



Transvenous embolization of dural carotid cavernous fistula through the facial and ophthalmic vein

Duralna fistula kavernoznog sinusa: embolizacija transvenskim pristupom kroz facijalnu i gornju oftalmičku venu

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Abstract

Introduction. Dural carotid cavernous fistula is acquired, relatively rare, condition comprising of numerous small-caliber meningeal arterial branches, draining directly into cavernous sinus. Endovascular therapy is the treatment of choice, preferably by a transvenous approach. In the case of inaccessible inferior petrosal sinus, other alternative routes are considered. We presented a case of dural carotid cavernous fistula completely occluded with Guglielmi detachable coils, using a transvenous approach through facial and superior ophthalmic vein. **Case report.** A 62-year-old man was referred with a gradual worsening proptosis, red eye, and decreased visual acuity, on the right side. Digital subtraction angiography revealed the presence of a right dural carotid cavernous fistula, predominantly supplied from dural branches of the right internal carotid artery siphon, with minimal contribution from the right middle meningeal artery and contralateral dural branches of the left internal carotid artery siphon. The fistula was drained through the dilated superior ophthalmic vein, and *via* the facial to the internal jugular vein. There was neither pacification of pterygoid and petrous sinuses, nor cortical venous reflux. Endovascular treatment was performed by a transvenous approach. A guiding catheter was placed in the right facial vein. A microcatheter was advanced through the dilated angular and superior ophthalmic vein, and its tip positioned into the right cavernous sinus. Coils were deployed, until a complete angiographic occlusion of the fistula had been achieved. The patient experienced rapid improvement in the symptoms, with complete normalization of his condition one month after the treatment. **Conclusion.** Coil embolization of dural carotid cavernous fistula by transvenous catheterization, through the facial and superior ophthalmic vein, can be considered as safe and effective treatment option in the presence of marked anterior drainage.

Key words:

carotid-cavernous sinus fistula; diagnosis; angiography, digital subtraction; therapeutics; neurosurgical procedures; embolization, therapeutic.

Apstrakt

Uvod. Duralne karotidnokavernozne fistule su stečene, relativno retke lezije krvnih sudova u orbitokavernoznoj regiji. Endovaskularno lečenje smatra se metodom izbora u lečenju duralnih fistula kavernoznog sinusa. U slučaju neprohodnog donjeg petroznog sinusa, razmatraju se drugi pristupi. Prikazan je slučaj uspešne okluzije duralne fistule kavernoznog sinusa, plasiranjem platinskih spirala putem facijalne i gornje oftalmične vene. **Prikaz bolesnika.** Prikazan je bolesnik muškog pola, star 62 godine sa postepenim razvojem proptoze bulbusa, crvenila i slabljenja vida na desno oko. Digitalnom suptrakcionom angiografijom potvrđeno je postojanje indirektno karotidnokavernozne fistule koja se dominantno irigirala iz duralnih grana sifona desne unutrašnje karotidne arterije, a manjim delom iz desne srednje meningealne arterije i kontralateralno iz duralnih grana sifona leve unutrašnje karotidne arterije. Fistula se drenirala preko dilatirane desne gornje oftalmične vene i, dalje, preko facijalne u unutrašnju jugularnu venu. Nije bilo ni opacifikacije pterigoidnog i petroznih sinusa, niti kortikalnog venskog refluksa. Embolizacija je izvedena transvenskim putem. Vodeći kateter bio je pozicioniran u desnoj facijalnoj arteriji. Mikrokater je plasiran u kavernozi sinus, preko dilatirane angularne i gornje oftalmične vene. Kavernozi sinus bio je ispunjen platinskim spiralama, sve do potpune okluzije fistule. Stanje bolesnika se rapidno popravljalo, sve do potpunog povlačenja svih simptoma, mesec dana posle embolizacije. **Zaključak.** Embolizacija duralnih fistula kavernoznog sinusa platinskim spiralama, transvenskim pristupom preko facijalne i gornje oftalmične vene, može se smatrati sigurnom i efikasnom metodom kod izražene prednje drenaže fistule.

Ključne reči:

karotidno-kavernozna fistula; dijagnoza; angiografija, digitalna suptrakcija; lečenje; neurohirurške procedure; embolizacija, terapijska.

Introduction

Dural carotid cavernous fistula (dCCF) is acquired, rare lesion with no exact data on incidence and prevalence. A population-based data reported incidence for intracranial vascular malformations was 1.84 per 100,000 person-years during 1965–1992¹. Dural arteriovenous fistulas comprise 10%–15% of all intracranial arteriovenous malformations², while Awad et al.³ published meta-analysis in which the incidence of dCCF was 11.9% among all dural arteriovenous fistulas. dCCF is comprised of dural fistulous communications between branches of the external carotid artery (ECA) and/or the internal carotid artery (ICA), and the cavernous sinus (CS). They are more common in women during menopause⁴. The diagnosis of dCCF is often late, after unsuccessful symptomatic treatment of the patient's "red eye". Although etiology is still not fully understood, it is associated with previous trauma, pregnancy, sinusitis, surgical intervention and thrombosis of CS⁵. Unlike their counterparts – direct carotid cavernous fistulas (arteriovenous communication through wall defect on cavernous portion of ICA), dCCF have a slower developing symptomatology, due to low-flow arterial supply⁶. Endovascular treatment is a method of first choice, for the dCCF. It is performed in cases with progressive worsening of the eye symptomatology, cortical venous reflux (with or without hemorrhage), or intolerable symptoms for the patient. Transvenous embolization remains preferred approach^{7,8}. In the case of inaccessible inferior petrosal sinus, other alternative routes are considered. Among those, the superior ophthalmic vein (SOV) approach *via* the facial vein is often used as a second line treatment^{9,10}.

Case report

On admission, at the beginning of July 2010, a 62-year-old male patient presented with significant right eye redness and bulging, diplopia, blurred vision and a headache. Two months earlier, the patient noticed his right eye slightly protruded, and double vision making him discomfort. He experienced progressive worsening of symptoms, over following time. On ophthalmological examination there was a decreased visual acuity, ophthalmoplegia, significant proptosis with conjunctival congestion and chemosis on the right eye (Figure 1). Auscultation revealed no systolic sound. There were no other symptoms and known diseases.

Computerised tomography (CT) and magnetic resonance imaging (MRI) studies showed dilated right SOV and congestion of retrobulbar soft tissue. Digital subtraction angiography (DSA) demonstrated the presence of right dCCF, predominantly supplied from dural branches of the right ICA siphon, with minimal contribution from the right middle meningeal artery and dural branches of the contralateral carotid siphon (Figure 2). There was an exclusive dCCF drainage into the right SOV (Figure 3). A progressive ocular symptomatology indicated endovascular treatment. Because of the dominant ICA supply, the transarterial approach was not a viable option. Therefore, transvenous embolization through the facial vein and SOV, was a clear solution.



Fig. 1 – The typical ocular signs of dural carotid cavernous fistula on the right, including exophthalmos, chemosis, and conjunctival hyperemia ("red eye")

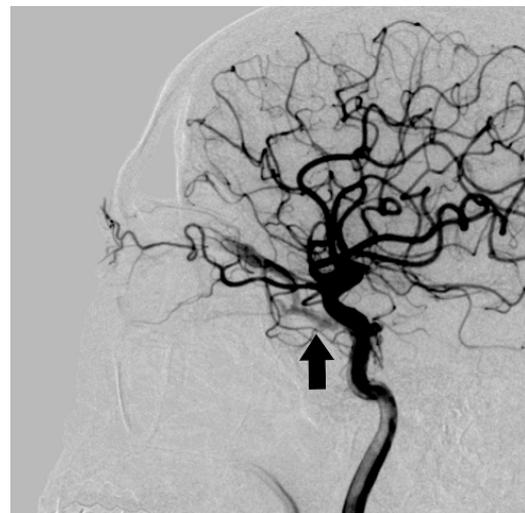


Fig. 2 – Internal carotid artery (ICA) injection, lateral view, typical angiographic appearance of dural carotid cavernous fistula dominantly supplied from dural branches of the right ICA siphon (wide arrow)



Fig. 3 – Exclusive venous drainage *via* the superior ophthalmic vein (arrowhead), and the facial vein (curved arrow)

Transvenous embolization was performed in general anesthesia, under systemic heparinization. After placement of 6F sheath in the right femoral artery, a 6F guiding catheter (Envoy, Cordis Neurovascular Inc., Miami Lakes, FL) was positioned in the right ICA. This catheter was left in place during the procedure, for intermittent angiographic evaluation of dCCF patency, and for generating a roadmap picture. After 6F sheath was placed in the right femoral vein, a 5F guiding catheter (Envoy, Cordis Neurovascular Inc., Miami Lakes, FL) was positioned in the right brachiocephalic vein. Through the catheter positioned in the ICA, a venous phase roadmap was obtained. With roadmap guidance, 5F catheter was navigated through the internal jugular vein into distal portion of the facial vein. Superselective CS catheterization was achieved with a coaxially navigated microcatheter (Echelon 0.010", eV3, Irvine, CA), through the dilated SOV. Position in CS was confirmed by microcatheter injection of contrast material. CS was then loosely packed with Guglielmi detachable coils (GDC), until a complete occlusion of dCCF (Figure 4). At the end of the procedure, DSA of both sides of ICA and ECA, showed stagnation of contrast material in the right ICA feeders, as a sure sign of a complete and durable fistula obliteration (Figure 5).

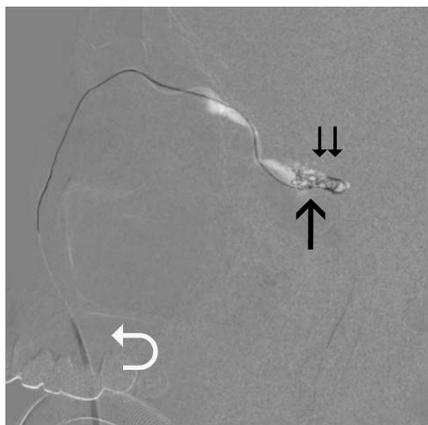


Fig. 4 – A roadmap image during embolization. The guiding catheter was placed in the facial artery (white curved arrow); tip of the microcatheter inside cavernous sinus (CS) (arrow); coils gradually filling the CS (small arrows)



Fig. 5 – Obliteration of dural carotid cavernous fistula, with stagnation of contrast material in the right internal carotid artery feeders

The patient experienced rapid improvement in following days and weeks, until a complete resolution of the ocular symptoms, one month after the treatment (Figure 6). Control ophthalmological examination, seven months after embolization, revealed complete resolution of visual disturbances, with normal position and motility of the right eye.



Fig. 6 – The complete resolution of the ocular signs after successful treatment of the lesion

Discussion

Obliteration of dural communications and reduction of blood pressure in CS is the primary treatment goal for dCCF. Prior to the treatment, a complete catheter angiography workup is required, for accurate localization of all feeding arteries, and understanding of venous drainage hemodynamics. In the presented case, besides the dominant right ICA supply, there was also recruitment of feeders from the right ECA and contralateral ICA. Symptoms and clinical presentation are proportional to shunt size and pattern of venous drainage. Overwhelming of physiological venous outflow capacity (petrosal sinuses, pterygoid plexus), is compensated by retrograde drainage to ipsilateral ophthalmic artery, cortical veins, or contralateral CS, depending on individual venous anatomy. Retrograde venous drainage through the ophthalmic veins (mainly SOV) is accompanied conjunctival congestion (“red eye”), proptosis, glaucoma, and double vision⁷. Patients usually complain of headache and retrobulbar noise in the head (bruit, pulsatile tinnitus). Other common findings are cranial nerve palsies. In more severe cases retinal ischemia occurs, with decreasing of visual acuity. In our patient, ocular symptomatology was significantly reduced in the first 48 hours, and completely resolved one month after embolization. Reversibility is conditioned by gravity and duration of symptoms. In such cases, in spite of cured dCCF, recovery is prolonged for many months, often with irreversible ophthalmoplegia and permanently decreased visual acuity^{7,8}.

Spontaneous occlusion occurrence varies in the literature, and is on average 35% according to Tomsick⁴. dCCF with benign course should be first subjected to intermittent,

self-administered manual carotid-jugular compression, that alone may result in cure in 30% of patients¹¹. These are rarely life-threatening lesions. When symptoms are prolonged and cause significant impairment of patients quality of life, dCCF should be treated. Malignant course, with impending loss of vision, or cortical venous drainage (with or without intracranial hemorrhage), requires a prompt endovascular treatment^{8, 12, 13}. The two standard embolization approaches are in use: transarterial and transvenous. Transarterial embolization can be time-consuming, dangerous (ICA feeders, ECA-ICA anastomosis) and often impossible task. It seldom provides a complete dCCF occlusion. More often, after a partial occlusion and initial success, revascularization occurs in time^{14, 15}. For patients with dCCF transvenous embolization remains a preferred option. CS is most easily approached through the inferior petrosal sinus. When inferior petrosal sinus is inaccessible, other alternative routes are considered^{12, 16}. In the case of endovascularly inaccessible CS, combined surgical and endovascular approach is a viable solution. A microcatheter is introduced to CS, through surgically exposed and punctured SOV. Some authors¹⁷ also suggest direct percutaneous cannulation of CS, via the transorbital approach using fluoroscopic guidance. For most resilient cases, radiotherapy is recommended⁷.

Transfemoral SOV catheterization through facial vein, is an elegant and safe approach^{9, 10, 18}. Although it can sometimes be impaired with the difficult vascular anatomy and venous stenosis, small diameter and tortuous facial vein, angular vein or SOV, are seldom restricting catheterization. He et al.¹⁹ are applying this approach whenever transarterial embolization proves to be unsuccessful. Szikora⁷ recommends the approach over SOV, when infe-

rior petrous sinus is not a patent for catheterization. In the presented case, with exclusive dCCF drainage through SOV accompanied with its marked dilatation, therapeutic decision-making was straightforward. Catheterization of CS was achieved with minor difficulties, at the facial-jugular vein junction. Subsequent coil deployment went without difficulties, until a complete dCCF obliteration had been achieved. A variety of embolic materials are used alone or combined, for transvenous treatment. Because of their properties, coils surpassed detachable balloons, previously dominant embolic agent for intracavernous embolization. Coils better conform to the shape of CS, are less traumatic to sinus walls, and can be delivered with more accuracy. Liquid embolic agents (NBCA, Onyx), are also used in combination with coils or individually¹².

Potential complications of transvenous catheterization are iatrogenic perforation of venous vessels, nervus abducens lesion caused by coil mass effect, and combined with surgery – lesions of orbital structures and rarely infection⁷. Markedly septated CS can result in a partial embolization, and deterioration of symptoms, caused by shifting of venous drainage towards SOV and cortical veins. Nonetheless, all these complications are reported with low incidence^{15, 20}. The overall rate of transient and permanent complications is very low, 11.6% and 1.8%, respectively¹².

Conclusion

Transvenous embolization with GDC coils, through the facial and SOV, is a safe and effective treatment for dCCF. It can be considered a treatment of choice in case of predominant SOV drainage.

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