JCEN Journal of Cerebrovascular and Endovascular Neurosurgery

Journal of Cerebrovascular and Endovascular Neurosurgery
pISSN 2234-8565, eISSN 2287-3139, https://doi.org/10.7461/jcen.2022.E2022.07.003

Case Report

Aneurysmectomy and graft interposition for giant thrombosed proximal internal carotid artery aneurysm: Technical details

Ki Dong Baek[1], Jae Hoon Kim[1], Hee In Kang[1], Cheol Su Jwa[1], In-Suk Bae[1], Sung Ho Shin[2]

[1]Department of Neurosurgery, Nowon Eulji Medical Center, Eulji Universtity, Seoul, Korea
[2]Department of Thoracic and Cardiovascular Surgery, Soonchunhyang University Bucheon Hospital, Bucheon, Korea

J Cerebrovasc Endovasc Neurosurg. 2023 June;25(2):203-207

Received: 6 July 2022
Revised: 4 October 2022
Accepted: 5 October 2022

Correspondence to
Jae Hoon Kim

Department of Neurosurgery, Nowon Eulji Medical Center, Eulji University, 68, Hangeulbiseok-ro, Nowon-gu, Seoul 01830, Korea

Tel +82-2-970-8267
Fax +82-2-979-8268
E-mail grimi2@hanmail.net
ORCID https://orcid.org/0000-0002-9179-8569

A giant thrombosed extracranial internal carotid artery aneurysm (ECCA) is extremely rare and its treatment is challenging. Despite the advance of endovascular technique, open surgery is still considered a first-line treatment in giant thrombosed ECCA. We describe a case of giant thrombosed ECCA which was successfully treated by aneurysmectomy and graft interposition with the technical details.

Keywords Aneurysm, Transplants, Thrombosis

INTRODUCTION

Extracranial internal carotid artery aneurysm (ECCA) is a rare disease. Especially, the treatment of a giant thrombosed ECCA is technically challenging and unfamiliar to neurosurgeons. A giant thrombosed ECCA usually presents as a pulsatile neck mass and cause neurological events such as transient ischemic attack or ischemic stroke.[3] The treatment of these aneurysm is mandatory for symptomatic cases and some authors recommended to treat an aneurysm of more than 2-cm in size in asymptomatic case.[2] Although some authors have reported favorable short-term outcomes and low morbidity rate following endovascular treatment, the evidence to support favorable long-term outcomes and lower recurrence rate is still lacking.[1)3)6)8)10)12] Therefore, surgical resection and flow restoration are gold standard methods to treat this aneurysm. We report a case of a giant thrombosed ECCA which was treated by aneurysmectomy and graft interposition with technical details.

CASE DESCRIPTION

A 72-year-old woman presented with left side weakness and dysarthria. She had a medical history of hypertension, diabetes mellitus, osteoporosis, and thyroid cancer. Fourteen years ago, she underwent total thyroidectomy for thyroid cancer and subsequently received radioactive iodine ablation therapy. She also underwent craniotomy and aneurysmal neck clipping due to ruptured anterior communicating artery aneurysm 2 months later. Her brain diffusion weighted image showed high signal intensity in the right caudate nucleus and periventricular white matter (Fig. 1A). Cerebral angiography was performed following intravenous administration of recombinant tissue plasminogen activator which indicated a thrombosed ECCA and occlusion of the mid-portion of the right middle cerebral artery (Fig. 1B, C). Unfortunately, we could not perform mechanical thrombectomy due to ECCA and tortuous common carotid artery (CCA) (Fig. 1D). Thereafter, the patient's motor weakness rapidly improved. Subsequent neck 3 dimensional angiography demonstrated complete recanalization of the right middle cerebral artery and 4 cm sized ECCA with contrast filling and thrombus (Fig. 1E, F). Taking into consideration a tortuous CCA and the thrombosed nature of ECCA, we decided to perform open surgery 4 months later.

The patient was administered 100 mg acetylsalicylic

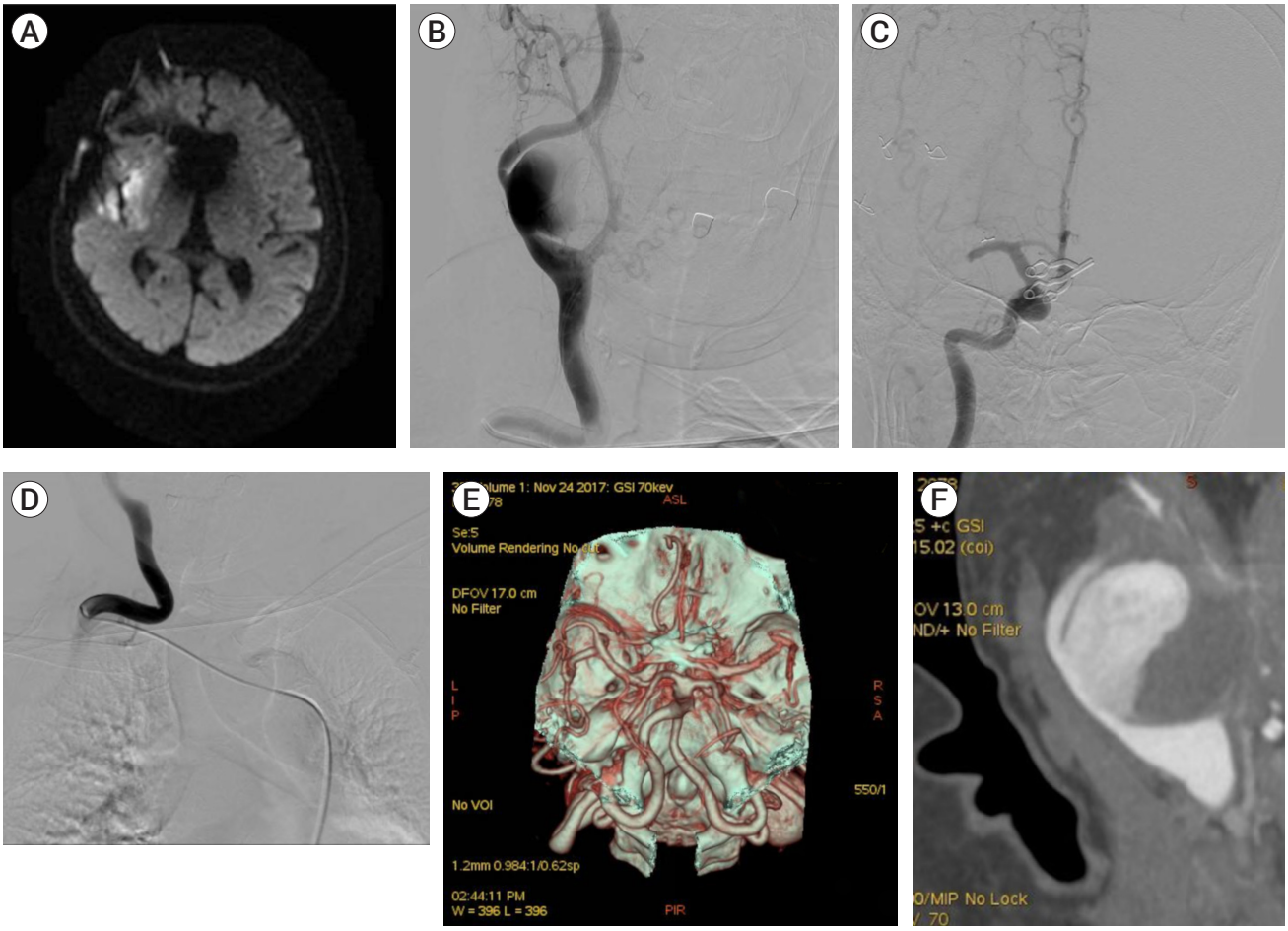

Fig. 1. (A) Brain diffusion weighted image showing high signal intensity in right caudate nucleus and periventricular white matter. (B, C) Cerebral angiography showing a thrombosed extracranial carotid artery aneurysm and occlusion of the mid-portion of the right middle cerebral artery. (D) Right common carotid artery angiogram showing tortuous common carotid artery. (E, F) Neck 3-dimentional angiogram showing complete recanalization of the right middle cerebral artery and 4 cm sized extracranial carotid artery aneurysm with contrast filling and thrombus.

acid, starting 7 days before the surgery. The operation was performed under normocarbic, normotensive general anesthesia. The cerebral hemoglobin oxygen saturation was continuously monitored using near-infrared spectroscopy (Edwards ForeSight Brain Oxygenation Sensors®, Edwards Lifesciences; Irvine, CA, USA) throughout the procedure. The patient was positioned supine with the head extended and turned away from the side of operation. A linear skin incision was made along the anterior border of the sternocleidomastoid muscle. The aneurysm, common carotid artery (CCA), external carotid artery (ECA), and distal internal carotid artery (ICA) were exposed (Fig. 2A). The aneurysm was firmly adhered to the external carotid artery and the posterior wall of carotid sheath. Prior to cross-clamping the CCA, ICA, and ECA, we administered systemic anticoagulation with unfractionated heparin and maintained activated clotting time >200 seconds throughout the operation. After cross-clamping, carotid shunt (Pruitt-Inahara®, LeMaitre Vascular; Burlington, MA, USA) was first inserted into CCA via a small arteriotomy and secured by pulling up on the silk ties. The aneurysm

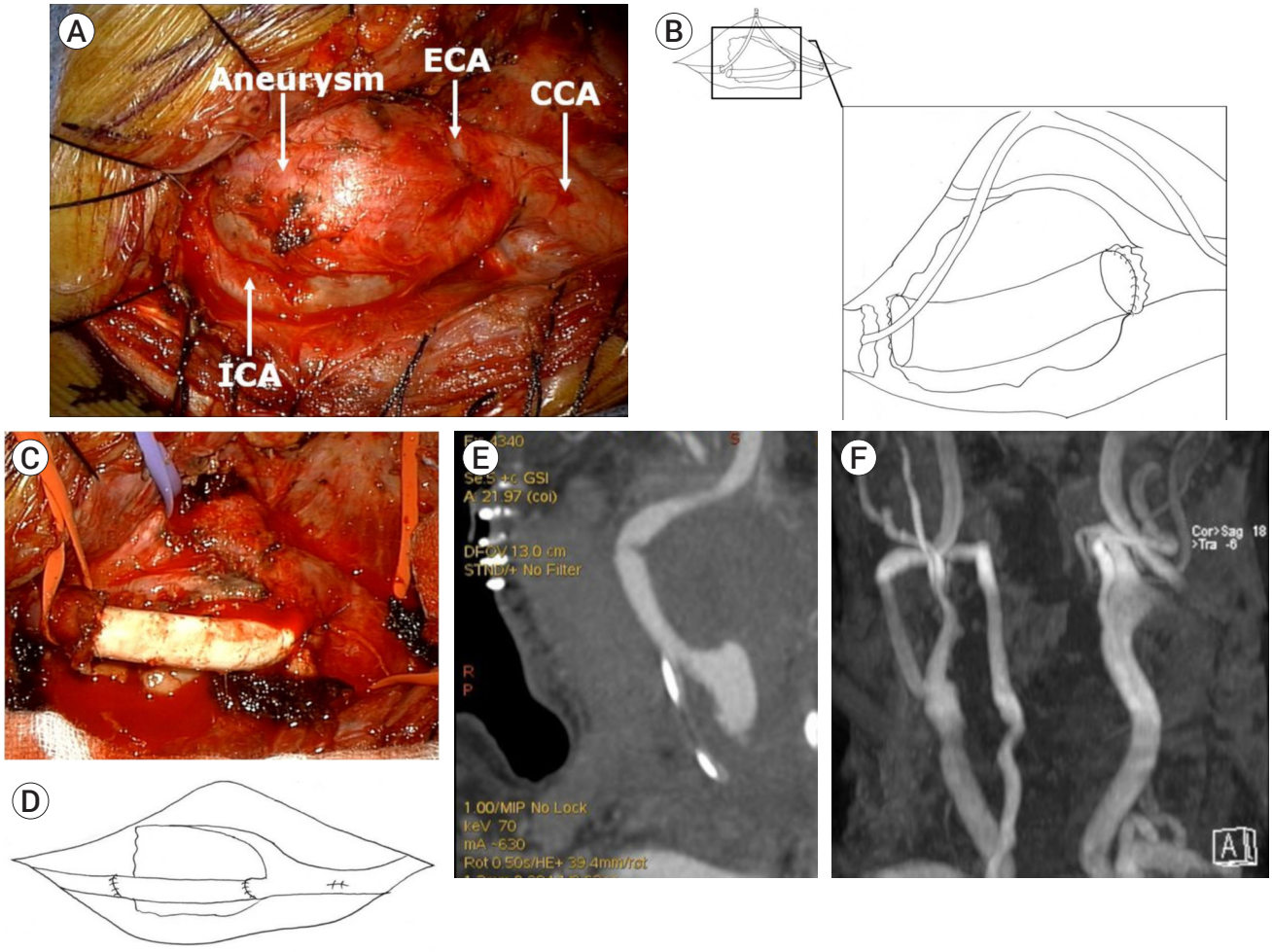

Fig. 2. (A) Intraoperative photography showing the aneurysm stuck to the internal and external carotid artery at the bifurcation of the common carotid artery. (B) Schematic drawing depicting the placement of carotid shunt and interposition graft following aneurysmectomy. After partial resection of the aneurysm leaving posterior wall, the anastomosis is initially performed at the proximal internal carotid artery with a continuous non-locking fashion and then the distal internal carotid artery. (C, D) Schematic drawing and intraoperative photography showing the completion of the graft interposition procedure. After removal of carotid shunt, the arteriotomy site is secured. (E, F) Three-dimensional computed tomographic angiography taken 7 days after surgery and magnetic resonance angiography taken one year later demonstrating no residual aneurysm and patent interposition graft. ECA, external carotid artery; CCA, common carotid artery; ICA, internal carotid artery

was opened through a linear incision to the proximal and distal ends and a distal shunt tube was inserted into the orifice of the ICA. After confirming the flow to the carotid shunt, carotid shunt irrigation with mixed solution (20% albumin 20 ml+heparin 5000 IU+normal saline 200 ml) was performed every 10 minutes. The suture was performed with double armed 6-0 Prolene. Following suturing the graft (6 mm polytetrafluoroethylene (PTFE) standard wall type) into the proximal ICA with a continuous, non-locking fashion, the CCA clamp was released briefly to test the anastomosis being placed a separated clamp just distal to graft anastomosis (Fig. 2B). And then, the graft was pulled distally to match the appropriate length. Prior to completing distal anastomosis, the ICA clamp was released briefly to identify back bleeding to confirm distal thrombus and the carotid shunt was removed (Fig. 2C, D).

The patient discharged uneventfully and modified Rankin Scale score at 1 year was 0 points. A follow-up computed tomographic angiography taken 7 days after surgery and magnetic resonance angiography taken one year later showed no residual aneurysm and patent interposition graft (Fig. 2E, F).

DISCUSSION

The causes of ECCA include atherosclerosis, dissection, trauma, congenital and infection.[3] The exact pathophysiology of ECAA remain unclear, however Welleweerd et al.[11] suggested two distinct categories: dissection and degeneration in histological study of ECAA. Meanwhile, the pathogenesis of partially thrombosed aneurysms is different from the classical saccular aneurysms. The growth from repeated intramural thrombus in the aneurysmal wall has been suggested as its pathogenesis. Mural thrombus might act as a triggering factor for perivascular growth factors.[5]

Two current management strategies of ECCA are conservative treatment or intervention. Asymptomatic small aneurysms may be managed conservatively, but symptomatic aneurysms are considered surgical or endovascular candidates. Although open surgery with aneurysm resection and flow restoration remains the gold standard, endovascular treatment is an alternative to open surgery.[1)3)6)8)12)]

In a single center study of 20 asymptomatic ECCA with conservative management, the ipsilateral stroke rate was 1.1 per 100 patient-years during median 46.5 months follow-up. The authors concluded conservative management seems justified in patients without growth.[7] Attigah et al.[1] reported long-term results (median follow-up 13.5 years) following surgical therapy of 64 ECCA. Perioperative stroke rate was 1.6%. Permanent and transient cranial nerve injury rates were 6.3% and 20.3%, respectively. The ipsilateral stroke-free times were 96%, 96%, 93%, and 87% after 5, 10, 15, and 20 years, respectively. Although there was a considerable risk of cranial nerve injury, the authors concluded that surgical reconstruction of ECCA is a safe procedure with good long-term results. A systematic review of endovascular stenting of ECCA included a total of 113 reports, involving 224 patients.[6] The incidence of strokes was 1.8% and the overall in-hospital mortality was 4.1%, but unrelated to procedures. Stent-graft patency was achieved in 93% with thrombosis of the aneurysmal sac during a mean follow-up period of 15.4 months. The authors concluded that endovascular treatment is feasible with a high success rate and relatively low complication rate. However, endovascular techniques need to be further evaluated due to little or no long-term follow-up results. In a recent review of 39 articles including a total of 1,239 patients, the 30 day mortality rate and stroke rate were 4.6% and 6.6% in conservatively treated patients (11%) and 1.9% and 5.1% in surgery group (89%), respectively.[10] The most common surgery-related complication was cranial nerve damage (11.8%). The authors concluded that due to limitations in reporting of results and confounding in indication, it was not possible to determine the optimal treatment strategy of ECAA and multicenter international registry is needed.

In this report, we selected surgical treatment due to tortuous proximal vessel and concerns regarding symptomatic recurrence. There are several technical points of

view on performing aneurysmectomy and graft interposition. When end-to-end anastomosis is impossible due to no redundancy of ICA, graft interposition may be utilized. The femoral vein may be limited in its use in the routine procedure due to the time needed to harvest the vein or size mismatch. The artificial graft materials include polyester (Dacron) and PTFE. PTFE grafts may be more resistant to infection than Dacron. Although the use of carotid shunts remains controversial, we recommend its use for reducing cerebral ischemia in cases with poor collaterals and in the presence of recent stroke under monitoring with near-infrared spectroscopy. The proximal shunt tube may be inserted into the distal CCA via the orifice of resected ICA or separate small arteriotomy on the distal CCA.[4] We recommend inserting the proximal shunt tube through a separate small arteriotomy to facilitate anastomosis. If the proximal shunt tube is inserted into the orifice of the proximal ICA, the shunt tube passing through the graft remains inside the graft throughout the anastomosis and may hinder suturing. Some authors recommend complete excision of the aneurysm to minimize the risk of recurrence while others advocate leaving the posterior wall of the aneurysm, which reduces the risk of a cranial nerve injury.[2)7)] Because the aneurysm was tightly adhered to the posterior wall of the carotid sheath and ECA, we left the back wall of the aneurysm intact. Furthermore, the aneurysm sac is helpful in preventing postoperative hematoma wrapping around stitch leakages.

CONCLUSIONS

Aneurysmectomy with graft interposition is feasible for the management of a giant thrombosed ECCA presenting with thromboembolic stroke. The vascular neurosurgeons need to know about surgical techniques in the management of ECCA.

Disclosure

The authors report no conflict of interest concerning the materials or methods used in this study or the findings specified in this paper.

REFERENCES

1. Attigah N, Külkens S, Zausig N, Hansmann J, Ringleb P, Hakimi M, et al. Surgical therapy of extracranial carotid artery aneurysms: long-term results over a 24-year period. Eur J Vasc Endovasc Surg. 2009 Feb;37(2):127-33.
2. de Jong KP, Zondervan PE, van Urk H. Extracranial carotid artery aneurysms. Eur J Vasc Surg. 1989 Dec;3(6):557-62.
3. El-Sabrout R, Cooley DA. Extracranial carotid artery aneurysms: Texas Heart Institute experience. J Vasc Surg. 2000 Apr;31(4):702-12.
4. Hosoda K, Fujita S, Kawaguchi T, Shibata Y, Tamaki N. The use of an external-internal shunt in the treatment of extracranial internal carotid artery saccular aneurysms: technical case report. Surg Neurol. 1999 Aug;52(2):153-5.
5. Krings T, Alvarez H, Reinacher P, Ozanne A, Baccin CE, Gandolfo C, et al. Growth and rupture mechanism of partially thrombosed aneurysms. Interv Neuroradiol. 2007 Jun;13(2):117–26.
6. Li Z, Chang G, Yao C, Guo L, Liu Y, Wang M, et al. Endovascular stenting of extracranial carotid artery aneurysms: a systematic review. Eur J Vasc Endovasc Surg. 2011 Oct;42(4):419-26.
7. Pourier VEC, Welleweerd JC, Kappelle LJ, Rinkel GJE, Ruigrok YM, van der Worp HB, et al. Experience of single center in the conservative approach of 20 consecutive cases of asymptomatic extracranial carotid artery aneurysms. Eur J Neurol. 2018 Oct;25(10):1285-89.
8. Szopiński P, Ciostek P, Kielar M, Myrcha P, Pleban E, Noszczyk W. A series of 15 patients with extracranial carotid artery aneurysms: surgical and endovascular treatment. Eur J Vasc Endovasc Surg. 2005 Mar;29(3):256-61.
9. Valentine RJ. Asymptomatic internal carotid artery aneurysm. J Vasc Surg. 2003 Jan;37(1):210.
10. Welleweerd JC, de Borst GJ, de Groot D, van Herwaarden JA, Lo RT, Moll FL. Bare metal stents for treatment of extracranial internal carotid artery aneurysms: long-term results. J Endovasc Ther. 2015 Feb;22(1):130-4.
11. Welleweerd JC, Nelissen BG, Koole Dave, de Vries JP, Moll FL, Pasterkamp G, et al. Histological analysis of extracranial carotid artery aneurysms. PLoS One. 2015 Jan;10(1):e0117915.
12. Zhou W, Lin PH, Bush RL, Peden E, Guerrero MA, Terramani T, et al. Carotid artery aneurysm: evolution of management over two decades. J Vasc Surg. 2006 Mar;43(3):493-6.