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Enterprise Treatment for Recurrent Basilar Tip Aneurysm after PulseRider-assisted Coil Embolization: A Case Report

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Abstract

PulseRider (Cerenovus, Irvine, CA, USA) is a relatively novel device used for the treatment of wide-neck aneurysms with a coil-assisted effect. However, treatment options for recurrent aneurysms after PulseRider-assisted coil embolization remain controversial. Here we report a case of recurrent basilar tip aneurysm (BTA) treated with Enterprise 2 after PulseRider-assisted coil embolization. A woman in her 70s underwent coil embolization for a subarachnoid hemorrhage with ruptured BTA 16 years ago. Recurrence was detected at 6-year follow-up, and an additional coil embolization was performed. Nevertheless, gradual recurrence still occurred, and PulseRider-assisted coil embolization was performed without any complications 9 years after the second treatment. However, recurrence was detected once more at 6-month follow-up. Thus, stent-assisted coil embolization using Enterprise 2 (Cerenovus) through PulseRider was selected for angular remodeling. Enterprise 2 was deployed between the right P2 segment of the posterior cerebral artery (PCA) and basilar artery (BA) after an effective coil embolization, which achieved effective angular remodeling between the right PCA and BA. The patient's postoperative course was uneventful, and no recanalization was detected after half a year. Although PulseRider is effective for wide-neck aneurysm treatment, recurrence remains a possibility. Additional treatment using Enterprise 2 is safe and effective with the expectation of angular remodeling.

Keywords: basilar tip aneurysm, PulseRider, Enterprise, closed-cell stent, angular remodeling

Introduction

Remarkable advances have been made in the endovascular treatment of unruptured cerebral aneurysms, with several devices available for treatment. PulseRider (Cerenovus, Irvine, CA, USA) is one such device used for aneurysm neck reconstruction. It is a relatively new device that has been available in Japan since 2020. Some reports have shown that this device achieves adequate occlusion (Raymond occlusion classification classes I and II) in 87.5%-92.7% of patients at 6-24 months follow-up, with a postoperative complication rate of 0%-8.8%.[1-6] Thus, PulseRider use is becoming increasingly popular because of its efficacy and safety. Conversely, a certain number of recurrent aneurysms have been identified after PulseRider-assisted coil embolization, and there is no established treatment for these cases.[1,3-6] Here, we report a case of a recurrent basilar tip aneurysm (BTA) treated with Enterprise 2 (Cerenovus) after PulseRider treatment.

Case Report

A 77-year-old woman with a history of hypertension and smoking habits underwent coil embolization 16 years ago for subarachnoid hemorrhage (SAH) caused by a ruptured BTA. She had an uneventful postoperative course and a modified Rankin Scale score (mRS) of 1 at the time of discharge due to the intraoperative complication of visual disturbance. Recurrence occurred 6 years later, and coil embolization was performed again. Despite additional coil embolization, gradual aneurysm recurrence was detected, and she was referred to our hospital 9 years after the sec-

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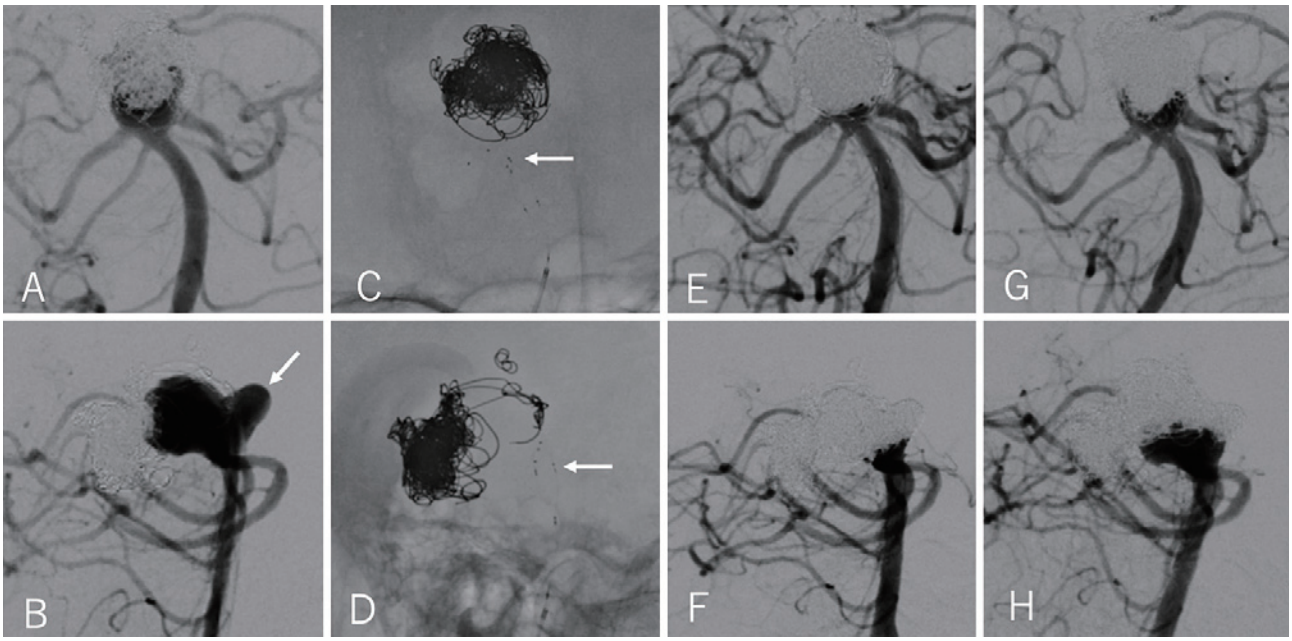

Fig. 1 Pre- and postoperative findings of PulseRider-assisted coil embolization and stent-assisted coil embolization 16 years after initial treatment. The anterior view (A) and lateral view (B) of digital subtraction angiography (DSA) show the recanalization of the basilar tip aneurysm with an anterior bleb (white arrow). The anterior view (C) and lateral view (D) of the X-ray photograph show the deployed T-shaped PulseRider (white arrow). The anterior view (E) and lateral view (F) of DSA demonstrate appropriate aneurysm obliteration after PulseRider-assisted coil embolization. The anterior view (G) and lateral view (H) of DSA show the recanalization of the basilar tip aneurysm at 6-month follow-up of PulseRider-assisted coil embolization.

ond treatment. Digital subtraction angiography (DSA) at our hospital revealed a large BTA with an anterior bleb, which had maximum diameters of 16 mm at the dome and 8.5 mm at the neck (Fig. 1A, B). The previous coils were compacted upward and backward (Fig. 1C, D). We scheduled PulseRider-assisted coil embolization for this aneurysm. Dual antiplatelet therapy (aspirin 100 mg/day and clopidogrel 75 mg/day) was initiated 2 weeks before the treatment. Informed consent was obtained from the patient for the case report.

First treatment

A microcatheter (Prowler Select Plus, Cerenovus) was guided from the left vertebral artery (VA) to the basilar artery (BA), and a T-shaped PulseRider was successfully deployed in a hybrid-type configuration: the right leaf in the right posterior cerebral artery (PCA) and the left leaf in the aneurysm (Fig. 1C, D). For coiling, two microcatheters (Excelsior SL-10, Stryker, Fremont, CA, USA, and Headway 17, Terumo, Tokyo, Japan) were inserted into the aneurysm via the leaf of the PulseRider from the right VA. Thus, we performed an effective PulseRider-assisted coil embolization. The PulseRider was detached after coiling. Postoperative DSA showed appropriate occlusion, which was equivalent to Raymond occlusion classification class II (Fig. 1E, F). No intraprocedural complication occurred, and the patient had an uneventful postoperative course with an mRS score of 1 at discharge. Dual antiplatelet therapy was gradually decreased after 3 months.

Second treatment

Magnetic resonance angiography at 6-months follow-up revealed the fourth recurrence of the aneurysm, which required additional treatment (Fig. 1G, H). Therefore, we performed a double-catheter technique and stent-assisted coil embolization using Enterprise 2 for angular remodeling. Dual antiplatelet therapy was restarted 2 weeks before the treatment. Because the BA tip is narrow for triple catheters, a microcatheter for stenting (Prowler Select Plus) was guided from the left VA to the lower BA, and only a micro-guide wire (Synchro2 soft, Stryker, Fremont, CA, USA) was guided to the right PCA (Fig. 2A, B). Crossing the lesion with the micro-guide wire through the PulseRider was easy. Subsequently, two microcatheters were inserted for coiling to the aneurysm through the PulseRider from the right VA (Fig. 2C). Finally, a microcatheter for stenting (Prowler Select Plus) was navigated to the right PCA, and Enterprise 2 was deployed between the right P2 segment of the PCA and BA after coil embolization (Figs. 2D, E, F and 3A, B). After stenting, apposition of Enterprise 2 was assessed with cone-beam computed tomography. Postoperative DSA showed appropriate occlusion equivalent to Raymond occlusion classification class II, and no complications such as the displacement of the

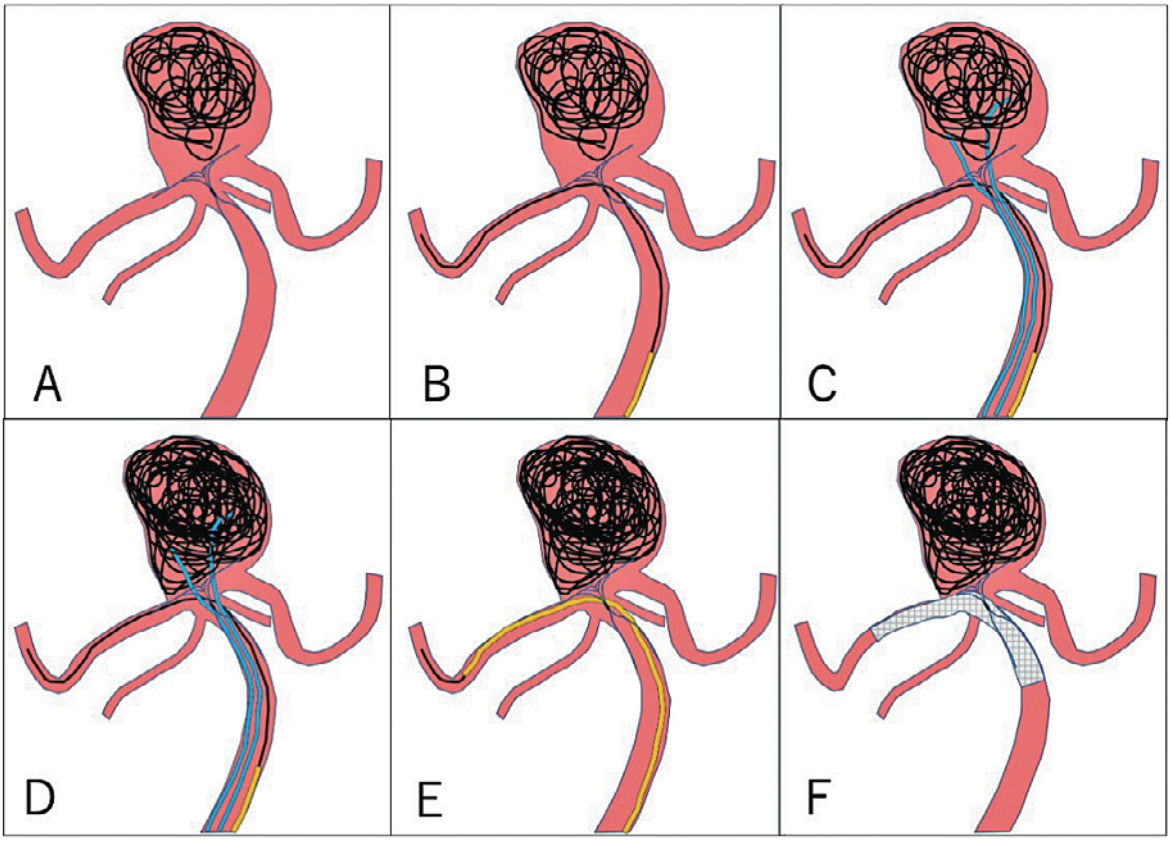

Fig. 2 Schema of the treatment method. Previously deployed PulseRider and coil (A). A micro-guide wire is inserted into the right posterior cerebral artery (PCA) through PulseRider (B). Two microcatheters for coiling are navigated into the aneurysm (C), and an additional coil is inserted (D). A microcatheter for stenting is inserted into the right PCA after coiling (E), and the stent is deployed from the right PCA to the basilar artery through PulseRider (F).

PulseRider or sagging were observed (Fig. 3C, D). Angular remodeling between the right PCA and BA was observed after the treatment (Fig. 4). The patient had no complications and was discharged with an unchanged mRS score. DSA after 6 months showed no obvious recurrence, and the dose of dual antiplatelet therapy was tapered off thereafter (Fig. 3E, F).

Discussion

BTAs account for 5% of all intracranial aneurysms and have a slightly higher recurrence rate after coil embolization than that of aneurysms at other sites.[7,8] There are several indicators for predicting the recurrence of BTAs: larger size, dome/neck ratio ≤2, posterior dome orientation, angle between BA and BTA of 160°-180°, symmetrical PCA on both sides, and cranial BTA.[9] Furthermore, in the embolization method itself, stent-embolized aneurysms have a lower recurrence rate than that of nonstented aneurysms, and Y-stent placement has been reported to have a lower recurrence rate than that of single-stent placement.[10] However, the drawbacks of Y-stenting include difficulty in positioning at a steep angle, the procedure is technically complex, and there are relatively frequent complications.[11] PulseRider is known to be easier to use in cases of steep angulation of bifurcation branches and has lower metal coverage than Y-stenting.[1] Therefore, it is likely to be advantageous for procedural ischemic events.[4,6,11,12] Long-term therapeutic effects have been reported to be similar to those of Y-stenting, but larger aneurysms are more likely to recur than in Y-stents.[6,11] This may be explained by a reduced flow diversion effect, and direct flow to the aneurysm cannot be changed in a large terminal-type aneurysm like that in our case.[1,6]

The hemodynamic effects of intracranial bifurcation aneurysms have been reported to be significantly improved by straightening the parent artery with flow diversion by metallic coverage.[13] Vascular straightening by stenting dramatically alters apex hemodynamics in a favorable direction by blunting apical pressure, including the narrowing and migration of the flow impingement zone.[14] Therefore, straightening the parent artery with a stent may be the optimal way to reduce the recurrence of intracranial bifurcation aneurysms.[13] It has also been reported that parent artery straightening is likely to be involved in higher occlusion rates in flow-diverter stents.[15] Specifically, it has been

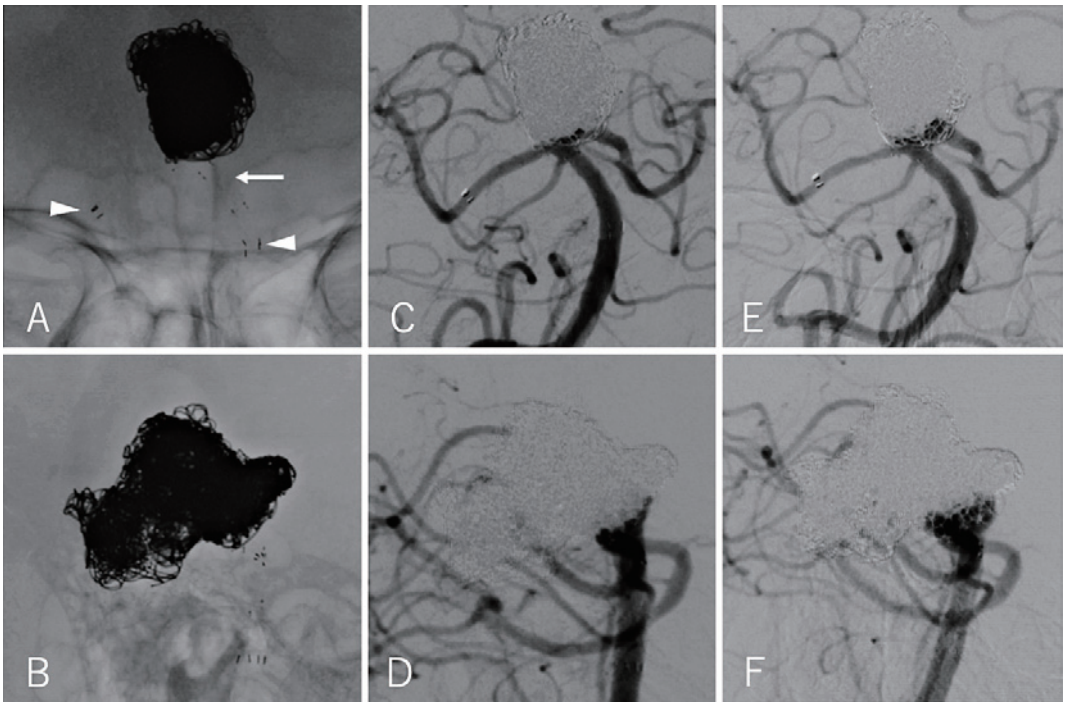

Fig. 3 Postoperative findings after stent-assisted coil embolization. The anterior view (A) and lateral view (B) of the X-ray photograph show an additional stent (arrowhead) and a previously deployed T-shaped PulseRider (white arrow). Anterior view (C) and lateral view (D) of digital subtraction angiography (DSA) showing appropriate aneurysm obliteration after additional stent-assisted coil embolization. Anterior view (E) and lateral view (F) of DSA taken 6 months later showing no recanalization.

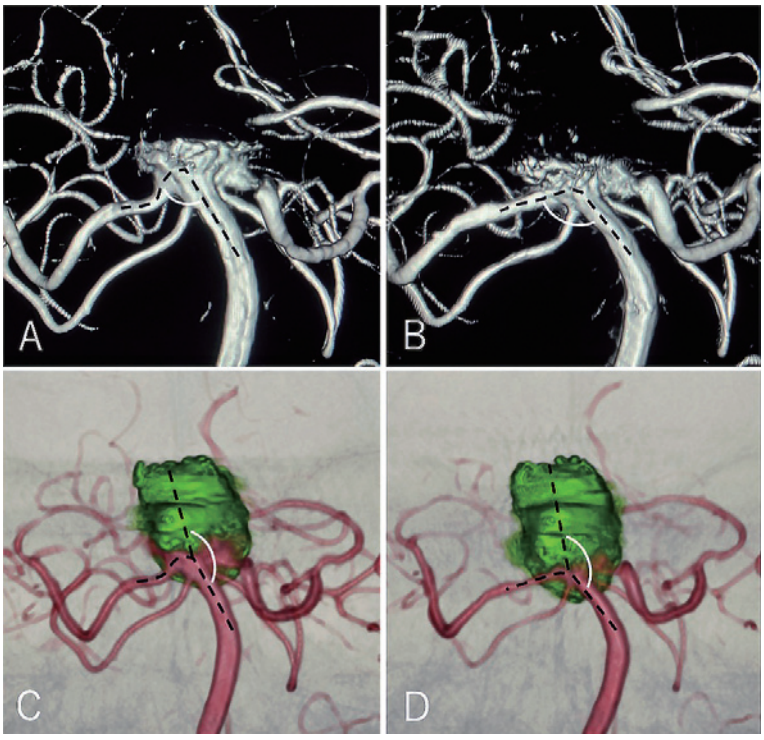

Fig. 4 Anterior view of digital subtraction angiography three-dimensional rotational angiography showing significant angular change. The angle between the right posterior cerebral artery and basilar artery was approximately 80° before stent-assisted coil embolization (A). The angle changed to approximately 105° after the treatment, and angular remodeling over 20° was observed (B). The angle between the basilar artery and the aneurysm was approximately 170° before stent-assisted coil embolization (C). The angle changed to approximately 150° after the treatment, and angular remodeling of 20° was observed (D).

shown that a vessel angle of 20° or more likely indicates stable aneurysms, regardless of neck or aneurysm size.[16] In our case, the angle actually changed by more than 20° (Fig. 4A, B). In addition, the angle of BA and BTA, the wide angle of which can predict risk of recurrence, decreased from 170° to 150° (Fig. 4C, D).[9]

Owing to its relatively open design and low metal loading, PulseRider is known to not preclude further endovascular interventions such as adding coils or placing a stent through the device.[3] Similar to our case, very few studies conducted stent placement through PulseRider, and none of these cases reported complications.[1,3,17] So far, LVIS/LVIS Jr (Microvention Terumo, Tustin, CA, USA) and Neuroform Atlas (Stryker) have been reported for BTA,[1,3] and Enterprise 2 and LVIS Jr for anterior communicating artery aneurysm.[3,17] However, there were no reports of Enterprise 2 for BTA. Enterprise 2 is effective in that it can be placed without difficulty for BTA after PulseRider placement and has the potential for better angular remodeling than other stents (Fig. 2).[13,18] Therefore, Enterprise 2-induced remodeling of the BTA aneurysm appears to be the better method for decreasing recurrence after PulseRider placement.[13] Because PulseRider has low metal coverage, the risk of thrombus formation is low and there is a high possibility that even if a stent is added, it can be treated with the same antiplatelet therapy as that after normal single-stent placement.[3,5]

In conclusion, we report a case of recurrent BTA after PulseRider-assisted coil embolization treated with Enterprise 2. Additional coil insertion and stent placement through PulseRider was easy, and angular remodeling was confirmed. Stent-assisted coil embolization using Enterprise 2 after PulseRider placement was a viable and safe option, which prevented further recurrences.

Conflicts of Interest Disclosure

All authors report no conflicts of interest concerning this article.

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