A Case of Spontaneous Acute Subdural Haematoma in Traumatic Carotid-Cavernous Fistula

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Summary

We report a case of acute subdural haematoma in traumatic carotid-cavernous fistula. The patient had a history of head trauma four years ago. Postoperative study revealed CCF of dominant posterior drainage with giant pseudoaneurysm. Thereafter endovascular treatment using detachable balloons and detachable platinum micro-coils made successful occlusion of the fistula preserving the ICA.

Introduction

Three to 10% of carotid-cavernous fistulae (CCF) present with intracranial haemorrhage, and are associated with a poor outcome^{2,6,7,11,20}. We report a case of acute subdural haematoma in traumatic carotid cavernous fistula. After evacuation of haematoma, CCF was treated successfully with detachable balloons and detachable platinum micro-coils, preserving the internal carotid artery (ICA).

Case Report

A 26-year-old man had a history of right skull base fracture with right frontal brain contusion in August 1993 that was treated by de-

compressive lobectomy and cranioplasty at another hospital.

He recovered sufficiently to pursue normal activity after rehabilitation, however, he had right ophthalmoplegia and blindness caused by this injury.

On May 20, 1997, he complained of severe headache and collapsed on the street while walking. There was no evidence of head injury at that time. He was transported to the emergency center of Nagoya Ekisaikai Hospital. Glasgow coma scale on admission was 8. He had left hemiparesis. Computed tomographic (CT) scan showed right acute subdural haematoma (figure 1). Emergency craniotomy with evacuation of the haematoma was performed.

There was bleeding from the pulsating arterialized cortical vein that was coagulated and clipped (figure 2).

The next day, cerebral angiography showed right direct CCF with a giant pseudoaneurysm at the horizontal segment of ICA. All drainage systems were directed to the right inferior petrous sinus.

There was no cortical venous drainage on this angiogram (figure 3). According to the history of this patient, the CCF developed after significant head trauma four years before ad-

Figure 1 Computed tomographic scan on admission showed right acute subdural haematoma.

mission. The diagnosis was late because no angiographic examination was performed. As he did not have chemosis or exophthalmos, previous doctors were not aware of CCF 4 years ago.

Two weeks after admission, his consciousness and left hemiparesis recovered and endovascular treatment for the CCF was planned.

Endovascular Treatment

Blood supply to right hemisphere from left ICA through the anterior communicating artery was not sufficient because the flow was aspirated to the fistula. So the balloon occlusion test of right ICA resulted in mild left hemiparesis after ten minutes' occlusion. In this

case, the safest treatment is trapping of ICA with balloons or coils because there was the risk of rupture of pseudoaneurysm during the procedure.

However, we selected the way to preserve the right ICA as the safest way to maintain cerebral blood flow because of positive balloon occlusion test. We inserted another balloon into the contralateral femoral artery to occlude ICA in case of aneurysm rupture.

To occlude the fistula with a large cavity, Gold Valve Balloon (GVB 12: Nycomed Co.) attached at the top of a coaxial catheter (Nycomed Co.) was transarterially introduced into the fistula through a No. 10 French guiding catheter, however the balloon was damaged in the guiding catheter and pulled. Then the balloon was changed to smaller one (GVB16: Nycomed Co.) and introduced into the fistula. Not to navigate the balloon into the pseudoaneurysm directory, we tried to occlude the fistula orifice with a single balloon. The balloon proved unstable at the entry of fistula, so we gently introduced balloons into the cavernous sinus and inflated and detached. Flow reduction of the fistula was observed after detachment of two GVB16. Then, interlocking detachable platinum micro-coils (IDC: Target Therapeutics/Boston Scientific Co.) were transarterially introduced into the residual cavity of the fistula through a Fastracker 18 microcatheter (Target Therapeutics/Boston Scientific Co.). After packing of the aneurysm using 23 IDCs (total length: 440 cm), complete occlusion of the CCF was observed with patency of the right ICA (figure 4).

Patient's deficit was mild weakness of the right finger, however, he returned to work two months later. Follow-up angiography after two years showed occlusion of the fistula with patency of the right ICA.

Discussion

Clinical findings of CCF

Clinical findings of traumatic CCF are closely associated with the pattern of venous drainage^{3,16}, and typical symptoms are proptosis, chemosis, oculomotor palsy and visual disturbance^{3,4}.

They are induced by anterior venous drainage through the superior ophthalmic vein^{3,4}. However, patients with minimal proptosis and

Figure 2 There was bleeding from pulsating arterialized cortical vein (arrow) which was coagulated and clipped.

chemosis are likely to have dominant posterior venous drainage^{3,4}.

The diagnosis of CCF was delayed in this case because the patient did not have chemosis or proptosis. The change in eye symptom in CCF was not detected because he had already had right blindness with total ophthalmoplegia after direct injury four years ago. The diagnosis of traumatic CCF with giant aneurysm tends to be late because there was an interval between growth of the aneurysm and rupture to cavernous sinus^{13,19}. So the physicians were not aware of CCF with dominant posterior venous drainage.

Intracranial haemorrhage in CCF

Intracranial haemorrhages are seen in 2.6% of CCFs and occur at the site of cortical venous drainage⁷. This is caused by combined arterial ischaemia and increased venous pressure². High venous pressure is attributed to occlusion of outflow pathways^{7,20} or arterialized blood into the cortical veins⁶.

We could not review the case of acute subdural haematoma in CCF in the literature. In this case, surgery revealed that the rupture of abnormal cortical vein induced acute subdural haematoma. The abnormal cortical vein was tortuous, pulsating and arterialized, which looked like the drainage vein of arteriovenous fistula.

There are several case reports of acute sub-

Figure 3 Cerebral angiography showed right direct carotid cavernous fistula (CCF). The fistula was located at the horizontal segment of intracavernous ICA with giant pseudoaneurysm in the ethmoid sinus. All of the drainage was directed into the inferior petrous sinus. Late phase angiography showed no cortical venous drainage.

dural haematoma in arteriovenous malformation^{12,17}.

The possible mechanism of bleeding is the presence of adhesions between the arteriovenous malformation and the arachnoid membrane^{15,17}. Spontaneous or traumatic tearing of adhesions causes bleeding from into the subdural space. In CCF, arterialized blood may pass from the cavernous sinus to the superficial cortical veins through collateral venous channels⁶.

Rupture of these veins may induce acute subdural haematoma in CCF. In an emergency situation of obvious acute subdural haematoma proved on CT, angiography is not needed usually. Postoperative angiography showed no abnormal cortical veins clipped on surgery, however, we could not completely deny the relationship between CCF and the abnormal cortical vein which was found on surgery because subdural haematoma was on the same side of CCF.

Treatment of CCF

Transarterial balloon embolization is regarded as the best therapy for traumatic CCF^{3,4,10,14}. Balloons can be directed across the fistula into the cavernous sinus and inflated to produce the fistula obliteration⁸. Complete cure rate of CCF with detachable balloons was 84-96%^{3,5,14}, and the rate of the preservation of internal carotid artery was 53-59%^{3,5,14}. In case of difficulty in closing the fistula selectively with detachable balloons, permanent occlusion of the internal carotid artery was needed for complete cure^{3,14}.

The technical difficulties of transarterial balloon embolization are failure to enter the balloon into the cavernous sinus through the small orifice, large false aneurysm in cavernous sinus, or leak of fistula after balloon detachment^{3,8}. In some patients who have had prior balloon embolization with subtotal occlusion, navigation of additional balloons into the fistula is often unsuccessful because of the presence of balloons partially blocking the fistula orifice^{8,18}.

Transvenous balloon occlusion of the fistula was supplementary combined in cases of incomplete occlusion of fistula after the transarterial approach^{3,9}. However, venous routes to pass the balloon are not always accessible^{3,8,14}.

Recently, transarterial or transvenous coil embolization for CCF has been accepted as the management for cases that fail to respond to traditional embolization techniques^{1,8,9,18}. Recent techniques of detachable platinum micro-coil include GDC (Guglielmi detachable coil: Target Therapeutics/Boston Scientific Co.) that can control the placement and are easy to retrieve, reposition, or to exchange^{1,18}. GDCs are very pliable and adapt to the shape of the cavernous sinus, and the rate of ICA preservation is high^{1,18}.

The disadvantages of GDC in the treatment of CCF are time involved and the cost, because many coils are needed to occlude the fistula¹⁸. We used IDC in this case because IDC is also retrievable and it can be detached immediately after passage of the interlocking part of the coil, and the cost is less than GDC.

Conclusions

Endovascular treatment with a combination of detachable balloons and micro-coils successfully cured the traumatic CCF with a large

Figure 4 After packing with balloons and IDCs, complete occlusion of the CCF was observed with patency of the right ICA.

pseudoaneurysm. There was a possible association between traumatic CCF and acute subdural haematoma in the pathophysiology of this case. Early diagnosis and adequate treatment of traumatic cerebrovascular injury is important in cases of severe head trauma.

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