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Transvenous Coil Embolization of Traumatic Carotid-Cavernous Fistula Associated with a Persistent Primitive Trigeminal Artery

- Case Report -

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ABSTRACT

A 45-year-old male presented with left pulsatile tinnitus and left conjunctival chemosis after blunt head trauma. Cerebral angiography demonstrated a left carotid-cavernous sinus fistula associated with a persistent primitive trigeminal artery. The fistula was packed with detachable coils through the transvenous approach and was successfully occluded without complication, while preserving the patency of the persistent primitive trigeminal artery. The patient's symptoms resolved soon after treatment. Persistent primitive trigeminal artery can be associated with a traumatic cavernous sinus fistula and transvenous coil embolization can be a safe and effective method to immediately occlude the fistula. **(Kor J Cerebrovascular Surgery 8:66-9, 2006)**

KEY WORDS : Carotid-cavernous sinus fistula · Persistent primitive trigeminal artery · Coil embolization

Introduction

The persistent primitive trigeminal artery (PPTA) is the most common persistent carotid-basilar anastomosis with an angiographic incidence of 0.1 to 0.3 %.[3)18)] Although the PPTA is usually an incidental finding, it can occasionally cause cranial nerve dysfunction such as oculomotor nerve palsy[19)] or abducent nerve palsy,[10)] trigeminal neuralgia,[17)] hemifacial spasm,[1)] and various cerebrovascular abnormalities such as aneurysms,[13)] arteriovenous malformation,[15)] moyamoya disease[12)] and carotid-cavernous sinus fistula.[2-9)11)14)16)18)] We present a case of traumatic carotid-cavernous sinus fistula originating from a PPTA, which was treated by transvenous coil embolization through the inferior petrosal sinus.

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Case Report

A 45-year-old male had a motorcycle accident followed by the sudden onset of a left pulsatile bruit and left conjunctival chemosis without subsequent neurological deficit. A Left ICA angiogram demonstrated a PPTA arising from the cavernous ICA and having a fistulous connection with the left cavernous sinus, draining into the ipsilateral superior ophthalmic vein and the ipsilateral inferior petrosal sinus. Right vertebral angiogram showed a PPTA with flow of contrast material into left cavernous sinus, indicating a trigeminal-cavernous fistula. The PPTA was of the Saltzman type 2. The posterior cerebral arteries received their blood supply predominantly through patent posterior communicating arteries, and the posterior circulation was independent of the anastomosis. These angiographic features confirmed the clinical diagnosis of a left-sided carotid-cavernous fistula associated with a Saltzman type 2 PPTA (Fig. 1). No discrete aneurysm and cortical venous drainage were identified.

We decided to perform detachable coil embolization via

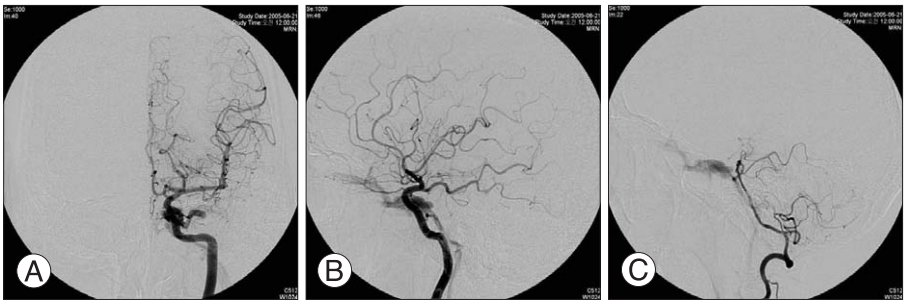

Fig. 1. Anteroposterior (A) and lateral (B) views of left carotid angiogram shows a persistent trigeminal artery arising from cavernous internal carotid artery and fistulous connection with the left cavernous sinus draining into the superior ophthalmic vein anteriorly and the inferior petrosal sinus posteriorly. Lateral view (C) of right vertebral angiogram shows a persistent trigeminal artery with flow of contrast material into left cavernous sinus.

the transvenous route. The patient received intravenous anticoagulation with a 5000 U heparin bolus. Through the left transfemoral venous approach, a No. 5 F guiding catheter (Envoy; Cordis Endovascular Systems/Johnson & Johnson, Miami, FL) was directed into the left inferior petrosal sinus, and a two-tip microcatheter (Excelsior 14; Cordis Endovascular Systems) was introduced through the guiding catheter into the affected cavernous sinus. Two complex-shaped platinum coils (Complex Fill; Cordis, Miami, FL), 10 mm × 30 cm and 7 mm × 21 cm in size, were detached initially in the posterior part of cavernous sinus. Subsequently, six more platinum microcoils (Tornado Embolization Coil, Cook, Bloomington, IN), 5/50 mm in size, were placed at the distal portion of the left inferior petrosal sinus. After embolization, final control angiogram showed complete obliteration of the fistula and preservation of the ICA and PPTA (Fig. 2). The patient's symptoms resolved completely after this procedure. There were no procedural complications.

Discussion

Carotid-cavernous sinus fistulas (CCF) are abnormal communication between the ICA and the cavernous sinus and they have been classified depending on the arterial origin. Although CCFs are not rare, they have been reported in association with PPTA in only several published articles.[2-9)11)14)16)18)] The PPTA-cavernous sinus fistula occurred at the junction of the ICA and PPTA[6)8)] or directly on the PPTA itself[11)18)] and developed spontaneously[2)3)18)] or after trauma.[5)6)8)] Clinical symptoms of PPTA-cavernous sinus fistulas do not differ from those caused by direct CCF and therefore PPTA-cavernous sinus fistulas require immediate treatment if there is progressive visual loss, corneal exposure, intolerable bruit, severe retroorbital pain, or cortical venous drainage.[16)18)]

It has been reported that ruptured carotid-trigeminal aneurysms may be responsible for producing the fistula either with or without trauma.[7)8)] It is also possible that PPTA-cavernous sinus fistulas do not have a definite relationship with aneurysm as in our patient, and some authors have suggested that structural defect or fragility of the PPTA itself may predispose toward vessel rupture either spontaneously or after trauma.[2)3)9)18)] Actually ruptured aneurysm may be often difficult to detect in the cavernous sinus by cerebral angiography, because of the high-flow fistula that develops and the destruction of the sac of the aneurysm.[9)18)] In the present case, we concluded that the

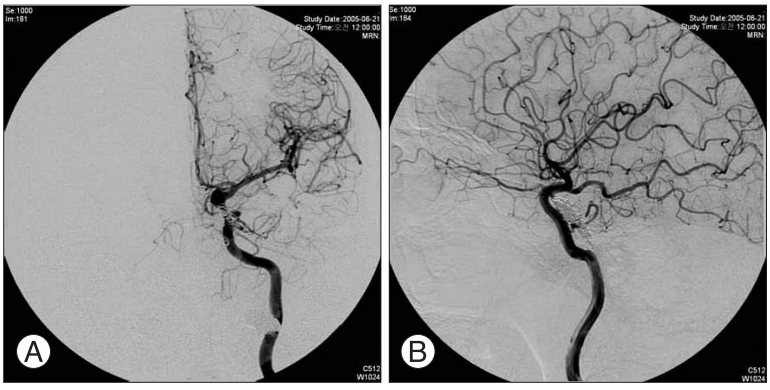

Fig. 2. Anteroposterior (A) and lateral (B) views of left carotid angiogram obtained just after coil embolization shows a completely obliterated fistula and patency both of the persistent primitive trigeminal artery and the internal carotid artery.

PPTA itself might predispose toward development of a PPTA-cavernous sinus fistula associated with trauma based on the absence of aneurysm on the cerebral angiography and presence of history of preceding head trauma.

Treatment options have evolved from ICA ligation to endovascular surgery.[2)3)5-9)16)18)] For endovascular surgery, the choice of treatment with respect to materials as well as routes of approach is predicted on several factors such as location and size of the fistula, availability of catheter access to the fistula, importance of patency of the ICA and PPTA, and the relative risk and benefit.

Before treatment of PTA-cavernous sinus fistulas is attempted, one must consider Saltzman type of PPTA, especially when the PPTA is sacrificed during treatment. This patient exhibits an example of Saltzman type 2 in which the PPTA is not a mandatory collateral channel, and the posterior cerebral arteries receive their blood supply mainly through patent posterior communicating arteries. In Saltzman type 1, however, the PPTA is a major vessel between the cavernous ICA and the basilar artery and it is an important supply to the distal basilar artery, posterior cerebral artery, and superior cerebellar artery territories.[6)14)] Therefore, all efforts should be made to maintain the patency of PPTA in Saltzman type 1.

Transarterial detachable balloon occlusion is the well-established method for treating direct high-flow CCF while preserving a patent parent ICA.[16)] When the volume of cavernous sinus compartment was large enough to accommodate the detachable balloon for embolization and the size of the orifice of the fistula was smaller than the inflated balloon, but large enough to allow entry of the deflated or partly inflated balloon, balloon occlusion of the fistula has been performed.[5)6)9)14)] However, coil embolization has been chosen when the orifice of the fistula was too small to prevent entry of the balloon and the volume of the cavernous sinus was too small to inflate the balloon.[3)16)18)] Although transarterial access to the cavernous sinus is preferred treatment of choice to close direct CCF, transvenous access offers an alternative route in cases in which transarterial access is not possible because of unfavorable position or size of the orifice of the fistula and has supplanted transarterial embolization of dural feeders originating from the external carotid artery or the ICA.[16)] In our patient, the inferior petrosal sinus was well visualized and accessing the cavernous sinus through the inferior petrosal sinus was easily achieved.

The important risk of transvenous coil embolization includes incomplete closure of the orifice, leading to venous hypertension from increased drainage into cortical veins and the ophthalmic veins and thereby aggravating ocular symptoms or hemorrhage.[16)18)] In the present case, coils were placed as close to the fistula orifice as possible to avoid redirection of the flow into the remaining venous pathway and transvenous coil embolization was carefully and completely performed from the junction between the superior ophthalmic vein and the cavernous sinus to the posterior part of the cavernous sinus. Finally, complete occlusion of the fistula was achieved with preservation of the ICA and PPTA.

Conclusion

Although the presence of PPTA is generally thought to be of uncertain significance, the PPTA can be the site of fistulization after trauma. The transvenous approach to the cavernous sinus can be an effective access route for traumatic PPTA-cavernous sinus fistula, which can be successfully occluded by coil embolization with minimal morbidity.

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