Case Report

Anterior Temporal Approach and Clipping of a High-Riding Basilar Tip Aneurysm: Case Report and Review of the Surgical Technique

Aaron Musara, Yasuhiro Yamada[1], Katsumi Takizawa[2], Liew Boon Seng[3], Tsukasa Kawase[1], Kyosuke Miyatani[1], Rikki Tanaka[1], Saeko Higashiguchi[1], Ambuj Kumar[4], Raja Krishnan Kutty[5], Vigneshwar Ravisankar[6], Yoko Kato[1], Takao Teranishi[1]

Department of Surgery, Neurosurgery Unit, University of Zimbabwe College of Health Sciences, Harare, Zimbabwe, [1]Department of Neurosurgery, Banbuntane Hotokukai Hospital, Fujita Health University, Nagoya, Aichi, [2]Department of Neurosurgery, Asahikawa Red Cross Hospital, Asahikawa, Hokkaido, Japan, [3]Department of Neurosurgery, Sungai Buloh Hospital, Sungai Buloh, Selangor, Malaysia, [4]Department of Neurosurgery, NSCB Government Medical College, Jabalpur, Madhya Pradesh, [6]Department of Neurosurgery, MGM Healthcare, Chennai, Tamil Nadu, [5]Department of Neurosurgery, Government Medical College, Thiruvananthapuram, Kerala, India

Address for correspondence:
Dr. Aaron Musara, Department of Surgery, Neurosurgery Unit, University of Zimbabwe College of Health Sciences, Harare, Zimbabwe.
E-mail: musaraaaron@zol.co.zw

Abstract

Basilar apex aneurysms constitute 5%–8% of all intracranial aneurysms. Microsurgical clipping of basilar tip aneurysms is still advocated for as it is safe, especially for unruptured basilar tip aneurysms which have a low risk of postoperative mortality or morbidity. Careful patient preparation is needed preoperatively because the risk of intraoperative rupture is significant. Good surgical techniques should be applied. The skill will need to be preserved as endovascular surgery becomes more popular.This is a case of basilar tip aneurysm managed by clipping through the anterior temporal approach, followed by a review of the literature.

Keywords: *Aneurysm clipping, aneurysm rupture, basilar artery aneurysm, posterior circulation*

Introduction

Basilar tip aneurysms are one of the most complex vascular lesions to treat surgically because of their location, depth of the approach, and close proximity of vital neurovascular structures such as the mesencephalon, cranial nerves, major vessels, and perforating arteries to the thalamus.[1] In the last few years, there has been a shift from microsurgical clipping to endovascular therapy in patients with basilar apex aneurysm. Part of this phenomenon has been related to the risk of intraoperative rupture and the risk of vital perforators like the thalamobasilar to be involved in the aneurysm dissection and clipping, resulting in unfavorable outcomes.[2]

Microsurgical clipping of basilar tip aneurysms is considered safe in unruptured basilar tip aneurysms with a low risk of postoperative mortality or morbidity, especially with the use of advanced preoperative planning investigations such as digital subtraction angiography, computed tomography (CT) and magnetic resonance (MR) angiography, as well as computational flow dynamics. Intraoperative multimodality patient monitoring such as intraoperative neuromonitoring, neuroendoscopy, indocyanine green (ICG) angiography, and digital intraoperative angiography (DIVA) have increased the safety of the procedure.[3] It also offers a more permanent solution with less risk of recurrence after good tip obliteration. The durability of aneurysm occlusion remains superior in surgical cases compared to endovascular treatment.[4] Microsurgical clipping is sometimes the only treatment modality available in limited resource settings. The skill will need to be continually preserved.

This report presents a case of a basilar tip aneurysm with detailed description of the surgery until clipping of the aneurysm. This is followed by review of the literature.

Case Report

A 74-year-old female patient presented at our hospital, Banbuntane Hotokukai Hospital, with a progressive headache for over a 5-year period. Her sister had been diagnosed of subarachnoid hemorrhage secondary to a ruptured aneurysm. The patient examination was nonrevealing.

CT scan with contrast revealed a basilar tip aneurysm [Figure 1a]. On further investigation, CT angiography done confirmed the presence of a high-riding aneurysm of the basilar tip measuring 7 mm and high riding at 9.8 mm from the posterior clinoid process and 10 mm from the dorsum sellae, a lateral right paraclinoid aneurysm, and a small right posterior

How to cite this article: Musara A, Yamada Y, Takizawa K, Seng LB, Kawase T, Miyatani K, *et al*. Anterior temporal approach and clipping of a high-riding basilar tip aneurysm: Case report and review of the surgical technique. Asian J Neurosurg 2019;14:1283-7.

Access this article online

Website: www.asianjns.org

DOI: 10.4103/ajns.AJNS_121_19

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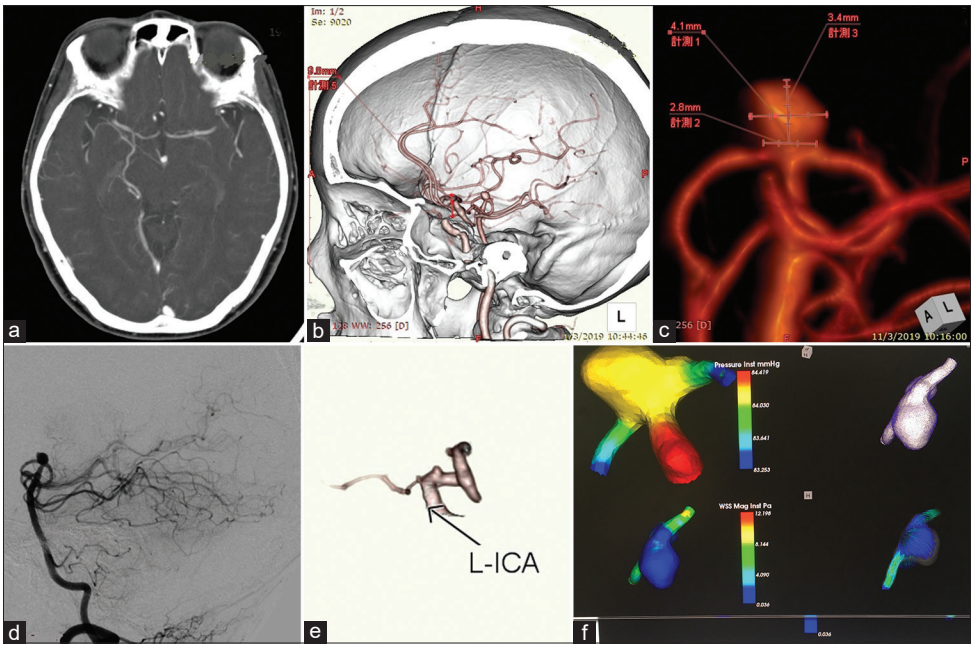

Figure 1: (a) Computed tomography scan of the brain which showed the basilar tip aneurysm. (b) Three-dimensional sagittal view computed tomography scan image of the circle of Willis showing the high-riding aneurysm. (c) Three-dimensional reconstruction image of the aneurysm. (d) Digital subtraction angiography image of the posterior circulation showing the aneurysm. (e) Computed tomography angiogram showing the left carotid artery aneurysm. (f) Shows the computational flow dynamics with high wall pressure, low wall sheer pressure, vectors divergent at the bases, and streamline flow through the aneurysm suggestive of an impending rupture of the aneurysm of the basilar tip aneurysm

communicating artery aneurysm. Digital subtraction angiography confirmed the presence of the aneurysms and demonstrated the presence of some perforators around the basilar tip aneurysm [Figure 1b-d]. The paraclinoid aneurysm had a wide neck which would be difficult to treat with coiling [Figure 1e]. The aneurysm of the internal carotid-posterior communication artery bifurcation was blister-like. A decision was made for microsurgical clipping of all the aneurysms in consultation with the patient and her relatives.

The patient was laid supine with the head turned left by 30°, the neck slightly extended, and the head held with the Sugita head holder at about 20° elevation. A curvilinear scalp incision was fashioned 1 cm from the tragus to just across the midline behind the hairline. A frontotemporal osteotomy was performed, and the lesser wing of the sphenoid was drilled away. Extradural anterior clinoidectomy was performed. Bone removal was extended to include a part of the lateral portion of the roof of the orbit and part of the zygomatic bone anteriorly.

The dura was opened from over the removed anterior clinoid process area in a curvilinear fashion, followed by arachnoid dissection to expose the carotid artery. The carotid aneurysm was exposed by sharp arachnoid dissection but was left alone so that it could be clipped last [Figure 2e]. The Sylvian fissure was fully opened by microdissection to expose deep into the suprachiasmatic cistern. From the carotid cistern area, wide arachnoid dissection was performed, extending posterolateral to the carotid artery. The anterior choroidal arteries were reflected medially to expose the posterior cerebral artery. The third nerve was freed by arachnoid dissection up to just beyond the posterior communicating-posterior cerebral arteries junction to get it off the way. Dissection was continued between the posterior cerebral artery and the anterior choroidal arteries to expose the basilar tip. The membrane of Lilliquist was opened. The basilar artery came into view, and the aneurysm was exposed by gentle traction on the mesencephalon. An area free of perforators was identified for possible temporary clipping on the basilar artery in case of need.

The aneurysm dome was noted to be having a thin wall through both the endoscopic and microscopic views [Figure 2a and b]. This was in line with the findings of computational flow dynamics [Figure 1f]. Intraoperative ICG angiography done confirmed the perforators around the wall of the aneurysm [Figure 2c]. The perforators seen close by the aneurysm dome were separated and gently dissected away from the line of clipping [Figure 2d].

An aneurysm clip was carefully applied. The clip release was continued slowly with the aid of the suction catheter in retracting. Some slight bleeding from around the area was controlled using Surgicel, Gelfoam with fibrin glue, and Neoveil application with compression for about 7 min. The bleeding seemed to have been caused by pressure of the retraction needed at clip application. The bleeding stopped. DIVA showed complete obliteration of the aneurysm. Neuromonitoring done throughout the operation did not show any adverse changes. The operation was continued with clipping of the other two aneurysms, followed by routine closure.

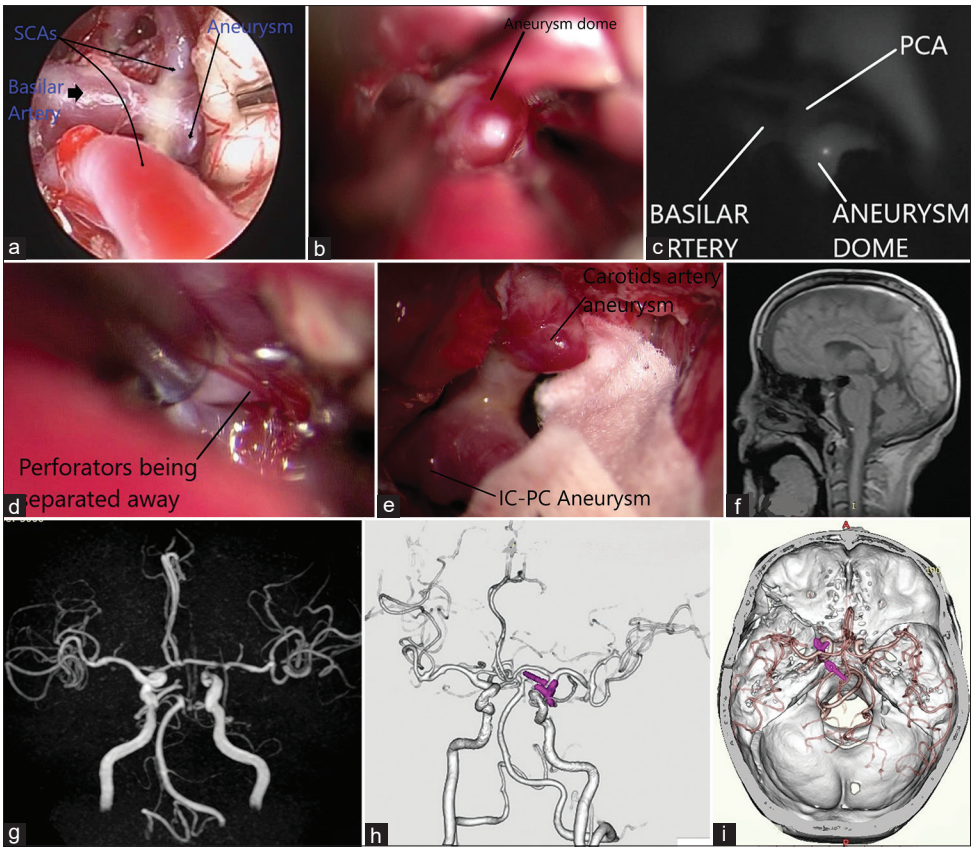

Figure 2: (a) The endoscopic view of the posterior fossa with the aneurysm and the surrounding vessels labeled. (b) The aneurysm dome fully exposed with its thin tip wall. (c) The indocyanine green angiography image showing visualization of the aneurysm at contrast administration. (d) Perforators that had to be separated away from the aneurysm done before clipping are shown. (e) The aneurysms on the clinoid segment of the carotid artery and at the bifurcation of the posterior communicating artery (internal carotid-posterior communicating artery aneurysm). (f) Postoperative magnetic resonance imaging scan image showing the condition of the surrounding brain postoperation. (g) Angiographic images showing the complete obliteration of the aneurysm and the position of the clips. (h) Computed tomography angiography images showing the complete obliteration of the aneurysm and the position of the clips. (i) Computed tomography scan reconstruction images showing the complete obliteration of the aneurysm and the position of the clips

The patient recovered very well with no deficits and was discharged home. The postoperative MR imaging scan showed no areas of vascular compromise, while angiography showed complete closure of the aneurysm neck [Figure 2f-i].

Discussion

Basilar apex aneurysms constitute 5%–8% of all intracranial aneurysms.[4] Complex basilar aneurysms are often difficult to treat by endovascular treatment, and often, treatment failure occurs. Complexity of an aneurysm refers to the features of the aneurysm, including large or giant size aneurysms, high-riding bifurcation, wide dysmorphic base, low bifurcation, dysmorphic posteriorly projecting dome, and therefore, the aneurysm and dolichoectasia.[5,6] Large aneurysms are 11–25 mm in size, while giant aneurysms are >25 mm in size.[7] One of the ways of classifying high-riding basilar tip aneurysms is for high-riding aneurysms to be classified as being 1 cm or greater above the dorsum sellae, making them difficult to access. Our patient's aneurysm was 10 mm above the dorsum sellae, thereby qualifying it to be a high-riding aneurysm.[1]

The treatment of a patient with multiple aneurysms requires the treating team to consider the patient's treatment for all aneurysms rather than to focus on one. Our patient had multiple aneurysms. Microsurgical clipping was chosen so that all aneurysms are dealt with at once. Treating the blister-like aneurysm of the internal carotid-posterior communicating artery junction was judged to be best done by clipping.

Cerebral aneurysms in the posterior circulation are known to have a higher rupture risk than those in the anterior circulation. High-flow conditions, characterized by large and concentrated inflow jets, complex and oscillatory flow patterns, and uneven wall shear stress distributions are associated with aneurysm rupture, especially for basilar tip aneurysms.[8] Proper patient preparation is, therefore, very important to prevent catastrophic hemorrhage. A clear understanding of the anatomy is needed prior to embarking on this surgery.

Cerebral angiography has been the cornerstone of the preoperative evaluation of patients with basilar artery aneurysms. Although CT angiography and MR angiography continue to improve, digital subtraction cerebral

angiography remains a crucial element in preoperative evaluation, as it offers higher spatial resolution.[9] The reconstructed images of the aneurysm with related bony surfaces that can be rotated and viewed from multiple angles can help the surgeon to understand an individual patient's anatomy.[10] A well-prepared patient is one important step for preventing intraoperative complications.

Some studies have documented the anterior temporal approach, which was used in this operation as providing a good view for basilar tip aneurysms. Some difficulties may be faced if the aneurysm is high riding.[1,11] Arachnoid dissection for exposure of the aneurysm can be through the pretemporal or transsylvian approaches.[10,12-14] Both the anterior temporal and the transsylvian approaches were used in this case because of the presence of other aneurysms. It provided a good view of the basilar artery as well as of the aneurysm allowing for the dissection away of perforators.[15]

Use of the neuroendoscope was useful in ensuring the safety of the operation. It provided excellent visualization of the aneurysm, augmenting the three-dimensional microscopic view to give a clearer view and understanding of the aneurysm. It has been documented as an adjunct to increase the rate of complete occlusion of aneurysms. The use of the endoscope prior to clipping is helpful in making sure no perforators are compromised during clipping.[16-18]

Endovascular coil embolization is sometimes preferred in the management of unruptured intracranial aneurysms because it is less invasive than surgical clipping. It is especially preferred for basilar tip aneurysms. However, the long-term risk and durability of coil embolization are not yet fully understood. The frequencies of incomplete occlusion of aneurysms or recurrences are higher after coil embolization than that after surgical clipping.[19,20] In some studies, on the management of basilar tip aneurysms, the majority were being treated via endovascular means, albeit with higher percentage of residual lesions and recurrences. The presence of other aneurysms as was the case in this instance should be considered so that the patient's aneurysms are all attended to satisfactorily. Microsurgery is appropriate for aneurysms with complex neck morphologies, in young patients desiring a more durable treatment and well as in the elderly with no serious comorbidities.[21,22] Aneurysm clipping remains as the immediately available option in countries without facilities for coiling. The skill will need to be continually preserved.

Conclusion

The anterior temporal approach provides good access to high-riding basilar tip aneurysms. Careful patient preparation is an important adjunct to surgery for basilar tip aneurysms. Aneurysm clipping remains as the immediately available option in countries without facilities for coiling. The skill will need to be continually preserved.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest

References

1. Nakov VS, Spiriev TY, Todorov IT, Simeonov P. Technical nuances of subtemporal approach for the treatment of basilar tip aneurysm. Surg Neurol Int 2017;8:15.
2. Granados OS, da Costa MD, Costa BL, González-Echeverría K, Paganelli SL, Caramanti RL, *et al.* Microsurgery for upper basilar tip aneurysm with intraoperative rupture: 3-dimensional operative video. Oper Neurosurg (Hagerstown) 2019;16:43.
3. Seng LB, Yamada Y, Rajagopal N, Mohammad AA, Teranishi T, Miyatani K, *et al.* Multimodality techniques in microsurgical clipping as the gold standard treatment in the management of basilar tip aneurysm: A case series. Asian J Neurosurg 2018;13:1148-57.
4. Tjahjadi M, Serrone J, Hernesniemi J. Should we still consider clips for basilar apex aneurysms? A critical appraisal of the literature. Surg Neurol Int 2018;9:44.
5. Krisht AF, Krayenbühl N, Sercl D, Bikmaz K, Kadri PA. Results of microsurgical clipping of 50 high complexity basilar apex aneurysms. Neurosurgery 2007;60:242-50.
6. Rahme R, Kurbanov A, Keller JT, Abruzzo TA, Jimenez L, Ringer AJ, *et al.* The interlenticulostriate approach to very high-riding distal basilar trunk aneurysms. Oper Neurosurg (Hagerstown) 2017;13:338-44.
7. Cerebral Aneurysms Fact Sheet | National Institute of Neurological Disorders and Stroke. Available from: https://www.ninds.nih.gov/Disorders/Patient-Caregiver-Education/Fact-Sheets/Cerebral-Aneurysms-Fact-Sheet. [Last accessed on 2019 Mar 31].
8. Doddasomayajula R, Chung B, Hamzei-Sichani F, Putman CM, Cebral JR. Differences in hemodynamics and rupture rate of aneurysms at the bifurcation of the basilar and internal carotid arteries. AJNR Am J Neuroradiol 2017;38:570-6.
9. Scalzo F, Liebeskind DS. Perfusion angiography in acute ischemic stroke. Comput Math Methods Med 2016;2016:2478324.
10. Hsu FP, Clatterbuck RE, Spetzler RF. Orbitozygomatic approach to basilar apex aneurysms. Neurosurgery 2005;56:172-7.
11. Nukui H, Mitsuka S, Hosaka T, Kakizawa T, Horikoshi T, Miyazawa N, *et al.* Technical points to improve surgical results in cases with basilar tip aneurysms. Neurol Med Chir (Tokyo) 1998;38 Suppl:74-8.
12. Ikeda K, Yamashita J, Hashimoto M, Futami K. Orbitozygomatic temporopolar approach for a high basilar tip aneurysm associated with a short intracranial internal carotid artery: A new surgical approach. Neurosurgery 1991;28:105-10.
13. Hakuba A, Liu S, Nishimura S. The orbitozygomatic infratemporal approach: A new surgical technique. Surg Neurol 1986;26:271-6.
14. Gonzalez LF, Amin-Hanjani S, Bambakidis NC, Spetzler RF. Skull base approaches to the basilar artery. NeurOSURG FOCUS 2005;19:E3.
15. Chen SF, Kato Y, Kumar A, Tan GW, Oguri D, Oda J, *et al.* Intraoperative rupture in the surgical treatment of patients with intracranial aneurysms. J Clin Neurosci 2016;34:63-9.
16. Fischer G, Oertel J, Perneczky A. Endoscopy in aneurysm surgery. Neurosurgery 2012;70:184-90.

17. Yoshioka H, Kinouchi H. The roles of endoscope in aneurysmal surgery. Neurol Med Chir (Tokyo) 2015;55:469-78.
18. Nwagwu CI, Mathews MS, Scott JA, Denardo AJ, Horner TG. Ruptured giant basilar artery aneurysm in a comatose adolescent: Successful obliteration using intraoperative SSEP, BAER, and MEP monitoring. A case report. Interv Neuroradiol 2006;12:237-44.
19. Sugiyama S, Niizuma K, Sato K, Rashad S, Kohama M, Endo H, *et al.* Blood flow into basilar tip aneurysms: A predictor for recanalization after coil embolization. Stroke 2016;47:2541-7.
20. Bohnstedt BN, Ziemba-Davis M, Sethia R, Payner TD, DeNardo A, Scott J, *et al.* Comparison of endovascular and microsurgical management of 208 basilar apex aneurysms. J Neurosurg 2017;127:1342-52.
21. Sekhar LN, Tariq F, Morton RP, Ghodke B, Hallam DK, Barber J, *et al.* Basilar tip aneurysms: A microsurgical and endovascular contemporary series of 100 patients. Neurosurgery 2013;72:284-98.
22. Nanda A, Sonig A, Banerjee AD, Javalkar VK. Microsurgical management of basilar artery apex aneurysms: A single surgeon's experience from Louisiana state university, Shreveport. World Neurosurg 2014;82:118-29.