

Case Report

Therapeutic Clip Occlusion of the Anterior Choroidal Artery Involved with Partially Thrombosed Fusiform Aneurysm: A Case Report

Sherif Rashad, MD,^{*} Hidenori Endo, MD,[†] Ahmed Elsayed Sultan, MD,^{*‡§}
Hiroaki Shimizu, MD,^{||} Miki Fujimura, MD,^{*} Kenichi Sato, MD,[†]
Yasushi Matsumoto, MD,[†] and Teiji Tominaga, MD^{*}

Background: We describe a rare case with partially thrombosed fusiform anterior choroidal artery (AchA) aneurysm successfully treated with therapeutic occlusion of the AchA. **Clinical presentation:** A 58-year-old man presented with transient mild hemiparesis of the right side. Magnetic resonance imaging (MRI) showed an ischemic lesion in the posterior limb of the left internal capsule. Digital subtraction angiography (DSA) revealed a left internal carotid artery saccular aneurysm (14.5-mm diameter) arising from the supraclinoid segment. The left AchA was not detected in the initial DSA, and MRI showed the aneurysm to be partially thrombosed. The second DSA performed 2 weeks after the onset showed recanalization of the thrombosed portion of the aneurysm with the left AchA apparently arising from its tip. The aneurysm was diagnosed as a partially thrombosed fusiform AchA aneurysm. **Results:** Open surgery was performed and a titanium clip was applied to the base of the fusiform aneurysm under motor evoked potential monitoring, which remained unchanged after clipping. Occlusion of the aneurysm was confirmed by Doppler ultrasound and intraoperative fluorescence angiography. Furthermore, Doppler ultrasound and fluorescence angiography showed that the blood flow supplying the pyramidal tract was reconstituted by the retrograde collateral flow from the choroidal segment. The aneurysm was completely obliterated in postoperative DSA, which demonstrated retrograde filling of the AchA through the posterior circulation. The patient manifested transient weakness of the right side postoperatively, which was completely recovered after short-term rehabilitation. **Conclusions:** This case illustrates the unique clinical course of a rare partially thrombosed fusiform AchA aneurysm, successfully treated with therapeutic clip occlusion of the AchA under the multimodal monitoring. **Key Words:** Fusiform aneurysm—thrombosed aneurysm—anterior choroidal artery—ischemic stroke—proximal occlusion.

© 2015 by National Stroke Association

From the ^{*}Department of Neurosurgery, Tohoku University Graduate School of Medicine, Sendai, Japan; [†]Department of Neurosurgery, Kohnan Hospital, Sendai, Japan; [‡]Department of Neuroendovascular Therapy, Kohnan Hospital, Sendai, Japan; [§]Department of Neurosurgery, Faculty of Medicine, Alexandria University, Alexandria, Egypt; and ^{||}Department of Neurosurgery, Akita University Graduate School of Medicine, Akita, Japan.

Received January 29, 2015; revision received April 11, 2015; accepted April 17, 2015.

Address correspondence to Hidenori Endo, MD, Department of Neurosurgery, Kohnan Hospital, 4-20-1 Nagamachi-minami, Taihaku-ku, Sendai 982-8523, Japan. E-mail: hideendo@gmail.com.

1052-3057/\$ - see front matter

© 2015 by National Stroke Association

<http://dx.doi.org/10.1016/j.jstrokecerebrovasdis.2015.04.024>

Anterior choroidal artery (AchA) aneurysms represent approximately 2% of cerebral aneurysms.¹ The most common cerebral aneurysms are the saccular type, which arise from the bifurcation of the AchA from the internal carotid artery (ICA). Aneurysms arising from the distal segments of the AchA are rarely reported.² Fusiform AchA aneurysms are also rare; in fact, Lehecka et al³ recently reported that fusiform AchA aneurysms comprised only 2% of the AchA aneurysm in the Kuopio series. Safety and efficacy of surgical treatment for these fusiform AchA aneurysms are unclear. Here, we report a case of a partially thrombosed fusiform AchA aneurysm with ischemic onset successfully treated with proximal clip occlusion under multimodal monitoring. We discuss the anatomic collateral circulation for AchA territory and the importance of intraoperative monitoring during therapeutic occlusion of AchA.

Case Report

A 58-year-old man presented with complaints of transient mild weakness followed by numbness of the right side of the body. Diffusion-weighted imaging and T2-weighted imaging showed a high-intensity lesion in the posterior limb of the left internal capsule (Fig 1, A). Digital subtraction angiography (DSA) revealed an aneurysm (14.5-mm diameter) arising at the supraclinoid segment of the left ICA (Fig 1, B). The aneurysm was interpreted as a saccular type of the nonbranching site

of the left ICA with an accompanying bleb at its tip. DSA showed a thin posterior communicating artery that originated proximally relative to the aneurysm. The AchA was not clearly visible, suggesting that occlusion of the AchA occurred at the onset of the cerebral infarction. Magnetic resonance imaging (MRI; Fig 1, C) showed the aneurysm to be partially thrombosed without surrounding hemorrhage.

Second MRI (Fig 1, D) done after 2 weeks showed recanalization of the thrombosed part of the aneurysm, which was confirmed by the second DSA (Fig 1, E). The second DSA showed that the recanalization of the thrombosed part with the AchA being visible (Fig 1, E). Furthermore, injection of contrast media from the microcatheter placed inside of the aneurysm showed an AchA arising from the tip of the aneurysm (Fig 1, F). Thus, the aneurysm was diagnosed as a partially thrombosed fusiform AchA aneurysm. We decided to perform surgery to prevent recurrent ischemic stroke and future bleeding.

Open surgery was performed under the motor evoked potential (MEP) monitoring. A left frontotemporal craniotomy was performed. The left sylvian fissure was widely split to expose the whole aneurysm (Fig 2, A). Several perforators, which had not been identified by the second DSA (Fig 2, B), originated from the aneurysmal sac. MEP temporarily decreased in amplitude during temporary clipping of these perforators, suggesting that these perforators supplied the pyramidal tract through the anterior perforated substance (Fig 3). The AchA was

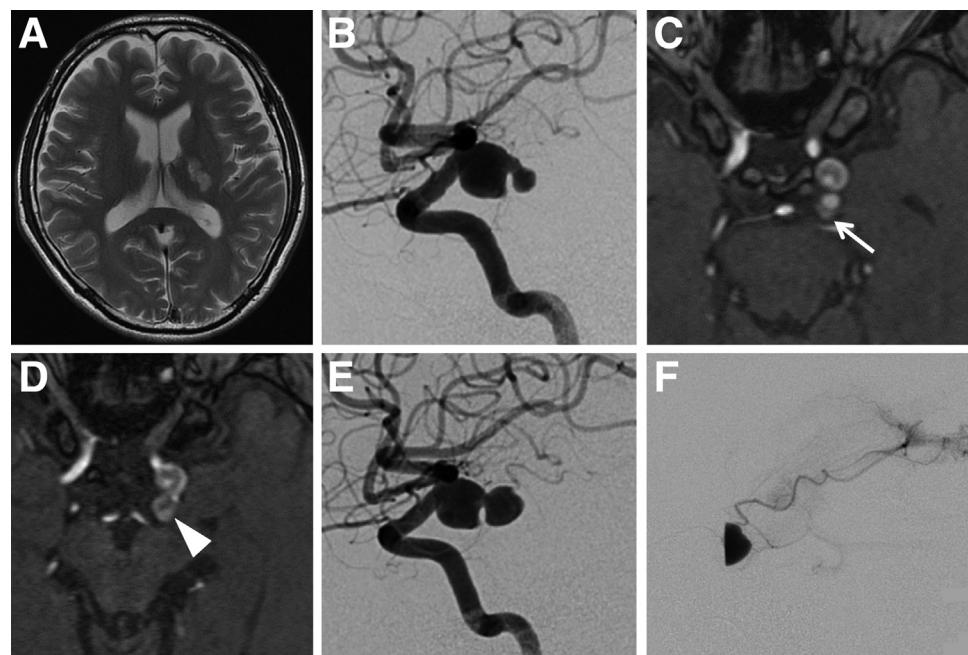


Figure 1. Preoperative imaging: (A) Axial T2WI showed a high-intensity lesion in the posterior limb of the left internal capsule. (B) Left internal carotid angiography (lateral view) revealed an aneurysm (14.5-mm diameter) arising at the supraclinoid segment. (C) Initial MRI showed the thrombus within the aneurysm (arrow). (D) MRI done after 2 weeks showing the recanalization of the thrombosed part of the aneurysm (arrowhead). (E) Second angiography (lateral view) showed an enlargement of the aneurysm (16.1-mm diameter) and an AchA arising from its tip. (F) Aneurysmography confirmed an AchA arising from the tip of the aneurysm. Abbreviations: AchA, anterior choroidal artery; MRI, magnetic resonance imaging; T2WI, T2-weighted imaging.

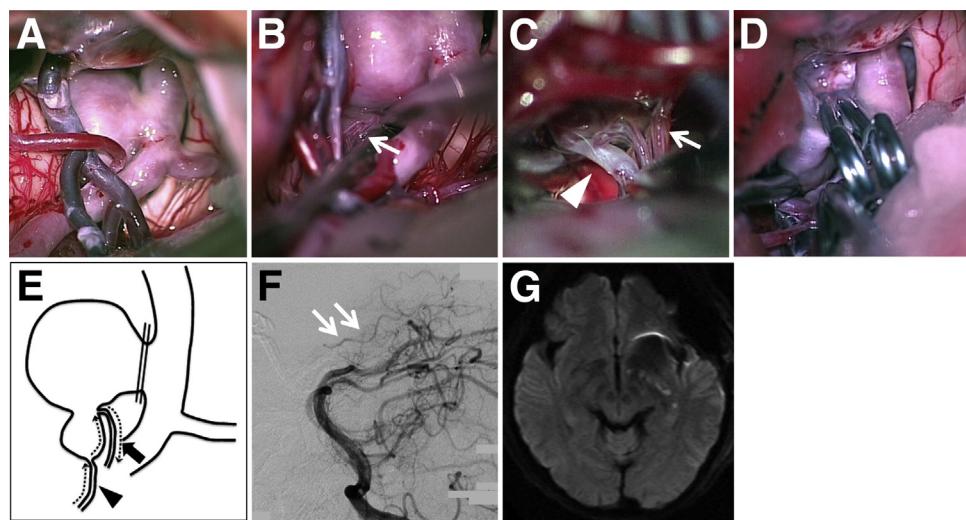


Figure 2. Intraoperative view: (A) Whole appearance of the aneurysm. (B) Several perforators originating from the aneurysmal sac (arrow). (C) AchA arising from the tip of the bleb (arrowhead). Arrow indicates the same perforators as shown in (B). (D) Two titanium clips applied to the base of the aneurysm. (E) Drawing showing the collateral flow to the pyramidal tract after the clip application. Black arrow and arrowhead indicating the same arteries as shown in (B) and (C). (F) Postoperative angiography of the left vertebral artery showing retrograde filling of the AchA through the posterior circulation (double arrow). (G) Postoperative DWI showing slight high-intensity lesions in the left AchA territory. Abbreviations: AchA, anterior choroidal artery; DWI, diffusion-weighted imaging.

seen arising from the tip of the aneurysm, which was compatible with the findings of the second DSA (Fig 2, C). The MEP remained unchanged by temporary occlusion of this artery. These findings suggested that this fusiform aneurysm was an enlarged AchA itself. The artery arising from the aneurysmal tip was the transition between the cisternal segment and the choroidal segment, the distal portion of which supplied the choroid plexus. A titanium clip was applied to the base of the fusiform aneurysm that corresponded to the origin of the AchA under MEP monitoring, which remained unchanged after the clipping (Fig 2, D). Occlusion of the aneurysm was confirmed by Doppler ultrasound and intraoperative

fluorescence angiography. Doppler ultrasound and intraoperative fluorescence angiography showed that the blood flow to the perforators supplying the pyramidal tract was reconstituted by the retrograde collateral flow from the choroidal segment (Fig 2, E). Postoperative DSA showed complete obliteration of the aneurysm with retrograde filling of the AchA through the posterior circulation (Fig 2, F). Postoperative diffusion-weighted imaging showed slight high-intensity lesions in the left AchA territory, resulting in transient mild weakness of the right side of the body (Fig 2, G). The patient required short-term rehabilitation and was discharged 1 month after surgery with complete recovery of the right hemiparesis.

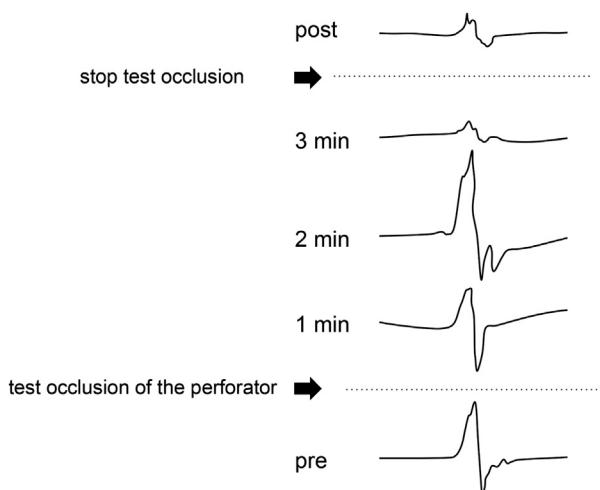


Figure 3. MEP findings: MEP amplitude decreased down to 80% subsequent to transient increase after the 3-minute temporary clip occlusion of the perforator. MEP gradually recovered after clip release. Abbreviations: MEP, motor evoked potential.

Discussion

AchA aneurysms are rare, only representing 2%-5% of all intracranial aneurysms.³ Whereas most of the AchA aneurysms are small and saccular, the occurrence of large, giant, or fusiform AchA aneurysms is much rarer. Lehecka et al³ presented their series of 99 AchA aneurysms, which only included 3 large (3%) and 2 fusiform (2%) AchA aneurysms. This shows the rarity of the presented case which is a fusiform large and partially thrombosed AchA aneurysm. To our knowledge, there is only one similar case with such unique features in the literature.⁴

Management of AchA aneurysms by open or endovascular surgery is usually problematic, as occlusion of the AchA carries a high morbidity.⁵⁻⁸ Occlusion of the AchA during surgical treatment will lead to contralateral hemiplegia or hemiparesis, hemianesthesia, and hemianopia, which is referred to as the AchA syndrome.⁵⁻⁷

In the present case, therapeutic occlusion of AchA was necessary to occlude the aneurysm considering the morphology of the aneurysm. However, reconstruction of AchA by bypass surgery during therapeutic occlusion of AchA was generally considered difficult because of the aneurysm's deep location and its small diameter. Furthermore, perforating branches that arise from the AchA may indicate the difficulty of such a surgery.

Trapping of the aneurysm in the present case was avoided as important perforators arose from the aneurysm itself. Proximal occlusion was adopted as the alternative treatment strategy, based on the existence of collateral circulation for AchA territory from the posterior choroidal artery. Takahashi et al⁹ demonstrated retrograde filling of AchA on angiogram in cases with occlusion of proximal AchA or the ICA. In the present case, this collateral flow was enough to supply vital structures in the AchA territory without filling or enlarging the aneurysm on postoperative angiogram.

Shih et al⁴ reported a pediatric case with dissecting aneurysm of the AchA, which was also successfully treated with proximal clip occlusion. However, validity of the therapeutic occlusion of AchA was not discussed in their report. In the present case, the blood flow in the AchA and its perforators was confirmed by Doppler ultrasound and intraoperative fluorescence angiography after the clip application. Furthermore, MEP changes were observed when a clip was applied to the perforators arising from the aneurysm, whereas no changes were observed with proximal occlusion. If ischemic complication was expected from the result of these monitoring, surgical strategy could be changed to wrapping or partial clipping. Among these monitoring, the MEP is the most important monitoring for successful treatment. Suzuki et al studied intraoperative MEP for 108 patients with ICA aneurysms who underwent surgical clipping. Among them, 4 of 19 patients with transient MEP changes after clipping or during temporary occlusion of the affected artery manifested transient hemiparesis postoperatively.¹⁰ One patient with MEP disappearance developed infarction in the internal capsule and experienced severe hemiplegia. They concluded that MEP monitoring is a reliable method for detecting ischemia in the AchA territory. In the present case, the patient manifested transient mild hemiparesis after surgery, although MEP did not disappear after aneurysmal clipping. Postoperative MRI showed a small infarction in the AchA territory. This might be because of insufficient collateral blood flow from posterior circulation immediately after aneurysmal clipping. The collateral blood flow would sufficiently develop after surgery, which was confirmed by postoperative angiography.

Although this approach could not be generalized to all AchA aneurysms, this case is an excellent demonstration of the importance of the various monitoring tools used

in the modern aneurysm surgery,¹¹⁻¹⁴ and how the interpretation of their data can alter the treatment decision to achieve the best results.

Conclusion

We report a rare case with partially thrombosed fusiform aneurysm successfully treated with proximal clip occlusion. Various monitoring tools are necessary for the therapeutic occlusion of AchA.

References

1. Yaşargil MG. Microneurosurgery. Clinical considerations, surgery of the intracranial aneurysms and results. Stuttgart, New York: Georg Thieme Verlag 1984:99-108.
2. Nishida A, Tokunaga K, Hishikawa T, et al. Endovascular coil embolization of a ruptured distal anterior choroidal artery aneurysm associated with ipsilateral middle cerebral artery occlusion—case report. *Neurol Med Chir* 2011; 51:716-719.
3. Lehecka M, Dashti R, Laakso A, et al. Microneurosurgical management of anterior choroid artery aneurysms. *World Neurosurg* 2010;73:486-499.
4. Shih P, Pinnaduwage T, Hu LS, et al. A pediatric patient with a dissecting thrombotic anterior choroidal artery aneurysm: case report. *Neurosurgery* 2010;67:E518.
5. Piotin M, Mounayer C, Spelle L, et al. Endovascular treatment of anterior choroidal artery aneurysms. *AJNR Am J Neuroradiol* 2004;25:314-318.
6. Friedman JA, Pichelmann MA, Piepgras DG, et al. Ischemic complications of surgery for anterior choroidal artery aneurysms. *J Neurosurg* 2001;94:565-572.
7. Bohnstedt BN, Kemp WJ 3rd, Li Y, et al. Surgical treatment of 127 anterior choroidal artery aneurysms: a cohort study of resultant ischemic complications. *Neurosurgery* 2013;73:933-939. discussion 9-40.
8. Kang HS, Kwon BJ, Kwon OK, et al. Endovascular coil embolization of anterior choroidal artery aneurysms. Clinical article. *J Neurosurg* 2009;111:963-969.
9. Takahashi S, Tobita M, Takahashi A, et al. Retrograde filling of the anterior choroidal artery: vertebral angiographic sign of obstruction in the carotid system. *Neuroradiology* 1992;34:504-507.
10. Suzuki K, Kodama N, Sasaki T, et al. Intraoperative monitoring of blood flow insufficiency in the anterior choroidal artery during aneurysm surgery. *J Neurosurg* 2003;98:507-514.
11. Bailes JE, Tantuwaya LS, Fukushima T, et al. Intraoperative microvascular Doppler sonography in aneurysm surgery. *Neurosurgery* 1997;40:965-970. discussion 70-2.
12. Irie T, Yoshitani K, Ohnishi Y, et al. The efficacy of motor-evoked potentials on cerebral aneurysm surgery and new-onset postoperative motor deficits. *J Neurosurg Anesthesiol* 2010;22:247-251.
13. Suzuki K, Kodama N, Sasaki T, et al. Confirmation of blood flow in perforating arteries using fluorescein cerebral angiography during aneurysm surgery. *J Neurosurg* 2007;107:68-73.
14. de Oliveira JG, Beck J, Seifert V, et al. Assessment of flow in perforating arteries during intracranial aneurysm surgery using intraoperative near-infrared indocyanine green videoangiography. *Neurosurgery* 2007;61:63-72. discussion -3.