



Surgical management of giant intrapetrous internal carotid aneurysm presenting with coil exposure after endovascular treatment

Le-Bao Yu^{1,2,3,4} · Dong Zhang^{1,2,3,4} · Shao-Hua Yang⁵ · Ji-Zong Zhao^{1,2,3,4}

Received: 10 December 2017 / Revised: 28 February 2018 / Accepted: 7 March 2018 / Published online: 23 March 2018
© Springer-Verlag GmbH Germany, part of Springer Nature 2018

Abstract

Giant intrapetrous internal carotid aneurysms (petrous ICA aneurysm) are rare. A giant petrous ICA aneurysm presenting with otorrhagia and coil exposure to the external auditory meatus (EAM) after endovascular treatment has never been documented before. The authors report here a case of successful surgical trapping with bypass intervention of a giant petrous ICA aneurysm presenting with coil exposure after endovascular treatment. A 58-year-old man presented with persistent otorrhagia having been admitted to our hospital because of the recurrence of a giant petrous ICA aneurysm after repeated embolization treatments with coils. An electronic otoscope examination demonstrated that a piece of coil escaped into his right EAM. After multidisciplinary consultation, an extracranial-intracranial (EC-IC) bypass with ICA occlusion and coil removal with a closed EAM filling were performed in stages. The patient recovered quickly without any neurological deficits. A digital subtraction angiography confirmed the absence of the aneurysm and patency of the bypass graft.

Keywords Intrapetrous internal carotid aneurysm · Coil escaping · Bypass surgery · Endovascular coiling

Background

Giant intrapetrous internal carotid aneurysms (ICA) are rare. Only a few studies generally consisting of case reports or small case series have been documented [8, 9, 11, 13, 14, 16, 18]. Traditional surgical clipping is not frequently utilized due to their complex location within the petrous bone, and extracranial-intracranial (EC-IC) bypass with proximal ligation of the internal carotid artery (ICA) is still the conventional treatment [1, 2]. However, mini-invasive endovascular techniques

have greatly evolved in the last two decades, allowing effective intervention for both ruptured and unruptured aneurysms, even in more complex anatomical and clinical conditions [6, 17]. Although endovascular treatment is a feasible treatment option for giant petrous ICA aneurysm, high residual and recurrence rates were observed in earlier reports [9, 15]. In this article, we reported a case of successful surgical trapping with bypass intervention of a giant intrapetrous ICA aneurysm presenting as otorrhagia and coil exposure caused by a penetrated coil after repeated endovascular treatment, which has never been documented before.

✉ Ji-Zong Zhao
zhaojz205@163.com

- ¹ Department of Neurosurgery, Beijing Tiantan Hospital, Capital Medical University, Beijing 100050, China
- ² China National Clinical Research Center for Neurological Diseases (NCRC-ND), Beijing 100050, China
- ³ Center of Stroke, Beijing Institute for Brain Disorders, Beijing 100050, China
- ⁴ Beijing Key Laboratory of Translational Medicine for Cerebrovascular Disease, Beijing 100050, China
- ⁵ Center for Neuroscience Discovery, Institute for Healthy Aging, University of North Texas Health Science Center, Fort Worth, TX 76107, USA

Case presentation

History and examination

A 58-year-old man presenting with persistent otorrhagia was admitted to our hospital because of the recurrence of a giant petrous ICA aneurysm. The patient had a history of two embolization treatments of the aneurysm in the local hospital 9 years and 1 year ago. Digital subtraction angiography (DSA) post coiling embolization of the aneurysm demonstrated that the aneurysm was completely filled with coils (Figs. 1 and 2). However, the patient suffered mild bloody discharge in his right

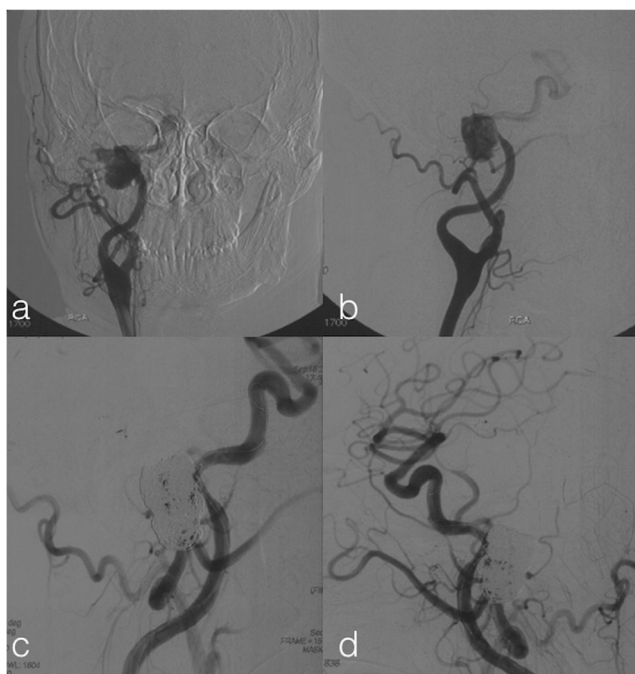


Fig. 1 Right carotid angiogram shows a giant right petrous carotid aneurysm (a and b). Postprocedural right carotid angiogram obtained after deployment of coils reveals the aneurysm was completely filled with coils for the first time (c and d)

ear for approximately 9 years after the first endovascular treatment, and conservative management with administration of oral antibiotics was applied during the previous 9 years until

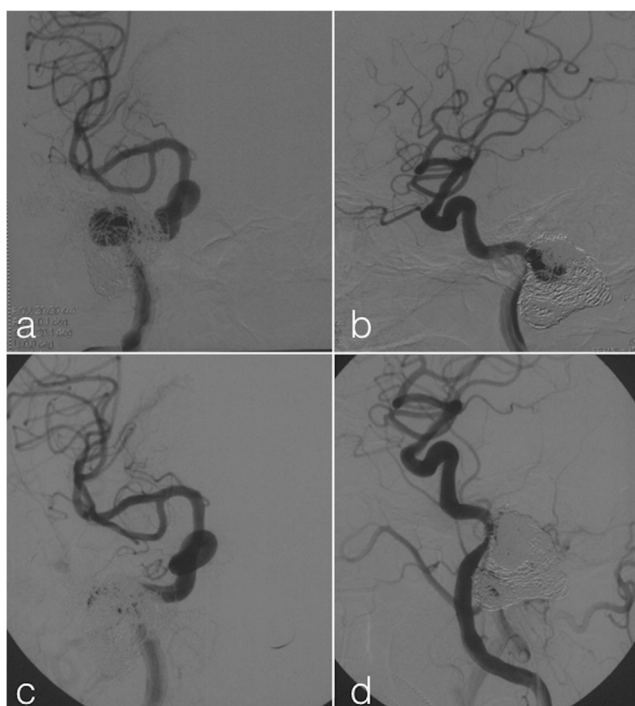


Fig. 2 Right carotid angiogram shows recurrence of the aneurysm (a and b). A repeat embolization with stent-assisted coiling was performed 8 years later after the first embolization (c and d)

the patient was admitted to our medical center, as the aneurysm was visualized again on angiographic imaging. An electronic otoscope examination revealed the coil exposure in his right EAM (Fig. 3). The patient was planned for bypass with ICA occlusion as he did not pass the balloon test occlusion (BTO).

Operation and postoperative course

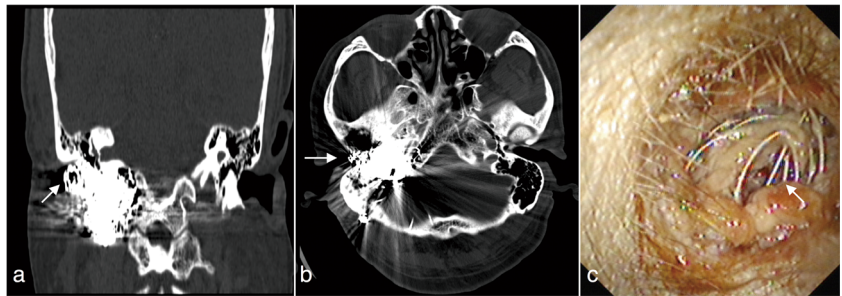
The patient was taken to the hybrid operating room. Then, a 15-cm segment of the radial artery was harvested, and end-to-end and end-to-side anastomosis were respectively performed at the main superficial temporal artery and middle cerebral artery. After the bypass surgery, we have intended to trap the aneurysm with endovascular means, but the guide wire could not pass though due to the block of old stents and coils around the neck of aneurysm. Therefore, the aneurysm was trapped by clipping just proximal to the takeoff point of the ophthalmic artery and occluding proximal to the aneurysm with endovascular coil embolization. DSA after the trapping showed complete disappearance of the aneurysm with patent bypass (Fig. 4a, b). The patient was discharged with no event, and the coils in the ECA were still present.

Three months later, the patient returned to our department to address the coils in his ear. Partial coil removal together with auditory canal occlusion was performed through the transpetrosal approach (Fig. 4d–f). The postoperative course was uneventful, and the patient continues to be asymptomatic.

Discussion

Asymptomatic petrous ICA aneurysm can be managed conservatively because of the protection of the surrounding bony structure, but patients with symptoms, especially bleeding, should undergo more aggressive treatment [3, 19]. Proximal ligation of the ipsilateral ICA was the most frequently utilized treatment of these aneurysms in the early 1960s [20]. However, the morbidity and mortality associated with internal carotid ligation were significant [16]. ICA occlusion with bypass appears to be a better strategy, and although the procedure is challenging, an acceptable outcome was observed [1, 10]. With the advances in endovascular techniques, several authors have reported their results in treating petrous ICA aneurysm with coiling embolization. The treatment has been effective, but aneurysm residue and recanalization were common, especially for giant petrous ICA aneurysms [9]. Complete occlusion was only achieved in approximately half of the large and giant cerebral aneurysms by endovascular embolization [22]. These studies demonstrated that although short-term management was

Fig. 3 CT and electronic otoscope examinations showed coils escaped into the external auditory meatus (**a**, **b** and **c**)



effective, the recurrence or coil compaction was the major problem leading to retreatment, which would increase morbidity. Embolization may be incomplete for giant aneurysms, and even if coiling is successful, the aneurysm may recanalize and regrowth or coils may suffer compaction, requiring further microsurgery [21]. In the present case, the aneurysm had recurred twice after complete embolization. Endovascular treatment would obviously have been an ineffective further treatment.

The advancement of modern endovascular technology allows mini-invasive endovascular intervention in more complex anatomical conditions [4, 5, 7, 14]. However, the endovascular approach has increased the risk of some certain complications such as aneurysmal perforation by guidewire, microcatheter, and/or coils. Ruptured aneurysms seem to be more susceptible to perforations related to endovascular intervention than unruptured ones [6]. In the present case, we were primarily concerned about the

exposed coils. Giant petrous ICA aneurysms are always associated with a chronic osseous erosion and a thin aneurysmal wall. Therefore, aneurysmal wall penetration by coils is possible, although it is extremely rare that the surrounding bony structure would be penetrated at the same time. Thus, a CT scan of the petrous bone is suggested to evaluate the situation around the aneurysm before any coiling for a petrous ICA aneurysm is performed. In this case, if the patient received flow-diverter or liquid embolic treatment for the recurrent aneurysm rather than repeated coiling, both the recanalization and the subsequent rupture might have been avoided. However, the existence of the escaped coils made it impossible to perform endovascular treatment, as those escaped coils required removal because they could have become a source of infection leading to intracranial infection in the future. Of course, we have to trap the aneurysm first to secure the removal safely. Accordingly, we planned the operation in stages.

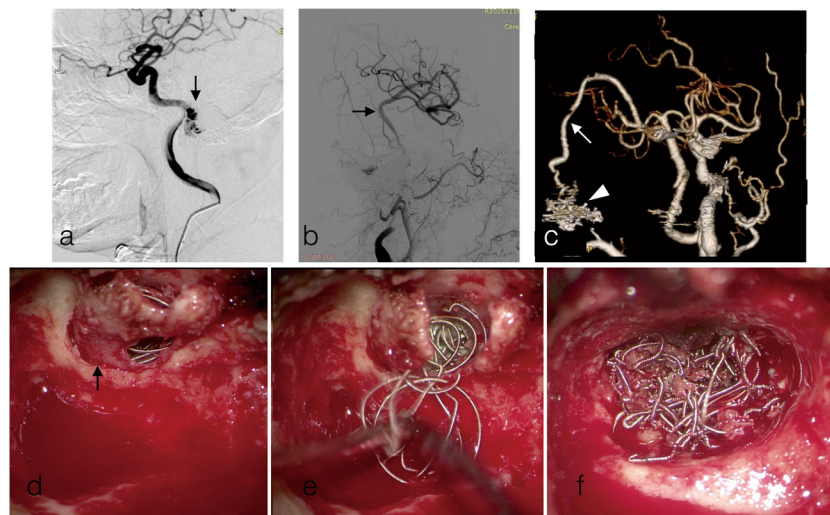


Fig. 4 Right carotid angiogram shows recurrence of the aneurysm for the second time (**a**, arrow). End-to-end and end-to-side anastomosis were respectively performed using the arterial graft at the main STA and MCA (M2); intraoperative angiography confirmed the patency of the bypass (**b**, arrow) and full suppletion of the entire right middle cerebral artery territory (**b**). The operation of the removal of the coils was performed with the transpetrosal approach. Many coils were seen in the

external auditory meatus (**d** and **e**). After removing these coils from the external auditory meatus and then removing the surrounding bone, more underlying coils appeared (**f**). We removed most of them, and a small portion of the coils deep inside could not be completely removed. CTA showed good patency of the bypass 3 months later (**c**, arrow), and a small portion of the residual coils were still there (**c**, arrow head)

Conclusion

The patient is lucky to not have had a carotid blow out through his ear during the 9 years of conservative management. We offered the surgical treatment immediately after the patient was admitted to our medical center, and the treatment of EC-IC bypass with ICA occlusion was effective. It is relatively safe to remove the coils inside the aneurysm after the aneurysm is trapped. A giant petrous ICA aneurysm is still challenging, and the optimal treatment has yet to be determined. Both microsurgical treatment and endovascular treatment are effective for some cases but not perfect [12]. Therefore, it is important to make an appropriate choice between these two options.

Acknowledgments We thank Dr. Yin-Xia (Chief of the Otorhinolaryngology Department, Beijing Tiantan Hospital, Capital Medical University) for general support.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflicts of interest.

Ethics approval This report was approved by the patient and the institutional ethical review board of Beijing Tiantan Hospital.

Informed consent The patient approved the publication of this case presentation.

References

- Abe H, Takemoto K, Higashi T, Inoue T (2011) Surgical treatment for aneurysms in the cavernous-petrous portion of the internal carotid artery. *Acta Neurochir Suppl* 112:77–83. https://doi.org/10.1007/978-3-7091-0661-7_14
- Akhtar MU, Akram M, Ahmed TM, Bhatti AM (2017) Superficial temporal artery-middle cerebral artery bypass for internal carotid artery petrous aneurysm: a case report. *JPMMA J Pak Med Assoc* 67:128–130
- Bien AG, Cress MC, Nguyen SB, Westgate SJ, Nanda A (2013) Endovascular treatment of a temporal bone pseudoaneurysm presenting as bloody otorrhea. *J Neurol Surg Rep* 74:88–91. <https://doi.org/10.1055/s-0033-1348954>
- Chen JB, Sun H, Zhou LX, He M, Lei D (2013) Successful endovascular treatment of carotid aneurysms in a patient with vascular Ehlers-Danlos syndrome. *J Neurol Surg Part A Cent Eur Neurosurg* 74(Suppl 1):e85–e88. <https://doi.org/10.1055/s-0032-1322591>
- Cinar C, Bozkaya H, Parildar M, Oran I (2013) Endovascular management of vascular injury during transsphenoidal surgery. *Interv Neuroradiol* 19:102–109. <https://doi.org/10.1177/159101991301900116>
- Cloft HJ, Kallmes DF (2002) Cerebral aneurysm perforations complicating therapy with Guglielmi detachable coils: a meta-analysis. *AJNR Am J Neuroradiol* 23:1706–1709
- Cohen JE, Grigoriadis S, Gomori JM (2007) Petrous carotid artery pseudoaneurysm in bilateral carotid fibromuscular dysplasia: treatment by means of self-expanding covered stent. *Surg Neurol* 68:216–220; discussion 220. <https://doi.org/10.1016/j.surneu.2006.08.082>
- Couldwell WT, Zuback J, Onios E, Ahluwalia BS, Tenner M, Moscatello A (2001) Giant petrous carotid aneurysm treated by submandibular carotid-saphenous vein bypass: case report. *J Neurosurg* 94:806–810. <https://doi.org/10.3171/jns.2001.94.5.0806>
- Depauw P, Defreyne L, Dewaele F, Caemaert J (2003) Endovascular treatment of a giant petrous internal carotid artery aneurysm. Case report and review of the literature. *Minim Invasive Neurosurg* 46:250–253. <https://doi.org/10.1055/s-2003-42358>
- Ferrolli P, Bisleri G, Nakaji P, Albanese E, Acerbi F, Polvani G, Broggi G (2009) Endoscopic radial artery harvesting for U-clip EC-IC bypass in the treatment of a giant petrous internal carotid artery aneurysm: technical case report. *Minim Invasive Neurosurg* 52:186–189. <https://doi.org/10.1055/s-0028-1105901>
- Hamamoto Filho PT, Machado VC, Macedo-de-Freitas CC (2013) A giant aneurysm from the petrous carotid presenting with isolated peripheral facial palsy. *Rev Assoc Med Bras* 59:531–533. <https://doi.org/10.1016/j.ramb.2013.07.004>
- Kadkhodayan Y, Shetty VS, Blackburn SL, Reynolds MR, Cross DT 3rd, Moran CJ (2013) Pipeline embolization device and subsequent vessel sacrifice for treatment of a bleeding carotid pseudoaneurysm at the skull base: a case report. *J Neurointerv Surg* 5:e31. <https://doi.org/10.1136/neurintsurg-2012-010394>
- Mangat SS, Nayak H, Chandna A (2011) Homer's syndrome and sixth nerve paresis secondary to a petrous internal carotid artery aneurysm. *Semin Ophthalmol* 26:23–24. <https://doi.org/10.3109/08820538.2010.541321>
- Mascitelli JR, De Leacy RA, Oermann EK, Skovrlj B, Smouha EE, Ellozy SH, Patel AB (2014) Cervical-petrous internal carotid artery pseudoaneurysm presenting with otorrhea treated with endovascular techniques. *BMJ Case Rep*. <https://doi.org/10.1136/bcr-2014-011286>
- Mascitelli JR, De Leacy RA, Oermann EK, Skovrlj B, Smouha EE, Ellozy SH, Patel AB (2015) Cervical-petrous internal carotid artery pseudoaneurysm presenting with otorrhea treated with endovascular techniques. *J Neurointerv Surg* 7:e25. <https://doi.org/10.1136/neurintsurg-2014-011286.rep>
- Morantz RA, Kirchner FR, Kishore P (1976) Aneurysms of the petrous portion of the internal carotid artery. *Surg Neurol* 6:313–318
- Orru E, Roccatagliata L, Cester G, Causin F, Castellan L (2013) Complications of endovascular treatment of cerebral aneurysms. *Eur J Radiol* 82:1653–1658. <https://doi.org/10.1016/j.ejrad.2012.12.011>
- Oyama H, Hattori K, Tanahashi S, Kito A, Maki H, Tanahashi K (2010) Ruptured pseudoaneurysm of the petrous internal carotid artery caused by chronic otitis media. *Neurol Med Chir* 50:578–580
- Palacios E, Gomez J, Alvernia JE, Jacob C (2010) Aneurysm of the petrous portion of the internal carotid artery at the foramen lacerum: anatomic, imaging, and otologic findings. *Ear, Nose, Throat J* 89:303–305
- Singh H, Thomas J, Hoe WL, Sethi DS (2008) Giant petrous carotid aneurysm: persistent epistaxis despite internal carotid artery ligation. *J Laryngol Otol* 122:e18. <https://doi.org/10.1017/s002221510800282x>
- Tsang AC, Leung KM, Lee R, Lui WM, Leung GK (2015) Primary endovascular treatment of post-irradiated carotid pseudoaneurysm at the skull base with the pipeline embolization device. *J Neurointerv Surg* 7:603–607. <https://doi.org/10.1136/neurintsurg-2014-011154>
- Wang B, Gao BL, Xu GP, Xiang C, Liu XS (2015) Endovascular embolization is applicable for large and giant intracranial aneurysms: experience in one center with long-term angiographic follow-up. *Acta Radiol* 56:105–113. <https://doi.org/10.1177/0284185113520312>