

## Open repair of extracranial-internal carotid artery aneurysm: a case report

Athanasios Chaidoulis, MD, Konstantinos Spanos, MD, MSc, PhD, Petroula Nana, MD, MSc, George Kouvelos, MD, MSc, PhD, Maria Ntalouka, MD, Eleni Arnaoutoglou, MD, MSc, PhD, Miltiadis Matsagkas, MD, PhD, FEBVS

Department of Vascular Surgery, University Hospital of Larissa, Larissa, Greece

### INTRODUCTION

The extra-cranial internal carotid artery (ICA) aneurysms are a rare pathology. Only, 0.1% to 2% of all carotid procedures are performed for aneurysm disease<sup>1</sup>. It also accounts only for 0.4 to 4% of all peripheral aneurysms<sup>1</sup>. There are many causes for extra-cranial internal carotid artery aneurysms, but degenerative disease is responsible for about 40% to 70% of all patients<sup>1</sup>. Fibromuscular dysplasia and collagen-vascular disease may also be the cause in younger ages. HIV is also a rare cause<sup>2</sup>. Iatrogenic injury and trauma are also a common cause in patients that have previously undergone carotid artery surgery or trauma.<sup>1</sup>

Although it is a rare condition, extra-cranial internal carotid artery aneurysms have potentially serious complications such as embolism and stroke, or even rupture, thus it is important for the clinician to understand the pathology and treatment options. Most of those aneurysms are asymptomatic. When it is symptomatic it is a vocal paralysis, dysphagia or stroke. They may lead to neurologic symptoms including transient attacks or ischemic stroke<sup>1</sup>.

Traditional open surgical treatment includes open resection of the entire aneurysm with or without arterial replacement with interposition of a graft. With the development of endovascular technology, extra-cranial carotid aneurysms treatment recently included endovascular and hybrid treatment techniques<sup>3</sup>. In this case report we describe the open repair of a large internal carotid artery aneurysm.

### CASE REPORT

A 60 year old female patient was referred to our vascular service for a left neck pulsatile mass that has grown the last few months. The patient underwent a computed tomography angiography (CTA) that showed a 21mm diameter extracranial left internal carotid artery aneurysm (Figure 1). There was no history of cerebrovascular symptoms, neck pain, or cervical trauma. No other aneurysms were identified in the cerebral

circulation. From her past medical history, the patient has hypertension and hypothyroidism under medication. Blood examinations were all in the normal range.



**Figure 1.** Computed tomography angiography 3D reconstruction with saccular left internal carotid artery aneurysm (LICA)

Given the size of the aneurysm (larger than 2cm), the gender of the patient (female) and the quite rapid growth, a decision to treat was made. There was a discussion whether the patient will be treated by open or endovascular intervention. The patient was in favor of endovascular treatment. However, there were several cons and pros for such a decision as there are described below:

Author for correspondence:

**Konstantinos Spanos, MD, MSc, PhD**

Department of Vascular Surgery, Faculty of Medicine,  
School of Health Sciences, University of Thessaly, Mezourlo,  
Larissa, Greece

Tel: +30 6948570321

E-mail: spanos.kon@gmail.com

ISSN 2732-7175 / 2021 Hellenic Society of Vascular and  
Endovascular Surgery Published by Rotonda Publications  
All rights reserved. <https://www.heljves.com>

## Cons:

- Severe angulation of left internal carotid artery (110°) (Figure 2).
- Long length of the stent-graft that would be needed (two stent-grafts may be needed)
- Great difference in diameter of proximal and distal part of the ICA; a tapered stent-graft would be ideal (not currently available)

## Pros:

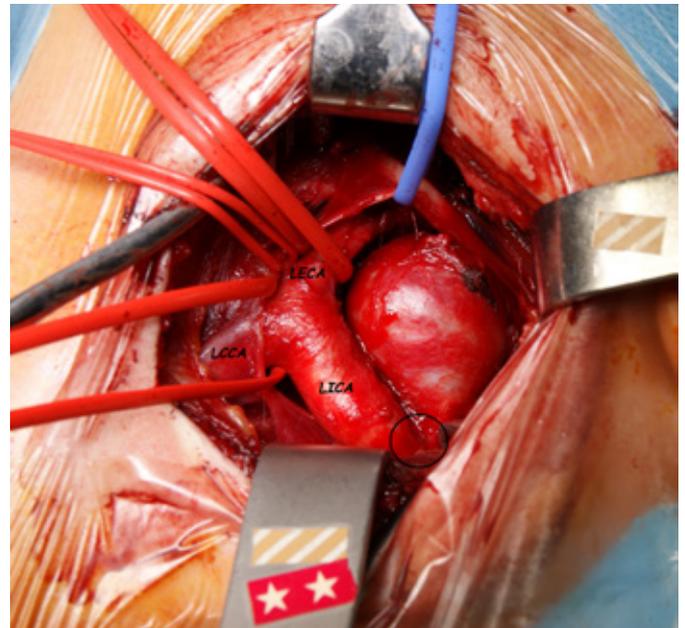
- Minimal invasive
- No risk for nerve injury
- No risk of neck hematoma

Regarding the open repair, the main disadvantage was the potential mismatch of a reversed vein graft and maybe the potential difficulty in distal surgical access.

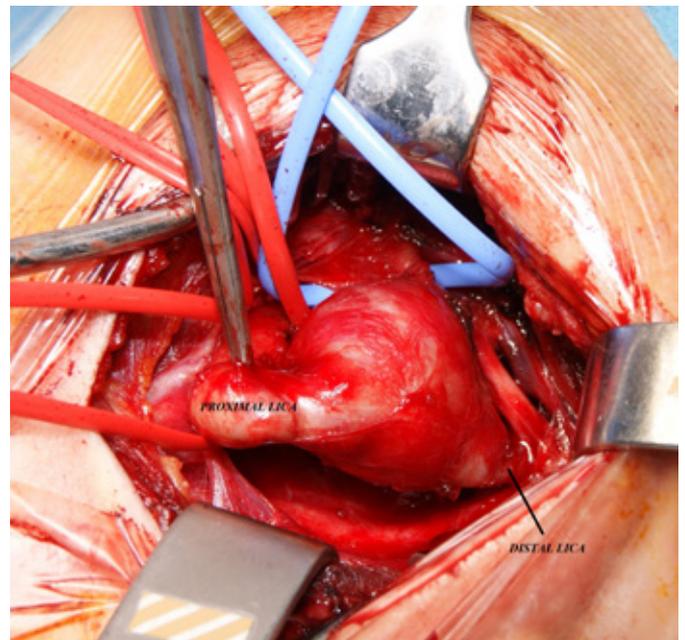


**Figure 2.** Computed tomography angiography 3D reconstruction showing the left carotid bifurcation and the acute angle distally to the aneurysm. (110°)

After discussion with the patient, it was decided to proceed with an open surgical repair. During the operation, the proximal part of the common carotid artery was dissected with obvious severe angulation of the internal carotid artery (Figure 3). Dissection and mobilization of the aneurysm led to dissection of the distal part of the internal artery and the recognition of hypoglossal nerve (Figure 4).



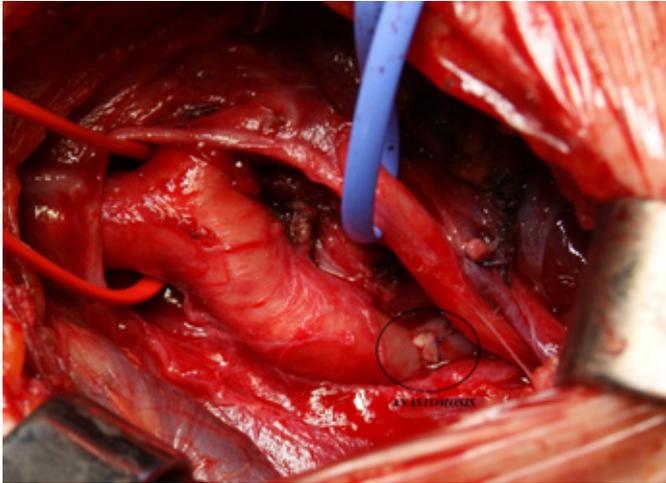
**Figure 3.** Intraoperative image showing the aortic bifurcation and the severe angulation of the internal carotid artery (circled).



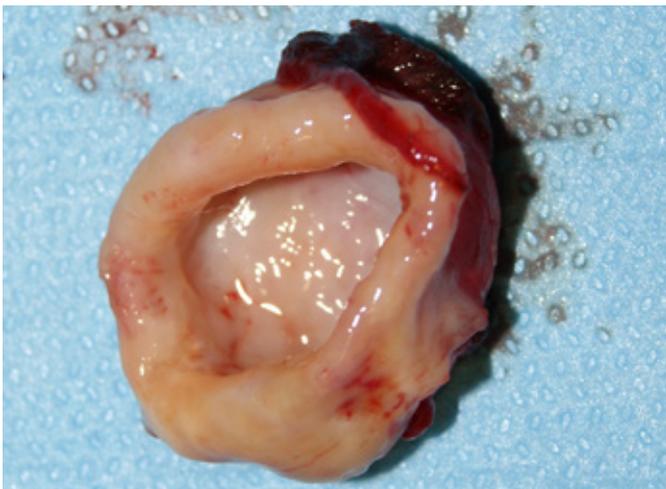
**Figure 4.** Intraoperative image showing the left internal carotid artery aneurysm mobilization.

A resection of the aneurysm was undertaken preserving the initial part of the ICA and an end-to-end anastomosis was feasible managing also the diameter mismatch (Figure 5). A tapered polytetrafluoroethylene (PTFE) graft was also available in case that a bypass was needed. The patient recovered uneventfully without neurological symptoms. She was discharged on the second postoperative day under single antiplatelet therapy and instructions for carotid duplex ultrasound after a month for follow up, which showed patency of the artery and normal flow to the brain, while the patient remains asymptomatic. Histology revealed non atheromatic tissue without ul-

ceration or thrombosis, rarefaction of the elastic component which was replaced by fibrous tissue (Figure 6). At 6 months follow-up the patient remains in excellent condition, while the computed tomography angiography showed a successful carotid reconstruction (Figure 7).



**Figure 5.** Intraoperative image after the resection of the aneurysm, preserving the initial part of the ICA and the end-to-end anastomosis.



**Figure 6a.** Macroscopic image of the resected aneurysm. **6b** The internal layers of the aneurysm, without atheromatosis, thrombosis or ulceration.



**Figure 7.** Postoperative computed tomography angiography, showing successful LICA reconstruction.

## DISCUSSION

Extra cranial carotid aneurysms are rare (0,4 - 1%). The patient may present with dysphagia, cranial nerve dysfunction, stroke, rupture, bleeding.<sup>4</sup> The most common location is near the carotid bifurcation. Colored ultrasound of the neck area can usually distinguish a solid tumor from a vascular disease.<sup>5</sup> The two dominant etiologies are arterial degeneration and pseudo aneurysms.

The treatment of extra cranial carotid internal artery aneurysm was mostly open surgery repair in the past,<sup>6</sup> while recently endovascular repair and hybrid techniques have been commonly used.<sup>5, 7</sup> The conservative therapy has shown very poor results.<sup>5</sup> There are no specific guidelines on the diameter threshold for extra-cranial internal carotid aneurysm invasive treatment indication.<sup>5</sup>

CTA of aortic arch and carotid arteries is necessary in order to assess the morphology of the aneurysm, and the relationship between the aneurysm and the surrounding tissues (vessels, nerves, and musculoskeletal structures).<sup>5</sup> The CTA plays an important role on the decision how to treat such aneurysms.

In open repair there can be a resection and end-to-end anastomosis or aneurysm resection with interposition graft (autogenous veins or synthetic grafts have been used) for revascularization.<sup>7</sup> The mismatch in diameter is a potential issue in these cases. Along this line, in our case, the diameter of proximal internal carotid was double the size of the distal part, thus a reversed vein graft would be not ideal for open treatment. For this purpose, we had a tapered PTFE graft available in order to use it if needed. However, in our case due to the severe angulation there was enough length of the initial part of the internal carotid artery to use for an end-to-end anastomosis after the resection of the aneurysm. Other treatment options that have been reported in the past are clipping, extracranial to intracranial bypass and ligation of the aneurysm.<sup>8</sup>

Recently, endovascular repair has been broadly used as an alternative treatment for the extra-cranial internal carotid artery aneurysm using cover stent grafts.<sup>9</sup> The major benefits are the minimal invasive nature of the procedure, lower comorbidities in terms of cranial nerve injury and potential cervical hematoma and maybe shorter length of hospital stay. Endovascular treatment appears to be a safe and feasible alternative for traditional open surgery, especially in the challenging anatomy and presence of serious comorbidities.<sup>10</sup> Although stroke can occur as the result of hemodynamic changes during the perioperative period. The choice of covered stents may be restrictive in cases of long lesions or with large differences in diameter between the proximal and distal part of the internal carotid.

Generally, the early and long-term outcome of invasive treatment in extra-cranial carotid aneurysm is favorable;<sup>10</sup> however, cranial nerve damage after surgery occurs frequently.<sup>5</sup> Unfortunately, due to the limitations in the available literature, it is not possible to determine the optimal treatment strategy, whether endovascular repair has gained a more robust position in extra-cranial carotid artery treatment. In any case each patient has to be individually assessed and treated accordingly to his/her specific anatomy and comorbidities. In the near future a multicenter international registry is needed in order to reveal the optimal treatment for extra-cranial carotid aneurysms.

## CONCLUSION

The optimal treatment of extra-cranial carotid aneurysm depends on the aneurysm morphology and location as well as patient's comorbidities. Open surgical repair is suitable and safe, however large registries are needed in order to specify the role of open and endovascular treatment of this particular disease.

**Acknowledgement:** None

**Conflict of interest:** None

## REFERENCES

- 1 Kraemer CJK, Zhou W. Carotid Aneurysm Review. *Int J Angiol.* 2019 Mar;28(1):17-19. doi: 10.1055/s-0039-1677675. Epub 2019 Feb 27. PMID: 30880886; PMCID: PMC6417903.
- 2 Silvestri V, Borrazzo C, Mele R, d'Ettoire G. Carotid Artery Aneurysm in HIV: A Review of Case Reports in Literature. *Ann Vasc Surg.* 2020 Feb; 63:409-426. doi: 10.1016/j.avsg.2019.09.012. Epub 2019 Oct 17. PMID: 31629845
- 3 Welleweerd JC, den Ruijter HM, Nelissen BG, Bots ML, Kappelle LJ, Rinkel GJ, Moll FL, de Borst GJ. Management of extracranial carotid artery aneurysm. *Eur J Vasc Endovasc Surg.* 2015 Aug;50(2):141-7. doi: 10.1016/j.ejvs.2015.05.002. Epub 2015 Jun 24. PMID: 26116488.
- 4 El-Sabrouh R, Cooley DA. Extracranial carotid artery aneurysms: Texas Heart Institute experience. *J Vasc Surg.* 2000 Apr;31(4):702-12. doi: 10.1067/mva.2000.104101. PMID: 10753278.
- 5 Pourier VE, De Borst GJ. Which carotid artery aneurysms need to be treated (and how)? *J Cardiovasc Surg (Torino).* 2016 Apr;57(2):152-7. Epub 2015 Nov 24. PMID: 26603291.
- 6 Strickland BA, Rennert RC, Bakhsheshian J, Ravina K, Fredrickson V, Giannotta SL, Russin JJ. Extracranial-Intracranial Bypass for Treatment of Blister Aneurysms: Efficacy and Analysis of Complications Compared with Alternative Treatment Strategies. *World Neurosurg.* 2018 Sep;117:e417-e424. doi: 10.1016/j.wneu.2018.06.046. Epub 2018 Jun 18. PMID: 29920386.
- 7 Lu WL, Wang B, Wu F, Wang MY, Pan JX, Xu H. Covered Stent-Assisted Open Surgery in the Treatment of an Extracranial Carotid Artery Pseudoaneurysm. *Ann Vasc Surg.* 2019 May;57:238-243. doi: 10.1016/j.avsg.2018.08.084. Epub 2018 Nov 24. PMID: 30476616.
- 8 Strickland BA, Rennert RC, Bakhsheshian J, Ravina K, Fredrickson V, Giannotta SL, Russin JJ. Extracranial-Intracranial Bypass for Treatment of Blister Aneurysms: Efficacy and Analysis of Complications Compared with Alternative Treatment Strategies. *World Neurosurg.* 2018 Sep;117:e417-e424. doi: 10.1016/j.wneu.2018.06.046. Epub 2018 Jun 18. PMID: 29920386
- 9 Gao P, Qi J, Wang M, Li G, Yang L, Dong D, Wu X. Endovascular treatment of extracranial carotid artery aneurysms using self-expandable covered stent grafts: A single center retrospective study. *Vascular.* 2021 Feb 17:1708538121990120. doi: 10.1177/1708538121990120. Epub ahead of print. PMID: 33596790.
- 10 Welleweerd JC, den Ruijter HM, Nelissen BG, Bots ML, Kappelle LJ, Rinkel GJ, Moll FL, de Borst GJ. Management of extracranial carotid artery aneurysm. *Eur J Vasc Endovasc Surg.* 2015 Aug;50(2):141-7. doi: 10.1016/j.ejvs.2015.05.002. Epub 2015 Jun 24. PMID: 26116488.