Facial Vein Catheterization for Transvenous Embolization of the Cavernous Sinus

Technique and Advantages of the Direct Jugular Vein Approach - Report of Three Cases

M.N. KARYGIANNIS, Z. SZATMARY, P.A. CLAUDINO, E. HOUDART

Department of Neuroradiology and Therapeutic Angiography, Hôpital Lariboisière, Paris, France

Key words: cavernous sinus, arteriovenous fistula, jugular vein, facial vein, transvenous embolization

Summary

We describe three cases of transvenous embolization of arteriovenous fistulas of the cavernous sinus, achieved through the facial vein approach.

The facial vein was catheterized from a jugular vein access. This cervical approach offered good stability to the guiding catheter that permitted us to negotiate difficult curves of the facial vein and to recanalize venous thrombosis in one case.

Introduction

Transvenous embolization has been used more and more often for the treatment of dural arteriovenous fistulas (DAVFs) affecting a sinus. DAVFs of the cavernous sinus are usually approached by the inferior petrosal sinus^{1,3-5}. More recently the facial vein (FV) was used to reach the cavernous sinus through the superior ophthalmic vein (SOV). Most authors reported catheterization of the FV by a femoral vein approach^{3,9,10}.

However we observed that direct jugular puncture provides better support to the guiding catheter, a factor that can probably increase the success rate of this technique. Below, we describe the technical aspects that make this approach effective.

Technique

During the years 2003 and 2004 three patients underwent endovascular treatment for DAVFs of the cavernous sinus via the facial vein. The interventions were performed using angiographic equipment (General Electric, GENS, Buc. France) with high quality road map fluoroscopy and were conducted under general anaesthesia.

The patients were anticoagulated with heparin, during and for 48 hours after the procedure to obtain twice the normal value. Femoral artery access was used for angiographic controls and road mapping. Cervical access was obtained with a 5F sheath introducer (Terumo Europe N.V.) whose tip had been previously steam shaped. An approximately 90° curve 2 cm long was given to the tip of the sheath (Figure 1) using a 0.035-inch hydrophilic guidewire (Terumo Europe N.V.) inside the sheath and a standard steamer. After that, the internal jugular vein was punctured with a 20G needle, about 2 cm above the clavicle, by delayed vein phase road-mapping guidance (anterior-posterior projection). Then the pre-shaped sheath was placed into the internal jugular vein with the tip of the sheath pointing to the ostium of the facial vein. Through this sheath a vertebral curve catheter (Terumo Europe N.V.) over a 0.035-inch hydrophilic guidewire (Terumo Eu-

Figure 1 5F sheath steam shaped with a 0.035-inch hydrophilic guidewire inside. The tip of the sheath has an approximately 900 curve 2 cm long.

rope N.V.) was inserted into the proximal part of the facial vein. Working on a new delayed vein phase road-mapping (lateral projection) an Excel 14 microcatheter (Boston Scientific, Fremont, CA), over a Transend 14 microwire (Boston Scientific-Target), was navigated into the distal facial vein. Then the 5F catheter was gently advanced up to the middle of the facial vein over the microcatheter and microwire. Finally, the micro guidewire was advanced through the angular vein to the SOV and then to the cavernous sinus where the tip of the microcatheter was positioned. Berenstein liquid coils (Boston Scientific-Target) were released into the sinus and into the origin of the SOV, up to exclusion of the fistula on the arterial control angiogram.

Case Report 1

A 57-year-old woman was admitted for DAVF of the right cavernous sinus. Cerebral angiography showed that the fistula was fed only by dural arteries arising from the right in-

ternal carotid artery and drained only through the right SOV (Figure 2A). The cavernous sinus was approached first through the right inferior petrosal sinus. After recanalization of the latter, the cavernous sinus was packed with mechanically detachable platinum coils (DCS William Cook Europe, Bjaeverskov, Denmark). On control angiography, the fistula was still patent at the anterior part of the cavernous sinus (Figure 2B), but due to the coils' density there was no further accessibility to the fistula through the taken route of the inferior petrosal sinus. A transvenous approach through the facial vein was decided. The microcatheter was navigated through the SOV up to the cavernous sinus (Figure 2C), and Berenstein liquid coils (Boston Scientific-Target) were deployed into the cavernous sinus and the proximal SOV. The control angiogram showed no more filling of the fistula (Figure 2D).

Case Report 2

An 86-year-old woman was admitted for an arteriovenous fistula of the left cavernous sinus. A cerebral angiography showed a direct shunt between the internal carotid artery and cavernous sinus. The fistula drained into the left SOV (Figure 3A). A first attempt at inferior petrosal sinus catheterization failed. After that, the cavernous sinus was accessed by arterial approach and a single coil was released at the point of the shunt. Despite immediate occlusion on the final angiogram (Figure 3B), the fistula reopened two days later. A cerebral angiogram showed recanalization of the fistula with a predominant drainage through the left SOV, into the ipsilateral facial vein (Figure 3C). After jugular vein puncture, the facial vein approach was used to reach the cavernous sinus (Figure 3D). Coils were deployed into the cavernous sinus to obtain a total exclusion of the fistula (Figure 3E).

Case Report 3

A 75-year-old man was admitted for a DAVF of the right cavernous sinus. On cerebral angiography it was determined that the fistula was fed by tiny meningeal branches of both the external carotid arteries (Figure 4A). The flow was extremely poor because of the lack of all drainage routes. Contrast medium stain was observed in the dilated SOV with endoluminal defect at angular vein level (Figure 4B). After an unsuccessful attempt to recanalize the infe-

Figure 2 A) Lateral arteriogram of the right internal carotid artery shows the fistula that is fed by dural arteries arising from the ICA and draining only through the right SOV. B) Lateral arteriogram of the right common carotid artery after coiling of the cavernous sinus demonstrates that the fistula is still patent at the anterior part. C) Lateral radiograph showing the microcatheter passing through the facial and the superior ophthalmic veins into the cavernous sinus. D) Lateral arteriogram of the right common carotid artery following coil embolization of the cavernous sinus and proximal SOV. The fistula is closed.

rior petrosal sinus, it was decided to attempt a recanalization of the angular vein through the facial vein. Finally we succeeded in passing through the thromboses of the angular vein and reached the cavernous sinus (Figure 4C). The fistula was occluded by injecting Berenstein liquid coils (total length 30 cm) into the cavernous sinus and into the origin of the SOV (Figure 4D).

Discussion

Transvenous embolization is considered to be an efficient and permanent endovascular treatment for DAVFs of the cavernous sinus^{1,3}. The approach is usually achieved through recanalization of the inferior petrosal sinus^{1,3}.

An alternative access to the cavernous sinus is the SOV. This is indicated in case of vein

Figure 3 A) Lateral arteriogram of the left internal carotid artery shows a direct shunt between the internal carotid artery and cavernous sinus. The fistula drains into the left SOV. B) Lateral arteriogram of the left internal carotid artery following coil embolization at the point of the shunt shows occlusion of the fistula. C) Lateral arteriogram of the left internal carotid artery demonstrates recanalization of the fistula with venous outflow into the SOV. D) Late phase of a lateral left internal carotid angiogram showing the microcatheter in the cavernous sinus by facial approach through the SOV. E) Lateral arteriogram of the left common carotid artery post embolization, confirms complete closure of the fistula.

drainage towards the SOV when the inferior petrosal sinus approach has failed. This approach has been reported after surgical exposure of the SOV^{6,7,8}. However, drawbacks of this technique include injury of the supraorbital nerve and the trochlea, infection, bleeding of the SOV, granuloma and cutaneous scars^{5,8}. The endovascular approach through the facial vein has been also reported^{3,9,10} and seems less traumatic than the surgical one. Biondi et Al¹⁰ described seven patients with dural carotid cavernous fistula in which it was possible to catheterize the FV and reach the SOV through the angular vein by a femoral approach (or jugular in one patient). Six of them were treated by deployment of coils. In one case it was not possible to pass through the thrombosed SOV. The same authors reported that in two cases it was difficult to navigate through the SOV roots.

However, navigation through the SOV via the FV is considered difficult because of the specific anatomical features of these veins such as: abrupt angulations at the junction of the FV with the internal jugular vein, tortuous SOV roots and tortuous course of the SOV inside the orbit. Moreover the possibility of a partial or total thrombosis (as in one of our patients) could impair navigation, particularly through the SOV. For these reasons other authors reported cases of dural carotid cavernous fistulas treated after surgical exposure of the FV at the base of the mandible¹¹, or by direct puncture of the FV¹².

In an attempt to overcome the difficulties of navigation through these complicated anatomic configurations, we developed a technique that provides a stronger support to the coaxial systems.

In comparison with jugular access, the femoral approach has the main disadvantage of

Figure 4 A) Lateral arteriogram of the left external carotid artery. The fistula is fed by tiny meningeal branches. B) Late phase of a lateral left external carotid angiogram shows stain of contrast medium into the cavernous sinus and the enlarged SOV with endoluminal defect at the angular vein level. C) Late phase of a lateral left external carotid angiogram shows the microcatheter passing through the angular vein into the SOV. D) Late phase of a lateral left external carotid angiogram following coil embolization of the cavernous sinus and proximal SOV. The fistula is totally occluded.

instability of the guiding catheter owing to the distance. In the venous system a catheter is very weak because the lumen of these vessels is much larger than the arteries. This can result in transposition of the guiding catheter during manipulations of the microcatheter. Moreover, herniation of the catheter into the right ventricle can change its position at the level of the FV. To avoid this, we prefer a direct puncture of the internal jugular vein.

The technical difficulty of the jugular approach results from the acute angle at the junc-

tion of the jugular with the facial vein. The catheter tends to herniate upward into the larger internal jugular vein at the junction. We use steam-shaping for the sheath before inserting it into the internal jugular vein. This is crucial for the success of the technique because it allows the tip of the sheath to be oriented toward the ostium of the FV and the 5F catheter to be stabilized during its insertion into the vein.

In addition, a guide catheter distally positioned within the FV accommodates the navigation.

Conclusions

For selective cases of dural arteriovenous fistulas of the cavernous sinus, catheterization of the facial vein constitutes a valuable treatment technique.

The jugular approach gives stronger support than the femoral one. Steam shaping is crucial for the success of the technique. Distal positioning of the guiding catheter into the facial vein accommodates the navigation to the cavernous sinus.

References

- 1 Halbach VV, Higashida RT et Al: Transvenous embolization of dural fistulas involving the cavernous sinus. *Am J Neuroradiol* 10: 377-383, 1989.
- 2 Yamashita K, Taki W et Al: Transvenous embolization of dural carotid-cavernous fistulae: technical considerations. *Neuroradiology* 35: 475-479, 1993.
- 3 Meyers PM, Halbach VV et Al: Dural carotid cavernous fistula: definitive endovascular management and long term follow-up. *Am J Ophthalmol* 134: 85-92, 2002.
- 4 Benndorf G, Bender et Al: Transvenous occlusion of dural cavernous sinus fistulas through the thrombosed inferior petrosal sinus: report of four cases and review of the literature. *Surg Neurol* 54: 42-54, 2000.
- 5 Oishi H, Arai H et Al: Complications associated with transvenous embolisation of cavernous dural arteriovenous fistula. *Acta Neurochir* 141: 1265-1271, 1999.
- 6 Goldberg Ra, Golday SH et Al: Management of cavernous sinus-dural fistulas: indications and techniques for primary embolization via the superior ophthalmic vein. *Arch Ophthalmol* 114: 707- 714, 1996.
- 7 Derang J, Ying H et Al: Treatment of carotid-cavernous sinus fistulas retrograde via the superior ophthalmic vein (SOV). *Surg Neurol* 52: 286-293, 1999.
- 8 Quinones D, Duckwiler G et Al: Embolization of dural cavernous fistulas via superior ophthalmic vein approach. *Am J Neuroradiol* 18: 921-928, 1997.
- 9 Halbach VV, Dowd CF et Al: Transvenous coil treatment of CCF. In: Tomsick T, ed. *Carotid Cavernous Fistulas*. Digital Educational Publishing, Cincinnati 1: 63-175, 1997.
- 10 Biondi A, Milea D et Al: Cavernous sinus dural fistulae treated by transvenous approach through the facial vein: report of seven cases and review of the literature. *Am J Neuroradiol* 24: 1240-1246, 2003.
- 11 Naito I, Magarisawa S, Wada H: Facial vein approach by direct puncture at the base of the mandible for dural carotid-cavernous fistula: a case report. *Interventional Neuroradiology* 8: 67-70, 2002.
- 12 Scott J, Narbo AD et Al: Facial venous access to cavernous region AV fistulas: a safe and reliable technique. *Proceedings of the ASITN/WFITN Scientific Conference*, New York, 1997.

Michail N. Karygiannis, M.D.
15A, Am. Artemidos str. 151 25 Athens,
Greece.
E-mail: mkarigen@yahoo.com