood flow of the right ICA (Fig. 2B). Serial follow-up angiography 3 and 9 months after the coil embolization demonstrated complete obliteration of the aneurysm (Fig. 2C). Neither coil compaction nor restenosis of the right ICA was observed, and the patient remained asymptomatic without further recurrence of visual symptoms or TIAS.

**Discussion**

Endovascular surgery such as PTA and/or stenting is increasingly reliable for the treatment of carotid stenotic diseases, but major complications include thromboembolic events and mechanical arterial injuries, possibly resulting in arterial dissection or vessel rupture. The layers of the arterial wall involved in the dissection show different pathological, angiographical, and clinical characteristics. Dissection in the subintimal layer tends to cause stenosis or occlusion of the arterial lumen, whereas dissection in the subadventitial layer is likely to result in formation of aneurysmal dilatations, as in the present case. Such aneurysmal dilatations are referred to as “false aneurysms” or “pseudoaneurysms,” which communicate with the lumen of a ruptured artery with walls consisting of fragile adventitia and periarterial fibrous tissue. Therefore, they tend to expand and grow under hemodynamic stress as in the present case.

Pseudoaneurysms carry the risks of secondary thromboembolic stroke, local symptoms due to the mass effect on the surrounding structures, and spontaneous rupture, although the frequencies of each complication are unknown. However, pseudoaneurysms are potentially lethal and require adequate treatment.

Several strategies have been advocated to manage arterial dissection. The natural course of arterial dissections is relatively favorable, as a high rate of angiographical improvement or spontaneous resolution can be expected. Therefore, conservative medical treatment using anticoagulation and/or antiplatelet agents is usually tried first. Despite such treatment for our patient, a small arterial dissection developed into a large pseudoaneurysm. Therefore, further intervention such as direct surgical repair or endovascular treatment was considered. Direct surgical techniques include aneurysm clipping, wrapping, trapping, and ICA ligation. Clipping and wrapping of the pseudoaneurysms may not necessarily be as easy as with true aneurysms, because the walls of the pseudoaneurysms may be extremely fragile. Trapping and ICA ligation may require additional artery reconstruction with high flow bypass grafting to maintain the blood flow of the parent artery. These procedures are technically demanding and are associated with a substantial morbidity rare. Considering the specific CBF pattern of this patient, higher morbidity may be inevitable. Endovascular embolization techniques using detachable coils can be used for the treatment of pseudoaneurysms. However, wide-neck aneurysms such as our case are difficult to treat, mainly because the detached coils are prone to migrate or herniate into the parent arteries, so a modification of the simple coil embolization technique is necessary.

The combination of coil embolization with intraarterial stenting was successful in seven patients with fusiform and wide-neck aneurysms, and pseudoaneurysms. Technical success in this series was achieved in 86% of patients and the incidences of periprocedural stroke and mortality were 0%. This method has also been applied to the treatment of traumatic or iatrogenic carotid pseudoaneurysms. This stent-supported coil embolization technique consists of stent placement in the parent artery across the aneurysm neck, navigation of a microcatheter into the aneurysm sac through the stent interstices, and coil embolization. The stent serves as a mechanical scaffold for intraaneurysm coil implantation, thus preventing coil herniation into the parent vessel, and allowing...
denser coil packing. Additionally, the stent may provide a matrix for endothelialization of the blood vessel. Therefore, this safe technique is useful to obliterate the aneurysm sac with concurrent preservation of the parent artery.3,4,8,12,13) Recently, a special covered stent, the surface of which is covered with special materials, has become available.3,4) This device may also be useful for the endovascular treatment of pseudoaneurysms. The covered stent will allow immediate closure of the aneurysm neck with preservation of the parent artery. However, an experimental study of covered stents suggests a higher rate of subacute thrombosis and delayed in-stent stenosis compared with conventional stents.1,2) After consideration of the advantages and disadvantages of each treatment as well as of the occlusion of the contralateral ICA in our patient, we selected coil embolization combined with stent support as the most appropriate therapy. Complete obliteration of the aneurysm as well as perfect preservation of the carotid patency were achieved. However, careful follow-up observation is necessary, because the safety and efficacy of this method in the long term is still unconfirmed.

References


Address reprint requests to: K. Iwasaki, M.D., Department of Neurosurgery, Himeji Medical Center, 68 Hon–mach, Himeji, Hyogo 670–8520, Japan.
e-mail: kiwasa@hmj.hosp.go.jp

Neurol Med Chir (Tokyo) 44, October, 2004