Spontaneous Isolated Dural Arteriovenous Fistula of the Cavernous Sinus: Endovascular Approach via the Foramen Ovale

A Technical Note

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Summary

The endovascular treatment of spontaneous dural cavernous sinus fistula (DAVF) can be accomplished by arterial approach, just with symptoms relief, or by numerous venous approaches through the inferior petrosal sinus, ophthalmic vein, anterior or posterior intercarvernous sinus and facial vein. Our case suggests the approach to the cavernous sinus via the foramen ovale and emissary veins puncture as an alternative when there is no possibility of venous approach conventionally described.

A 76-year-old woman presented with right conjunctival hyperemia, exophthalmos, intraocular pressure increasing and visual deficits in a period of six months. Angiographic diagnosis of spontaneous DAVF isolated from the cavernous sinus, Barrow Type C, with exclusive venous drainage through the superior ophthalmic vein. Endovascular treatment was performed under general anesthesia. Attempts to approach the cavernous sinus through the inferior petrosal sinus ipsilateral and contralateral intercarvernous, facial vein and pterygoid plexus, as well as by dissection and direct puncture of the superior ophthalmic vein were not possible. An approach to the cavernous sinus was performed by puncturing the foramen ovale, catheterization of the emissary vein of the foramen ovale with occlusion of the fistula with microcoils. There was a symptomatic regression with gradual normalization of intraocular pressure, exophthalmos and conjunctival hyperemia in three months.

The approach to the cavernous sinus through the foramen ovale and catheterization of the emissary cranial skull base vein is an exception and should be considered in cases of spontaneous and isolated DAVF not accessible by a conventional approach.

Dural arteriovenous fistulas (DAVF) occur in between 10% and 15% of all intracranial arteriovenous communications. DAVF of the cavernous sinus can be classified according to three criteria: 1) traumatic or spontaneous; 2) hemodynamically in low or high flow fistulas and 3) angiographically being direct or indirect. From the angiographic point of view, there is one classification which divides such fistula into four types, regarding the risk of complications which helps in determining the treatment.

Spontaneous cavernous sinus fistulas are low flow, have low morbidity and can occasionally lead to spontaneous regression. The indication for treatment includes: worsening of visual symptoms, especially with decreased visual acuity; secondary glaucoma, followed by an increase in venous pressure of superior ophthalmic vein; intractable retro-orbit-
Spontaneous Isolated Dural Arteriovenous Fistula of the Cavernous Sinus: Endovascular Approach... G. Cabral De Andrade

puncture, failing to reach the right cavernous sinus. After discussion with our team, it was decided to use the cranial skull base emissary vein of the foramen ovale after foramen ovale puncture as an approach to the cavernous sinus.

Technical Note

With the patient under general anesthesia, the right femoral artery was punctured with placement of a 5F introducer. Selective catheterization of the right external carotid artery was performed with a 4F catheter to control the occlusion of the cavernous sinus fistula. The foramen ovale percutaneous approach, providing the radioscopic image of the skull in lateral view, was performed via the anterolateral extraoral transoval upward, according to the parameters determined by Hartel, “Hartel points”. We used a 14G needle, inserted 3 cm lateral to the labial commissure, and directed to the point of intersection between the coronal plane passing 3 cm anterior to the tragus and the sagittal plane passing through the pupil. The puncture needle was positioned in the emissary vein of the foramen ovale with acquisition of the venous road map. The selective catheterization of the cavernous sinus with an Excel microcatheter (Boston Scientific, Galway, Ireland) and Transcend Platinum microguide (Boston Scientific, Galway, Ireland). Embolization was performed with DAVF occlusion of the cavernous sinus with platinum microcoils (05) of electrical detachment in real time under fluoroscopy with digital subtraction (Figure 2A). The immediate angiographic control was performed by injection in the right common ca-

Figure 1  A) Right chemosis, proptosis and temporal bruit paresis of cranial nerves of the extrinsic muscles of the right eye (III °, IV ° and VI °) with ophthalmoplegia. B) Angiography with diagnosis of spontaneous dural arteriovenous fistula (DAVF) and isolated from the right cavernous sinus with arterial supply derived from branches of the internal maxillary artery and sphenopalatine artery. C) Venous drainage was just by the superior ophthalmic vein.
The spontaneous regression of post-traumatic or spontaneous dural fistulas is rare but has been described and can occur with thrombosis of the involved sinus or even with the conservation of sinus patency, mostly dural fistulas being Type I. The choice of a therapeutic strategy ranges from conservative treatment, endoarterial, and intravenous embolization, as well as surgery and endovascular combined treatment. Complete occlusion with regression of symptoms and healing does not occur in all cases when subjected to an endoarterial approach. The combined surgical approach can be accomplished by dissection and direct puncture of the superior orbital vein or angular vein or by direct puncture of the superior orbital fissure. In the intravenous endovascular approach followed by microcoil occlusion the cavernous sinus DAVF can be accessed through the facial vein, superior ophthalmic vein, inferior petrosal sinus, anterior and posterior intercavernous sinus, clival venous plexus and superficial temporal vein. Recently a new approach was described in the cavernous sinus vein through the petro-occipital inferior vein, which is a small vein running to the condylar region, a region of venous confluence. The incidence of complications can be high in the venous access route, reaching 19.6%, including signs related to cranial nerves. This may be related to progressive cavernous sinus thrombosis, mass compression effect of the microcoil on the nerves in the cavernous sinus or direct injury by microguide or microcatheter. Subarachnoid hemorrhage can occur after venous perforation not recognized during the procedure, and in unusual cases of venous congestion of the brain stem, due to a change in venous}

### Discussion

Dural arteriovenous fistulas (DAVFs) occur in between 10 and 15% of all intracranial arteriovenous communications, where lesions are acquired after an attack on a dural venous sinus, which may due to thrombophlebitis, trauma, dural venous thrombosis or intracranial surgery, that stimulates an inflammatory reaction and subsequent neovascularization, angiogenesis and development of arterial pathological communications at arteriolar level. DAVF presentation is most commonly found in women during perimenopause (27%), where the transverse and sigmoid sinuses are most commonly involved, followed by the cavernous sinus. The cavernous carotid DAVF may present with ophthalmoplegia, proptosis, chemosis, retroocular pain and decreased visual acuity, and pulsatile tinnitus that can occur in 40-50% of cases. The diagnosis of these lesions should be accomplished by selective angiography of the intra and extracranial vessels to identify the vascular structures involved, where the most involved arteries are the ascending pharyngeal, middle meningeal and accessory meningeal, occipital and distal internal maxillary arteries.

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flow in the posterior fossa with arterial communications of the meningo-hypophyseal trunk redirected to the mesencephalopontine veins. The combined surgical and endovascular treatment with transcranial approach through the cranietomy and followed by direct puncture of the affected dural sinus with venous endovascular occlusion is an option in some cases of DAVF, when there is dural sinus thrombosis. Another basal communication with the cavernous sinus is given via emissary veins that connect the veins outside the cranium with the intracranial venous sinuses and are valveless. The basal skull foramen ovale has veins connecting the cavernous sinus through the pterygoid or pharyngeal plexuses.

The anatomic region of the foramen ovale includes another foramen called “Vesalius.” The foramen of Vesalius is small, variable but consistently symmetrical located medially anterior to the foramen ovale and laterally to the foramen rotundum and vidian canal and in some cases is partially assimilated to the foramen ovale and its vein, called the Vesalian vein or sphenoidal emissary vein are not constant and are found in only approximately one in three cases. Complications involving the approach of the foramen ovale into Meckel’s cave are infrequent but subarachnoid hemorrhage, carotid cavernous fistula, meningitis and death have been reported. So transoval anterolateral extraoral ascending access, according to the parameters determined by Hartel enables the approach to the cavernous sinus through emissary basal skull veins.

Conclusion

The approach to the cavernous sinus through the foramen ovale and catheterization of the cranial skull base veins can be recognized as a potential route for certain cases of spontaneous dural arteriovenous fistulas isolated from the cavernous sinus, which are indicated according to signs and symptoms classically defined and where there is no possibility of another intravenous therapy.
References
