

Carotid-cavernous fistula: an uncommon and easily missed complication of head trauma

頸動脈—海綿竇瘻管：一個罕有及容易忽略的頭部創傷併發症

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A 57-year-old woman attended the emergency department complaining of protrusion of the right eyeball for three days. The history revealed that she had head injury in a road traffic accident about five weeks ago. The accident had caused a fracture of the right angle of the mandible that was fixed internally by the maxillo-facial surgeon. Subsequent angiogram showed a right direct carotid-cavernous fistula. Endovascular therapy was successful in obliterating the fistula. She recovered well. Although carotid-cavernous fistula is an uncommon complication of head injury, emergency physicians should be aware of this condition because of its potential mortality and morbidity. (*Hong Kong j.emerg.med.* 2005;12:95-98)

一位 57 歲女士到急症室求診，申訴右眼球突出已有三天，病歷顯示她大約在五周前在一宗交通意外中頭部受傷。該意外導致下顎骨右角骨折而需要上顎面外科醫生做內固定手術，其後血管造影顯示右側有一直接頸動脈—海綿竇瘻管；經血管內治療法成功堵塞瘻管後，她健康復原得很好。雖然頸動脈—海綿竇瘻管並非頭部創傷常見的併發症，但由於其潛在病態及死亡的可能性，急症科醫生仍應警覺這疾病。

Keywords: Arteriovenous fistula, carotid-cavernous sinus fistula, craniocerebral trauma, exophthalmos, therapeutic embolisation

關鍵詞：動靜脈瘻管、頸動脈—海綿竇瘻管、顱腦創傷、眼球突出、治療性栓塞法

Case report

A 57-year-old lady attended the Accident and Emergency department (AED) of North District Hospital in December 2003 because of protrusion of the right eyeball for three days. She also complained of double vision, drooping of the right upper eyelid and mild headache. The history revealed that the lady

was a victim of a road traffic accident, which happened in China about five weeks ago. She drove a car and hit against the back of a lorry during the accident. At that time, she lost consciousness for about 10 minutes. She received preliminary treatment in a hospital in China. Computed tomography (CT) of the brain was performed in China at that time and no abnormality was detected. She attended the AED of North District Hospital for further treatment on the same day of the road traffic accident. At that time, physical examination showed normal vital signs. There was swelling of her right face. X-ray detected fracture of the right angle of the mandible. She was discharged from the AED after overnight observation and urgently referred to the dental surgeon. Open reduction and internal fixation of the fractured mandible were

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performed under general anaesthesia five days after the injury. The operation was uneventful. She was discharged seven days after admission. She did not complain of protrusion of eyeball or double vision during the initial consultation. However, she recalled that she heard noises coming from her right eye immediately after the injury but she did not pay attention to it and did not mention it to the emergency physician during the first consultation.

Physical examination showed ptosis of the right upper eyelid (Figure 1) and proptosis of the right eyeball. The conjunctiva was grossly congested. Ophthalmoplegia was noted and diplopia was present (Figure 2). Pupils were reactive on both sides and symmetrical, and there was no hyphema. The visual acuity was normal. A harsh orbital bruit was heard when the bell of a stethoscope was placed on the right eye. She was clinically euthyroid. X-rays including anteroposterior and lateral views of the orbit and Water's view did not reveal any fracture. In view of the history and physical examination, the provisional diagnosis for this patient was right carotid-cavernous fistula after head trauma.

She was admitted to the Ophthalmology Department of Tuen Mun Hospital. Cerebral angiogram showed a direct right carotid-cavernous fistula. There was an

arteriovenous fistulous communication between the cavernous segment of the right internal carotid artery and the right cavernous sinus (Figure 3). The rate of shunting was tremendous with overflow into the contralateral cavernous sinus.

Under the cover of neurosurgeons, interventional radiologists performed endovascular therapy three days after the diagnostic angiogram. The fistula was so enormous in size that it was impossible to preserve the right internal carotid artery. The fistula was closed by deploying Guglielmi detachable coils and platinum fibred coils across the arterio-venous communication at the cavernous segment and in the proximal cervical segment of the right internal carotid artery (Figure 4).

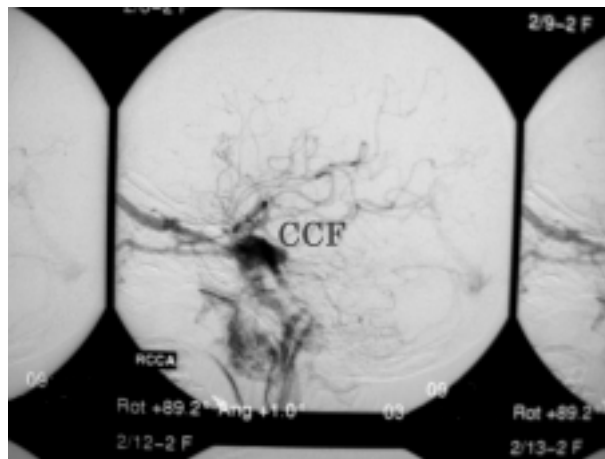


Figure 3. Right common carotid angiogram showing the right direct carotid-cavernous fistula (CCF).



Figure 1. Ptosis of the right eye.



Figure 2. Conjunctival congestion and ophthalmoplegia.

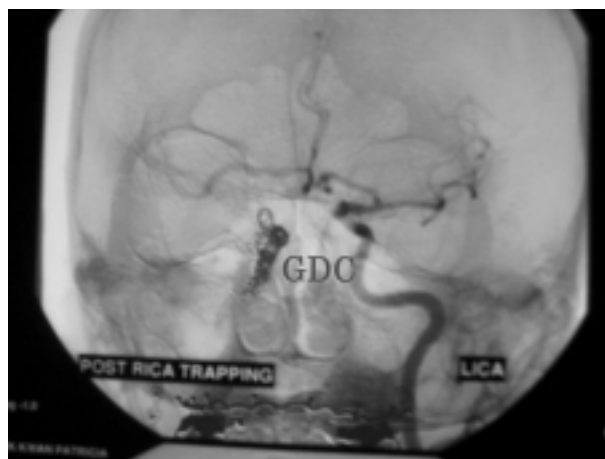


Figure 4. Obliteration of the right carotid-cavernous fistula with Guglielmi detachable coils (GDC).

The right cerebral hemisphere was perfused by cross-flow from the left internal carotid artery via the anterior communicating artery.

She recovered well and was discharged twelve days after admission. The congested conjunctiva and proptosis subsided and the diplopia improved. The visual acuity of the right eye remained normal.

Discussion

The cavernous sinuses lie in the middle cranial fossa lateral to the body of the sphenoid bone. The two sinuses are connected by intercavernous sinuses which are anterior and posterior to the hypophysis.¹ The sinus receives blood from the superior and inferior ophthalmic veins, the cerebral veins, the sphenoparietal sinus and the central vein of the retina. Numerous trabeculae cross the interior of the sinus. They drain into the internal jugular vein and the transverse sinus. The internal carotid artery enters the sinus from its base, runs forward and superiorly and then exits at the superior wall of the sinus. The carotid artery gives rise to several branches in the sinus. The sixth cranial nerve runs through the sinus. The third and fourth cranial nerves, and the ophthalmic and maxillary divisions of the trigeminal nerve lie in the lateral wall of the sinus.^{2,3}

Carotid-cavernous fistula (CCF) is an abnormal communication between the carotid arterial system and the venous cavernous sinus. The causes may be traumatic or spontaneous. Traumatic CCF is due to intracavernous tear of the carotid artery or its branches. Injury may be minor or severe. Ruptured carotid aneurysm, Ehlers-Danlos syndrome,⁴ hypertension, atherosclerosis and pregnancy are causes of spontaneous CCF.

CCF can be classified as direct or indirect. Direct fistulas consist of a direct connection between the intracavernous internal carotid artery and the cavernous sinus. They are usually high-flow and high-pressure fistulas.

Indirect fistulas are connection between dural branches of the external or internal carotid artery and the cavernous sinus. These fistulas tend to be of lower flow

and lower pressure with a slower progression of signs and symptoms. They are classified as indirect shunts because the fistulas arise from the dural arteries rather than directly from the internal carotid artery.⁵

Although penetrating cranial injuries can cause CCF, severe blunt trauma is the more common mechanism. Symptoms develop suddenly in direct fistulas that can occur days or even weeks after head injury, as in our case.⁶ Patients may hear noises in the head. They may also complain of red, swollen and protruding eyes, double vision, visual loss and pain.

The classic triad of physical signs are chemosis, pulsatile exophthalmos and ocular bruit.⁵ Reduced visual acuity, prominent facial veins, oedema of periorbital tissues, diplopia, ophthalmoplegia, papilloedema, increased intraocular pressure, retinal haemorrhage and optic atrophy may be present as well. A case of CCF with lethal epistaxis has been reported.⁷ Bilateral involvement is possible due to the connections between the two sinuses.

Indirect fistulas have a gradual onset and milder symptoms. The classic triad is usually absent. Patients usually present with chronic red eyes due to the tortuous arterization of the conjunctiva.

If untreated, as many as 90% of patients with direct CCF may lose vision while 20-30% of patients with indirect types will do so. Patients generally have good prognosis after treatment.

Selective carotid angiography has both diagnostic and therapeutic roles.

Contrast computed tomography scan and magnetic resonance imaging (MRI) help to establish the diagnosis and to demonstrate peripheral pathologies like proptosis, enlargement of superior ophthalmic vein and swelling of extraocular muscles. They are noninvasive but limited by the inability to show precise filling of the cavernous sinus. Other causes of enlargement of the superior ophthalmic vein, e.g. cavernous angioma of the orbit, can cause false-positive findings. False-negative finding is possible if the CCF does not drain into the superior ophthalmic vein.

Ultrasound shows similar findings as CT and MRI. It demonstrates the reversal of blood flow in the superior ophthalmic vein. B-scan shows dilated tortuous veins.

The goal of treatment^{1,2,5} is to obliterate the fistula and maintain the patency of the internal carotid artery. Conservative treatment may be effective in indirect fistulas. Self-compression of the ipsilateral carotid artery for about 30 seconds 4 times per hour may cause thrombosis of the fistula. The contralateral hand should be used for self-compression as it will cause weakness of the hand once cerebral ischaemia occurs.¹ This method has a cure rate of almost 30%. Spontaneous thrombosis of low flow fistulas may occur.

Direct CCF generally requires intervention to close as it rarely resolves spontaneously. Endovascular therapy is the treatment of choice. Angiography delineates the fistula and guides the delivery of the embolisation materials. The fistula is usually approached via the internal carotid artery. Silicone detachable balloon, Guglielmi detachable coils or platinum fibred coils may be used to obliterate the fistula. The transvenous approach via the internal jugular vein or femoral vein can be used if transarterial approach is not possible or effective. The transvenous route is more suitable for patients with Ehlers-Danlos syndrome to avoid arterial rupture or dissection.⁴ Direct operative repair is indicated if endovascular therapy fails.

Complications of endovascular treatment include formation of false aneurysm of the internal carotid artery, cranial nerve palsies, pain, cerebral embolism and infarction, retinal ischemia, intracerebral haemorrhage⁸ and acute glaucoma.⁹

Conclusion

Carotid-cavernous fistula is a well documented but uncommon complication of head injury. Its presentation is usually delayed. Emergency physicians should consider this complication in managing patients with head injury.

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