Interdisciplinary Neurosurgery 17 (2019) 107–112

Contents lists available at ScienceDirect

Interdisciplinary Neurosurgery

journal homepage: www.elsevier.com/locate/inat

Case reports & case series

Transclival clipping for giant vertebral artery aneurysm: A case report

Tsubasa Okuyama (M.D.)[a,b], Kentaro Horiguchi (M.D. Ph.D.)[b,*], Yoshinori Higuchi (M.D. Ph.D.)[b], Tatsuma Matsuda (M.D.)[c], Akihiko Adachi (M.D. Ph.D.)[b], Eiichi Kobayashi (M.D. Ph.D.)[b], Yasuo Iwadate (M.D. Ph.D.)[b]

[a] Department of Functional Brain Imaging Research, National Institute of Radiological Sciences, National Institute for Quantum and Radiological Science and Technology, 4-9-1 Anagawa, Inage-ku, Chiba-shi, Chiba 263-8555, Japan
[b] Department of Neurological Surgery, Chiba university Graduate School of Medicine, Chuoku, Chiba, Japan
[c] Department of Neurological Surgery, Kimitsu Chuo Hospital, Japan

ARTICLE INFO

Keywords:
Transclival clipping
Giant vertebral artery aneurysm
Vasa vasorum
Cerebrospinal fluid leakage
Flow diverter stent

ABSTRACT

Background: Endovascular treatment often achieves complete obliteration of VA giant aneurysm; however, retreatment may be required because of late recanalization. We report a case of giant VA aneurysm that showed regrowth after endovascular treatment and was treated with VA clipping using the endoscopic endonasal transclival approach.

Case description: A 47-year-old man with chief complaint of ataxia underwent endovascular treatment of giant VA aneurysm. One year later, he needed additional treatment to regrowth of the aneurysm. We were not able to accomplish aneurysmectomy via the transcondylar fossa approach because of difficulty in achieving hemostasis and ended with partial thrombectomy. Digital subtraction angiography (DSA) performed after 4 months revealed coil compaction and distal flow due to recanalization. Right VA elongation and position of anterior spinal artery (ASA), these factors made possible for us to perform transclival approach to VA. Despite the limited indications for its use, endonasal endoscopic transclival clipping may be effective in limited anatomical cases.

Conclusion: We report the use of endonasal endoscopic transclival clipping for giant VA aneurysm. This endonasal endoscopic treatment may be an optional alternative in only limited cases depending upon the anatomical location of the lesion because of limitations of vascular control and the inability to visualize the field in the presence of major bleeding. For treatment of progressive giant VA aneurysm, it is very important to avoid optimistic strategy for giant VA aneurysm initially.

1. Introduction

Giant aneurysms (> 25 mm) arising from the vertebral artery (VA) are rare and account for 5% of all intracranial giant aneurysms. In VA giant aneurysm, aneurysmal thrombosis sometimes makes the mass large because of swirling blood flow and the presence of vasa vasorum. The growing aneurysm tends to cause neurological symptoms due to compression of brainstem, cerebellum, lower cranial nerves, and other anatomically contiguous structures. Endovascular treatment often achieves complete obliteration of VA giant aneurysm; however, retreatment may be required because of late recanalization [10,12].

We report a case of giant VA aneurysm that showed regrowth after endovascular treatment and was treated with VA clipping using the endoscopic endonasal transclival approach. Written informed consent was obtained from the patient for publication of this case report and accompanying images.

2. Case report

2.1. History

A 47-year-old man with chief complaint of ataxia underwent endovascular treatment (internal trapping) of giant VA aneurysm at another institution. Follow-up magnetic resonance imaging (MRI) at

Abbreviations: AICA, anterior inferior cerebellar artery; AN, aneurysm; ASA, anterior spinal artery; BA, basilar artery; CH, clip head; CL, Clivus; CP, carotid prominence; CSF, cerebral spinal fluid; DS, dorsum sella; DSA, digital subtraction angiography; FDS, flow diverter stent; IF, Inlayer fascia; MRI, magnetic resonance imaging; RVA, right distal vertebral artery; UN, basilar artery union; VA, vertebral artery; VAG, vertebral angiography

* Corresponding author.
E-mail addresses: okuyama.tsubasa@qst.go.jp (T. Okuyama), ken1977hori@chiba-u.jp (K. Horiguchi), yhiguchi@faculty.chiba-u.jp (Y. Higuchi), papez@faculty.chiba-u.jp (E. Kobayashi), iwadatey@faculty.chiba-u.jp (Y. Iwadate).

https://doi.org/10.1016/j.inat.2019.04.004
Received 6 March 2019; Accepted 7 April 2019

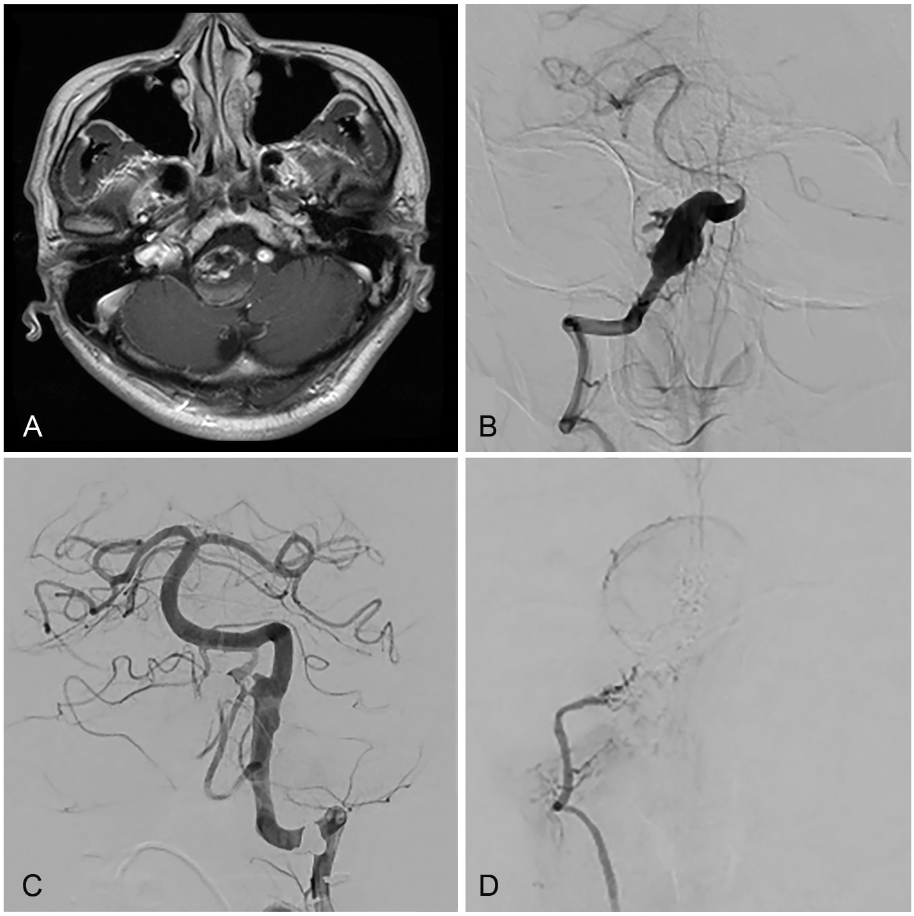

Fig. 1. A) Initial enhanced MRI (T1WI sequence) performed at our hospital 1 year after the first coil embolization.
B) Right vertebral angiography (VAG) before the first coil embolization (AP view).
C) Left VAG just after coil embolization (AP view).
D) Right VAG before the first direct surgery (AP view).

6 months showed signs of recanalization; however, the patient continued follow-up with no active intervention. One year later, he was referred to our hospital due to regrowth of the aneurysm (Fig. 1A, B, C).

Computed tomography and preoperative digital subtraction angiography (DSA) displayed a giant, partially thrombosed right VA aneurysm. Right vertebral angiography revealed mild perianeurysmal flow via vaso vasorum (Fig. 1D). We planned aneurysmectomy via direct open cranial surgery. We believed that proximal ligation alone would be enough to obliterate the aneurysmal flow. The patient underwent direct open surgery via the transcondylar fossa approach (Fig. 2). The extradural VA was ligated and aneurysmectomy was attempted. Although proximal flow was completely obliterated, fresh blood spouted out after opening the aneurysmal wall, which was likely attributable to blood flow from the vaso vasorum in the aneurysm wall. We were not able to perform aneurysmectomy because of difficulty in achieving hemostasis and ended with partial thrombectomy.

Postoperatively, the patient developed bilateral vocal cord paralysis. Therefore, tracheostomy was performed. DSA performed after 4 months revealed coil compaction and distal flow due to recanalization (Fig. 3A). Therefore, we planned further coil embolization and performed it via left VA (retrograde course); however, complete obliteration could not be performed due to failure to reach the lesion. Since the anterior spinal artery (ASA) originated 5 mm distal to the aneurysm, internal trapping was not considered owing to the high risk of ASA occlusion (Fig. 3B). Right VA was found elongated to the opposite site (Fig. 3C). Therefore, we decided that the right distal VA could be accessed via the endonasal endoscopic transclival approach. Finally, we planned two-staged surgery: endoscopic endonasal transclival clipping of right distal VA followed by direct open aneurysmectomy.

2.2. 1st operation

The patient was placed in the supine position; the head position was elevated by 10 degrees and rotated to the left. We used a hybrid operation room for confirmation of flow obliteration, identification of ASA, and preparation of balloon occlusion in case of rupture. Under general anesthesia, a 4 French short sheath was inserted into the left radial artery. A 0-degree endoscope and fixator were selected (Karl Stortz, Culver City, CA). Endoscope reached the sphenoid sinus through bilateral nostrils and opened the mid-clival bone (Fig. 4A). After incising the dura mater, basilar artery (BA) and right anterior inferior cerebellar artery (AICA) were detected inside the field of view (Fig. 4B). On the left side, VA union, distal part of the right VA and the aneurysm were confirmed. ASA was not detected in endoscopic operative view because the origin of ASA was located behind the aneurysm. Based on preoperative estimation, there was enough space between the distal edge of the aneurysm and the ASA bifurcation. Vascular clip applicators (FT762T, Aesculap AG, Tuttlingen, Germany) were inserted at right VA immediately distal to the aneurysm (Fig. 4C). After clipping, intraoperative DSA clearly showed the ASA and confirmed complete obliteration (Fig. 4E). Femoral fascia was set at intradural space and sutured by 6–0 proline at one point. The clip head was covered by other onlay fascia (Fig. 4D). Finally, the nasal septal flap and Integrane cotton (Koken, Japan) was used to cover the residual sphenoidal sinus as an

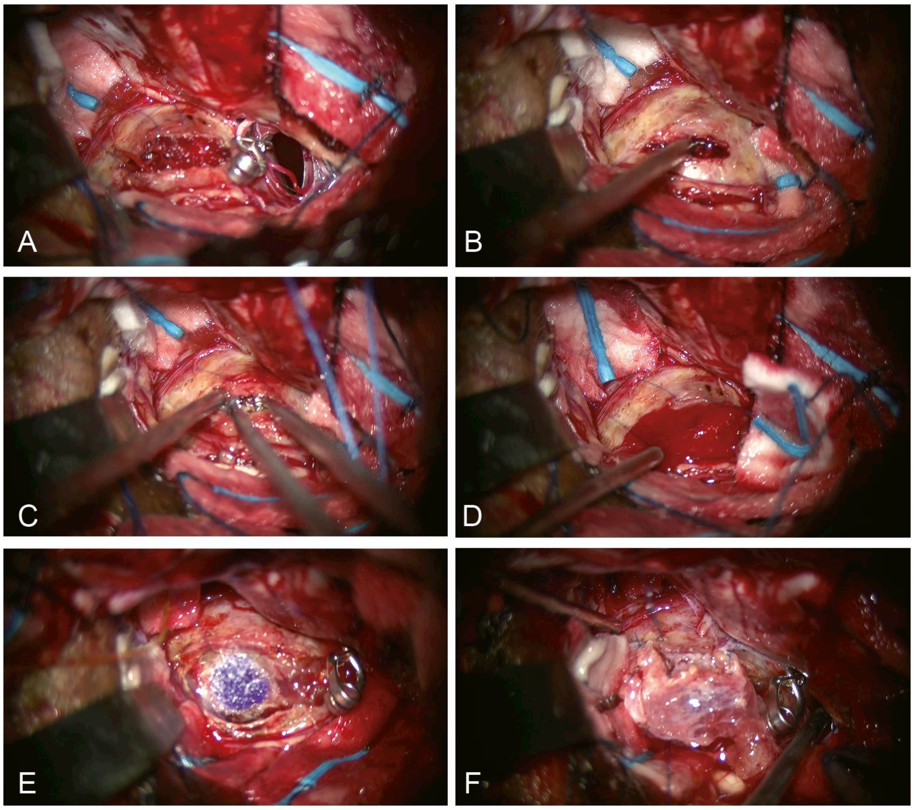

Fig. 2. Intraoperative photographs during the first direct surgery.
A) Proximal ligation of the aneurysm and opening of the aneurysm wall.
B) Removal of old hematoma.
C) Initial stage of thrombectomy.
D) Fresh blood sprouting from inside the aneurysm.
E) Use of Surgicel cotton with NBCA to achieve hemostasis.
F) Muscle patch covered aneurysm wall.

overlayer. Multilayer reconstruction was completed. No neurological deterioration or cerebral spinal fluid (CSF) leakage was observed after the operation.

2.3. 2nd operation

One month after the 1st operation, DSA confirmed no blood flow in the aneurysm, including the vaso vasorum. The second operation was also performed via the right transcondylar fossa approach. No fresh bleeding occurred after opening the aneurysm wall. Owing to adhesions around the right AICA, dissection between the AICA and cerebellum could not be performed easily (Fig. 5A) (Cerebellar infarction related AICA lesion was detected by postoperative MR images). As thrombus and coil mass were removed, the aneurysm size was reduced (Fig. 5B). The clip edge from the 1st operation was found at the prepontine cistern (Fig. 5C). After aneurysm resection, we confirmed that the inflammatory capsule had wrapped the clip edge.

2.4. Postoperative course

Postoperatively, the patient experienced transient central hiccups for over 2 weeks. Postoperative MR images showed total removal of aneurysm and right cerebellar infarction (Fig. 5D); however, there was no aggravation of ataxia. One month later, the patient was transferred to a rehabilitation hospital.

3. Discussion

In cases of giant VA aneurysm, slow progressive enlargement causes neurological symptoms due to compression of lower cranial nerves,

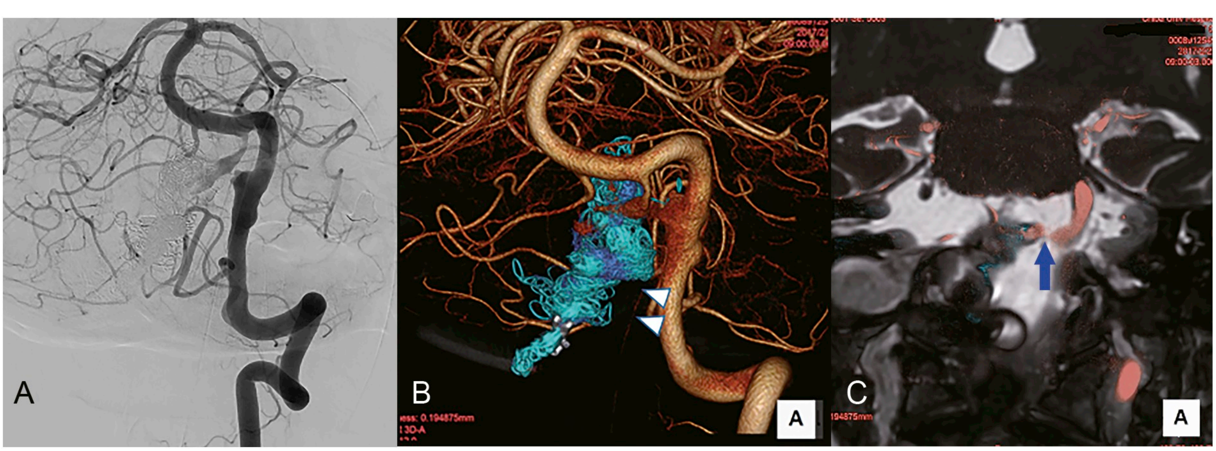

Fig. 3. A) Digital subtraction angiography performed 4 months after the first direct surgery. Coil compaction and distal flow due to recanalization is seen.
B) Preoperative 3D-DSA revealed the anterior spinal artery (arrow head).
C) MRI and DSA were merged to identify the clipping point (arrow).

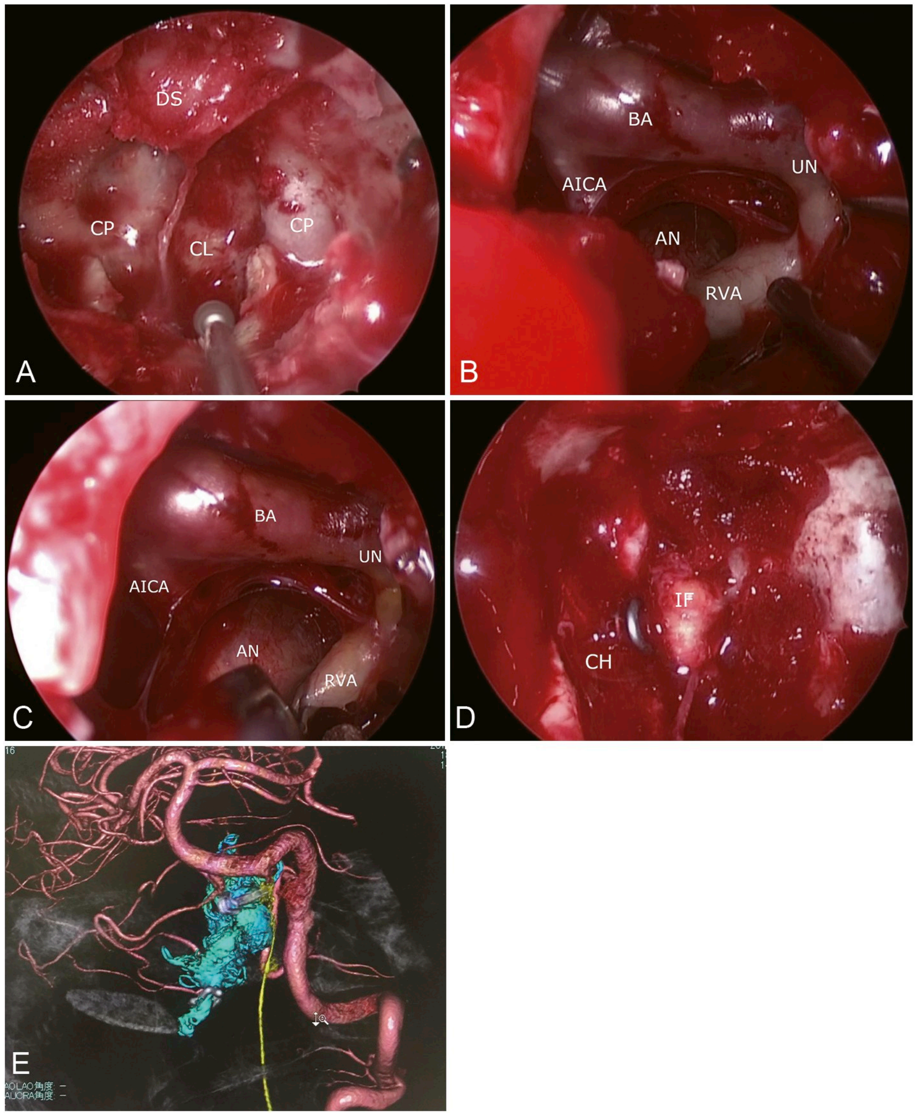

Fig. 4. A) Clivectomy.
B) Pre clipping view.
C) Post clipping view.
D) Reconstruction with inlayer fascia.
E) Intraoperative 3D-DSA after clipping shows the preserved anterior spinal artery.
AICA: anterior inferior cerebellar artery; AN: aneurysm; BA: basilar artery.
CH: clip head, CL: Clivus, CP: carotid prominence, DS: dorsum sella, IF: Inlayer fascia.
RVA: right distal vertebral artery, UN: basilar artery union.

brainstem, and cerebellum. Several recent reports have described progressive symptoms due to uncontrolled aneurysm enlargement in spite of multiple endovascular treatment [3,12]. Treatment with open surgery alone is associated with high complication rate, whereas endovascular alone often leads to recurrence and necessitates repeat treatment. There are certain prerequisites for the use of endoscopic endonasal clipping [4,6–8]. Firstly, it is necessary that clipping space is located on the midline behind the clivus. In other words, there should be adequate room not only for clip insertion, but also to allow for assessment of contiguous anatomical structures [2,5,11,14]. Our case demonstrated the most favorable condition because of elongated right VA and the midline location of the distal feeding artery. This aspect was ensured in only two reports about endoscopic VA clipping [4,14]. However, as the ASA was not visualized, concomitant use of intraoperative DSA was useful for ASA preservation. Needless to say, multimodality utilization contributed to the success of surgical treatment [13]. On the other hand, endscopic intraoperative near infrared indocyanine green videoangiography was reported in recent years [1]. That technology may be very useful. In this case, we couldn't prepare it.

CSF leakage is the most troubling complication of endoscopic transnasal surgery. The evolution of skull base reconstruction in recent years has helped reduce the occurrence of CSF leakage. We have already reported the technique of multilayer reconstruction [9]. No instances of CSF leakage have occurred in the last 4 years after use of this modified reconstruction method. The evolution of skull base reconstruction allowed successful endoscopic transnasal clipping.

Endovascular treatment of giant aneurysms has progressed since the introduction of the flow diverter stent (FDS). However, use of FDS in the posterior circulation poses some problems and there are limited indications for its use. Clipping is a simple and reliable method for hemostasis. Moreover, revascularization with external bypass is required if necessary.

Even if a thrombosed aneurysm has no obvious blood flow, there is some possibility of micro angiogenesis through the aneurysm wall

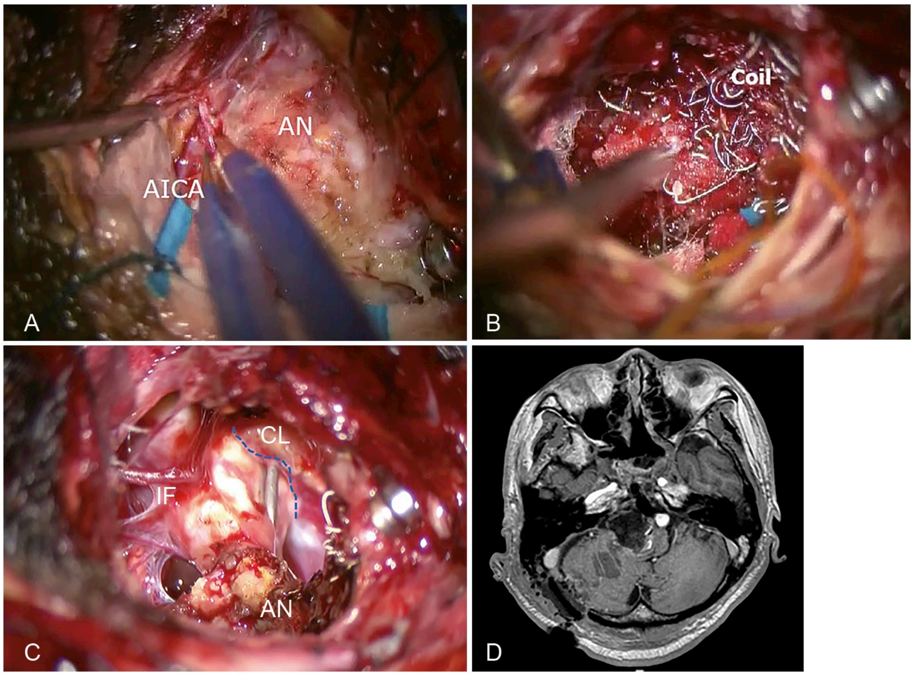

Fig. 5. A) Right anterior inferior cerebellar artery adhered to the aneurysm wall.
B) Surgi-cel cotton and coil mass are present in the aneurysm.
C) Final view after aneurysm removal. Dotted line indicates the border between extra and intra cranial space.
D) Total removal of aneurysm was confirmed in T1-weighted imaging.
AICA: Right anterior inferior cerebellar artery, AN: Aneurysm, CL: Clip.
Coil: Numerable coil, IF: Inlay fascia.

derived from surrounding structures [3,12]. In case of slow-growing giant aneurysms, due attention should be paid to angiogenesis in the aneurysm wall, as it may affect the results of endovascular treatment where hemostasis is achieved with coils. Multiple repeat interventions may increase the risk of complications. According to some past reports, resection of a thrombosed aneurysm is more desirable than only obliteration [10,12]. However, it is not enough for giant aneurysm to be treated with only coil embolization. Underestimation of the requirement of recanalization following coil embolization may lead the surgeon to an optimistic strategy.

Endonasal endoscopic transclival clipping may be effective in limited anatomical cases. However, this method has limitations of vascular control and the inability to visualize the field in the presence of major bleeding. We have not aimed to replace the microscopic technique for cerebral aneurysm, but only to provide an additional tool to the surgeon's armamentarium. The repeated surgical treatment was an aggravating factor in this case. We underline that it is very important to avoid optimistic strategy for initial treatment of giant VA aneurysm.

4. Conclusion

We report the use of endonasal endoscopic transclival clipping for giant VA aneurysm. This endonasal endoscopic treatment may be an optional alternative in only limited cases depending upon the anatomical location of the lesion because of limitations of vascular control and the inability to visualize the field in the presence of major bleeding. For treatment of progressive giant VA aneurysm, it is very important to avoid optimistic strategy for giant VA aneurysm initially.

Acknowledgement

The members of Chiba University Graduate School of Medicine in treatment long time are gratefully acknowledged. The authors thank Department of otorhinolaryngology and Department of Emergency and Clinical Care Medicine for special treatment.

Disclosure

The authors declare no conflicts of interest associated with this manuscript.

Conflict of interest

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

References

[1] G. Catapano, F. Sgulò, L. Laleva, L. Columbano, I. Dallan, M. de Notaris, Multimodal use of indocyanine green endoscopy in neurosurgery: a single-center experience and review of the literature, Neurosurg. Rev. 41 (2018) 985–998.
[2] G. Capo, M.C. Vescovi, G. Toniato, B. Petralia, V. Gavrilovic, M. Skrap, Giant vertebral aneurysm: a case report detailing successful treatment with combined stenting and surgery, Surg. Neurol. Int. (2018), https://doi.org/10.4103/sni.sni_170_17 (Published online Jan 16).
[3] A.R. Dehdashti, L. Thines, R.A. Willinsky, M. Tymianski, Symptomatic enlargement of an occluded giant carotido-ophthalmic aneurysm after endovascular treatment: the vasa vasorum theory, Acta Neurochir. 151 (2009) 1153–1158.
[4] V. Doan, A.M. Lemos-Rodriguez, S.B. Sreenath, A. Unnithan, P.F. Recinos, A.M. Zanation, et al., Using the endoscopic endonasal transclival approach to access aneurysms arising from AICA, PICA, and vertebral artery: an anatomical study, Journal of Neurological Surgery-Part B 77 (2016) 201–211.
[5] D. Drazin, L. Zhuang, W.I. Schievink, A.N. Mamelak, Expanded endonasal approach for the clipping of a ruptured basilar aneurysm and feeding artery to a cerebellar arteriovenous malformation, J. Clin. Neurosci. 19 (2012) 144–148.
[6] J. Enseñat, I. Alobid, M. de Notaris, M. Sanchez, R. Valero, A. Prats-Galino, E. Ferrer, Endoscopic endonasal clipping of a ruptured vertebral-posterior inferior cerebellar artery aneurysm: technical case report, Neurosurgery 69 (2011) onsE121–127.
[7] J.A. Forbes, S. D'herbemont, K.R. Lehner, D. Pineda Martinez, I.P. Navarro-Chávez, D. Mendez Rosito, T.H. Schwartz, Feasibility of endoscopic endonasal approach for clip application of cerebral aneurysms: a systematic review, J. Neurosurg. Sci. 62 (2018) 650–657.
[8] D.M. Heiferman, A. Somasundaram, A.J. Alvarado, A.M. Zanation, A.L. Pittman, A.V. Germanwala, The endonasal approach for treatment of cerebral aneurysms: a critical review of the literature, Clin. Neurol. Neurosurg. 134 (2015) 91–97.
[9] K. Horiguchi, Fukuhara Nishioka, M. Yamaguchi-Okada, S. Yamada, A new multilayer reconstruction using nasal septal flap combined with fascia graft dural suturing for high-flow cerebrospinal fluid leak after endoscopic endonasal surgery, Neurosurg. Rev. 39 (2016) 419–427.
[10] K. Iihara, K. Murao, N. Sakai, A. Soeda, H. Ishibashi-Ueda, C. Yutani, et al., Continued growth of and increased symptoms from a thrombosed giant aneurysm of the vertebral artery after complete endovascular occlusion and trapping: the role of vasa vasorum, J. Neurosurg. 98 (2003) 407–413.
[11] A.B. Kassam, A.H. Mintz, P.A. Gardner, M.B. Horowitz, R.L. Carrau, C.H. Snyderman, The expanded endnasal approach for an endoscopic transnasal clipping and aneurysmorrhaphy of a large vertebral artery aneurysm: technical case report, Operative Neurosurg. 59 (2006) 162–165.
[12] F.H. Pahl, A. Vellutini Ede, A.C. Cardoso, M.F. de Oliveira, Vasa vasorum and the glowing of thrombosed giant aneurysm of the vertebral artery: a case report, World Neurosurg. 85 (2016) (368.e1-4).

[13] Plitt, A. R., Patel, A. R., McDougall, C. M., Halderman, A. A., Barnett, S. L., & Welch, B. G. Combined microsurgical, endovascular, and endoscopic approach to the treatment of a giant vertebrobasilar aneurysm. Operative Neurosurg.: (Published online 2018 Nov 24. DOI:10.1093/ons/opy341).

[14] J.L. Sanmillan, M.T. Lawton, J. Rincon-Torroella, I.H. El-Sayed, X. Xhang, A.T. Meybodi, et al., Assessment of the endoscopic endonasal transclival approach for surgical clipping of anterior pontine anterior inferior cerebellar aneurysms, World Neurosurg. 89 (2016) 368–375.