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Case Report

A Hybrid Operation for the Treatment of Extracranial Carotid Artery Aneurysm with a 2-Year Follow-up

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This case was presented at the European Stroke Conference, Venice, Italy, in 2016.

ABSTRACT

Extracranial carotid artery aneurysms are less commonly observed. Hence, determining the optimal treatment strategy is difficult because of limitations in the reporting of results and confounding by indications based on the available literature. Here, we present a hybrid operation combining surgery and balloon occlusion to achieve distal outlet control, aneurysm resection, and reconstruction of the parent internal carotid artery for the treatment of extracranial carotid artery aneurysms, with good outcomes based on 2-year follow-up. We conclude that a hybrid operation combining surgery and endovascular assistance is a safe and effective choice for the treatment of extracranial carotid artery aneurysms.

KEYWORDS: Endovascular occlusion, Extracranial carotid artery aneurysm, Hybrid operation, Surgical reconstruction

INTRODUCTION

Extracranial carotid artery aneurysms (ECAAs) are less commonly observed and treated compared with carotid endarterectomy (2,8). Approximately 50% of patients with ECAA are diagnosed after the onset of focal cerebral ischemia, including cerebral ischemia, neurological symptoms, and complete stroke, according to a report by Attigah et al., due to embolic events or thrombotic occlusion (1). ECAA treatment includes surgical and endovascular therapies. However, in certain cases, it is difficult to clip the distal outlet of the aneurysm with surgical exposure because of the relatively high location or aneurysm blockage. In this case report, endovascular balloon occlusion was applied to the distal outlet.

CASE REPORT

A previously healthy 63-year-old woman was referred to us because of a progressively enlarged palpable left cervical mass, with an intermittent blunt headache for 5 months. She had no weakness or numbness of limbs, aphasia, amaurosis, and other symptoms of cerebral ischemia. The patient had no history of hypertension, diabetes mellitus, smoking, alcohol abuse, or cervical trauma. The physical examination showed an egg-size pulsatile mass on the left cervical area, with systolic blowing murmur under auscultation, without hoarseness or any other neurological deficit.

Computed tomography angiography (CTA) and digital subtraction angiography (DSA) demonstrated left internal carotid artery aneurysm (L-ICA AN) located from the fourth cervical vertebral segment (C4) to the skull base with a proximal tortuous segment, while the entry point was located at the C4 level and outlet at the inferior C1 level (Figure 1A-C). Cervical ultrasonography indicated L-ICA AN with an embolism within the aneurysm. Perfusion-weighted imaging (PWI) showed a poorer perfusion of the left hemisphere (Figure 2A) than that of the contralateral side. High-resolution (HR) magnetic resonance imaging (MRI)(Figure 2B) indicated possible tearing of the intima and underneath embolism within the lateral side of the aneurysm.

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A hybrid operation combining endovascular balloon occlusion of the distal outlet, aneurysm resection, and surgical reconstruction of the L-ICA with a vascular graft was performed under general anesthesia. Surgical and interventional procedures were as follows:

Step 1: A 6F catheter was placed from the right femoral artery for angiography during surgery to expose the aneurysm after dissecting the platysma and compressed sternocleidomastoid muscles (Figure 3A).

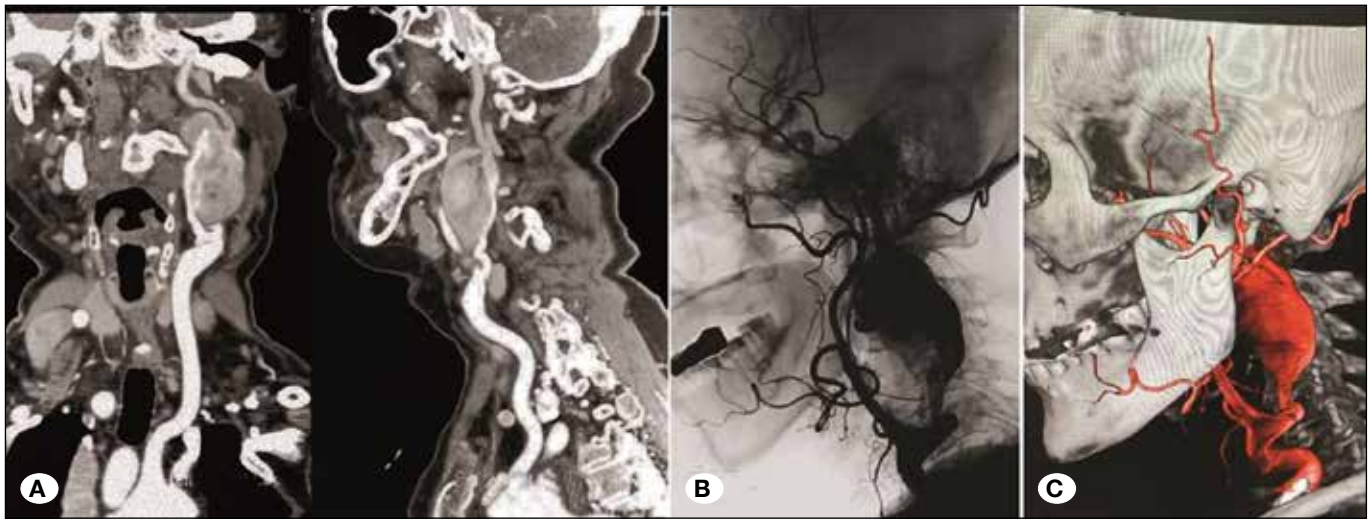

Figure 1: Computed tomography angiography (CTA) and digital subtraction angiography (DSA) of the extracranial carotid artery aneurysm before operation: Entry point of the aneurysm located at the fourth cervical vertebral segment (C4) level and outlet located at the inferior C1 level demonstrated by CTA **(A)**, DSA **(B)**, and DSA 3D reconstruction with bone **(C)**.

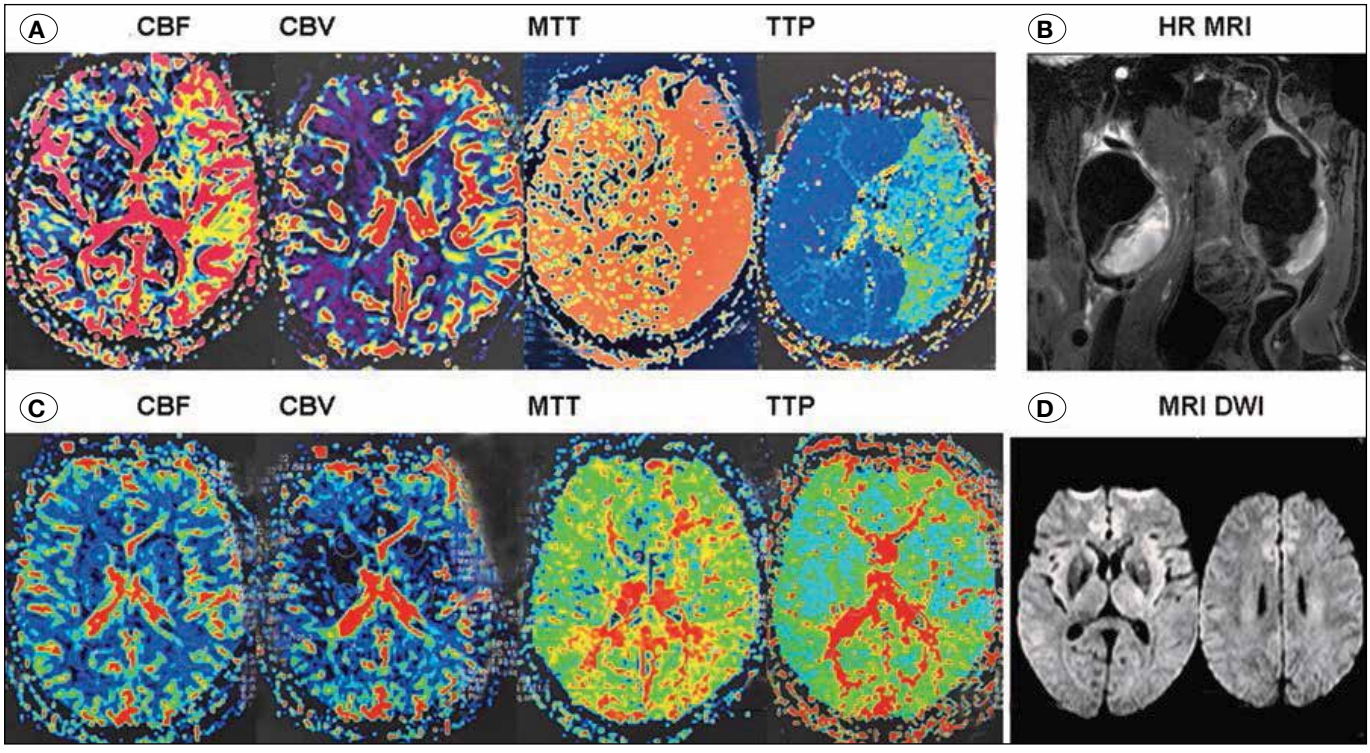

Figure 2: MRI evaluation of the extracranial carotid artery aneurysm before and after operation: Perfusion-weighted imaging (PWI) showed a poorer perfusion of the left hemisphere **(A)** compared with the contralateral side, with decreased cerebral blood flow (CBF), increased cerebral blood volume (CBV), and prolonged mean transit time (MTT) and time to peak (TTP). High resolution MRI **(B)** indicated possible tearing of the intima and underneath embolism on the lateral side of the aneurysm. Post-treatment MRI with PWI and diffuse-weighted imaging (DWI) displayed improved perfusion of the left hemisphere **(C)** and no fresh infarction **(D)**, respectively.

Step 2: The entry of the aneurysm was identified, and the left common carotid artery, extracranial carotid artery, and superior thyroid artery were clipped to occlude the influent blood flow (Figure 3B). Given that the outlet was at a relatively high location at the C1 level, making it difficult to expose and increasing the bleeding risk due to the rupture of the aneurysm, balloon (HyperForm™ Occlusion Balloon System, 7 mm × 7 mm, 104-4770, ev3 Endovascular, Inc., Plymouth, MN)-assisted occlusion was performed by local puncture at the proximal segment of the ICA (Figure 3C). Thereafter, the distal part of the aneurysm was isolated to expose the outlet.

Step 3: The aneurysm was resected (Figure 3D), and the balloon was withdrawn, while the distal part was controlled using a vascular clip.

Step 4: Reconstruction of the L-ICA with a 6-cm vascular graft (INTERING Vascular Graft 4-6 mm × 45 cm, IRS46045L, W.L. Gore and Associates, Inc. Flagstaff, AZ) (Figure 3E) with end-to-end anastomosis (Polypropylene, W8305, 6-0 PROLENE, ETHICON, LLC.) was performed.

Step 5: Hemostasis and suture of the incision was performed.

An immediate DSA recheck after surgery showed patency of the revascularization of the L-ICA with a vascular graft (Figure 3F). Intraoperative intravenous heparin was administered to prevent embolus during surgery, and dual antiplatelet therapy with aspirin (100 mg/day) and clopidogrel (75 mg/day) was prescribed before and 3 months after the surgery, followed by aspirin alone (100 mg/day).

The patient recovered well from the anesthesia and operation, with hoarseness mainly due to an ipsilateral injury of the recurrent laryngeal nerve and alleviated partially after the administration of methylprednisolone (40 mg, twice daily). Cervical ultrasonography 2 days after the treatment showed patency of the L-ICA without embolism formation, and MRI with PWI and diffuse-weighted imaging (DWI) revealed improved perfusion of the left hemisphere (Figure 2C) and no fresh infarction (Figure 2D).

The patient recovered well after discharge, based on a telephone interview, and a 2-year follow-up, including cervical ultrasonography and head MRI T1-WI, T2-WI, DWI, and PWI, indicated patency of the reconstructed carotid artery, no new onset of ischemic stroke of the left hemisphere, and improved perfusion similar to postoperative MRI examinations.

■ DISCUSSION

Our patient had no neurological deficit before admission, even with an embolism within the aneurysm and segmental stenosis, although some patients with ECAA have been diagnosed after the onset of focal cerebral ischemia or cranial nerve dysfunction resulting from compression (1). However, PWI indicated a poorer perfusion in the left hemisphere, implicating cerebral ischemia and a risk of cerebral infarction, but the poor perfusion of the aneurysm side was alleviated after treatment.

According to previous reports, the endovascular treatment of ECAA leads to a higher risk of cerebral embolization

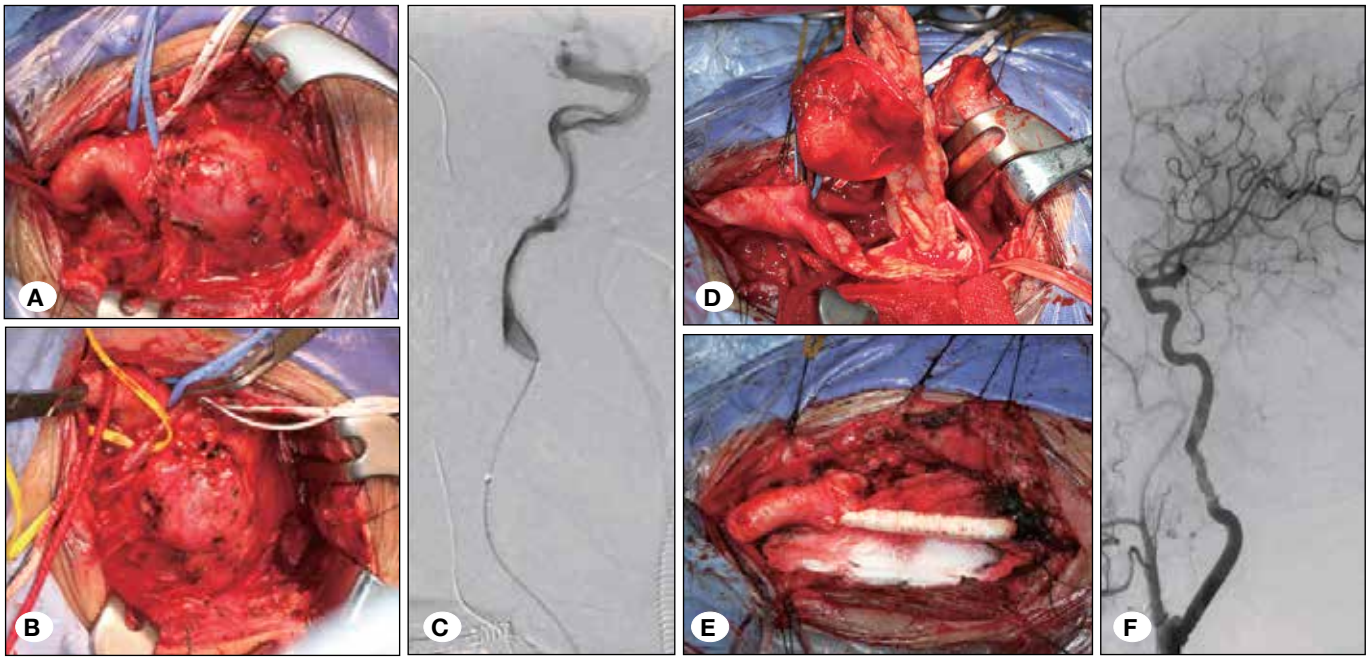

Figure 3: Illustrations of the key operation procedures: **A)** The aneurysm is exposed after dissecting the platysma and compressed sternocleidomastoid muscles. **B)** The entry of the aneurysm is identified, and the left common carotid artery, extracranial carotid artery, and superior thyroid artery were clipped to occlude the influent blood flow. **C)** Balloon-assisted occlusion of the outlet was introduced by local puncture at the proximal segment of the ICA. **D)** Resection of the aneurysm was performed. **E)** Reconstruction of the L-ICA with a 6-cm vascular graft was performed. **F)** An immediate re-check after surgery using DSA showed patency of the re-vascularization of the L-ICA with a vascular graft.

(approximately 20%) caused by coiling material and a thrombus in the sac of the aneurysm (4), despite its benefits of less operative trauma and less injury to the cranial nerves. A covered stent combined with cerebral protection devices or flow-diverting stents may provide a potential method for endovascular treatment (3,5). Surgical therapy mainly focuses on surgical resection by standard exposure of the carotid artery. To reduce intraoperative embolization risks, proximal and distal clamping of the aneurysm is usually performed before dissecting and mobilizing the aneurysm. As in this case, the proximal part was easily identified, whereas the distal part was located relatively high and was difficult to expose and clamp. Therefore, endovascular occlusion was introduced before exposing the outlet, to reduce the bleeding risk due to the rupture of the aneurysm, and it yields a safe and effective method of achieving distal control.

The surgical treatment of ECAA is a feasible method, with favorable long-term results by reducing the stroke rate. Complicated neurological deficits most frequently encountered after surgery are cranial nerve injuries, such as ipsilateral recurrent laryngeal nerve injury, as in this patient, manifested by hoarseness and the left vocal cord paralysis. After methylprednisolone administration and rehabilitation, symptoms can be alleviated partially, as in this patient, or completely. Transient ischemic attack or permanent neurological deficits were not detected in this patient. A recent systematic review found that invasive treatment results in favorable early and long-term outcomes, whereas cranial nerve injury after surgery is more frequent (7).

CONCLUSION

This case depicts a hybrid operation combining surgical reconstruction and endovascular balloon occlusion to achieve distal control, aneurysm resection, and the reconstruction of the L-ICA, with good outcomes based on a 2-year follow-up. Data on natural history are still scarce, and a registry (Carotid Aneurysm Registry) initiated by Dr. G.J. de Borst has been started to assess natural history, intervention results, and follow-up data of those patients with ECAA (6). Randomized controlled trials may not be feasible because of the limited number of patients with this rare disease.

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