Successful Treatment by Coil Embolization of a Direct Carotid-cavernous Fistula Occurring during Endovascular Catheter Navigation: A Case Report

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Objective: A case of a carotid-cavernous fistula (CCF) that was close to the superior ophthalmic vein (SOV) that occurred during endovascular catheter navigation and was treated by transarterial coil embolization is reported.

Case Presentations: An arteriovenous fistula and eye swelling occurred during percutaneous transluminal angioplasty (PTA) balloon catheter navigation. Suspecting and searching for a carotid-cavernous fistula, the microcatheter passed from the internal carotid artery (ICA) to the SOV. The fistula was considered to have occurred in the cavernous sinus close to the SOV. The fistula was closed by coil embolization from another microcatheter.

Conclusion: It is important to be aware that a CCF may occur at the anterior genu of a cavernous ICA during catheter navigation. In the case of a fistula caused by a guidewire/microcatheter, transarterial coil embolization is possible and may be tried first.

Keywords ▶ carotid-cavernous fistula, internal carotid artery, superior ophthalmic vein, complication, coil embolization

Introduction

Iatrogenic direct carotid-cavernous fistulas (CCFs) have been reported due to Fogarty catheter thromboendarterectomy,¹ carotid artery percutaneous transluminal angioplasty (PTA) or stenting,²,³ embolization of tumor vessels⁴ during catheter intervention for a cavernous internal carotid artery (ICA), and two cases during catheter exchange or navigation.⁵ A case of a CCF that was close to the superior ophthalmic vein (SOV) with eye swelling that occurred during PTA balloon catheter navigation and was treated by transarterial coil embolization is described.

Case Presentation

A 77-year-old woman without any medical history suffered a subarachnoid hemorrhage (Hunt and Kosnik Grade III). Symptomatic vasospasm occurred on the 11th day after clipping of a left ICA-posterior communicating artery aneurysm. A 6F Envoy XB MPC 90 cm (Cordis, Johnson & Johnson, Fremont, CA, USA) was inserted into the left ICA. Heparin (4000 units) was given. Angioplasty of the middle cerebral artery (M1) was performed using a Gateway Monorail 2.5 × 9 mm (Boston Scientific, Natick, MA, USA)/RADIFOCUS Guide Wire M 0.012 double angle (MicroVention TERUMO, Tustin, CA, USA). Sufficient M1 expansion was obtained. Next, an attempt was made to navigate a balloon catheter to the anterior cerebral artery with a microguidewire. After trying to pass the ICA several times, the angiogram showed an arteriovenous shunt with simultaneous visualization of the cavernous sinus and SOV, and left eye swelling occurred. There was no cortical venous reflux (Figs. 1A, 1B). Heparinization was reversed by protamine 15 mg. The balloon catheter was removed, and a search for a fistula around the IC cavernous portion using an Excelsior SL-10 pre-shaped 45 (Stryker, Kalamazoo, MI, USA)/RADIFOCUS Guide Wire M 0.012 double angle (MicroVention TERUMO) was
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conducted, but no fistula was found. When the combination of a Scepter C 4 × 10 mm (MicroVention TERUMO)/ASAHI CHIKAI 14 (ASAHI INTECC, Aichi, Japan) was advanced to the ICA to control blood flow, the tip of the microguidewire easily reached the SOV, which was located anterolateral to the ICA (Figs. 2A, 2B). Holding the Scepter C at the SOV, another Excelsior SL 10 microcatheter was inserted to the fistula. Coil embolization was started from the SOV (Fig. 3A). When a coil was filled to some extent, an ASAHI CHIKAI 14 300 cm was inserted into the balloon catheter, and the balloon catheter was pulled away. The microguidewire was held in the SOV. Coiling was continued from the SOV to over part of the cavernous sinus (Fig. 3B). The coils used were, sequentially: 2 Target Helical Ultra 4 mm × 6 cm, one 1 mm × 2 cm, one 2 mm × 2 cm, two 3 mm × 4 cm, one 3 mm × 6 cm, two 1.5 mm × 3 cm (Stryker, Kalamazoo, MI, USA). The microguidewire was finally removed. The angiogram showed that the reflux to the SOV had disappeared, but slight inflow to the cavernous sinus remained. After the left carotid artery was manually compressed for 2 to 3 min, the fistula disappeared, and the eye swelling was then relieved (Fig. 4). The procedure was completed without continuing the intracranial PTA. The angiogram on the next day showed no recurrence. The patient’s symptoms were relieved for 3 months.
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found when the guidewire of the balloon catheter was unexpectedly inserted into the SOV. The cavernous sinus is narrowest anteriorly, adjacent to the superior orbital fissure. The anteroinferior space is located in the concavity below the first curve of the intracavernous carotid where the SOV and inferior ophthalmic veins commonly open into the sinus. In the rare case of an ICA-SOV fistula caused by a penetrating gunshot injury, it demonstrates filling of the SOV in the early arterial phase, without involvement of the cavernous sinus. In this case, though the cavernous sinus and SOV were visualized at approximately the same time due to the high-flow shunt, the shunt was first visualized mainly in the SOV and then the cavernous sinus. The fistula was considered to have occurred at the junction of the anterior ascending/horizontal segment of the ICA, which is close to and led to the SOV. In two cases of iatrogenic CCFs by catheter penetration in which the fistulas’ locations were identified, the fistulas were positioned at the posterior curved portion of the cavernous ICA. It is necessary to search widely around the genu in particular to identify a CCF caused by a catheter.

Discussion

The area affected by traumatic injury causing a CCF was usually at the horizontal segment or the junction of the horizontal and posterior ascending segments of the intracavernous ICA. This portion is fixed to the skull base. The cause has been suggested to involve traumatic shear stress that lacerates the ICA or a tear of the inferolateral trunk (ILT) or meningohypophysial trunk of the ICA.

The search for a fistula around the cavernous portion of the ICA was conducted using a microcatheter and guidewire, but a fistula was difficult to identify. The fistula was found when the guidewire of the balloon catheter was unexpectedly inserted into the SOV. The cavernous sinus is narrowest anteriorly, adjacent to the superior orbital fissure. The anteroinferior space is located in the concavity below the first curve of the intracavernous carotid where the SOV and inferior ophthalmic veins commonly open into the sinus. In the rare case of an ICA-SOV fistula caused by a penetrating gunshot injury, it demonstrates filling of the SOV in the early arterial phase, without involvement of the cavernous sinus. In this case, though the cavernous sinus and SOV were visualized at approximately the same time due to the high-flow shunt, the shunt was first visualized mainly in the SOV and then the cavernous sinus. The fistula was considered to have occurred at the junction of the anterior ascending/horizontal segment of the ICA, which is close to and led to the SOV. In two cases of iatrogenic CCFs by catheter penetration in which the fistulas’ locations were identified, the fistulas were positioned at the posterior curved portion of the cavernous ICA. It is necessary to search widely around the genu in particular to identify a CCF caused by a catheter.

There has been a report that when traumatic CCFs were small, 21/22 cases were treatable by transarterial coil embolization alone. Iatrogenic CCFs were treated by stent placement, the transarterial route, or transvenous flow reduction followed by transarterial coiling. Though symptoms are subclinical, and there is a low-flow shunt, spontaneous healing is rarely possible, and treatment was necessary in this symptomatic case. Because it was thought that reinsertion might be difficult when the microcatheter deviated during the procedure, the microguidewire was held through the fistula,
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and coil embolization proceeded with another microcatheter. Though embolization was accomplished without coil deviation, there seemed to be the option of balloon-assisted coil embolization in this case.

In the case of a fistula caused by a guidewire/microcatheter, transarterial coil embolization is possible and may be tried first. It is necessary to remember that a CCF may occur during catheter navigation; therefore, it is important to navigate a microcatheter carefully, especially through the curves of a cavernous ICA.

Disclosure Statement

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References