Coil Embolization of an Aneurysm Located at the Trunk of the Persistent Primitive Trigeminal Artery
—Case Report—

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Abstract

A 71-year-old woman presented with an aneurysm at the trunk of the persistent primitive trigeminal artery (PPTA) manifesting as subarachnoid hemorrhage. Angiography and three-dimensional computed tomography revealed a wide-necked saccular aneurysm at the trunk of the left PPTA. Coil embolization with the balloon-assist technique was successful and PPTA patency was preserved. Preoperative conventional angiography should be performed to check for cross-filling of the PPTA. This case demonstrates that an aneurysm of the trunk of the PPTA can be successfully treated by coil embolization using the balloon-assist technique.

Key words: aneurysm, balloon assist technique, coil embolization, persistent primitive trigeminal artery

Introduction

Persistent primitive trigeminal artery (PPTA) is the most common embryological vascular remnant,1,4 is located between the carotid and vertebralbasilar arteries,17 and is recognized on 0.1–0.6% of cerebral angiograms. Saccular aneurysms associated with PPTA are very common, and account for 14–32% of all cerebral aneurysms.3,4,6,7,11,14 Most aneurysms associated with the PPTA are located at the bifurcation of the carotid artery and the PPTA, whereas aneurysms arising at the PPTA trunk are extremely rare. The deep location of PPTA trunk aneurysms renders direct surgery very difficult,17,18 so endovascular treatment has been attempted.7,9 We present the case of an aneurysm at the trunk of the PPTA treated successfully by coil embolization using the balloon-assist technique.

Case Presentation

A 71-year-old woman was admitted with severe headache. Computed tomography (CT) revealed subarachnoid hemorrhage (SAH) primarily involving the posterior fossa (Fig. 1). CT angiography demonstrated a PPTA with an aneurysm. The PPTA was separate from the left carotid artery (C5 portion) and connected to the basilar artery (Fig. 2). Three-dimensional (3D) left carotid angiography demonstrated a saccular aneurysm at the curved mid-por-

Fig. 1 Computed tomography scan obtained on admission showing subarachnoid hemorrhage predominantly located in the posterior fossa.

tion of the trunk of the left PPTA. The aneurysm measured 5 × 5 × 7 mm, and the neck was 4.8 mm. The distal sites of the basilar artery, bilateral posterior cerebral arteries (PCAs), and bilateral superior cerebellar arteries (SCAs) were well opacified through the PPTA (Fig. 3). Right vertebral angiography showed hypoplasticity of the distal site.
Fig. 2 Computed tomography angiogram showing a persistent primitive trigeminal artery (PPTA) separate from the left carotid artery (C5 portion) and connected to the basilar artery, and an aneurysm arising from the PPTA trunk (arrow).

Fig. 3 A: Three-dimensional left carotid angiogram, lateral view, showing the left persistent primitive trigeminal artery (PPTA) (arrowheads), and the distal sites of the basilar artery and bilateral posterior cerebral and superior cerebellar arteries filled through the PPTA. B: Three-dimensional left carotid angiogram, posterior view, showing the PPTA and a saccular aneurysm arising from the PPTA trunk (arrow), with the right vertebral artery (arrowheads) and the junction of the bilateral vertebral arteries.

Fig. 4 A: Right vertebral angiogram, anterior view, showing hypoplasitcity of the distal site of the right vertebral artery. B: Right vertebral angiogram, anterior view, after compression of the left carotid artery demonstrating the basilar artery and bilateral posterior cerebral and superior cerebellar arteries through the distal site of the vertebral artery.

Fig. 5 Left carotid angiogram, left anterior oblique view, showing the tip of the microcatheter in the aneurysm dome (arrow) and the HyperGlide occlusion balloon system (arrowheads).

Fig. 6 Right vertebral angiogram, anterior view, after inflation of the HyperGlide balloon at the aneurysm neck (arrowheads) in the persistent primitive trigeminal artery trunk showing the basilar artery and bilateral posterior cerebral and superior cerebellar arteries through the distal site of the vertebral artery, and the first coil embolizing the aneurysm sac (arrow).

of the right vertebral artery, but the distal site of the basilar artery was visualized during left carotid artery compression (Fig. 4). These findings suggested that the PPTA could be temporarily occluded during treatment of the PPTA trunk aneurysm.

A 6-Fr guiding catheter (Slim Guide; Medikit, Tokyo) was placed in the left internal carotid artery (ICA) under general anesthesia. Intravenous anticoagulation was induced with a 3000-U heparin bolus, and the activated clotting time was maintained at approximately 250 seconds. A two-tip marked microcatheter was navigated into the aneurysm sac. A Guglielmi detachable coil (GDC), deployed as the first framing coil, failed to lock in the aneurysm sac and herniated into the PPTA trunk. We decided to proceed to neck remodeling because of the width using a microballoon catheter (Fig. 5). A HyperGlide™ oc-
Fig. 7 Left carotid angiogram, left anterior oblique view, showing complete occlusion of the aneurysm, and preservation of the patency of the persistent primitive trigeminal artery, the basilar artery, and bilateral posterior cerebral and superior cerebellar arteries.

The specific hemodynamics of the PPTA, which directly branches and receives significant blood flow from the ICA, may induce the formation of aneurysms. Review of 261 patients with PPTA reported between 1950 and 2008 (including our case) found that 40 (15.3%) presented with PPTA-associated aneurysms. The aneurysm was located at the bifurcation of the cavernous portion of the ICA in 18 patients, at the trunk of the PPTA in 12, and at the junction of the ICA and the basilar artery in 3. No location was given in the remaining 7 cases. In our patient, CT and 3D angiography demonstrated that the aneurysm arose from the trunk of the PPTA.

Three types of aneurysm location are summarized in Table 1. A small number of patients with aneurysms at the ICA-PPTA bifurcation presented with SAH, but the most common presentation was cranial nerve palsy (abducens or oculomotor palsy) or carotid artery-cavernous sinus fistula. On the other hand, the most prevalent symptom of PPTA trunk aneurysms was SAH. Interventional neurosurgery was the most common treatment to address aneurysms associated with the PPTA, using ICA occlusion by direct surgery or interventional techniques using balloons, and aneurysm embolization with detachable coils.

The trunk of the PPTA is located deep in front of the brain stem and close to the cranial nerves and perforating vessels, so the surgical approach is very difficult and PPTA occlusion has been performed. Only 2 aneurysms on the PPTA trunk were treated directly, one by direct surgical clipping and one by endovascular treatment. The latter aneurysm arose from a PPTA variant. Our case demonstrates endovascular treatment of an aneurysm on the trunk of the PPTA. Flow preservation in the PPTA is highly important in patients undergoing treatment for PPTA trunk aneurysms, because insufficient flow in the main trunk of the PPTA compromises the circulation in the basilar artery and bilateral PCAs or SCAs, and may induce dangerous post-treatment sequelae.

The aneurysm neck was wide in our case, and the first

Table 1 Summary of aneurysms associated with the persistent primitive trigeminal artery (PPTA)

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<thead>
<tr>
<th>Location of aneurysm</th>
<th>Location of aneurysm</th>
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<tbody>
<tr>
<td>ICA-PPTA</td>
<td>PPTA trunk</td>
</tr>
<tr>
<td>No. of cases</td>
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<tr>
<td>Symptom</td>
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<td>CCF</td>
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<tr>
<td>others</td>
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attempt at coil placement failed because the coil mass herniated into the PPTA trunk. Therefore, we resorted to the balloon-assist technique using the HyperGlide occlusion balloon system. Complications associated with this technique include higher rate of thromboembolic events and increased risk of aneurysm or vessel rupture. To avoid these complications, precise control of the balloon placement and inflation is mandatory, and is facilitated by the technical properties of the HyperGlide balloon. We selected the HyperGlide because this low compliance balloon is indicated for sidewall aneurysms, and the aneurysm arising from the PPTA trunk was the sidewall type in our patient. On the other hand, the HyperForm balloon (ev3 Neurovascular) allows treatment of wide-necked intracranial aneurysms located on arterial bifurcations or small arteries. This highly compliant balloon offers the advantage of changing easily from the cylindrical shape to bulge into the origin of the arterial bifurcation and seal the aneurysm neck.

Our endovascular treatment safely and successfully embolized the ruptured aneurysm completely. We recommend that conventional angiography be performed with left ICA compression in patients undergoing endovascular treatment of PPTA aneurysms, to ascertain that distal flow in the PPTA, basilar artery, and bilateral PCAs and SCAs will be redirected from the right vertebral artery after inflation of the HyperGlide balloon.

References


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