Symptomatic Very Delayed Parent Artery Occlusion After Flow Diversion Stent Embolization

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Abstract

Flow diversion stents (FDSs) are constructed from high-density braided mesh, which alters intra-aneurysmal hemodynamics and leads to aneurysm occlusion by inducing thrombus formation. Although there are potential complications associated with FDS embolization, one of the serious complications is the parent artery occlusion due to the in-stent thrombosis. A 72-year-old woman with a symptomatic giant fusiform aneurysm in the cavernous segment of ICA underwent single-layer pipeline embolization device (PED) embolization. Six-month and 1-year follow-up conventional angiographies showed the residual blood flow in the aneurysm. Two-year follow-up MRI showed the aneurysm sac shrinkage and the antiplatelet therapy was discontinued. The patient suffered from symptomatic parent artery occlusion due to the in-stent thrombosis, 4 months after antiplatelet therapy discontinuation. The patient with the incompletely occluded aneurysm after PED embolization should be given long-term antiplatelet therapy because of the risk of delayed parent artery occlusion.

Key words: intracranial aneurysm, flow diversion stent, delayed parent artery occlusion, antiplatelet therapy

Introduction

Flow diversion stents (FDSs) are constructed from high-density braided mesh, which alters intra-aneurysmal hemodynamics and leads to aneurysm occlusion by inducing thrombus formation. The authors report a case of symptomatic delayed parent artery occlusion more than 2 years after the pipeline embolization device (PED, Medtronic/Covidien, Irvine, CA) embolization.

Case Report

A 72-year-old woman was presented with diplopia due to left abduces nerve palsy. Axial T2-weighted magnetic resonance image (MRI) showed a large well-delineated mass lesion in the left cavernous sinus (Fig. 1). Catheter angiography confirmed a giant fusiform aneurysm in the cavernous segment of the left internal carotid artery (ICA) (Fig. 2). PED embolization was scheduled with written informed consent from the patient and her family. The patient received dual antiplatelet therapy (DAPT) with aspirin (100 mg/day) and clopidogrel (75 mg/day) 10 days prior to the procedure. The procedure was performed under general anesthesia and systemic heparinization. A 4 × 35 mm PED was implanted across the fusiform aneurysm. Angiographies showed apparent flow stagnation immediately after PED implantation (Fig. 3). The patient was discharged on day 7 after the procedure without any new neurological deficits. Although conventional angiographies at 6 months and 1 year showed progressive thrombosis of the aneurysm, there was residual flow in the aneurysm (Fig. 4). DAPT was continued until 1 year after the procedure and single antiplatelet therapy with clopidogrel (50 mg/day) was continued until 2 years after the procedure. A 2-year follow-up MRI showed the aneurysm sac shrinkage with the partial improvement of pre-existing abduces nerve palsy (Fig. 5). Antiplatelet therapy was discontinued for patient's desire. Then, in an emergency, the patient was re-admitted to our hospital 4 months after the antiplatelet therapy discontinuation. The neurological examination showed motor aphasia and right-sided hemiplegia. Diffusion-weighted imaging showed new infarctions in the left frontal lobe cortex and centrum semiovale (Fig. 6). Subsequent angiography confirmed the in-stent thrombosis with left ICA occlusion and residual blood flow in the aneurysm (Fig. 7). The mechanical thrombectomy, catheter-mediated infusion of thrombolytic agents, and/or systemic thrombolytic therapy were not attempted because of collateral circulation. The patient was referred to a rehabilitation center upon being discharged with mRS 3 due to the persisting consequences of stroke.
perforators and side branches. Currently, only approved FDS is PED in Japan. There are potential complications associated with PED embolization. A review of the literature of PED embolization reported that complication risks are ischemic stroke (1.9%), transient ischemic attach (2.0%), intracranial hemorrhage (2.3%), subarachnoid hemorrhage (1.1%), PED migration (0.3%), side branch occlusion (2.3%), and groin/retroperitoneal hematoma (1.2%).

One of the serious complications associated with PED embolization are the parent artery occlusion due to the in-stent thrombosis. Although there are some reports of periprocedural in-stent thrombosis, those of delayed in-stent thrombosis are scarce. Chiu et al. (2015) reported two patients with delayed PED occlusions. One was an occlusion in a 3-layer PED construction in a pericallosal fusiform aneurysm, despite antiplatelet therapy with aspirin. It is unknown exactly when the PED formed a thrombus and occluded the parent artery because the patient was asymptomatic. The second was an occlusion in a 3-layer PED construction in a basilar aneurysm after stopping clopidogrel for an elective inguinal hernia repair. The patient died 13 months after retreatment with a third PED. Klisch et al. (2011) also reported two patients with delayed PED occlusions. Both the patients underwent PED embolization for large fusiform posterior circulation aneurysms. One was an occlusion in a 4-layer PED construction. The second was an occlusion in a single PED construction with 2 Solitaire stents inappropriately deployed in the aneurysm fundus (Medtronic/Covidien, Irvine, CA). The 1-year follow-up with conventional angiography demonstrated thrombosis of the aneurysm with minimal residual flow into the aneurysm.

Discussion

FDS can alter hemodynamics between an aneurysm and the parent artery resulting in gradual thrombosis of the aneurysm occurring over time. Subsequent inflammatory response, healing, and endothelial growth shrink the aneurysm and reconstruct the parent artery lumen while preserving...
fundus in both patients. Both the patients presented with symptomatic acute occlusions of the PED constructions within 14 days of clopidogrel discontinuation despite antiplatelet therapy with aspirin. Although multi-layer PED construction, to enhance the flow-diverting effect is selected to prompt the aneurysm thrombosis, it may increase the risk of parent artery occlusion.

In the study of PEDs for uncoilable or failed aneurysms, a total of five delayed parent vessel occlusions were reported: three patients (2.8%) at 180 days and two patients (1.9%), not seen at 180 days, at 1 year. However, angiographically detected in-stent thrombosis was not reported. Only one patient (0.9%) was diagnosed with an ischemic stroke. One delayed parent vessel occlusion was definitively related to non-compliance with antiplatelet medication. These cases suggested that the monitoring of antiplatelet effectiveness could be useful to reduce the frequency of delayed parent artery occlusions.

**Fig. 4** Follow-up angiographies at (A) 6 months and (B) 1 year showing the residual blood flow in the aneurysm.

**Fig. 5** Axial T2-weighted magnetic resonance image showing the aneurysm sac shrinkage.

**Fig. 6** Axial diffusion weighted imaging showing the acute infarctions in the left frontal lobe cortex and centrum semiovale.
Adequate antiplatelet therapy prior to FDS implantation and for at least several months afterwards is mandatory to prevent the in-stent thrombosis. Some patients particularly with in-stent stenosis after FDS implantation are at risk of in-stent thrombosis, when DAPT is discontinued or changed to single antiplatelet therapy. Because, the inter-individual variability of response to clopidogrel and aspirin are well known, the monitoring of platelet inhibition is important to prevent PED-related ischemic events.

Kadirvel et al. (2014) reported that antiplatelet therapy should not be stopped if the aneurysm could not be completely occluded after the PED embolization, because the device was not completely covered with endothelium. Because, in this case, in which the 1-year follow-up angiography showed incomplete aneurysm occlusion, the pipeline might not be completely covered with endothelium. Emergency conventional angiography suggested that the thrombus is developed at the non-covered part with endothelium. Therefore, we recommend that the patients with an incompletely occluded aneurysm after PED embolization, be given appropriate antiplatelet therapy, if the MRI showed progressive shrinkage of the aneurysm sac, until complete aneurysm occlusion can be obtained.

Conflicts of Interest Disclosure

All authors have registered online self-reported conflict of interest disclosure statement forms through the website for the Japan neurological society. No benefits in any form have been or will be received from any commercial party directly to the subject of this study. Informed consent of the patient for the use of this information was obtained. Institutional review board approval is not required for this type of retrospective study at our institution.

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