

## Commentary

# Interventional Treatment of Traumatic Carotid Cavernous Fistula

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Traumatic Carotid Cavernous Fistula (TCCF) refers to the rupture of the arterial wall or branches of the cavernous sinus segment of the internal carotid artery caused by trauma, resulting in abnormal arteriovenous communication between the internal carotid artery and the cavernous sinus. It is a rare vascular malformation. The main symptoms are immediately or several days and weeks after injury, including intracranial murmur, exophthalmos, eye swelling, increased intraocular pressure and decreased vision. In addition, there may be symptoms such as cavernous sinus and supraorbital fissure syndrome.

The diagnosis of internal carotid cavernous fistula is mainly determined by neuroimaging examination, such as head CT scan, neck MRI and cerebral angiography. These examinations can determine the location and size of the malformation and determine the boundary between the arterial blood supply area and normal blood vessels. DSA is the gold standard for the diagnosis of TCCF in the clinical diagnosis of this disease. Therefore, it is often necessary to use arterial catheterization for selective angiography of the whole brain, in addition to contralateral internal and external carotid artery angiography, contralateral internal carotid artery and vertebral artery are also photographed when the ipsilateral carotid artery is compressed and the blood flow is temporarily blocked. Usually on the imaging of the ipsilateral internal carotid artery, there is only a mass of contrast medium in the cavernous sinus, and the filling of the distal cerebral vessels is poor, and the exact location of the fistula is difficult to determine. Vertebral arteriography is used to compress the ipsilateral carotid artery at the same time, so that the contrast medium can be seen retrograde from the posterior communicating branch through the

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cavernous fistula of the internal carotid artery. At the same time, the contralateral internal carotid artery angiography can also understand the integrity of the Willis ring and estimate the compensation of the cerebral artery, which is helpful to judge whether the blood flow of the ipsilateral internal carotid artery can be interrupted. Selective external carotid artery angiography can show that the branches of the internal carotid artery are anastomosed with the middle meningeal artery, the accessory meningeal artery and the ascending pharyngeal artery at the bottom of the cavernous sinus to form the external carotid artery.

The treatment plan mainly includes operation and interventional therapy. Surgical treatment is a traditional treatment, which can be removed through the neck or scalp incision and cut off the abnormal communication between the cavernous sinus and the internal carotid artery to prevent the occurrence of complications such as hemorrhage and cerebral embolism. Endovascular interventional therapy for TCCF is a relatively new treatment. Endovascular interventional therapy has become one of the main methods for the treatment of the disease because of its advantages of minimally invasive, low trauma and less complications. More than 90% of CCF patients can be successfully cured by endovascular interventional therapy [1].

Interventional therapy mainly includes occlusion of fistula with detachable balloon, coil, Onyx glue, Willis covered stent or internal carotid artery. In 1974, Serbinenko initiated the detachable balloon to treat TCCF [2]. This operation has the advantages of simple operation, low cost and no space occupying effect, but it should be noted that for patients with small fistula and less blood theft, it is difficult for balloon to enter the fistula. Second, even if the fistula is completely blocked by balloon during the operation, due to balloon premature ejaculation and other reasons, the fistula may still recur after operation [3]. Therefore, for patients whose clinical symptoms are relieved and aggravated again after operation, it is necessary to guard against the possibility of fistula recurrence. The use of coils in the treatment of TCCF is also a common treatment, but when coil packing is used alone to a relatively dense degree, the micro catheter is often ejected from the fistula, which can easily lead to partial fistula being difficult to be completely occluded. Therefore, many scholars choose balloon-assisted, Onyx combined with spring coil packing to obtain better treatment results [4]. As a liquid embolic agent, Onyx can well disperse the gap between coils and reduce the use of coils, and the cost is lower than that of covered stents and simple packing with coils. Balloon-assisted occlusion of the fistula segment of the internal carotid artery can prevent the recurrent flow of the internal carotid artery into the internal carotid artery during the injection of Onyx, resulting in the infarction of the internal carotid artery and its branches, thus reducing the possibility of residual fistula [5]. The coil can provide a skeleton for Onyx to adhere to and gather on the mold to avoid being washed away by blood flow and to prevent over-filling of the cavernous sinus resulting in occlusion of normal draining veins. During the operation, the operation should be gentle and slow, and the times of pulling the balloon microcatheter back and forth should be reduced as much as possible to prevent the balloon from falling off prematurely. Reduce the stimulation of microcatheter

to blood vessel wall as far as possible to avoid vasospasm. Antispasmodic drugs, such as nimodipine, can be used when necessary. The main points of this operation are as follows: if Onyx flows back into the internal carotid artery during the operation [1], the common stent can be used to press the Onyx on the wall of the internal carotid artery so as to make the internal carotid artery unobstructed. The amount of coil filling should be appropriate [2], too much hinder the observation of Onyx and auxiliary balloon, and too little is not conducive to Onyx adhesion. Slow injection could make Onyx disperse better in the cavernous sinus near the fistula and reduce its potential toxicity [3]. The withdrawal of micro catheters and balloons should also be performed slowly to prevent Onyx from being taken out to the internal carotid artery occlusion. The main advantage of Willis covered stent is that the operation is simple and the internal carotid artery is unobstructed, so it is an ideal method for the treatment of TCCF. The main points of the operation include: the Willis covered stent may cause incorrect positioning or displacement in the process of dilatation [1], so it is necessary to accurately locate the fistula and release the stent around the fistula as far as possible. The diameter of the internal carotid artery at both ends of the fistula should not be too different [2], otherwise it will affect the adhesion of the covered stent. If the fracture piece protrudes into the vascular lumen, or when the distal and proximal vascular diameter of the stent is obviously inconsistent, resulting in difficulty and malopening of the stent, even if the stent is repeatedly dilated, some of the stent may not adhere to the wall well and there may be internal leakage outside the stent [6], some may even have delayed internal leakage.

In short, endovascular interventional therapy is the first choice and effective method for TCCF, which has replaced the traditional craniotomy ligation of carotid artery and cavernous sinus incision and repair. The advantages of simplicity, safety, effectiveness and less side effects are more accepted by patients and their families.

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