Traumatic Carotid Cavernous Fistula Complicated With Intracerebral Hemorrhage
—Case Report—

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Abstract

A 45-year-old woman presented with a rare case of traumatic carotid cavernous fistula (CCF) complicated with intracerebral hemorrhage after injury in a car accident. She had multiple injuries including facial bone fracture and slight subarachnoid hemorrhage around the left sylvian fissure. Emergent plastic surgery for the facial deformity was performed. Next day, she suffered intracerebral hemorrhage in the left frontal lobe. Angiography revealed CCF, predominantly draining to the left superficial sylvian vein. The left internal carotid artery was occluded by endovascular treatment. The clinical triad of traumatic CCF is orbital bruit, exophthalmos, and chemosis. Hemorrhagic complication such as subarachnoid hemorrhage, epistaxis, and otorrhagia may occur according to the venous drainage pattern. Traumatic CCF may be accompanied by intracerebral hemorrhage.

Key words: trauma, carotid cavernous fistula, intracerebral hemorrhage, endovascular treatment, coil embolization

Introduction

Traumatic carotid cavernous fistula (CCF) usually results in direct and high-flow shunting, so tends to manifest as severe and rapidly progressive symptoms.1,5) The symptoms of CCF depend on the direction of the venous drainage, and the severity is determined by the rate of blood flow through the shunt. Ophthalmic signs are more prominent with anterior venous drainage through the ophthalmic vein. Exophthalmos is pulsatile, with distended veins pushing the globe downward and laterally. Chemosis results from arterialization of the conjunctival and scleral veins. Extraocular muscle palsies may occur due to cranial nerve ischemia or edema caused by venous distention. In contrast, ophthalmic signs are minimal but cortical and brain stem dysfunction may be present with venous drainage predominantly through the superficial sylvian vein or superior and inferior petrosal sinuses. Furthermore, fistulas that drain into cortical veins have a high risk for subarachnoid or intracerebral hemorrhage (ICH). Here, we report a case of traumatic CCF complicated with ICH and discuss the etiology of the hemorrhage.

Case Report

A 45-year-old woman was injured in a car accident and brought to our hospital. She was comatose and had massive deformity of the face, especially on the right side. Her pupils were isocoric and light reflex was prompt. Computed tomography (CT) demonstrated depressed fracture of the facial bone as well as skull base fracture at the left carotid canal (Fig. 1A, B). Slight subarachnoid hemorrhage was seen around the left sylvian fissure (Fig. 1C). Radiography revealed right arm fracture. Emergent surgical reconstruction was performed for the facial bone fracture under general anesthesia. Postoperatively, she was treated in the intensive care unit.

Next day, right hemiparesis appeared and CT revealed ICH in the left frontal lobe (Fig. 1D). We considered the ICH as a part of the cerebral contusion and treated the patient conservatively. Although the wound on the face had healed about 2 weeks later, chemosis and swelling of the left eye could not be relieved. Periorbital bruit was noted with greater severity on the left side. Cerebral angiography demonstrated arteriovenous shunt at the cavernous portion of the left internal carotid artery (ICA), and almost complete absence of filling of the ICA above the fistula with venous drainage from the left cavernous sinus into the ipsilateral superior ophthalmic vein, superficial sylvian vein, and the bilateral inferior petrosal sinuses (Fig. 2). Reflex to the left frontal region and venous congestion were predominant.

Transvenous embolization was performed via the left inferior petrosal sinus. The drainage routes to the left sphenoparietal sinus and the left superior ophthalmic veins were embolized with detachable coils (Fig. 3A, B). Then, transarterial occlusion of the shunt was attempted, preserving the left ICA (Fig. 3C). During embolization, a portion of the platinum coil projected through the fistula into the parent artery. To eliminate the risk of clot forma-
Traumatic CCF Complicated With ICH

Fig. 1 A: Bone window computed tomography (CT) scan showing facial bone depressed fracture especially on the right side. B: Bone window CT scan showing skull base fracture at the left carotid canal (arrow). C: Brain CT scans showing slight subarachnoid hemorrhage on the left side. D: Brain CT scans one day after admission showing intracerebral hemorrhage in the left frontal lobe as well as intraventricular hemorrhage.

Fig. 2 A, B: Anteroposterior (A) and lateral (B) views of the left internal carotid angiogram showing a high-flow carotid cavernous fistula draining into the left superior ophthalmic vein, superficial sylvian vein, and bilateral inferior petrosal sinuses. Reflux to the frontal vein was predominant (arrow). C: Anteroposterior view of the right internal carotid angiogram showing collateral flow to the left cerebral hemisphere. D: Lateral view of the left vertebral angiogram showing overflow to the anterior circulation and some contribution to the arteriovenous shunt. E: Venous phase of the left vertebral angiogram showing predominant venous congestion at the left frontal region (arrow).

Fig. 3 A: Anteroposterior view of the left internal carotid angiogram during transvenous embolization showing the sphenoparietal sinus was occluded with coils (arrow). B: Lateral view of the left internal carotid angiogram during transvenous embolization showing the superior ophthalmic vein was occluded with coils (arrow). C: Lateral view of the left internal carotid angiogram during transarterial embolization showing the coils were placed at the cavernous sinus (arrow). D, E: Anteroposterior (D) and lateral (E) views of the postoperative control left internal carotid angiogram showing left internal carotid artery occlusion.

Intracranial hemorrhage due to cortical reflux through a CCF is well known but rarely reported. A series of 100 consecutive direct CCFs treated with detachable balloons reported the most common presentations were orbital bruit (80%), exophthalmos (72%), chemosis, adduces palsy (49%), and conjunctival injection (44%), and only one case of ICH was included as an early complication.10,11) Four cases of ICH were found among 127 cases with direct CCF, one had a fatal pontine bleed, another had temporal lobe hemorrhage, one had temporal and frontal lobe hemorrhage, and the last had multifocal hemorrhages.7) All four patients exhibited cortical venous drainage from the fistula, which correlated with the site of the hemorrhage. Another report of 54 cases of traumatic CCF described opthalmic symptoms or bruit, but no intracranial hemorrhage.4) Since traumatic CCF generally occurs as a direct and high-flow fistula, hemodynamic stress is severe in the drainage system.12) Most CCFs have a balanced...
In our case, drainage to the superficial sylvian vein was remarkable (Fig. 2B), with significant venous congestion in the left frontal region (Fig. 2E). Moreover, the cerebral tissue was fragile because of the coexisting cerebral contusion. These conditions affected each other and resulted in ICH in our case. Cerebral ischemia due to the steal phenomenon and lethal epistaxis may occur as a rare complication of traumatic CCF. Detection of traumatic CCF is not easy. At first, we could not recognize the ICH due to the traumatic CCF, and the diagnosis was delayed because the patient was comatose and the chemosis or exophthalmos were complicated with the severe facial deformity. However, periorbital bruit should be investigated. Fracture around the carotid canal is an important finding, which suggests carotid injury, and CT angiography is recommended to detect any vascular lesion.

Urgent treatment is required for traumatic CCF associated with progressive visual loss, corneal exposure, cortical venous drainage, or hemorrhagic complication. Conventionally, direct CCF was treated with detachable balloons deployed via a transarterial route. However, these balloons are no longer available, and are commonly replaced by coils. The treatment goal is to occlude the fistula and preserve the ICA. Shunt occlusion may require a large number of detachable coils and result in high-cost treatment, so permanent occlusion of the ICA may be the treatment of choice in the presence of total steal.

In our case, complete steal phenomenon was present with no filling of the ICA beyond the fistula without ischemic sign. Therefore, balloon test occlusion was not required. Following transvenous embolization for the drainage route, transarterial occlusion of the shunt was attempted. However, coil placement at the shunt point resulted in moderate compromise of the parent ICA. The coils protruded into the lumen of the ICA, and created a risk of thromboembolism, which may cause transient ischemic attack or stroke. Therefore, the left ICA was occluded subsequently. ICA occlusion was performed for 23 cases of direct CCF. No ischemic events, hemorrhage, or de novo aneurysm formation occurred after 1 to 14 years (mean 6.9 years). Therefore, ICA occlusion remains an option for treatment following hemodynamic evaluation.

Traumatic CCF can be a cause of intracranial hemorrhage. Prompt evaluation and urgent treatment are required.

References


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