ScientificScholar®
Knowledge is power
Publisher of Scientific Journals

www.surgicalneurologyint.com

Surgical Neurology International

Editor-in-Chief: Nancy E. Epstein, MD, Professor of Clinical Neurosurgery, School of Medicine, State U. of NY at Stony Brook.

SNI: General Neurosurgery

Editor
Eric Nussbaum, MD
National Brain Aneurysm and Tumor Center, Twin Cities, MN, USA

SNI
Open Access

Case Report

Successful shrinkage of a recurrent partially thrombosed symptomatic large basilar tip aneurysm using a Target 3D Coil

Noriaki Ashida[1], Atsushi Fujita[2], Hideya Hayashi[1], Masashi Higashino[3], Yusuke Ikeuchi[2], Hirofumi Iwahashi[1], Masamitsu Nishihara[1], Kohkichi Hosoda[4], Takashi Sasayama[2]

[1]Department of Neurosurgery, Kobe City Nishi-Kobe Medical Center, [2]Department of Neurosurgery, Graduate School of Medicine, Kobe University, Kobe, [3]Department of Neurosurgery, Jyunshin Hospital, Kakogawa, [4]Department of Neurosurgery, Myodani Hospital, Kobe, Japan.

E-mail: *Noriaki Ashida - nonoriaki5511@gmail.com; Atsushi Fujita - afujita@med.kobe-u.ac.jp; Hideya Hayashi - hideya007@icloud.com; Masashi Higashino - mh926@med.kobe-u.ac.jp; Yusuke Ikeuchi - ikesuke35@yahoo.co.jp; Hirofumi Iwahashi - hirofumi.iwahashi@gmail.com; Masamitsu Nishihara - nissy2@mac.com; Kohkichi Hosoda - khosoda@med.kobe-u.ac.jp; Takashi Sasayama - takasasa1127@gmail.com

***Corresponding author:**
Noriaki Ashida,
Department of Neurosurgery,
Kobe City Nishi-Kobe Medical Center, Kobe, Japan.

nonoriaki5511@gmail.com

Received: 17 January 2024
Accepted: 27 February 2024
Published: 22 March 2024

DOI
10.25259/SNI_44_2024

Quick Response Code:

ABSTRACT

Background: Standalone coil embolization is often less effective for partially thrombosed intracerebral aneurysms (PTIA) because of the risk of frequent recurrence if the coil migrates into the thrombus. This report describes a case of PTIA at the basilar tip in which simple coil embolization using a Target 3D Coil resulted in sustained remission without recurrence during long-term follow-up.

Case Description: The patient was a 63-year-old male who presented with right oculomotor nerve palsy after having undergone direct surgery for a basilar artery aneurysm 15 years earlier. Recurrence with partial thrombosis of the basilar artery aneurysm was diagnosed. Target 3D Coil embolization with frame construction in the aneurysmal sac was performed, resulting in the complete disappearance of the aneurysm and improvement of the oculomotor nerve palsy. Magnetic resonance imaging at five years postoperatively confirmed that the thrombus had completely disappeared, and there was no recurrence of the aneurysm. The closed loops in the Target 3D Coil may have contributed to the cohesive mass of coils remaining in the sac of the PTIA, potentially leading to healing.

Conclusion: The characteristics of the Target 3D Coil may have prevented migration of the coil into the thrombus, potentially contributing to the successful resolution of the aneurysm.

Keywords: Coil embolization, Partially thrombosed intracranial aneurysm, Target 3D Coil

INTRODUCTION

Partially thrombosed intracerebral aneurysm (PTIA) at the basilar tip is a progressive condition that is often associated with neurological symptoms because of mass effect.[16] No treatment strategy has been established for PTIA. Clipping through direct surgery is particularly challenging in cases requiring reoperation, and parent artery occlusion may be impossible depending on the hemodynamics and location of the aneurysm. Simple coil embolization into the region of blood flow (aneurysmal sac) of a PTIA is associated with a high recurrence rate, with one contributing factor being the restoration of blood flow as a result of embedding the coil in a thrombus.[8] In this

report, we describe our experience with coil embolization in a patient with a large PTIA at the basilar tip that presented with recurrent enlargement and oculomotor nerve palsy after direct surgery. The aneurysmal sac was treated with coil embolization, resulting in sustained remission without recurrence in the long term. The aneurysm disappeared, and the patient's neurological symptoms improved. This report highlights the potential efficacy of the Target 3D Coil (Stryker Neurovascular, Fremont, CA, USA) when used for framing to prevent recurrence.

CASE PRESENTATION

A 48-year-old male underwent open surgical wrapping of an unruptured intracranial aneurysm at the basilar tip in 2003. Ten years later, final postoperative follow-up magnetic resonance angiography (MRA) and T2-weighted imaging (T2WI) of the head revealed blood flow within the aneurysmal sac, but no evidence of enlargement [Figure 1a and b], and outpatient follow-up was concluded. However, 18 years after surgery, the patient developed right eyelid ptosis and diplopia, prompting a return visit to the clinic. Head MRA revealed apparent enlargement of the basilar artery aneurysm [Figure 1c], and T2WI showed a mass measuring 18.6 mm × 17.0 mm × 16.8 mm within the interpeduncular fossa which exhibited the target sign and partial flow void [Figure 1d]. Based on these findings, we made a diagnosis of recurrent enlargement of the basilar tip intracranial aneurysm, now classified as a large basilar tip PTIA, resulting in the onset of right oculomotor nerve palsy.

Cerebral angiography demonstrated an inflow of contrast agent into the neck portion of the PTIA (presumed to be the aneurysmal sac) measuring 3.4 mm × 3.0 mm and extending from the basilar tip to the left posterior cerebral artery [Figure 2a]. Given the postoperative status, clipping by repeat surgery was predicted to be challenging, and parent artery occlusion was considered potentially fatal due to the risk of cerebral infarction. The patient had a history of atrial fibrillation and was taking warfarin, which raised concerns regarding the possibility of an excessive antithrombotic state as a result of the use of antiplatelet agents with concurrent stenting. Therefore, the decision was made to perform initial simple coil embolization for the aneurysmal sac, with consideration of additional stent-assisted therapy for its rectifying effect during recurrence.

The procedure was performed through the right femoral artery. A 6-Fr guiding catheter (Envoy; Codman Neuro, Raynham, MA, USA) was introduced at the C3 vertebral body level through the right vertebral artery. With the assistance of a 4-mm × 7-mm balloon catheter (HyperForm; Micro Therapeutics, Irvine, CA, USA), coil embolization was initiated using a coil delivery microcatheter (SL10; Stryker Neurovascular, Fremont, CA, USA). To prevent embedding

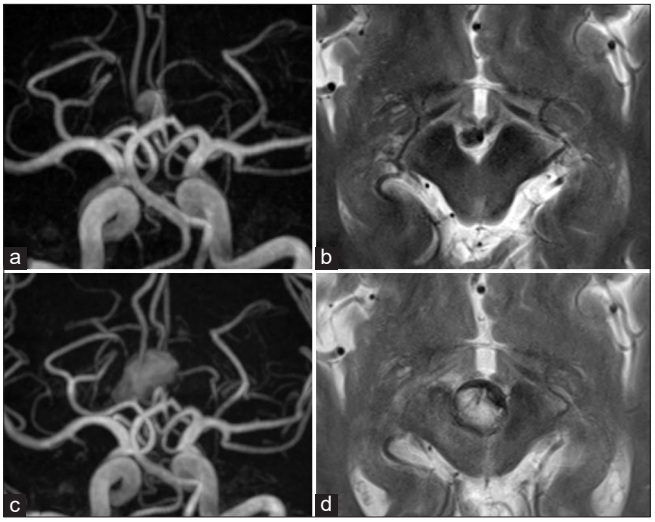

Figure 1: Radiological findings after the initial treatment (a and b) and at the time of recurrence (c and d). (a) MRA image demonstrating blood flow in the aneurysm at the basilar tip. (b) T2WI shows a flow void in the aneurysm, but no thrombus is observed. (c) MRA image showing enlargement of both blood flow in the aneurysm and the surrounding thrombus. (d) T2WI illustrates midbrain compression as a result of the thrombus in the basilar tip. MRA: Magnetic resonance angiography, T2WI: T2-weighted image.

of the coil in the thrombus, we used a soft 3-mm × 6-cm Target 3D device as the framing coil; this consisted of closed-loop secondary coils, allowing the formation of a well-constructed frame within the aneurysmal sac [Figure 2b]. Five detachable coils (Target 360 UltraSoft 3 mm × 6 cm; Target helical Nano 2 mm × 2 cm × 2; and Target helical Nano 1.5 mm × 2 cm × 2) were then inserted into the frame. After that, the intra-aneurysmal blood flow disappeared, and the surgery was concluded [Figure 2c and d]. No perioperative complications were observed.

Follow-up MRA two months after surgery revealed residual thrombus but no restoration of blood flow to the sac [Figure 3a]. T2WI showed a tendency for thrombus reduction and alleviation of midbrain compression [Figure 3b]. Further reduction occurred rapidly, and MRA performed at six months postoperatively revealed a significant reduction of thrombus [Figure 3c], with further alleviation of midbrain compression seen on T2WI [Figure 3d]. The pupil asymmetry and ocular motor dysfunction associated with oculomotor nerve palsy improved postoperatively and eventually resolved. The ptosis remained unchanged, causing functional impairment in daily life; therefore, at five months postoperatively, levator resection was performed using a Gore-Tex suture (CV4), allowing binocular vision. However, subsequent improvement in ptosis resulted in increased difficulty with eyelid closure. Approximately two years later, the suture was removed, allowing the eyelids to

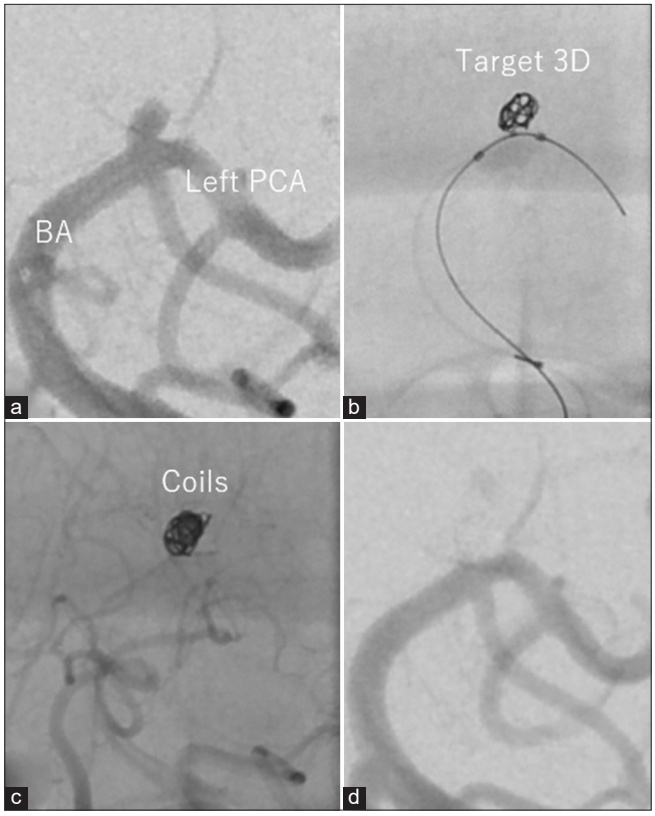

Figure 2: Cerebral angiographic findings after coil embolization. (a) Angiographic image showing the region of blood flow in the basilar tip aneurysm. (b) The frame was created by the Target 3D Coil with balloon assistance. (c) Final image obtained after coil embolization. (d) Final angiographic image showing the disappearance of the aneurysmal sac. BA: Basilar artery, PCA: Posterior cerebral artery.

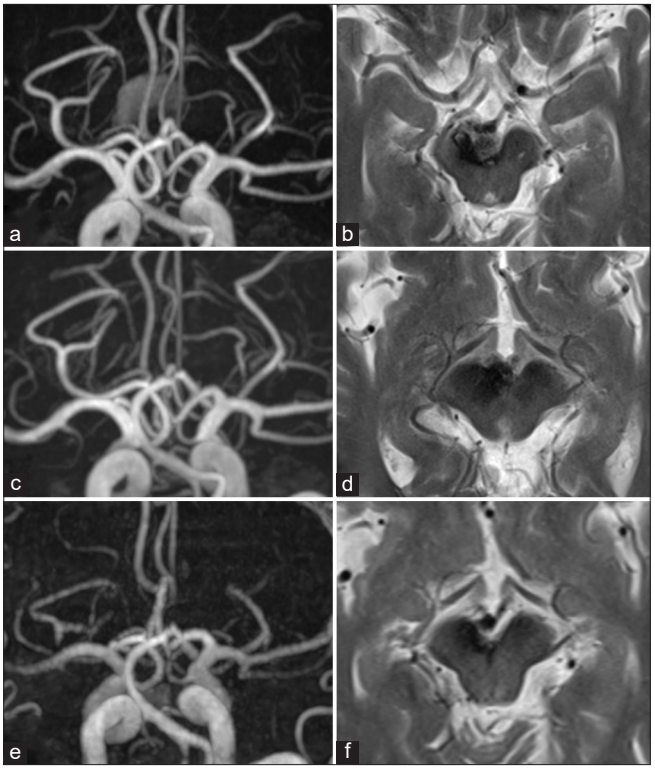

Figure 3: Radiological findings at 2 months (a and b), 6 months (c and d), and 5 years (e and f) after coil embolization. (a) MRA image revealing residual thrombus at the basilar tip. (b) T2WI showing that the thrombus has reduced in size, as has the midbrain compression. (c) MRA image indicating a significant reduction in thrombus at the basilar tip. (d) T2WI confirms the further reduction in midbrain compression as a result of thrombus. (e) MRA image demonstrating the complete disappearance of the thrombus. (f) T2WI shows complete resolution of the midbrain compression. MRA: Magnetic resonance angiography, T2WI: T2-weighted image.

close successfully. The most recent radiological examination, performed at five years postoperatively, confirmed the complete disappearance of the thrombus [Figure 3e]. T2WI showed that the midbrain compression, once eliminated, remained resolved [Figure 3f].

DISCUSSION

In the treatment of symptomatic large PTIA, coil embolization into the aneurysmal sac resulted not only in the disappearance of intra-aneurysmal blood flow but also in the complete resolution of PTIA itself. Ultimately, the patient's neurological symptoms improved, and his course has been recurrence-free in the long term.

The recurrence rate following intracranial surgery for large PTIA is typically higher than that for conventional large arterial aneurysms, especially when aiming to achieve a cure by simple coil embolization into the aneurysmal sac of PTIA, as documented in the literature.[3,7,8,11] The mechanisms of enlargement in PTIA differ from those in typical arterial aneurysms and include subintimal dissection,[14] wall hemorrhage from vasa vasorum, and progression of thrombosis.[9] Moreover, PTIA has unique characteristics in terms of the mechanism of recurrence after coil embolization. While conventional aneurysms often recur as a result of enlargement of the aneurysmal sac[4,6] or compaction of the coil,[5,10], PTIA is also associated with coil migration into the thrombus.[8] One cause of this is the water hammer effect,[8] but the propensity of coils to adhere to the aneurysmal wall may be another contributing factor. The tendency of coils to spread outward when attempting to adhere to the aneurysmal wall can result in the embedding of the coil into the thrombus, leading to the return of blood flow at the neck of the aneurysm. In our case, healing was achieved solely by coil embolization into the aneurysmal sac. This was made possible by the nature of the Target 3D device, which was used as a framing coil and tends to remain in place, showing an inclination to solidify inward. It is presumed that the coils did not embed into the thrombus but instead remained

in the neck portion, potentially preventing recurrence and contributing to the healing effect.

One factor determining the nature of coils in relation to the aneurysm wall is the configuration of the coil loops. These loops, which form the secondary coil diameter, can be broadly categorized as open or closed. Open loops refer to coils where part of the loop remains unclosed. These loops tend to spread outward when adhering to the aneurysmal wall. When using such coils in a PTIA, the coil loops may embed into the thrombus in the long term, potentially leading to restoration of blood flow. In contrast, closed loops are fully closed and remain in place, solidifying inward due to internal forces. The Target 3D Coil used for framing in this case consists entirely of closed loops; this coil remains in place and achieves more than 90% closure.[2,15] The nature of the Target 3D Coil may have contributed to the cohesive mass of coils remaining in the PTIA, potentially assisting with healing.

Flow diverter stents with flow-altering effects are now widely used in the treatment of difficult-to-manage cerebral aneurysms.[1] However, in cases involving lesions in the posterior circulation, there remain many uncertainties regarding effectiveness and treatment outcomes. There has been a report on the use of low-profile stents with substantial flow-diverting effects that entailed the use of multiple stents.[17] In this case, we contemplated a similar treatment approach but chose to omit it from the initial strategy to avoid excessive anti-thrombotic therapy. However, in the event of recurrence, we plan to consider this as the next option. Combining a Target 3D Coil with a low-profile stent that can provide the anticipated flow-diverting effect might be more effective in terms of preventing recurrence.

Disappearance of the aneurysm itself following treatment of PTIA has been observed occasionally, but the precise mechanism remains unclear. The mechanism possibly includes interruption of the blood supply to the vasa vasorum as a result of the disappearance of intra-aneurysmal blood flow,[13] which is similar to the absorption process for intracranial bleeding associated with occlusion of neovascularization in the aneurysm wall and thrombus,[12] and potentially also the involvement of macrophages.[8]

CONCLUSION

Our case demonstrates the effectiveness of straightforward coil embolization for a symptomatic large PTIA. The characteristics of the Target 3D Coil may have prevented coil migration into the thrombus, potentially contributing to the successful resolution of the aneurysm. The patient has remained recurrence-free in the long term. This highlights the potential for healing with a simplified coil treatment approach, considering the coil characteristics for a large PTIA.

Ethical approval

Institutional Review Board approval is not required.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consents.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

Use of artificial intelligence (AI)-assisted technology for manuscript preparation

The authors confirm that there was no use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript and no images were manipulated using AI.

REFERENCES

1. Chancellor B, Raz E, Shapiro M, Tanweer O, Nossek E, Riina HA, *et al*. Flow diversion for intracranial aneurysm treatment: Trials involving flow diverters and long-term outcomes. Neurosurgery 2020;86(Suppl 1): S36-45.
2. Cloft HJ, Joseph GJ, Tong FC, Goldstein JH, Dion JE. Use of three-dimensional Guglielmi detachable coils in the treatment of wide-necked cerebral aneurysms. AJNR Am J Neuroradiol 2000;21:1312-4.
3. Ferns SP, van Rooij WJ, Sluzewski M, van den Berg R, Majoie CB. Partially thrombosed intracranial aneurysms presenting with mass effect: Long-term clinical and imaging follow-up after endovascular treatment. AJNR Am J Neuroradiol 2010;31:1197-205.
4. Hasan DM, Nadareyshvili AI, Hoppe AL, Mahaney KB, Kung DK, Raghavan ML. Cerebral aneurysm sac growth as the etiology of recurrence after successful coil embolization. Stroke 2012;43:866-8.
5. Hope JK, Byrne JV, Molyneux AJ. Factors influencing successful angiographic occlusion of aneurysms treated by coil embolization. AJNR Am J Neuroradiol 1999;20:391-9.
6. Hoppe AL, Raghavan ML, Hasan DM. Comparison of the association of sac growth and coil compaction with recurrence in coil embolized cerebral aneurysms. PLoS One 2015;10:e0123017.
7. Kim SJ, Choi IS. Midterm outcome of partially thrombosed intracranial aneurysms treated with guglielmi detachable coils. Interv Neuroradiol 2000;6:13-25.
8. Kim YJ, Ko JH. Endovascular treatment of a large partially thrombosed basilar tip aneurysm. J Korean Neurosurg Soc 2012;51:62-5.

9. Krings T, Alvarez H, Reinacher P, Ozanne A, Baccin CE, Gandolfo C, *et al.* Growth and rupture mechanism of partially thrombosed aneurysms. Interv Neuroradiol 2007;13:117-26.
10. Lawton MT, Quinones-Hinojosa A, Chang EF, Yu T. Thrombotic intracranial aneurysms: Classification scheme and management strategies in 68 patients. Neurosurgery 2005;56:441-54; discussion-54.
11. Lee J, Cho WS, Yoo RE, Yoo DH, Cho YD, Kang HS, *et al*. The fate of partially thrombosed intracranial aneurysms treated with endovascular intervention. J Korean Neurosurg Soc 2021;64:427-36.
12. Matsuda Y, Terada T, Tetsuo Y, Tsumoto T. Partially thrombosed giant basilar tip aneurysm that remarkably decreased in size after stent-assisted coiling associated with the disappearance of neovascularization. Neuroradiology 2022;64:837-41.
13. Mitsui T, Nakagawa I, Kotsugi M, Park H, Yokoyama S, Myouchin K, *et al*. Remarkable shrinkage of a thrombosed giant aneurysm by stent-assisted jam-packed coil embolization. Surg Neurol Int 2021;12:328.
14. Mizutani T, Miki Y, Kojima H, Suzuki H. Proposed classification of nonatherosclerotic cerebral fusiform and dissecting aneurysms. Neurosurgery 1999;45:253-9; discussion 9-60.
15. Okuda H, Hirokawa N, Saitoh M, Otani A, Someya M, Usami Y, *et al*. Stiff coils enhance shape retention and pressure resistance in an aneurysm model even at low volume. Minim Invasive Ther Allied Technol 2022;31:767-76.
16. Roccatagliata L, Guedin P, Condette-Auliac S, Gaillard S, Colas F, Boulin A, *et al.* Partially thrombosed intracranial aneurysms: symptoms, evolution, and therapeutic management. Acta Neurochir (Wien) 2010;152:2133-42.
17. Sattur MG, Li Y, Almallouhi E, Lena J, Spiotta AM. Lessons learned from endovascular coil embolization of pericallosal artery aneurysms and adoption of flow diversion: A retrospective cohort assessment of the efficacy of coiling and flow diversion. World Neurosurg 2019;129:e444-51.

How to cite this article: Ashida N, Fujita A, Hayashi H, Higashino M, Ikeuchi Y, Iwahashi H, *et al*. Successful shrinkage of a recurrent partially thrombosed symptomatic large basilar tip aneurysm using a Target 3D Coil. Surg Neurol Int. 2024;15:103. doi: 10.25259/SNI_44_2024